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A Conceptual Framework for Managed Aquifer Recharge in the Columbia River Basalts of the Lower Yakima River Basin

Bethany Kharrazi
Central Washington University, kharrazib@cwu.edu

A CONCEPTUAL FRAMEWORK FOR MANAGED AQUIFER RECHARGE IN THE COLUMBIA RIVER BASALTS OF THE LOWER YAKIMA RIVER BASIN

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by

Bethany Kharrazi

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We hereby approve the thesis of

Bethany Kharrazi

Candidate for the degree of Master of Science

APPROVED FOR THE GRADUATE FACULTY

_____ _____
Dr. Carey Gazis, Committee Chair

_____ _____
Dr. Lisa Ely

_____ _____
Dr. Breanyn MacInnes

_____ _____
Dean of Graduate Studies

ABSTRACT

A CONCEPTUAL FRAMEWORK FOR MANAGED AQUIFER RECHARGE IN THE COLUMBIA RIVER BASALTS OF THE LOWER YAKIMA RIVER BASIN

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In the Yakima River Basin in south-central Washington, increasing demands for water, overallocation of surface water, and a changing climate are leading to a loss of water storage and increasing water deficits in drought years. A warming climate has reduced snowpack in the Cascade Range, a vital reservoir for the irrigated agricultural industry which supports the basin's economy. Managed aquifer recharge (MAR) is a sustainable and cost-effective approach for securing water supply by storing water underground for recovery during drought. Diminishing groundwater levels in regional basalt aquifers over the last several decades suggest there is significant storage available for intentional recharge of these aquifers.

This study focuses on the areas around Rattlesnake Ridge east of Yakima, Washington. The region consists of east-west trending folds and faults of the Yakima Fold Belt with bedrock composed of the Grande Ronde, Wanapum, and Saddle Mountain formations of the Columbia River Basalt Group, and sedimentary interbeds of the Ellensburg Formation. The basalt aquifers are targets for MAR due to the immense thicknesses and vast spatial extent of the formations, the water-bearing vesicular flow tops and interbeds, and the structural controls of the Yakima Fold Belt.

Informed by the 2011 study of the Columbia Plateau Regional Aquifer System by the U.S. Geological Survey, this research quantifies the groundwater storage available for MAR in the Wanapum and Saddle Mountain Basalt aquifers through reconstructions of subsurface stratigraphy and analysis of historical groundwater level changes. This research finds that there has been nearly 100,000 acre-feet of groundwater storage lost annually in the basalt aquifers of the study area in the last fifty years. Because the Wanapum aquifer is thickest (typically over 1,000 ft thick) and experienced the most groundwater storage loss, it is the best candidate for MAR in the study area, although all basalt aquifers are suitable for a successful MAR program.

ACKNOWLEDGEMENTS

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I would like to thank my advisor, Carey Gazis, and my committee members for their mentorship and support. I am grateful for fellow master's students, particularly Emily Polizzi and Edward Vlasenko, who assisted with fieldwork and provided moral support throughout this research process. Thank you to my loving parents, Drs. Lisa and Martin Kharrazi; my siblings and role models, Rebekah, Shira, Jeremy and Evan; and my partner, Sam Fixler, for their encouragement along the way.

This research was conducted on the traditional lands of the federally recognized Confederated Tribes and Bands of the Yakama Nation. I want to express my gratitude for the legacy of the original people, their lives, and their descendants, and acknowledge the role that agriculture has played in manipulating indigenous lives and cultural landscapes.

We must move through the world as water: gentle and with purpose, powerful and capable of great change.

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CHAPTER I

INTRODUCTION

For nearly 200 years, agriculture has played a prominent role in modifying cultural landscapes and increasing pressures on water supplies in the Yakima River Basin. This chapter outlines a brief history of water use in the basin to show the significance and purpose of this thesis research and contextualize how this study informs water security efforts at the local and watershed scale.

The Yakima River Basin

The Yakima River Basin is a 6,155 mi^2 subbasin in south-central Washington.[1] The watershed is located within the greater Columbia River Basin which spans 258,000 mi^2 of North America including two Canadian provinces and seven U.S. states. The Yakima River flows for about 215 miles from the headwaters in the Cascade Range (8,184 ft above mean sea level) to the confluence with the Columbia River (340 ft above mean sea level). The geology includes the Columbia River Basalt Group with interbedded sediments of the Ellensburg Formation. Tectonically driven compression forms the Yakima Fold Belt which controls the topography and groundwater movement in the southern part of the basin.

The northern section of the watershed is called the upper basin and is mainly used for timber, cattle, recreation, hay cultivation, and fish and wildlife habitat, while the lower basin to the south is mostly used for agriculture (Anderson et al., 2009). The lower basin supports the watershed's $4.5 billion irrigated agricultural economy and about 45,000 jobs. The Yakima

[1] Imperial units are used in this thesis to be consistent with local and national water resources data.

River Basin is not only the nation's leader in hops production, but also harvests other high-value crops like wine grapes, grains, vegetables, orchard crops, and dairy products. Other notable crops are apples, alfalfa, and corn, which in combination with hops demand the most from irrigation (McKinley and Sandison, 2012).

Mean annual precipitation in the alpine upper basin is about 140 in, while the arid lower basin receives only 6 to 9 in of precipitation every year (Figure 1). The uneven distribution of precipitation results in a prominent upstream-downstream hierarchy (Gibson and Campana, 2018) where the lower basin is dependent on water supplied from the upper basin. Very little precipitation is available to naturally recharge the groundwater aquifers of the lower basin which are exploited annually, mainly for irrigation (Vaccaro and Olsen, 2007).

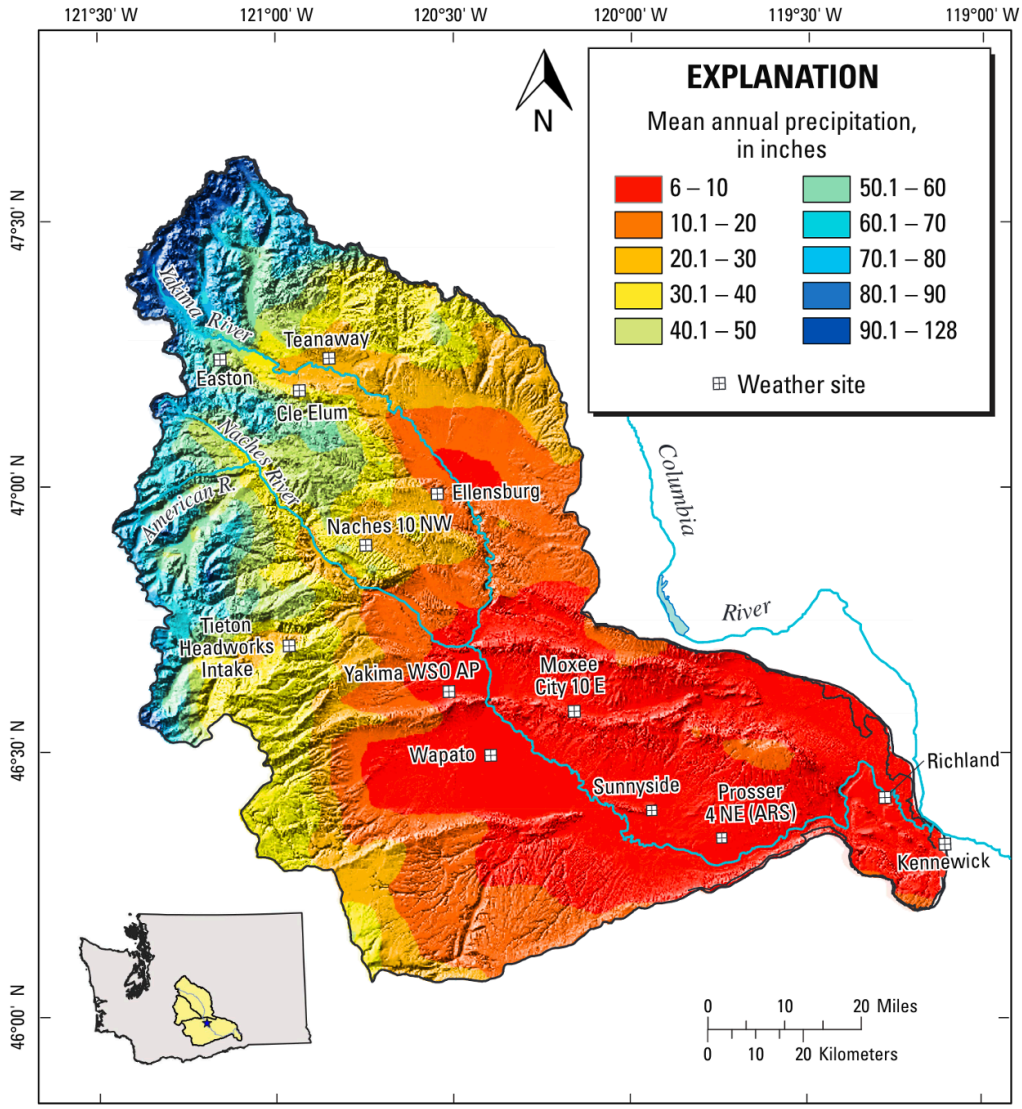


Figure 1. Mean annual precipitation (in) in the Yakima River Basin. Figure from Vaccaro and Olsen (2007).

Development of Agriculture

The Yakima River Basin had not always been an agriculturally productive region. Before white settlement, the native peoples of the Columbia Plateau, including the Yakama people, inhabited the area for about 11,500 years. Their subsistence involved hunting, fishing, and foraging, as well as trading between tribes. Before Euro-Americans physically arrived in the basin, their foreign diseases spread west, causing high rates of Native American mortality. By

the early 19th century, white explorers, militaries, missionaries, and later, cattlemen and miners (Vaccaro and Olsen, 2007) settled in the basin. With their prospects for homesteading, they brought new ideas that conflicted with the existing ideologies of the native peoples. Where the native inhabitants viewed their surroundings as nature, white settlers viewed their surroundings (including the native people) as a series of resources that could be exploited for capital gain. By the mid-1800s, agriculture became the foundation upon which white settlers established and maintained control over the Native Plateau peoples. Encompassing the ideals of private property, cultivation, and market economies (Wester, 2014), farming was consistently used in assimilation efforts and transformed the ecology of the Yakima River Basin.

As Federal Indian policy toward native peoples shifted from coexistence to removal and assimilation (Wrone, 1986), a treaty was necessary to establish and protect native rights. The Yakama Nation Treaty of 1855 established reservation and territory land for fourteen bands and tribes of Native Plateau peoples, as well as fishing, hunting, and gathering rights which are still recognized today.

For non-Indians, displacing native people to the Yakima Indian Reservation was not enough. With the authorization of the Dawes Act in the 1880s, federal control over reservation lands strengthened and farming became the cornerstone of civilization and assimilation efforts. School farms were developed to promote agriculture by separating children from their families and turning them against their culture, field matrons patrolled reservation lands to assimilate native women into farming lifestyles, forced farming made Yakama people into laborers, and federal allotments of reservation land bound them to the Euro-American ideology of private property (Wester, 2014; Shellenberger, 2023). These techniques worked to strip the land and identity from the Yakama and annihilated their ability to control their own resources. However,

with little water to support cultivation on arid reservation lands, these federal efforts failed to transform large numbers of Yakama people into farmers, although few developed successful ranches (Wester, 2014).

Irrigation and Surface Water Allocation

Irrigation was necessary for agricultural success in the lower basin. Starting on a small scale in 1848, white missionaries diverted surface water for wheat, hay, and vegetable crop production (Wester, 2014). It didn't take long for irrigation to be widely adopted. By the 1880s, the first canal systems were built, and the city of Yakima was established and then moved several miles north for access to the Northern Pacific Railway, enabling the transportation of agricultural goods. As canals were constructed, farmers and land began to organize into irrigation companies and districts (Pfaff, 2001). By the turn of the century, Yakima County had the largest canal system in Washington, tripling the acreage of irrigated land in just 10 years (Pfaff, 2001) to about 120,000 total acres (Parker and Storey, 1913; Bureau of Reclamation, 1999).

As irrigation became more widespread, colonial interventions on indigenous landscapes and culture persisted. To make capital out of uncultivated reservation lands, allotment regulations intensified. If land allotments were not used "productively," regulations allowed them to be leased or sold to non-Indians (Wester, 2014). This resulted in another cycle of non-Indian homesteading on Yakama lands, as well as the overexploitation of natural resources for the capital benefit of colonizers.

To keep up with the growing acreage of irrigable lands over the second half of the 19th century, the federal government began funding large projects to secure water supply for

agriculture. The Yakima Project, authorized in 1905, vastly increased water storage volume in the Yakima Basin. This was achieved by constructing dams to form five surface reservoirs (Keechelus, Kachess, Cle Elum, Bumping, and Rimrock water storage facilities). With a total capacity of about 1.07 million acre-feet of water (McKinley and Sandison, 2012), these reservoirs still serve the basin today. The Yakima Project is responsible for making the arid lower basin one of the most agriculturally productive regions in the state (Office of Columbia River, 2018) and the country (Pfaff, 2001), supporting the irrigation of 465,000 acres (Anderson et al., 2009).

Despite the enhancement in surface water storage and flow regulation of the Yakima River and its tributaries, the lower basin remains dependent on snowpack accumulated in the headwaters in the winters to melt in the spring, releasing large amounts of water from storage in time for the irrigation season from April to October. Thus, snowpack is considered the "sixth reservoir" (McKinley and Sandison, 2012), and undoubtedly the most important for the water demands in the basin.

Climate changes in the Yakima Basin suggest that water crises are right around the corner, if not occurring already. Increased air temperatures cause precipitation to fall as rain rather than snow in the upper basin (McKinley and Sandison, 2012), and drought conditions have become more frequent in the lower basin (Office of Columbia River, 2018). The Yakima Basin is expected to experience a 12% decrease in snowpack for a 1˚C rise in air temperature, and a 27% decrease in snowpack for a 2˚C rise in air temperature (Vano et al., 2010). As snowpack volume decreases and snowmelt occurs earlier in the season, spring and summer runoff will not be sufficient for growing municipal and agricultural water demands.

Like with many western states, water rights in Washington were issued on a first-come-first-served basis. Water rights holders before 1905 were deemed senior water rights holders, while water rights allotted after 1905 were issued to junior water rights holders. The 1945 Consent Decree, ratified by the District Court of Eastern Washington under Civil Action No. 21, determined water quantity entitlements by specifying water users as proratable and nonproratable. Nonproratable users are those with senior water rights who are given priority over proratable junior water rights holders who receive reduced water supplies (Bureau of Reclamation, 2012), particularly during drought years (Anderson et al., 2009). From 1992 to 2012, water supply reduction occurred about every four years (McKinley and Sandison, 2012) and with intensified climate changes to come, prorationing is expected to occur more frequently and at more extreme measures.

Groundwater Use

Despite costly large-scale efforts like the Yakima Project to secure surface water supplies, groundwater storage enhancements have been minimal even though groundwater is being consumed at growing rates and cannot be naturally restored from year to year (Casanova et al., 2016). Groundwater represents over 90% of Earth's available freshwater and in many regions of the world, groundwater use is greater than surface water use (Jakeman et al., 2016). About $3.7x10^9$ acre-feet of groundwater had been extracted globally between 1900 and 2008 (Konikow, 2011) and in climatically dry regions, like the lower Yakima Basin, groundwater is especially exploited (Dillon et al., 2019).

Annual groundwater pumping in the Yakima Basin has increased by about 270% between 1960 and 2000 (Vaccaro and Sumioka, 2006), partly due to the post-World War II advancements in well drilling technology (Vaccaro and Olsen, 2007). Most groundwater is used for irrigation

(Figure 2), but other agricultural uses include pre-irrigation, frost and heat protection, and fertilizer and pesticide application (Vaccaro and Sumioka, 2006).

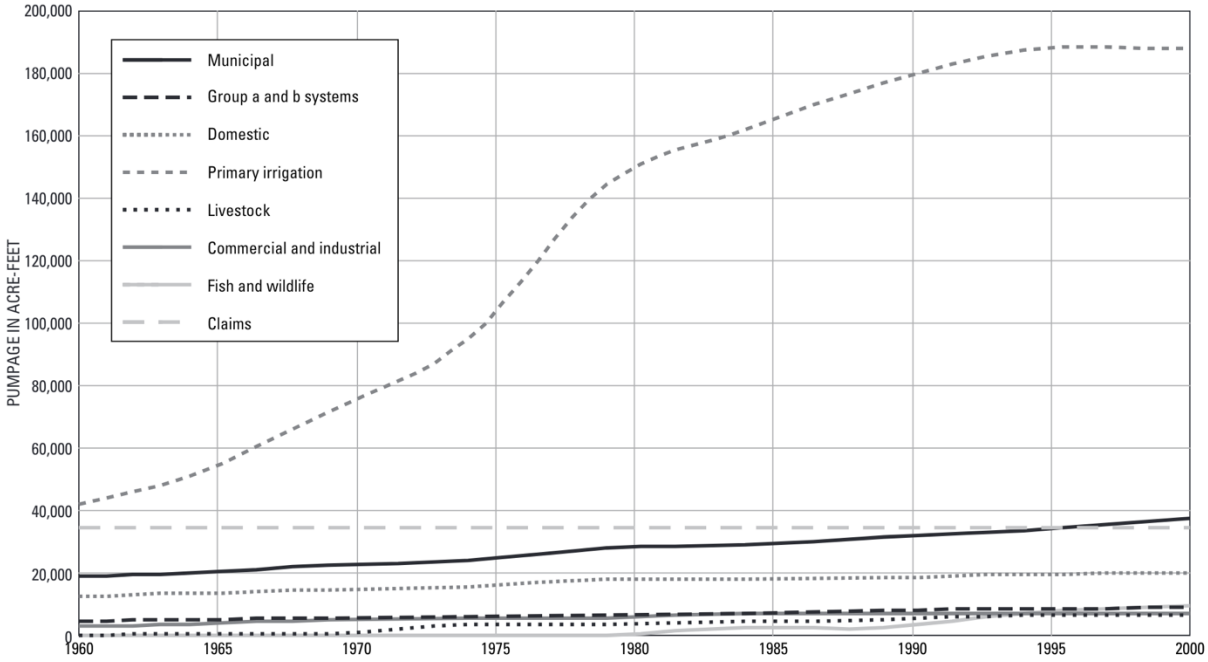


Figure 2. Estimated annual groundwater pumpage (acre-feet) in the Yakima Basin, categorized by water use from 1960 to 2000. Figure from Vaccaro and Sumioka (2006).

Unlike surface water, groundwater issues can go unrecognized because groundwater processes and storage are hard to observe directly. As a result, they can be difficult to conceptualize (Jakeman et al., 2016). Compared to surface water resources, groundwater is more reliable (Fienen and Arshad, 2016), especially for watersheds that rely on snowpack, like the Yakima River Basin. This is because groundwater is less responsive to short-term climate fluctuations, like decreased snowpack and drought conditions, since it is buffered from surface interactions (Fienen and Arshad, 2016). With the growing reliance on groundwater, managing this resource will require prioritization (Jakeman et al., 2016) and studies like this to investigate alternative water storage solutions.

The Yakima Basin Integrated Plan

During water shortages, the hardship is not felt equally among water users. To solve this issue, as well as other water-related concerns in the watershed, the Yakima Basin Integrated Plan (YBIP) was developed by a variety of basin stakeholders including the Yakama Nation, irrigators, state and federal government agencies, and fisheries (McKinley and Sandison, 2012). The YBIP is a watershed-scale water plan to accomplish goals in seven elements (Figure 3): reservoir fish passage, structural and operational changes to existing facilities, surface water storage, groundwater storage, habitat and watershed protection enhancement, improved water conservation, and market reallocation.

This research is funded through the groundwater storage subcommittee of the YBIP as part of the Rattlesnake Ridge Managed Aquifer Recharge Investigation study. The goal of the study is to evaluate groundwater storage enhancement in the basalt aquifers within the vicinity of the Roza Irrigation District (RID) and specifically the Rattlesnake Ridge area (Figure 4) to supplement water supply for proratable water users in the lower basin. The research presented in this thesis provides the study with a hydrogeologic framework for assessing the potential for managed groundwater recharge and storage.

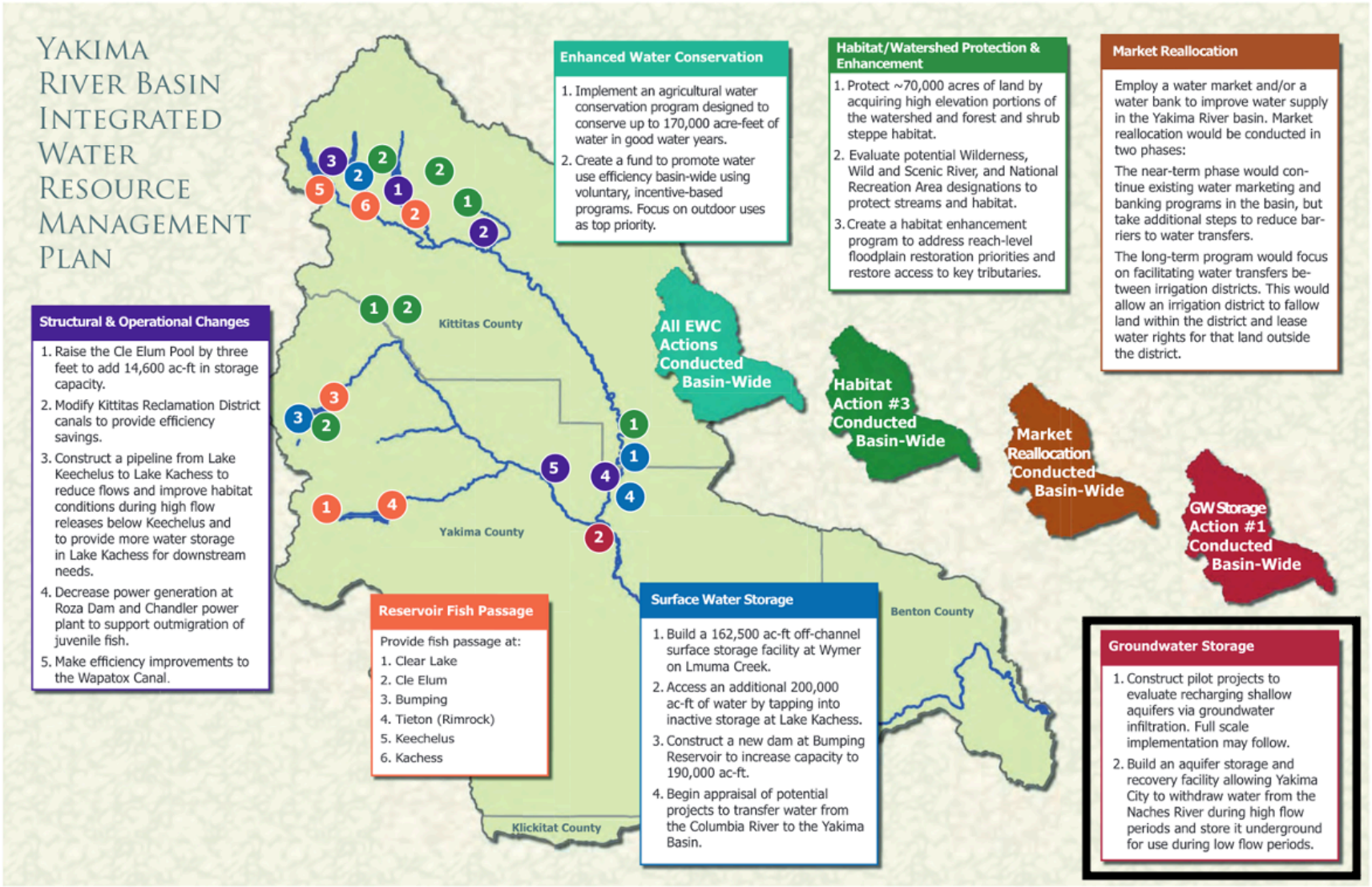


Figure 3. The seven elements of the Yakima Basin Integrated Plan. This study is a part of the groundwater storage element, boxed in black. Figure modified from McKinley and Sandison (2012).

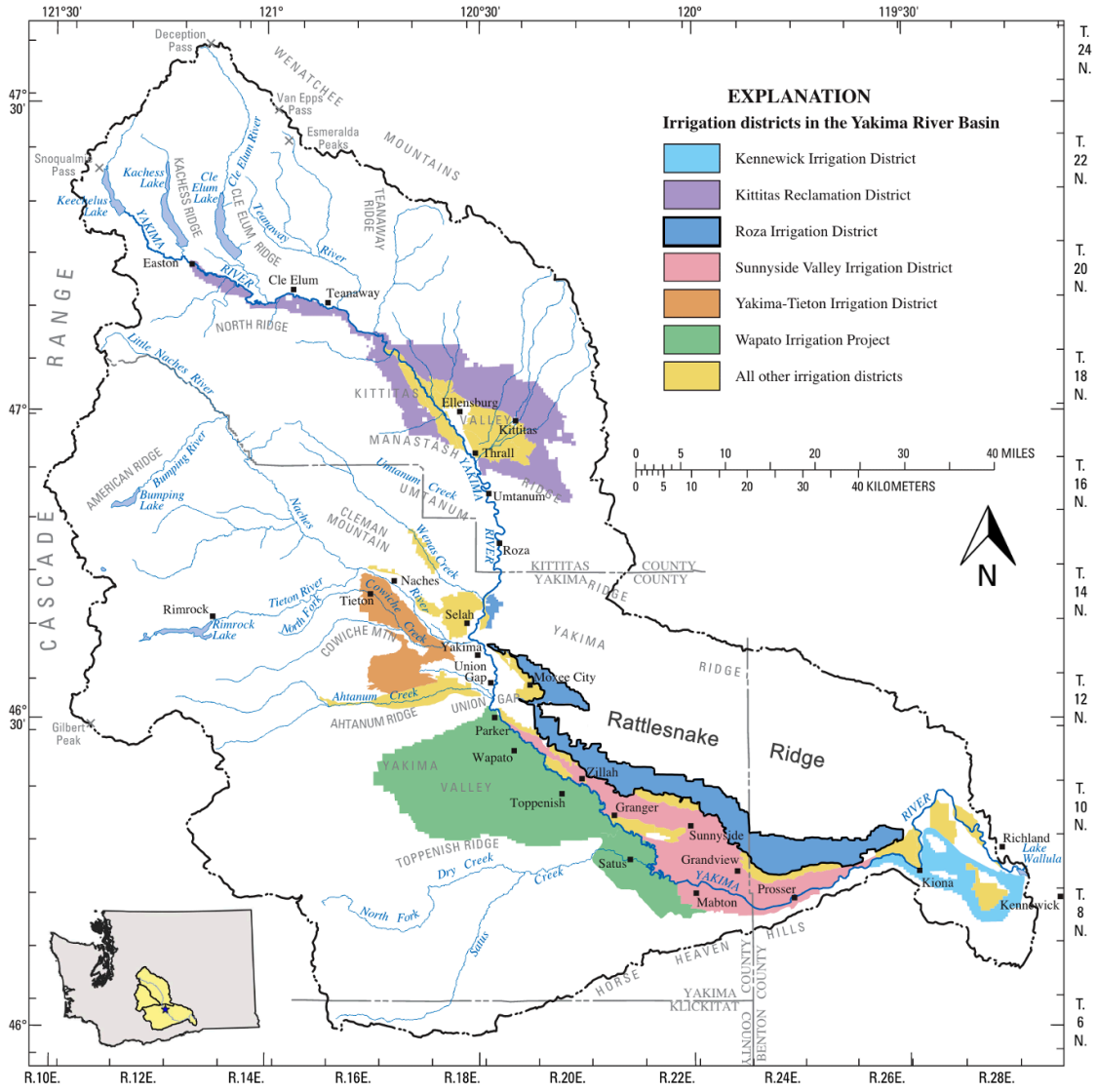


Figure 4. Map of irrigation districts in the Yakima River Basin. The Roza Irrigation District is highlighted in dark blue and outlined in black. Rattlesnake Ridge is labeled. Figure modified from Vaccaro et al. (2009).

CHAPTER II

BACKGROUND

This chapter presents geologic and hydrogeologic context for this study by providing a thorough background on managed aquifer recharge, the geologic units, and the structural controls on groundwater movement in the study area.

Managed Aquifer Recharge

Surface water naturally recharges groundwater aquifers through infiltration. In the lower Yakima River Basin, water infiltrates into basalt aquifers from the ground surface, usually where basalt is exposed at ridges or reaches of losing streams. Basalt aquifers can also be recharged by groundwater leaking from overlying sedimentary units. In the valleys on the eastern side of the Yakima Basin, recharge often occurs through the irrigation of fields (Vaccaro and Olsen, 2007) replenishing sedimentary aquifers and eventually contributing small amounts of water to the underlying basalt aquifers (Sleeper, 2020). With little annual precipitation in the lower basin, these 'natural' recharge methods are slow, especially for replenishing deeper basalt units, which can be storing water that is thousands of years old (Vlassopoulos et al., 2009).

Managed aquifer recharge (MAR) refers to intentionally storing surface water in aquifers to develop underground reservoirs or provide other environmental benefits like enhancing stream baseflow (Dillon, 2005; Anderson et al., 2009) and supporting groundwater-dependent aquatic ecosystems (Sprenger et al., 2017). This study refers to MAR as an "engineering tool" (Gibson and Campana, 2018) to restore groundwater levels in naturally occurring aquifers that experience greater rates of groundwater withdrawal than natural recharge.

British hydrologist Ian Gale coined the term "managed aquifer recharge" in the early 2000s (Dillon et al., 2019). MAR has also been called enhanced recharge, water banking, suitable underground storage (Dillon, 2005), intentional recharge (Sprenger et al., 2017; Dillon et al., 2019), injection recharge (Anderson et al., 2009), subsurface injection (Price et al., 1965), and artificial recharge (Price et al., 1965; Dillon et al., 2019), depending on the methods used. In MAR, both water quantity (the amount of available storage) and water quality (the chemical characteristics of combining surface water with existing groundwater) are important (Dillon et al., 2019) since MAR can be used for drinking water sources and can negatively affect the health of soils and groundwater supplies if not managed appropriately.

MAR is growing in popularity because it has had positive impacts on communities large and small. Global MAR capacity has increased from 8.1×10^5 to 8.1×10^6 acre-feet/year from 1965 to 2015 (Dillon et al., 2019), but it is not necessarily a new phenomenon. Over 1,000 years ago, MAR was used in South India, where rainwater was captured in ponds and then percolated into shallow aquifers used for drinking water (Sakthivadivel, 2007). Today, India still leads the world in MAR programs (Figure 5), averaging about 2.4×10^6 acre-feet/year of recharge through infiltration, with the majority used for agriculture and urban water consumption (Fienen and Arshad, 2016). In 1955, groundwater recharge wells were used in Israel and because of their success, 135 wells were recharging 8.1×10^3 acre-feet/year by 1967 (Harpaz, 1971). The first wells used for MAR in the U.S. were in the 1950s in southern California where they were used to mitigate seawater intrusion (Dillon et al., 2019). The first U.S. well field for MAR was in New Jersey in 1969 and it is still in use today (Dillon et al., 2019). Since then, MAR applications have rapidly increased. In the U.S., 500 wells and 175 wellfields were in operation in 2016 (Dillon et al., 2019), with most of the wells used to store and later recover drinking water.

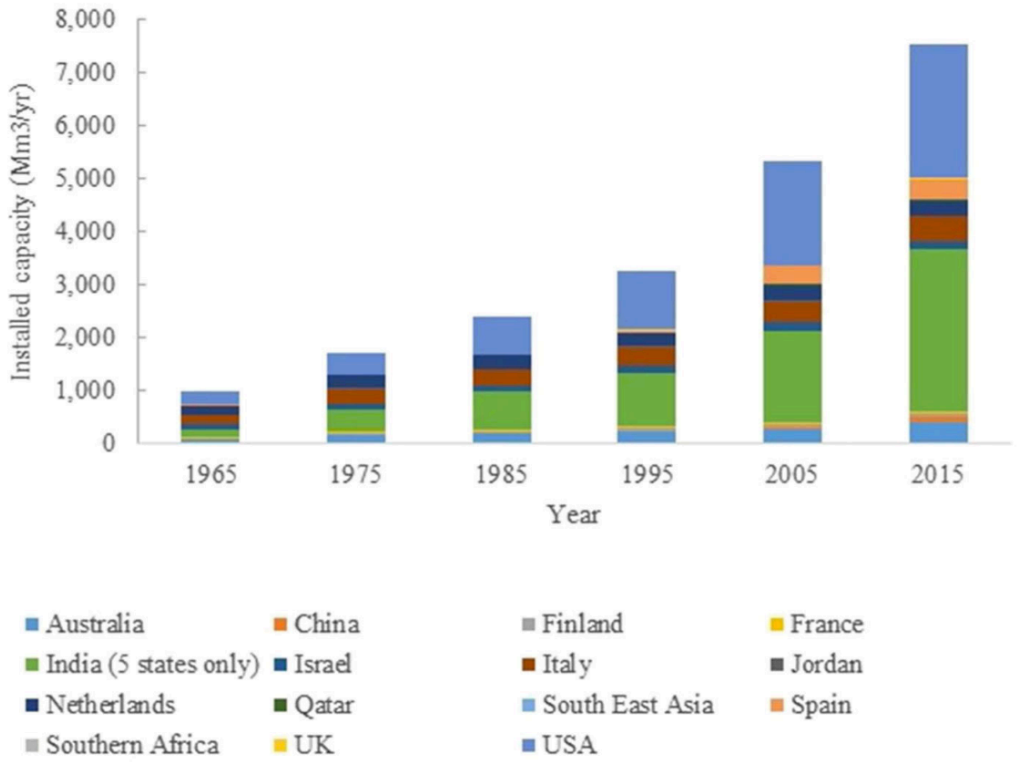


Figure 5. Global managed aquifer recharge capacity categorized by country from 1965 to 2015. Figure from Dillon et al. (2019).

Since the 1950s, MAR programs have become more common in Oregon and Washington, and by 1965 there were MAR systems in many large and small cities including Portland, Oregon, and Tacoma and Richland in Washington (Price et al., 1965), with many targeting similar basalt aquifers to this study (Germiat and Flynn, 2005). In 2000, Washington State Legislature established a new definition of "reservoir" under water rights code RCW 90.03.370 to describe not only surface water reservoirs but also "any naturally occurring underground geological formation where water is collected and stored for subsequent use as part of an underground artificial storage and recovery project" which has given more opportunities for MAR programs in Washington. Five years later, Chapter 173-157 WAC established water rights and permitting

guidelines for injection projects (Germiat and Flynn, 2005), putting MAR efforts into large-scale applications.

Compared to other water storage strategies, like constructing surface water reservoirs, a MAR program can be more cost-effective and sustainable. Dams built to store surface water can be vulnerable to water loss through evaporation and are highly influenced by climatic shifts from year to year, like fluxes in annual precipitation in a watershed (Dillon, 2005). MAR can be used as a buffer (Dillon et al., 2019) to secure water supplies amidst climate fluctuations in the Yakima Basin because groundwater storage reservoirs are not as vulnerable to drought conditions.

Although MAR can be a more suitable water storage option, there can be some challenges with this type of water storage, like waterlogging and slope instability (Dillon, 2005). But proper investigations of the geology and hydrogeology to assess MAR feasibility, such as the research conducted in this project, can help prevent these problems. As it stands, there are some guidelines available for evaluating MAR feasibility but a universal standard for MAR investigation methodology does not yet exist (Dillon et al., 2019). This is due to the diverse sets of lithologies, structural boundaries, watershed sizes, and water qualities unique to various regions of the world. Dillon et al. (2022) provide five requirements for a successful MAR project:

1. Sufficient demand for recovered water
2. Adequate source water for recharge
3. Suitable aquifer for storage and recovery
4. Sufficient land area to treat and recover water
5. Capability for effective management

The study area was chosen for investigating MAR potential because it contains these elements of a successful MAR program. In drought years, the RID receives junior proratable water supplies for over 72,000 acres. The district's water users would benefit from alternative water supplies to meet their remaining needs in these years. Source water for MAR would be comprised of water diverted from the Yakima River at the Roza Dam, delivered using the Roza Irrigation Canal. Since the canal system is already in place, delivering surplus surface water to MAR recharge sites would be relatively simple. Groundwater level trends suggest that with decades of groundwater exploitation, there are large amounts of aquifer storage available for MAR and this thesis provides evidence for this understanding. The water quality of the source water is generally believed to be compatible with existing groundwater in recharged aquifers, but like most MAR projects, water will require treatment. Groundwater recovery would only occur during dry years or state-declared droughts to augment groundwater levels and aquifer conditions. Shallow aquifer recharge (SAR) and aquifer storage and recovery (ASR) are two types of MAR applications explored for the study area.

Shallow Aquifer Recharge

Shallow aquifer recharge (SAR) refers to infiltration into a shallow unconfined aquifer through a permeable ground surface (Sprenger et al., 2017; Gibson and Campana, 2018). Usually, SAR involves the construction of an infiltration pond or ditch where recharge water can percolate down into the target aquifer (Figure 6). This MAR technique is popular in Europe (Dillon, 2005). SAR has also been called enhanced infiltration and aerial recharge (Sprenger et al., 2017), or surface spreading (Price et al., 1965) in the past.

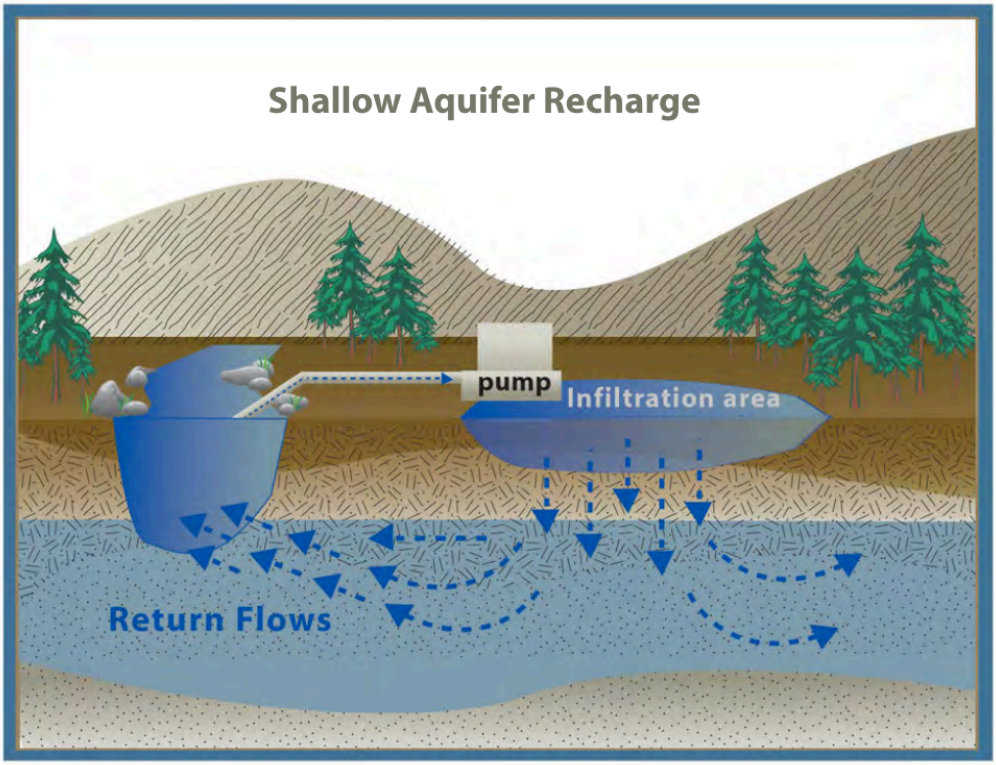


Figure 6. Shallow aquifer recharge with passive recovery through an infiltration pond. Figure from McKinley and Sandison (2012).

Ideal SAR aquifers should be highly permeable, and any overlying sediments should be good conduits for infiltration into the target aquifer below (Anderson et al., 2009). Despite their shallow depth, SAR aquifers should be thick enough to store large quantities of water to make sufficient enhancements to aquifer conditions and water storage. Structural confinements within the aquifer are necessary if SAR methods are implemented for later recovery. Alternatively, SAR projects can be designed so that recharge water returns to a surface water body at a desirable time.

SAR can result in mounding, where the addition of water into the aquifer concentrates in the subsurface around the infiltration pond area (Gibson and Campana, 2018). While mounding is to be expected to some degree, long-term mounding would be a major limitation in SAR

because the mounded groundwater can reach the surface and thus minimize the storage potential of the aquifer (Gibson and Campana, 2018).

Aquifer Storage and Recovery

Aquifer storage and recovery (ASR), involves injecting recharge water through a well into a confined aquifer (Gibson and Campana, 2018) and extracting it for later use (Anderson et al., 2009) (Figure 7). Depending on the recovery well or method of discharge, ASR can be specified further; ASR refers to injection and recovery from the same well, while aquifer storage transfer and recovery refers to injection into one well and recovery from a separate well (Dillon, 2005).

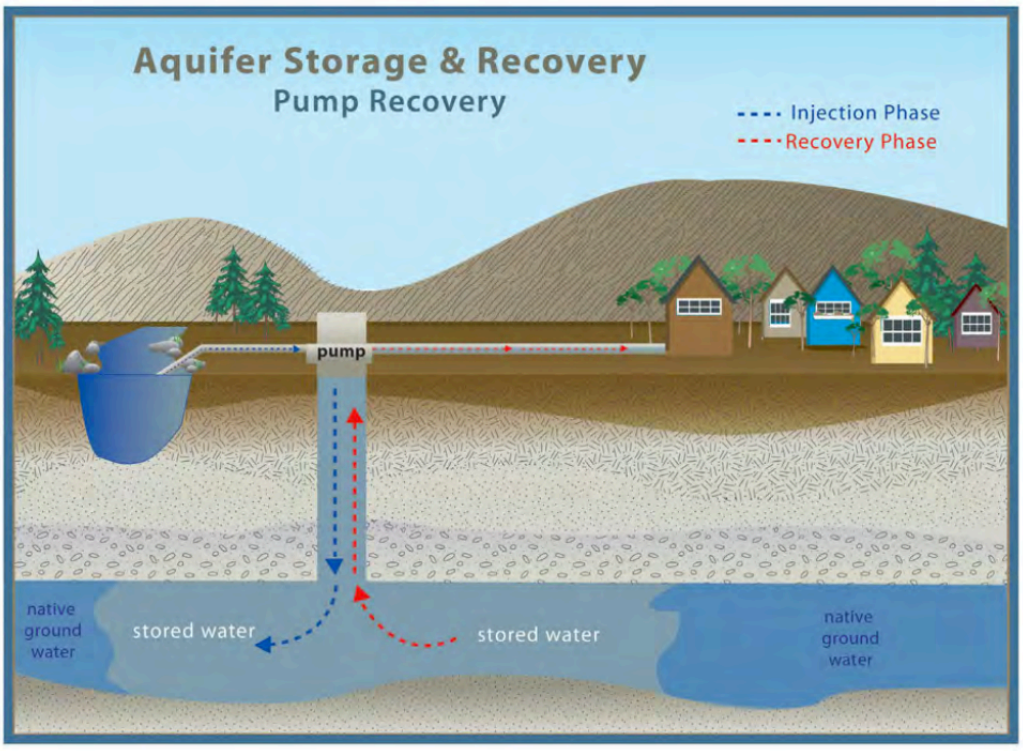


Figure 7. Aquifer storage and recovery through an injection well. Figure from McKinley and Sandison (2012).

While ASR is less costly than building surface reservoirs, this method of MAR remains a big investment and is more expensive than SAR. Because of this, ASR has only been practiced in developed countries (Casanova et al., 2016). Costs related to ASR include infrastructure for obtaining and treating surface water, drilling or retrofitting wells, land acquisition, and permitting (Anderson et al., 2009). Water rights are necessary for the diversion, storage, and consumption of recharge water, as modified in water rights code RCW 90.03.370 (McKinley and Sandison, 2012). With many wells in the study area already completed in target ASR aquifers, costs can be reduced with well modifications (Anderson et al., 2009), but many wells are nearly 50 years old and may lack efficiency. Despite these costs, ASR is typically preferred as a MAR method for restoring aquifers in deeper geologic units like the Wanapum Basalts studied in this project. ASR is also ideal in dry climates where water availability varies seasonally, like in the Yakima River Basin, where there is excess water for storage during the wet seasons and high water demand in the dry seasons (Anderson et al., 2009; Sprenger et al., 2017).

Stratigraphy and Hydrogeologic Properties

Flood basalts erupted through fissures in eastern Washington, eastern Oregon, and western Idaho between 17 and 6 Ma, producing the Columbia River Basalt Group (CRGB) that covers over 80,000 mi^2 of these Pacific Northwest states (Reidel et al., 2003, 2013; Vaccaro and Olsen, 2007; Burns et al., 2011). Volcanism was initiated in the back-arc between the volcanic Cascade Range and the Rocky Mountains (Camp et al., 2017). Although the fissures were active for about 10 million years, more than 90% of the basalt erupted in a one-million-year window at the beginning of flood basalt volcanism (Kasbohm and Schoene, 2018). From oldest to youngest, the CRBG in the study area consists of the Grande Ronde Basalt, Wanapum Basalt, and Saddle Mountain Basalt. Because of the large volume and storage capability, the CRBG units are

considered to be a major regional aquifer system in the U.S. called the Columbia Plateau Regional Aquifer System (CPRAS). The CPRAS contains productive basalt aquifers used for drinking water, irrigation, and city water supplies.

The stratigraphic relationship of basalt units and sedimentary interbeds is presented in Table 1. Sedimentary units interbedded between basalt flows are collectively referred to as the Lower Ellensburg Formation. These sedimentary units were deposited during times of quiescence between flood basalt flows (Burns et al., 2011) and serve as stratigraphic marker beds to differentiate basalt units (Swanson and Wright, 1978). These sediments originated in the Cascade Range to the west of the study area during hiatuses in flood basalt volcanism. Sediments were often deposited as mud and debris flows or lahars (Kirk and Mackie, 1993) and accumulated into thick interbeds in structural depressions (Hansen et al., 1994). In general, interbeds are fine-grained, inefficient at transmitting water, and thin compared to the basalt flows (Schmidt et al., 2007). However, the sediment grain sizes, porosities, thicknesses, and lateral extents of the interbeds vary in the Columbia Plateau and study area due to the duration of pauses between flood basalt volcanism, Cascade volcanic events, and proximity to source rocks (Hansen et al., 1994).

Table 1. Simplified stratigraphy of the Columbia River Basalt Group and Lower Ellensburg Formation

Era	Period	Epoch	Age (Ma)	Formation	Member	Description
Cenozoic	Quaternary	Holocene	0-5.6	Overburden		Landslide, flood, loess deposits
		Pleistocene				
	Neogene	Pliocene				
		Miocene	5.6 – 15.8	Upper Saddle Mountain	Elephant Mountain	Basalt flow
				Lower Ellensburg	Rattlesnake Ridge	Sedimentary interbed
				Lower Saddle Mountain	Pomona	Basalt flow
				Lower Ellensburg	Selah	Sedimentary interbed
				Lower Saddle Mountain	Umatilla	Basalt flow
			15.8 – 16.1	Lower Ellensburg	Mabton	Sedimentary interbed
				Wanapum	Priest Rapids	Basalt flow
					Roza	Basalt flow
				Lower Ellensburg	Squaw Creek	Sedimentary interbed
				Wanapum	Frenchman Springs	Basalt flow
				Lower Ellensburg	Vantage	Sedimentary interbed
			16.1 – 16.5	Grande Ronde		Basalt flow

Note: Stratigraphy after Kasbohm and Schoene (2018), Reidel et al. (2013), and Bentley et al. (1993). Units are color-coded with the maps, cross-sections, graphs, and tables in this thesis.

In some regions of the CPRAS and study area, the interbeds of the Lower Ellensburg Formation can store considerable quantities of groundwater (Schmidt et al., 2007; Burns et al., 2011) and wells have been drilled to access the resource. However, compared to the CRBG

aquifer units, these interbeds are only minor aquifers and can even be confining units, or aquitards, on a regional scale (Burns et al., 2011). Where interbeds are permeable or saturated, they are vertical extensions, or conduits (McKinley and Sandison, 2012), that transmit water to underlying basalt aquifers. This project focuses on the Vantage, Squaw Creek, Mabton, Selah, and Rattlesnake Ridge members of the Lower Ellensburg Formation, from oldest to youngest.

The repeated sequences of basalt and sedimentary layers form a 'layered cake' pattern to the stratigraphy, with basalt units as thick segments of cake and sedimentary units as the thin filling to separate them (Figure 8). This allows for the stratigraphy of specific regions of the Columbia Plateau to be interpreted from well reports and other available information, as done in this project.

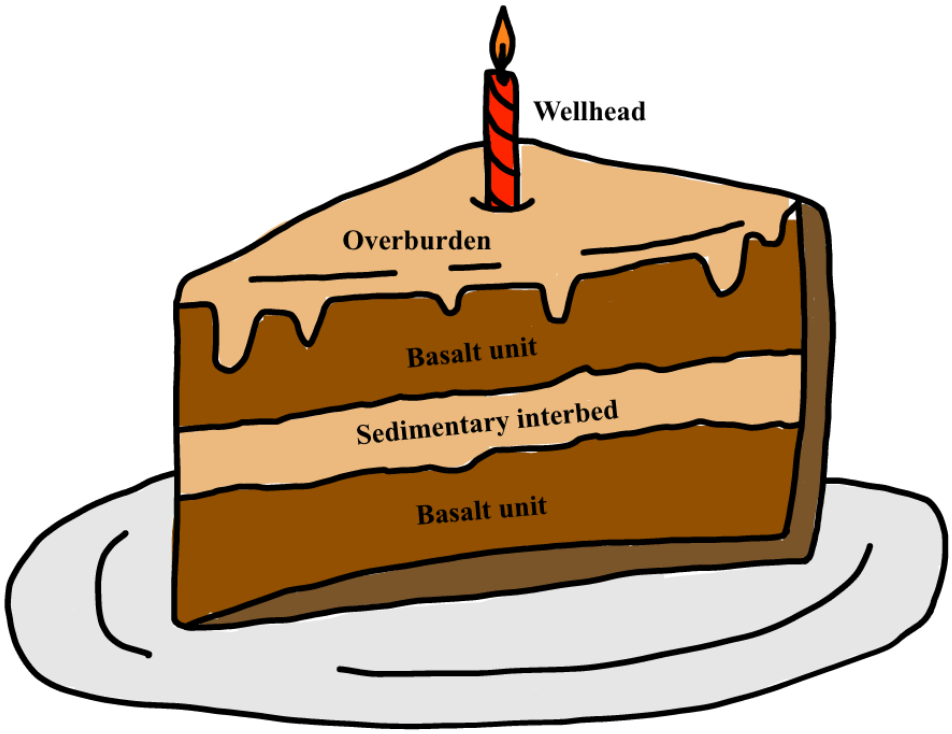


Figure 8. Illustration of the stratigraphic “layered cake” sequence of basalt units as cake and interbedded sediments as filling between them. The icing represents the overburden, and the candle symbolizes a well that penetrates the subsurface.

Accounting for about 90% of the volume of the CRBG, the Grande Ronde Basalts (GRB) are the oldest flood basalt flows and cover about 42,000 mi^2 (Swanson and Wright, 1978; Schmidt et al., 2007; Kahle et al., 2009; Burns et al., 2011). In the central region of the Columbia Plateau, the GRB is more than 15,000 ft thick (Burns et al., 2011). The GRB has a fine-grained and non-porphyritic texture (Swanson and Wright, 1978) which makes it easy to identify in the field, although exposures in the study area are infrequent. Because the GRB erupted consistently and massively in a relatively short window of time from 16.5 to 16.1 Ma (Kasbohm and Schoene, 2018), sedimentary interbeds are rare and thin where present (Burns et al., 2011). The GRB are not studied at length in this project because they are deep in the subsurface and there are only a select number of wells completed in the aquifer.

The Vantage member of the Lower Ellensburg Formation separates the top of the GRB from the bottom of the Wanapum Basalt. The interbed consists primarily of clay and shale but can have small amounts of sand (Bingham and Grolier, 1966; Burns et al., 2011). Due to the high clay content, this interbed is considered a confining later separating the Grande Ronde Basalt aquifer from the Wanapum Basalt aquifer (Kirk and Mackie, 1993; Hansen et al., 1994). Wells completed in the GRB have higher head than wells in the Wanapum which indicates that the Vantage interbed is a confining layer (Kirk and Mackie, 1993).

The Wanapum Basalts (WNB) erupted during a narrow window of time from 16.1 to 15.8 Ma (Kasbohm and Schoene, 2018). While the WNB is less laterally extensive and voluminous than the GRB (Swanson and Wright, 1978), they comprise 6% of the CRBG. Compared to the GRB, the WNB are medium-grained (Swanson and Wright, 1978; Hansen et al., 1994) and more frequently exposed in the study area. The Wanapum aquifer is of particular interest for MAR through ASR in the study area because the aquifer is confined, productive, primarily used for

irrigation, and has experienced groundwater level declines (Kirk and Mackie, 1993; Schmidt et al., 2007). The three members of the WNB studied in this project are the Frenchman Springs, Roza, and Priest Rapids members, listed from oldest to youngest. The Squaw Creek member of the Ellensburg Formation is the major sedimentary interbed found within basalt flows of the WNB.

The Squaw Creek interbed is located stratigraphically between the Frenchman Springs and Roza members of the Wanapum Basalt.[1] This interbed consists almost entirely of diatomite, although there are clays, silts, sands, and fine conglomerates as well (Bingham and Grolier, 1966). Highly permeable, the interbed can be considered a conduit of vertical groundwater flow between the underlying Frenchman Springs and overlying Roza members of the WNB, connecting these units into one massive aquifer.

The Wanapum Basalt is separated from the younger Saddle Mountain Basalts by the Mabton member of the Lower Ellensburg Formation. This interbed consists of clay and shale, although some silt and sand are found (Myers and Price, 1981). Similar to the Vantage interbed, the Mabton contains enough clay to be considered a confining layer (Kirk and Mackie, 1993; Hansen et al., 1994; Germiat and Flynn, 2005), constraining vertical flow between the uppermost member of the Wanapum Basalt and lowermost member of the Saddle Mountain Basalt.

The Saddle Mountain Basalt (SDMB), the youngest and least extensive formation of the CRBG, erupted during a time of waning flood basalt volcanism and accelerating folding in the study area (Swanson and Wright, 1978; Schmidt et al., 2007; Burns et al., 2011) about 15.8 to

[1] The Squaw Creek interbed of the Ellensburg Formation is named after an offensive, racist, and sexual slur for indigenous Native American women. The occurrence of this term in geological sciences represents the legacy of colonialism and the scientific discipline. Yale University provides a catalog of literature on colonialism and the geosciences and is available at: https://guides.library.yale.edu/earthplanetarysci/colonialism.

5.6 Ma (Kasbohm and Schoene, 2018). The SDMB accounts for about 1% of the total volume of the CRBG (Swanson and Wright, 1978; Schmidt et al., 2007). The SDMB is the target for MAR through SAR in the study area because the aquifer is shallow and has experienced storage loss from groundwater withdrawal. The three members of the SDMB in the study area include the Umatilla, Pomona, and Elephant Mountain members, listed from oldest to youngest. The Selah and Rattlesnake Ridge sedimentary interbeds of the Lower Ellensburg Formation are found within the basalt flows of the SDMB.

The Selah interbed of the Lower Ellensburg Formation is positioned between the Umatilla and Pomona members of the SDMB and is composed of silt, sand, and gravel-sized conglomerates (Kent, 1978). As a saturated interbed (Anderson et al., 2009), the Selah member is a minor aquifer and therefore transmits water between the Umatilla and Pomona members, forming a thick aquifer unit of the Lower SDMB. The Rattlesnake Ridge interbed separates the Pomona member from the Elephant Mountain member in SDMB. The top two-thirds of the Rattlesnake Ridge interbed is a sandy and coarse layer that is highly permeable, but the lower third is clay-rich and reduces vertical flow to the underlying Pomona basalt member, serving as a confining layer (Kirk and Mackie, 1993) that divides the SDMB aquifer into two distinct units: the Lower Saddle Mountain, containing the Umatilla and Pomona basalt members and the Selah interbed, and the Upper Saddle Mountain, comprised of the Elephant Mountain basalt member with water stored in the upper two-thirds of the Rattlesnake Ridge interbed.

The flood basalt flows of the Columbia River Basalt Group have a recognizable structure that has been heavily studied for nearly fifty years (Swanson and Wright, 1978; Kirk and Mackie, 1993; Hansen et al., 1994; Reidel et al., 2003; Camp et al., 2017). Formed from cooling,

the internal structure of a typical basalt flow includes a flow base, an interior of entablature and colonnade, and a flow top (Figure 9).

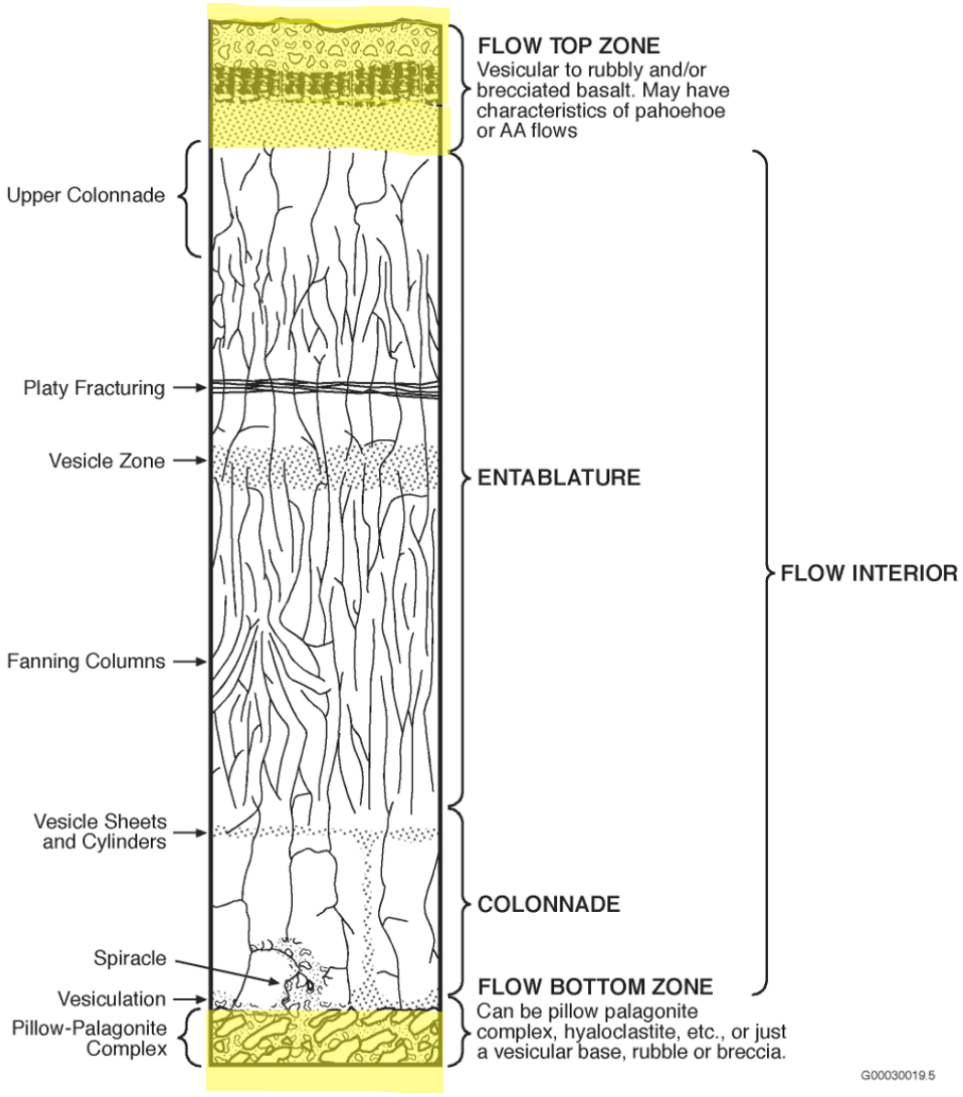


Figure 9**.** The simplified structure of a typical Columbia River Basalt Group flood basalt flow. The interflow zone is highlighted in yellow. Figure modified from Reidel et al. (2003).

The physical characteristics of a basalt flow determine the hydrogeologic properties of the basalt aquifers. Water-bearing zones occur in vesicles and brecciated sections, and within joints and fractures of a basalt flow, while zones of low transmissivity occur in denser interiors

of the flow (Anderson et al., 2009). Interflow zones describe the combination and contact between the flow top of one basalt flow and the flow base of an overriding basalt flow (Kirk and Mackie, 1993; Hansen et al., 1994). Water can move efficiently in all directions in the interflow zones but flow interiors are dominated by vertical hydraulic movement (Figure 10).

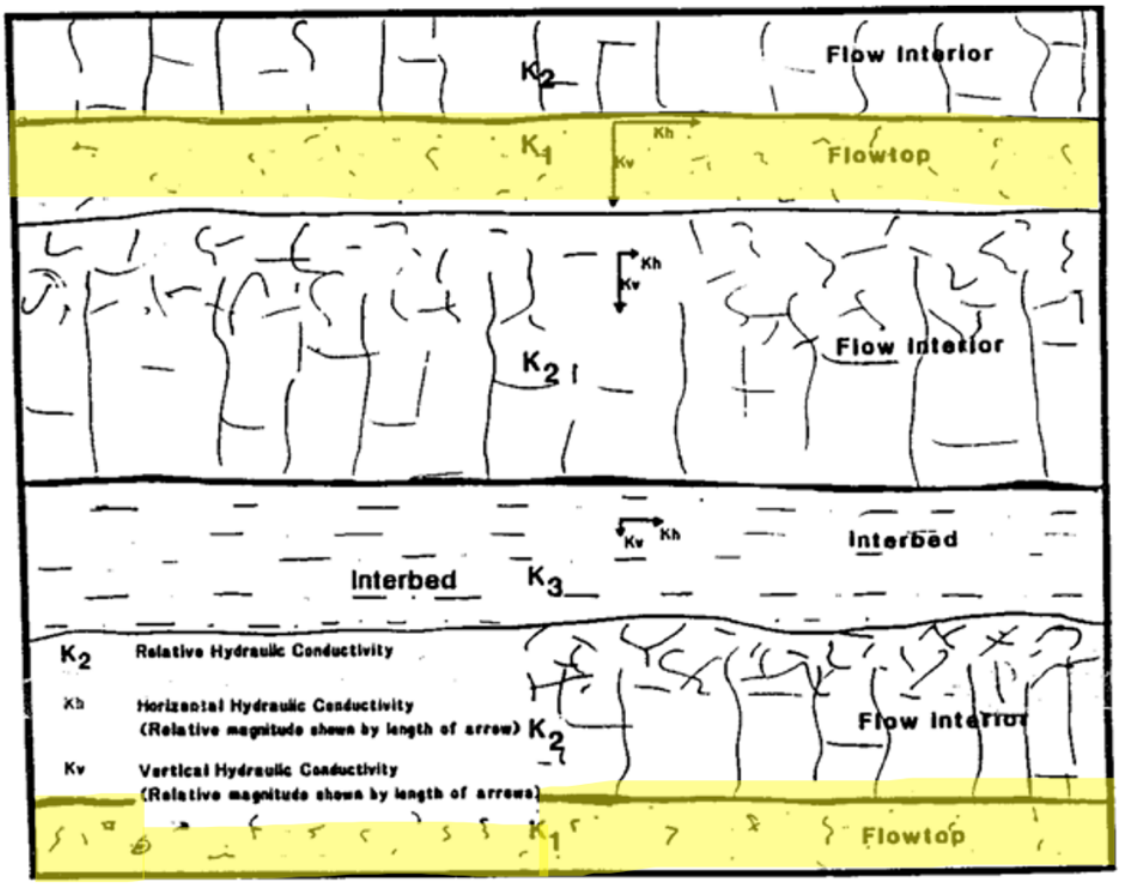


Figure 10. Relative hydraulic conductivity of basalt flows and interbeds of the Columbia River Basalt Group. Interflow zones are highlighted in yellow. Figure modified from Kirk and Mackie (1993).

The flow base makes up a thin section of a typical basalt flow (Camp et al., 2017) and represents the contact between a flood basalt lava flow and the substrate it is flowing over. Identifiable for its glassy and vesicular textures formed from rapid cooling, the flow base is fine-

grained and sometimes includes pillow-palagonite basalts (Hansen et al., 1994) if the flow cooled in contact with water.

The flow interior is the densest and thickest section of a basalt flow and is comprised of entablature and colonnade (Figure 9). As the lava flow cooled and contracted at the surface, jointing and fracturing occurred, developing the structures of the flow interior. Just above the flow base, coarse pseudo-hexagonal basalt columns are typically found, comprising the colonnade section of the flow interior. The columns formed from slow internal bottom-up cooling (Reidel et al., 2003) and are oriented vertically. Basalt columns are typically about 3 ft in diameter and 25 ft long on average and can have secondary jointing cutting across them (Hansen et al., 1994).

Despite the length of the columns, the entablature section of the flow interior makes up about 70% of the thickness of a basalt flow (Swanson and Wright, 1978) and is located above the colonnade. The contact between the colonnade and entablature is sharp (Swanson and Wright, 1978) and represents a shift in cooling rates and patterns within a basalt flow. Compared to the colonnade, entablature forms from rapid internal top-down cooling (Reidel et al., 2003) and consists of fractured fine-grained basalt in smaller fan-shaped columns (Swanson and Wright, 1978; Hansen et al., 1994). The messy columns in entablature are usually about 2 ft in diameter and cross-jointing is less consistent than in the colonnade (Swanson and Wright, 1978; Hansen et al., 1994). The uppermost part of the entablature can be more scoriaceous and vesicular compared to the rest of the flow interior (Swanson and Wright, 1978; Hansen et al., 1994) and can even contain an upper colonnade (Camp et al., 2017) that allows for vertical groundwater movement from the flow top to the flow interior.

While the massive flow interior is less porous than the flow top and base, the vertical fractures create permeable zones (Hansen et al., 1994) that allow for groundwater to move efficiently throughout the entire basalt flow structure. The high vertical hydraulic conductivity of the flow interior ultimately connects flows for continuous groundwater movement and storage (Kirk and Mackie, 1993), serving as an important basalt aquifer function. Additionally, flow interiors can contain one or even a series of vesicular zones that can be several feet thick (Reidel et al., 2003), where large quantities of water can be stored. These vesicles are not formed during lava cooling, but rather represent gas bubbles trapped in lava flows (McMillan et al., 1989).

The flow top is usually 10-20% of a basalt flow (Reidel et al., 2003, 2013) and contains vesicular, rubbly, brecciated, and hummocky textures (Reidel et al., 2003; Camp et al., 2017) from when the surface of the lava flow cooled quickly in contact with the air. The basalt flow top is porous, permeable, and capable of storing significant amounts of groundwater, which is why groundwater extracted from basalt aquifers primarily comes from the flow tops and interflow zones. The porosity of a CRBG flow top is typically about 20% but can be as high as 45% (Kirk and Mackie, 1993; Whiteman et al., 1994; Zakharova et al., 2012). The interflow zone contains the highest storage potential due to the increased porosity and permeability from the laterally continuous vesicular structures from the flow top and the flow base (Kirk and Mackie, 1993).

The Upper Ellensburg Formation, which overlies the uppermost unit of the CRBG, is referred to as “overburden” in this project, although this term also includes Quaternary deposits at the surface. Consisting of the Cascade-sourced sediments and erosion from glacial ice (Vaccaro and Olsen, 2007) ranging from clays to gravels, the Upper Ellensburg Formation is generally categorized as a semi-unconsolidated volcaniclastic sandstone. The Quaternary sediments that top the overburden unit consist of unconsolidated fluvial, colluvium, wind-blown

loess, and Missoula flood deposits. In general, these deposits transmit water effectively into underlying aquifers, however, there are touchet beds from flood deposits that are considered impermeable.

Structural Controls on Groundwater Flow

As the Pacific plate moves northwest and the Juan de Fuca plate subducts under the North American plate, shearing causes compression in the Yakima Basin (Atwater, 1970), deforming the CRBG into the series of narrow anticlinal ridges and broad synclinal basins (Hansen et al., 1994; Reidel et al., 2003) of the Yakima Fold Belt. Compression initiated about 5 Ma toward the end of flood basalt volcanism and produced the east-west trending ridges and valleys that control the movement and connection of groundwater in the lower Yakima Basin.

The Yakima Fold Belt covers an area of about 5,400 mi^2 of the western Columbia Basin (Reidel et al., 2003). Anticlinal ridges are asymmetrical with steep north limbs and shallow south limbs (Hansen et al., 1994; Reidel et al., 2003; Schmidt et al., 2007). Synclines are wide valleys where most farming is concentrated in the lower basin. Folding-associated thrust faults (Swanson and Wright, 1978; Reidel et al., 2003) as well as northwest-southeast trending faults that crosscut the folds (Kirk and Mackie, 1993) introduce structural and hydraulic complexity to the study area.

Rattlesnake Ridge is a fold anticline that prevents lateral groundwater movement from Moxee Valley to the north to the Lower Yakima Valley to the south (Germiat and Flynn, 2005), especially within the WNB aquifer (Kirk and Mackie, 1993). This is due to the presence of folded confining interbeds that block water from flowing between basalt aquifers across the folds. The Meyers Anticline and Hog-Ranch Naneum Anticline (Figure 11) are north-south

trending folds that cross Moxee Valley to the north of Rattlesnake Ridge. Kirk and Mackie (1993) have determined that these folds influence groundwater movement in the SDMB, but not the WNB.

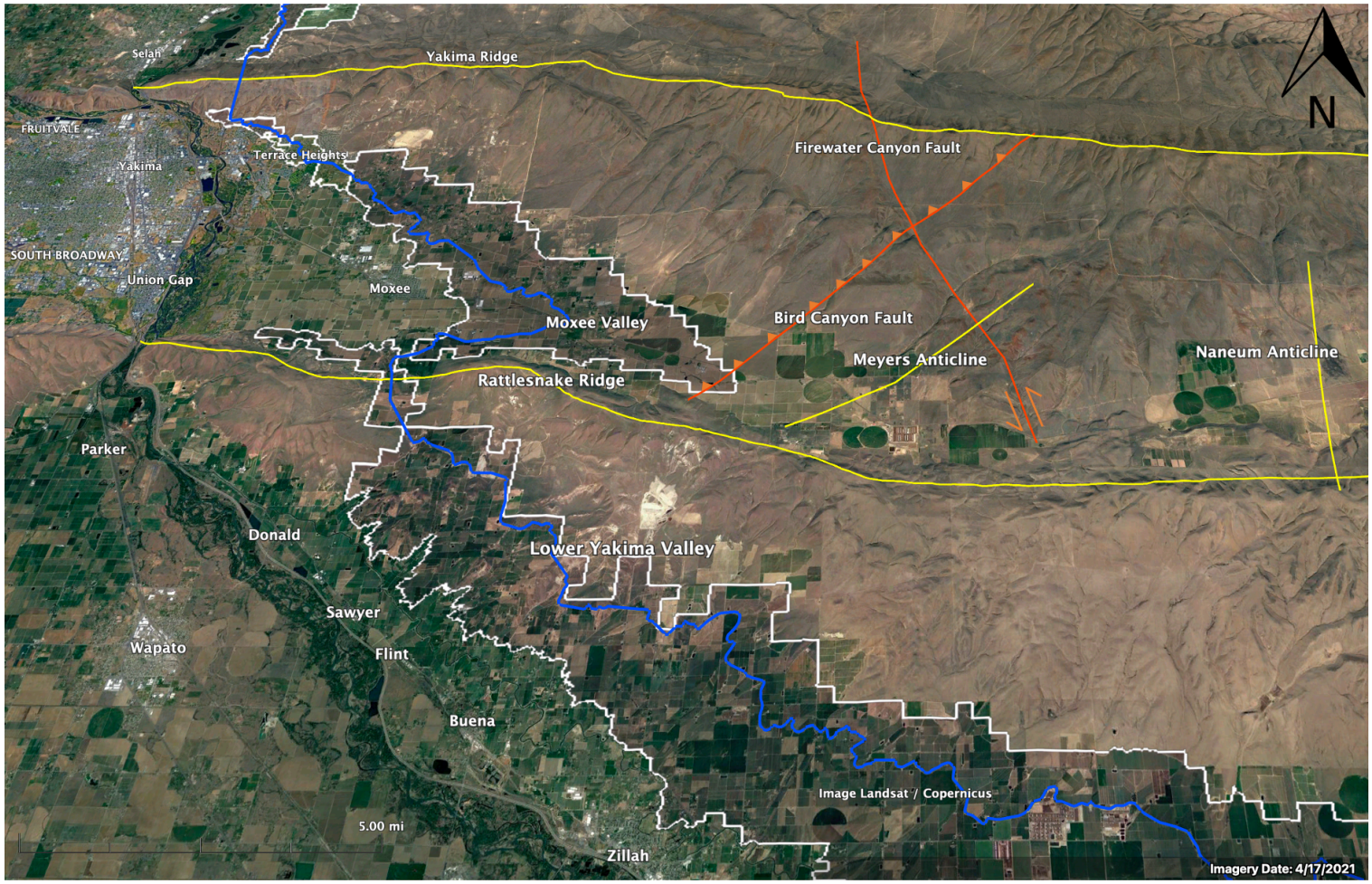


Figure 11. Map of notable faults and folds of the study area. Faults are marked in orange and folds are marked in yellow. The Roza Irrigation District is outlined in white, and the Roza Canal is in blue. Imagery from Google Earth.

Faults have varying effects on groundwater movement in the study area. Compressive faults like thrust and reverse faults are common and typically act as barriers to groundwater flow because they are filled with brecciated rock fragments. While thrust faults can complicate MAR efforts, high-angle reverse faults can be strategically utilized to create a groundwater cell for concentrating recharged water for future recovery via ASR. Thrust faults are usually located near fold axes (Reidel et al., 2003) and inhibit vertical groundwater flow. Steeper reverse faults can be found further from fold axes and reduce horizontal groundwater flow. The northeast-southwest trending Bird Canyon Fault (Figure 11) in Moxee Valley is a reverse fault that is deemed as a "buried" feature because it predates the SDMB (Kirk and Mackie, 1993). As a result, the Bird Canyon fault is most relevant for groundwater movement in the WNB aquifer for this project. Unmapped faults are likely within the study area, based on field observations.

Compared with reverse faults, normal faults are rare and are understood to originate from rupture independent of folding (Swanson and Wright, 1978) and can enhance vertical groundwater movement. Strike-slip faults develop independent of folding and can be barriers to groundwater flow. The northwest-southeast trending Firewater Canyon Fault in Moxee Valley crosses the Bird Canyon Fault and Meyers Anticline (Figure 11). It was initially mapped as a right-lateral strike-slip fault (Drost and Whiteman, 1986), but is now considered a left-lateral strike-slip fault (Kirk and Mackie, 1993). The Firewater Canyon Fault is younger than the WNB and moderately affects groundwater movement in the SDMB (Kirk and Mackie, 1993).

Fractures are important to groundwater flow and recharge, enhancing vertical hydraulic conductivity within aquifers (Kirk and Mackie, 1993), particularly at anticlinal ridges. Fractures can be associated with the original cooling and emplacement of basalt, folding, and faulting. Fractures within the basalt structure are found at the flow base and colonnade, enhancing vertical

groundwater movement in those sections of a typical basalt lava flow (Hansen et al., 1994). At anticlinal ridges, where local extension deforms basalt rock, fractures can be conduits of natural recharge. Surface water can infiltrate down into aquifers, recharging deeper basalt units. Fracturing associated with faulting occurs as splays and secondary faults, augmenting local hydraulic conductivity within the rupture.

Previous Investigations

Investigations into the CPRAS began with the Regional Aquifer-System Analysis program by the U.S. Geological Survey in the 1980s (Sun and Johnston, 1994) which identified the stratigraphic units of basalt aquifers of the CPRAS from geologic mapping by Swanson and Wright (1978) and Drost and Whiteman (1986). Within the last forty years, there has been detailed research on the geology and hydrogeology of the Columbia Plateau (McMillan et al., 1989; Drost et al., 1990; Kirk and Mackie, 1993; Hansen et al., 1994; Whiteman et al., 1994; Reidel et al., 2003, 2013; Kahle et al., 2009) including modeling completed by Burns et al. (2011) which is described as the U.S. Geological Survey CPRAS model in this thesis. Additionally, work by Vaccaro and others has yielded hydrogeologic frameworks for the Yakima Basin that have involved estimations of historical groundwater pumping, models of groundwater flow, and land use analyses relating to groundwater recharge (Vaccaro and Sumioka, 2006; Vaccaro and Olsen, 2007; Vaccaro et al., 2009; Ely et al., 2011). This work has provided the foundation for the research presented in this thesis and study. The following chapters outline the methodology and findings of this exploration, as well as comparisons to previous research and evaluations of aquifer storage availability.

CHAPTER III

METHODS

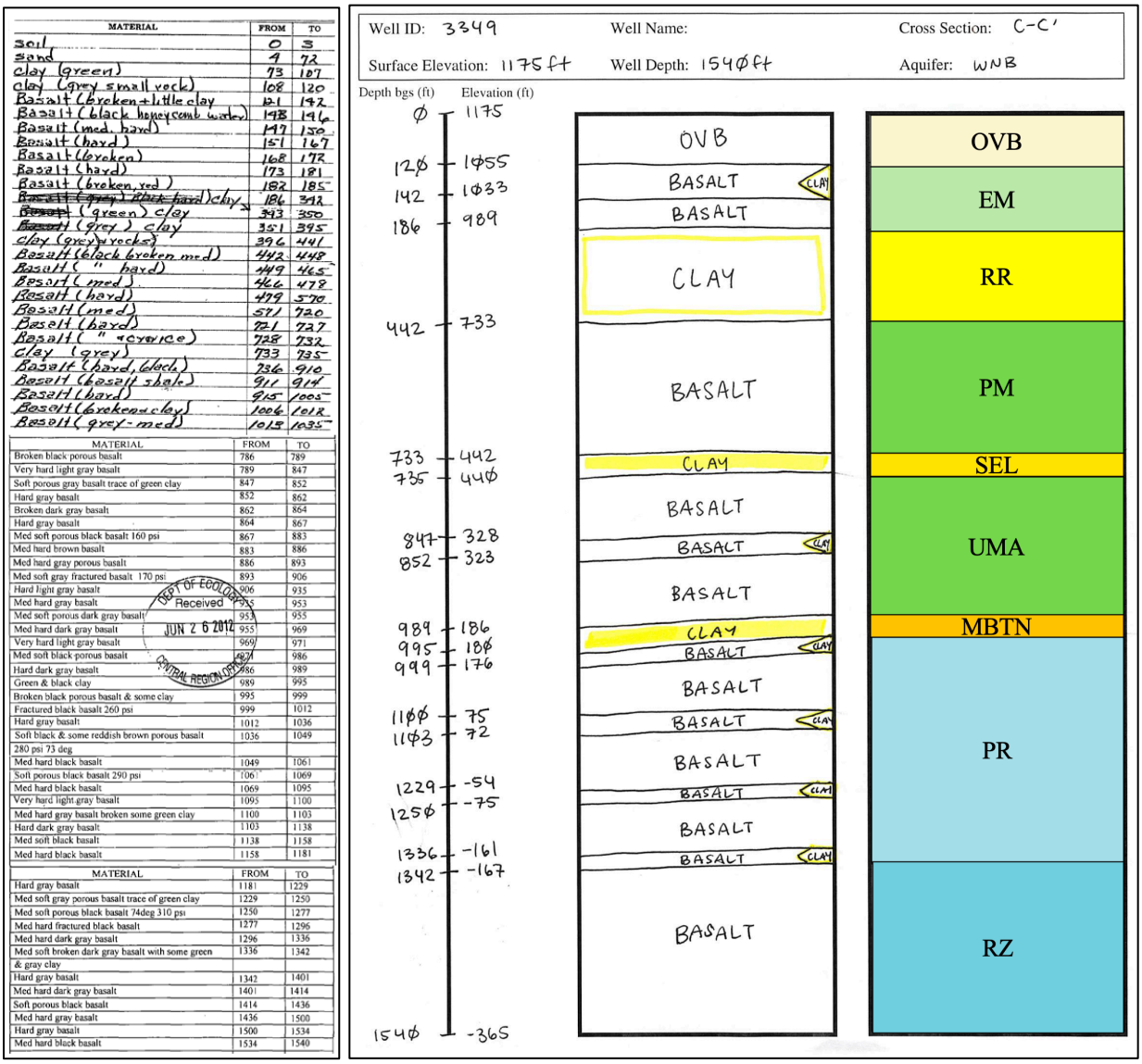
The Rattlesnake Ridge MAR project, funded by the Washington State Department of Ecology (ECY), is a joint effort between Central Washington University, Geosyntec Inc., and Coho Water Resources, LLC. Therefore, the information and methods presented in this thesis often reflect a degree of collaboration. Brian Webb (Geosyntec, Inc.) assisted in developing elevation profiles for the cross-sections and Sherry Wilhelm (Coho Water Resources, LLC) made the ArcGIS maps in this thesis. Bob Anderson (Geosyntec, Inc.) was responsible for initiating communication between well owners and the project team.

Stratigraphic Interpretations of Well Reports

Well reports are publicly available through the Well Report Viewer database (Washington State Department of Ecology, 2023b) of the ECY Well Construction and Licensing website. Well reports include driller notes on the geologic material that is recovered during drilling and the depth of that material. These driller notes were interpreted to reconstruct the subsurface geology of the study area by superimposing the known stratigraphy of the region (Table 1) onto the driller notes.

Interpreting driller notes is a similar process to extracting information from preexisting geologic field notes or core logs. To focus the stratigraphic reconstruction on only the Columbia River Basalt Group and sedimentary interbeds, every layer above the youngest basalt unit was described as “overburden” (OVB). The OVB encompasses the deposits after flood basalt volcanism like the Upper Ellensburg Formation and Quaternary sediments. Due to the relatively simple and repetitive geology (Figure 8), it was easy to interpret the layers described by drillers

as either basalt (sometimes described as “black rock”) or sediment (e.g., clay, shale, sand, or gravel). A sketch was made to visualize the stratigraphy of interest by consolidating subsequent basalt layers and marking sedimentary interbeds (Figure 12). The sketch offered a visualization of the driller notes which could then be more easily interpreted for member-specific stratigraphy. The interbedded sedimentary layers are assumed to be the Lower Ellensburg Formation and they served as marker beds to differentiate basalt units from one another (Figure 12). The Rattlesnake Ridge interbed, for example, is recognizable for its thickness and proximity to the ground surface. Identifying this layer in the driller notes means that the basalt layer above the interbed is the Elephant Mountain member of the Saddle Mountain Basalt and the basalt layer below the interbed is the Pomona member of the SDMB. This process is repeated for all the interbeds to assign basalt or sedimentary members to the stratigraphy.



MATERIAL	FROM	TO
soil	0	3
sand	3	72
clay (green)	73	107
clay (grey small rock)	108	120
Basalt (broken + little clay	121	142
Basalt (black honeycomb water)	148	196
Basalt (med. hard)	197	150
Basalt (hard)	151	167
Basalt (broken)	168	172
Basalt (hard)	173	181
Basalt (broken, red)	182	185
Basalt (grey black hard) clay	186	342
Basalt (green) clay	343	350
Basalt (grey) clay	351	395
clay (grey w rocks)	396	441
Basalt (black broken med)	442	448
Basalt (" hard)	449	465
Basalt (med)	466	478
Basalt (hard)	479	570
Basalt (med)	571	720
Basalt (hard)	721	727
Basalt (" vesicle)	728	732
clay (grey)	733	735
Basalt (hard, black)	736	910
Basalt (basalt shale)	911	914
Basalt (hard)	915	1005
Basalt (broken + clay)	1006	1018
Basalt (grey - med)	1019	1035

MATERIAL	FROM	TO
Broken black porous basalt	786	789
Very hard light gray basalt	789	847
Soft porous gray basalt trace of green clay	847	852
Hard gray basalt	852	862
Broken dark gray basalt	862	864
Hard gray basalt	864	867
Med soft porous black basalt 160 psi	867	883
Med hard brown basalt	883	886
Med hard gray porous basalt	886	893
Med soft gray fractured basalt 170 psi	893	906
Hard light gray basalt	906	935
Med hard gray basalt	935	953
Med soft porous dark gray basalt	953	955
Med hard dark gray basalt	955	969
Very hard light gray basalt	969	971
Med soft black porous basalt	971	986
Hard dark gray basalt	986	989
Green & black clay	989	995
Broken black porous basalt & some clay	995	999
Fractured black basalt 260 psi	999	1012
Hard gray basalt	1012	1036
Soft black & some reddish brown porous basalt	1036	1049
280 psi 73 deg		
Med hard black basalt	1049	1061
Soft porous black basalt 290 psi	1061	1069
Med hard black basalt	1069	1095
Very hard light gray basalt	1095	1100
Med hard gray basalt broken some green clay	1100	1103
Hard dark gray basalt	1103	1138
Med soft black basalt	1138	1158
Med hard black basalt	1158	1181

MATERIAL	FROM	TO
Hard gray basalt	1181	1229
Med soft gray porous basalt trace of green clay	1229	1250
Med soft porous black basalt 74deg 310 psi	1250	1277
Med hard fractured black basalt	1277	1296
Med hard dark gray basalt	1296	1336
Med soft broken dark gray basalt with some green & gray clay	1336	1342
Hard gray basalt	1342	1401
Med hard dark gray basalt	1401	1414
Soft porous black basalt	1414	1436
Med hard gray basalt	1436	1500
Hard gray basalt	1500	1534
Med hard black basalt	1534	1540

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Figure 12. The driller notes and stratigraphic interpretation of well 3349. Driller notes from the well report are displayed on the left, and the sketch of the stratigraphic layers and interpretation of Columbia River Basalt Group and Lower Ellensburg Formation members are on the right. Sedimentary layers are highlighted in yellow on the sketch. Where drillers describe basalt layers with "some clay" or other sediments, the sketch of that layer includes a notch on the right to indicate that the sediments are secondary in abundance to the basalt. The members are color-coded with the stratigraphy and labeled with abbreviations (OVB = overburden, EM = Elephant Mountain basalt, RR = Rattlesnake Ridge interbed, PM = Pomona basalt, SEL = Selah interbed, UMA = Umatilla basalt, MBTN = Mabton interbed, PR = Priest Rapids basalt, and RZ = Roza basalt). All of the well reports and stratigraphic interpretations for wells used in this study are included in Appendix A.

Additional assumptions were made to reconstruct the most detailed subsurface stratigraphy. Where the boundary between the Priest Rapids and Roza members of the Wanapum was unclear in the driller notes, the thickness of both members was made equal since they have been observed to have similar thicknesses (Bingham and Grolier, 1966). Although interbeds can be difficult to map due to their limiting extents, these interpretations assumed stratigraphic depths and thicknesses of sedimentary interbeds when unclear. For example, a driller may write that one layer contains both basalt and clay. In this case, this layer could be interpreted as a sedimentary interbed if the depth is comparable to interbeds more clearly noted in neighboring well reports. This assumption suggests that sedimentary interbeds are continuous in the study area which is not completely accurate. The unit depths modeled by Burns et al. (2011) were consulted for identifying boundaries of basalt units and sedimentary interbeds when interpretations were especially obscure. Finally, many drillers noted specific geologic members as they drilled, which strengthened stratigraphic interpretations in this research.

Cross-Section Development

Three cross-sections were developed in the study area based on the stratigraphic reconstructions from driller notes. The deepest wells within a half mile from the cross-section lines were selected to capture the greatest stratigraphic information. Cross-section development followed a four-step cycle represented in Figure 13: (1) interpret driller notes, (2) illustrate cross-sections digitally, (3) compare interpretations to one another and references, and (4) modify interpretations.

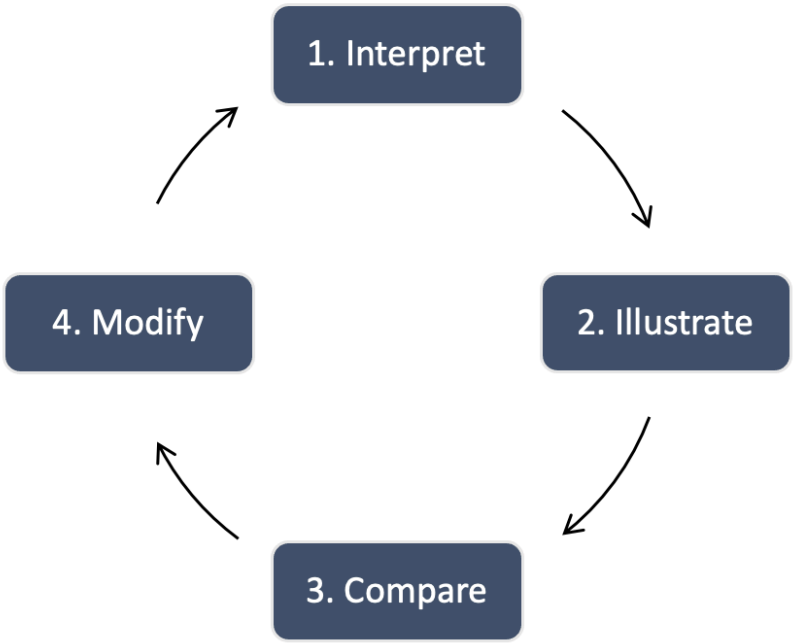


Figure 13. Simplified methodology for cross-section development: (1) interpret driller notes, (2) illustrate cross-sections based on interpretations, (3) compare stratigraphic interpretations to one another and available geologic maps, and (4) modify to make geologic sense of the stratigraphy. This process is repeated until interpretations are solidified.

Once initial interpretations of driller notes were completed, the contacts between units were plotted onto the corresponding cross-section digitally with knowledge of surface geology and faults and folds mapped by Bentley et al. (1993) and Kirk and Mackie (1993). Surface elevation profiles for each cross-section were constructed by Brian Webb (Geosyntec, Inc.) using the 3D Analyst tool in ArcMap, then extracted as an x-y plot for cross-section illustration in Inkscape, a scalable vector graphics editor. Wells were plotted across the distance of the cross-section line and polygons for each stratigraphic layer were drawn using nodes for the interpreted contacts between stratigraphic units at each well.

After making the initial illustration of the subsurface stratigraphy, it was easy to identify improbable geologic contacts or discontinuities by comparing the interpretations to one another.

Modifications were made to reconfigure the most likely subsurface stratigraphy by going back to the driller notes. At the modification stage, other changes were made, like discarding wells from a cross-section. Wells were removed from a cross-section if the driller notes were confusing or lacked detail, or if wells were too close to each other to illustrate the stratigraphy clearly. This process (Figure 13) was repeated several times to make the most geologic sense of the study area. Appendix A contains the final stratigraphic interpretations of each well used in the three cross-sections with well reports.

As a result of these efforts, three cross-sections were developed. The A-A' cross-section trends north-south and uses data from 8 wells within an average of 940 ft of the cross-section line (Table 2). The wells are concentrated within the study area on the north end of the cross-section in the Lower Yakima and Moxee Valleys. The southern end, outside of the study area, is largely based on surface geology and mapped faults and folds. The A-A' cross-section encapsulates the north-south trending folding of the Yakima Fold Belt. The B-B' cross-section trends east-west and was constructed using 18 wells within an average of 1,450 ft of the cross-section line (Table 2). It contains stratigraphy of the Lower Yakima Valley along the southern flank of Rattlesnake Ridge. The C-C' cross-section trends east-west and used 19 wells within an average of 1,110 ft of the cross-section line (Table 2). It captures the stratigraphy of Moxee Valley along the northern flank of Rattlesnake Ridge. A map of the cross-section lines is included in the following chapter, alongside the three cross-sections.

Table 2. Summary table of well and cross-section line data

Cross-section	Trend	Location	Number of wells	Length of cross-section (mi)	Well distance from cross-section line (ft)	
					Range	Average
A-A'	north-south	Yakima to Toppenish Ridge	8	38	20 – 2,960	940
B-B'	east-west	Lower Yakima Valley	18	34	240 – 3,300	1,450
C-C'	east-west	Moxee Valley	19	13	50 – 2,380	1,110

Historic Groundwater Levels

ECY has been monitoring groundwater levels in numerous wells within the study area for over fifty years and the records are publicly available on the ECY Environmental Information Management System (EIM) online database (Washington State Department of Ecology, 2023a). Fifty-five groundwater level hydrographs in the study area were provided by ECY with Well ID and aquifer information for each well. The specific water level records were then obtained from the EIM database. These records include well site coordinates, surface elevation, and depth, as well as the water levels measured over time.

Once water level data was compiled and wells were organized by aquifer (Saddle Mountain and Wanapum), several analyses were performed. First, hydrographs were plotted for each well (Appendix B). Then, the rate of water level change over the entire record was calculated in ft/yr. Wells were classified as declining if the rate was less than or equal to -1 ft/yr, stable if the rate ranged from -1 to 1 ft/yr, and increasing if the rate was greater than or equal to 1 ft/year. Finally, water level trends were analyzed for select wells in the SDMB and WNB aquifers to observe changes in pumping over time.

CHAPTER IV

RESULTS

This chapter includes three cross-sections and a compilation of fifty years of groundwater level data. These results provide the geologic and hydrogeologic data important for evaluating MAR potential in the study area.

Cross-Sections

Figure 14 provides a map of the cross-section lines. The A-A' cross-section (Figure 15) shows the subsurface geology of the Lower Yakima and Moxee Valleys and Yakima, Rattlesnake, and Toppenish Ridges based on the stratigraphic interpretations of 8 well reports, as well as surface geology maps and previously published literature (Kirk and Mackie, 1993; Bentley et al., 1993; Department of Natural Resources, 2016). This north-south trending illustration displays the Yakima Fold Belt series of anticlinal ridges and synclinal valleys. The B-B' cross-section (Figure 16) is east-west trending in the Lower Yakima Valley, illustrating the interpreted subsurface geology from 18 wells. The C-C' cross-section (Figure 17) is east-west trending and represents the geology under Moxee Valley derived from stratigraphy interpreted from 19 wells. Appendix A contains the well reports and stratigraphic reconstructions for wells used in all cross-sections and Appendix C includes more information about the wells used to illustrate each cross-section.

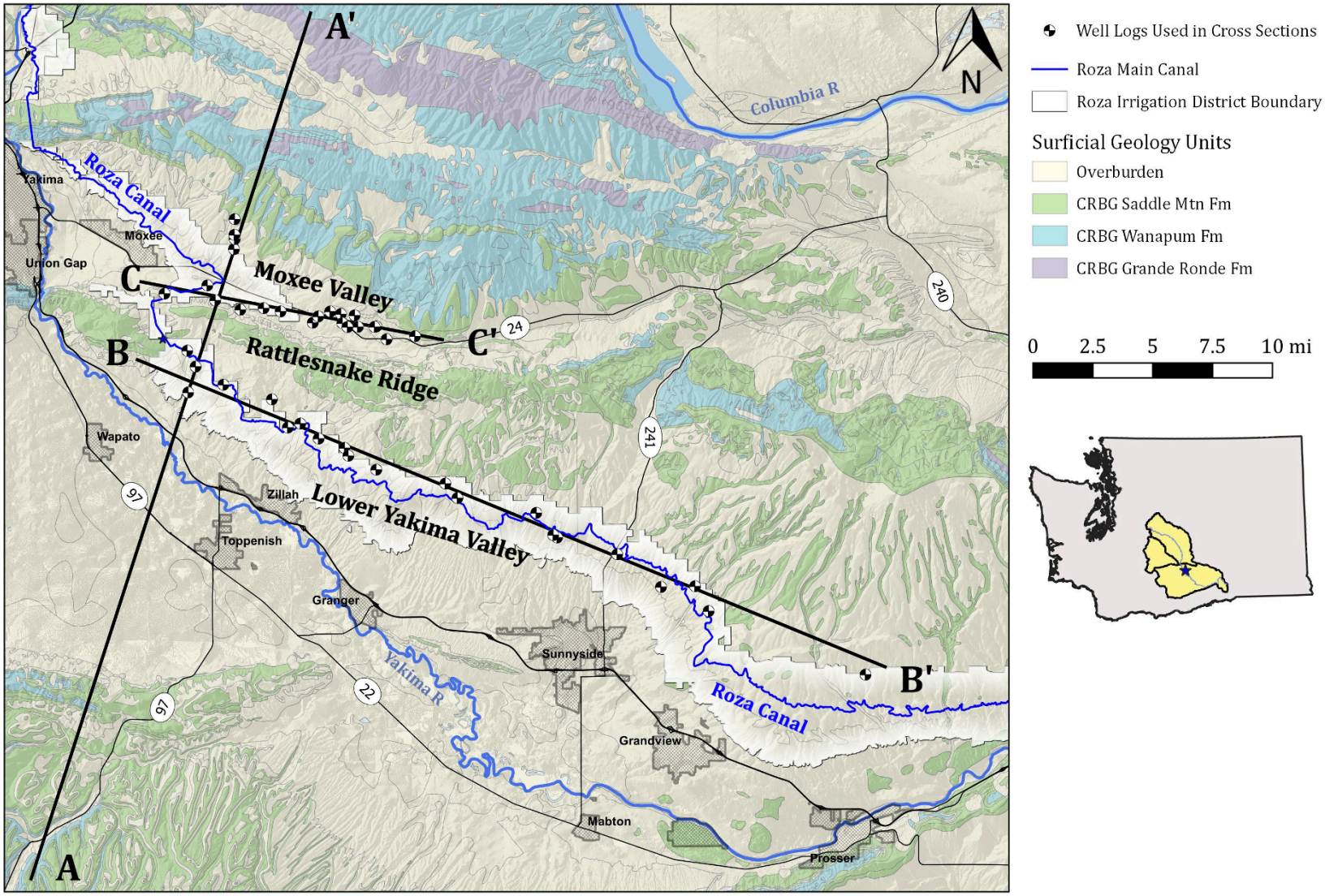


Figure 14. Surface geology map of the study area with three cross-section lines (A-A', B-B', and C-C'). The Roza Canal (blue) is within the Roza Irrigation District (shaded in white). Rattlesnake Ridge, Moxee Valley, and the Lower Yakima Valley are labeled. Map by Sherry Wilhelm (Coho Water Resources, LLC).

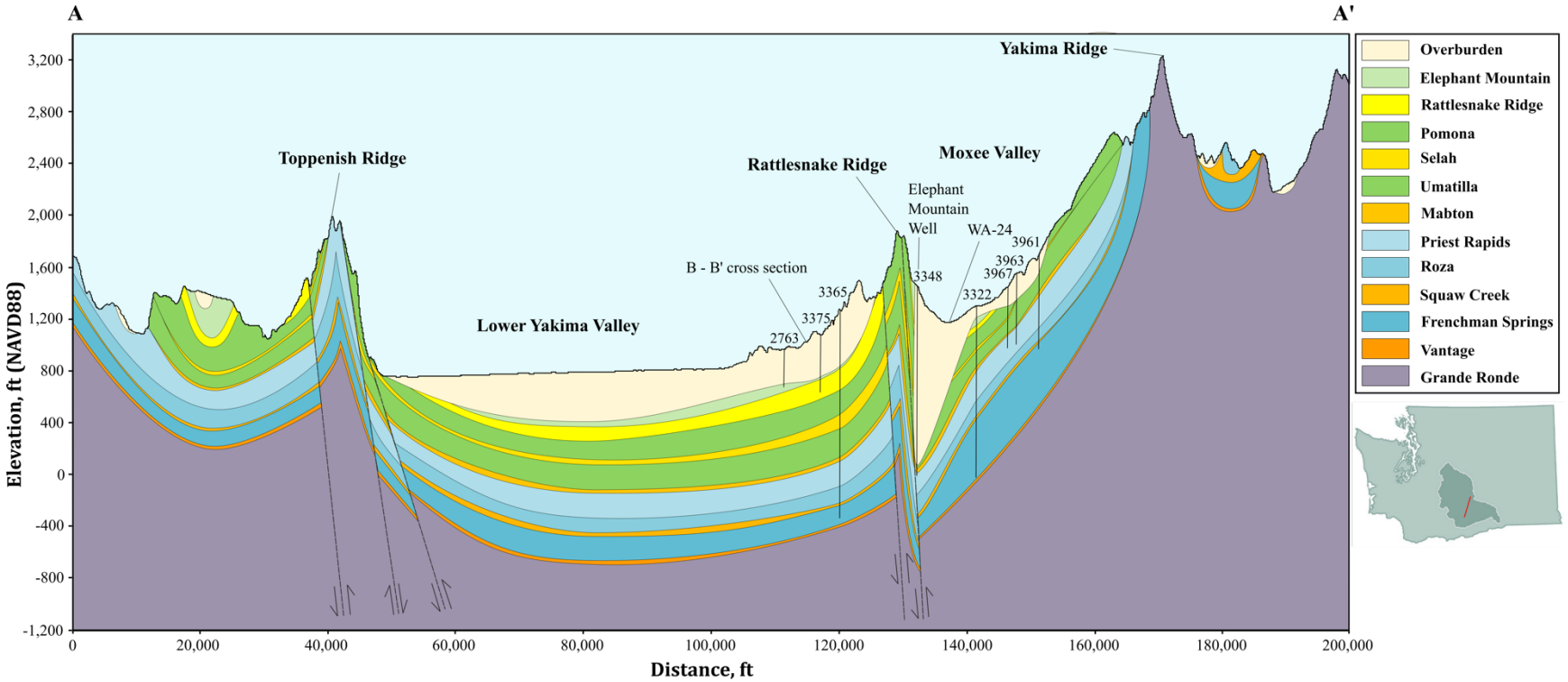


Figure 15. A-A’ cross-section trending north-south featuring Yakima, Rattlesnake, and Toppenish Ridges and the Lower Yakima and Moxee Valleys. Stratigraphic legend is provided with color-coded units. The inset map includes a red line representing the location of the cross-section line within the Yakima Basin and Washington State.

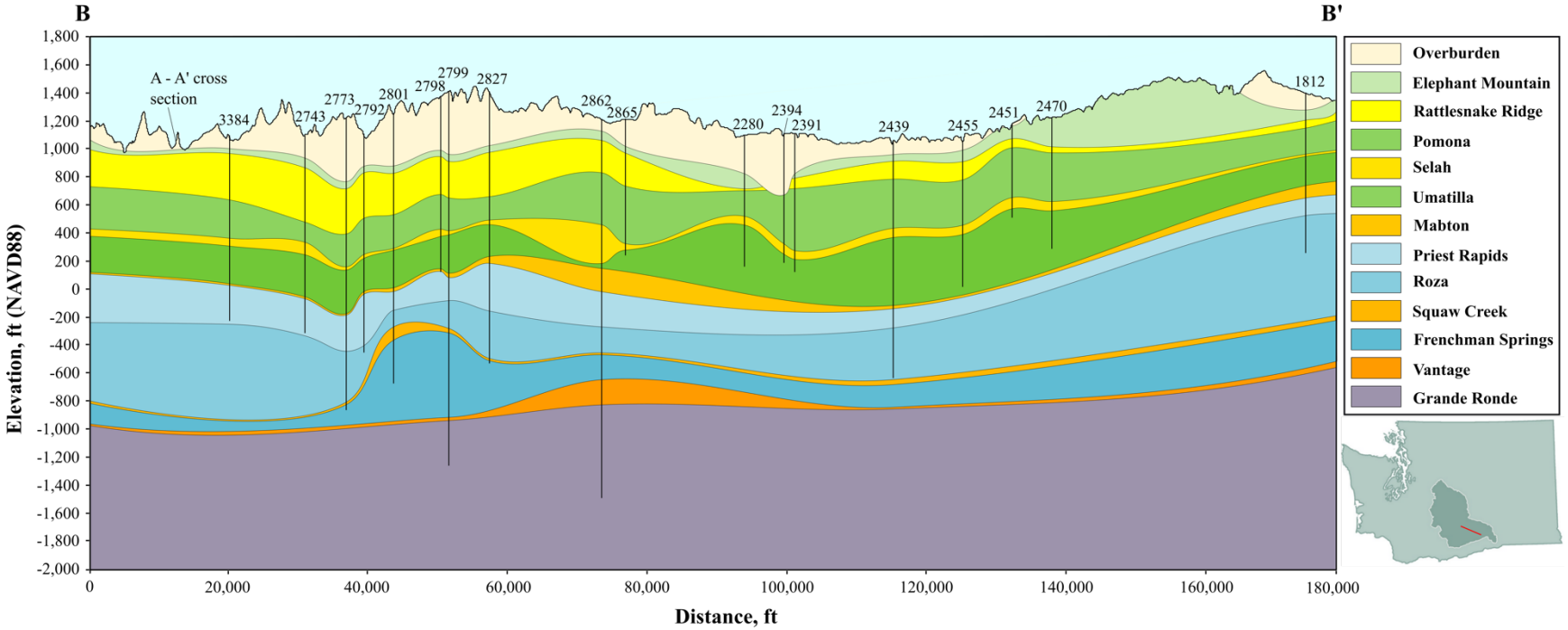


Figure 16. B-B’ cross-section trending east-west in the Lower Yakima Valley. Stratigraphic legend is provided with color-coded units. The inset map includes a red line representing the location of the cross-section line within the Yakima Basin and Washington State.

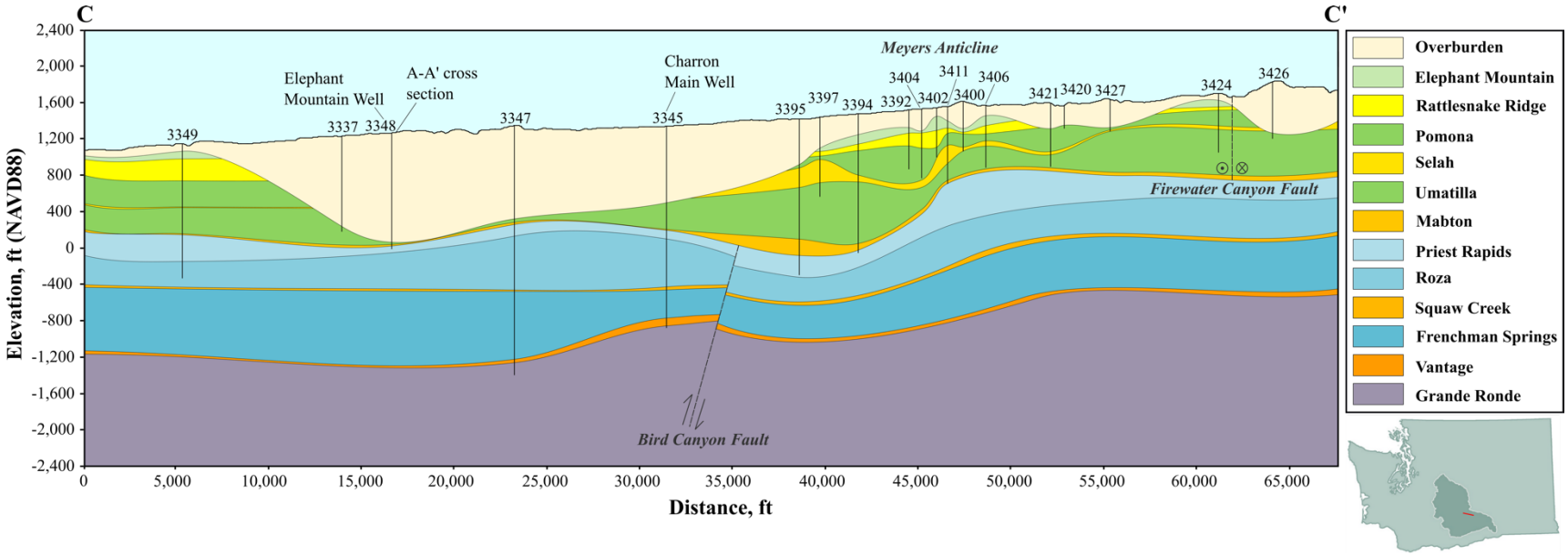


Figure 17. C-C’ cross-section trending east-west in Moxee Valley including the reverse Bird Canyon Fault, strike-slip Firewater Canyon Fault, and Meyers Anticline. Stratigraphic legend is provided with color-coded units. The inset map includes a red line representing the location of the cross-section line within the Yakima Basin and Washington State.

Based on the stratigraphic interpretations completed for wells along the B-B’ (Figure 16) and C-C’ (Figure 17) cross-sections, member thicknesses can be estimated and compared between the Lower Yakima Valley and Moxee Valley (Figure 18). Results from two sample t-tests show that the difference in member thicknesses between the two valleys is not always statistically significant (Table 3). Appendix D includes more detail on the statistical analysis.

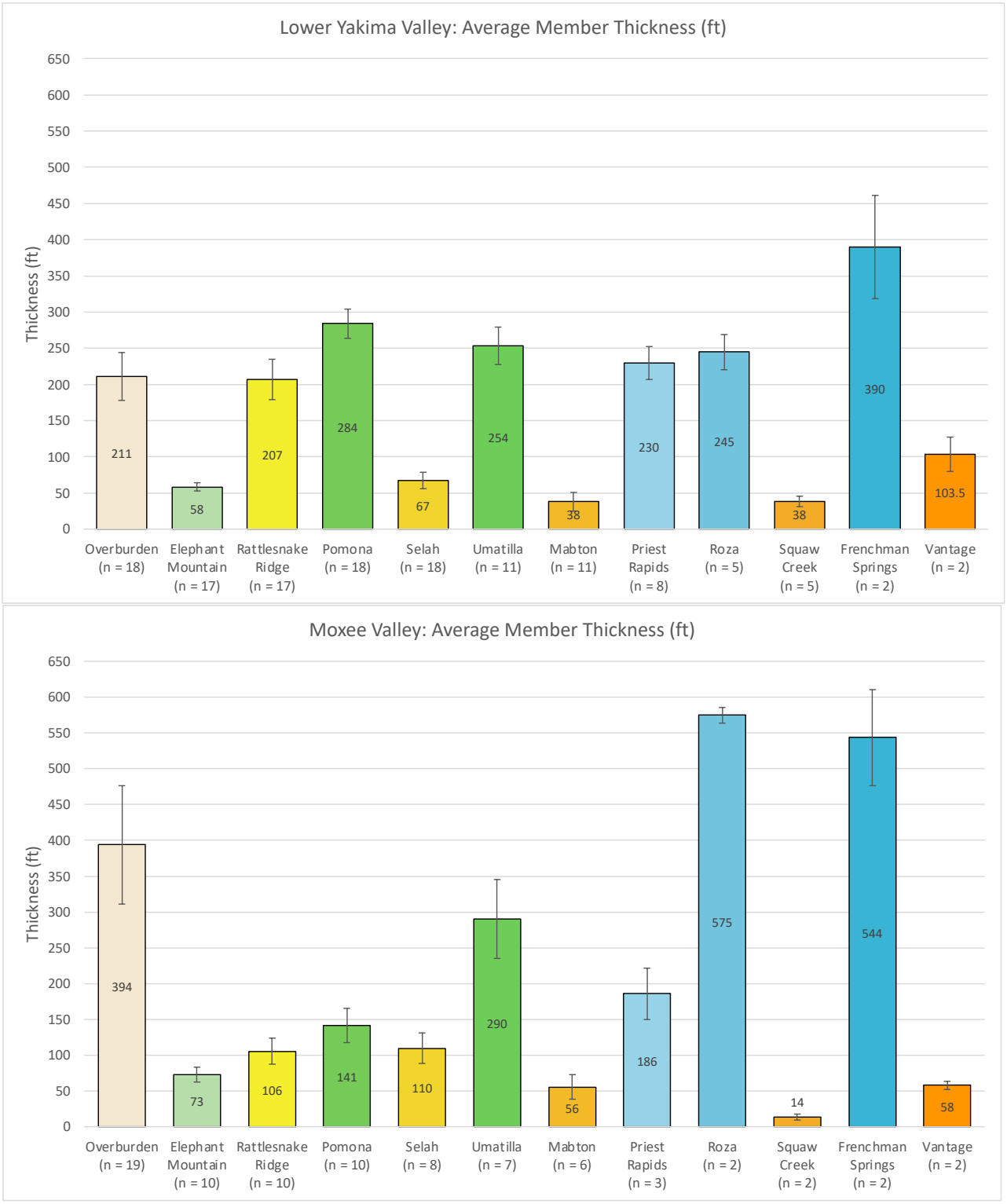


Figure 18. Average member thicknesses (ft) of the wells in the Lower Yakima Valley (B-B' cross-section) and Moxee Valley (C-C' cross-section) with standard error bars, color-coded with the stratigraphy. The number of wells used to calculate the average thickness (n) is labeled under each member.

Table 3. Two sample t-test results of the differences in member thicknesses between the Lower Yakima Valley and Moxee Valley

Member	P-value
Overburden	0.052
Elephant Mountain Basalt	0.376
Rattlesnake Ridge Interbed	0.013
Pomona Basalt	0.002
Selah Interbed	0.261
Umatilla Basalt	0.715
Mabton Interbed	0.621
Priest Rapids Basalt	0.686
Roza Basalt	0.004
Squaw Creek Interbed	0.28
Frenchman Springs Basalt	0.657
Vantage Interbed	0.643

Note: Members with statistically significant p-values (based on a 95% confidence interval) are highlighted in yellow. Information is available in Appendix D.

Groundwater Elevation Change

Wells monitored by ECY in the Saddle Mountain and Wanapum aquifers provided a long historical record of groundwater levels. There were 27 wells completed in the Saddle Mountain aquifer and 20 wells completed in the Wanapum aquifer in this analysis, with most of the water levels declining ($\leq$ -1 ft/year) over approximately fifty years. Few wells in each aquifer were stable (-1 $\leq$ 1 ft/year) and even fewer were increasing ($\geq$ 1 ft/year) over this time period. On average, the SDMB and WNB wells experienced an average drawdown of -1.61 ft/year and -3.07 ft/year respectively (Table 4, Figure 19). A two sample t-test suggests that the difference in groundwater level change rates between the two aquifers is not statistically significant (Appendix D), however, these values still represent groundwater level change in the study area and are used in calculations in this thesis.

Table 4. Annual groundwater level changes over fifty years in 47 wells in the Saddle Mountain and Wanapum aquifers

Aquifer	Date Range	Number of Wells				Rate (ft/year)	
		Total	Declining (≤ -1 ft/yr)	Stable (-1 ≤ 1 ft/yr)	Increasing (≥ 1 ft/yr)	Range	Average
Saddle Mountain	1964-2019	27	18	6	3	-8.07 – 6.24	-1.61
Wanapum	1974-2019	20	14	3	3	-10.55 – 2.88	-3.07

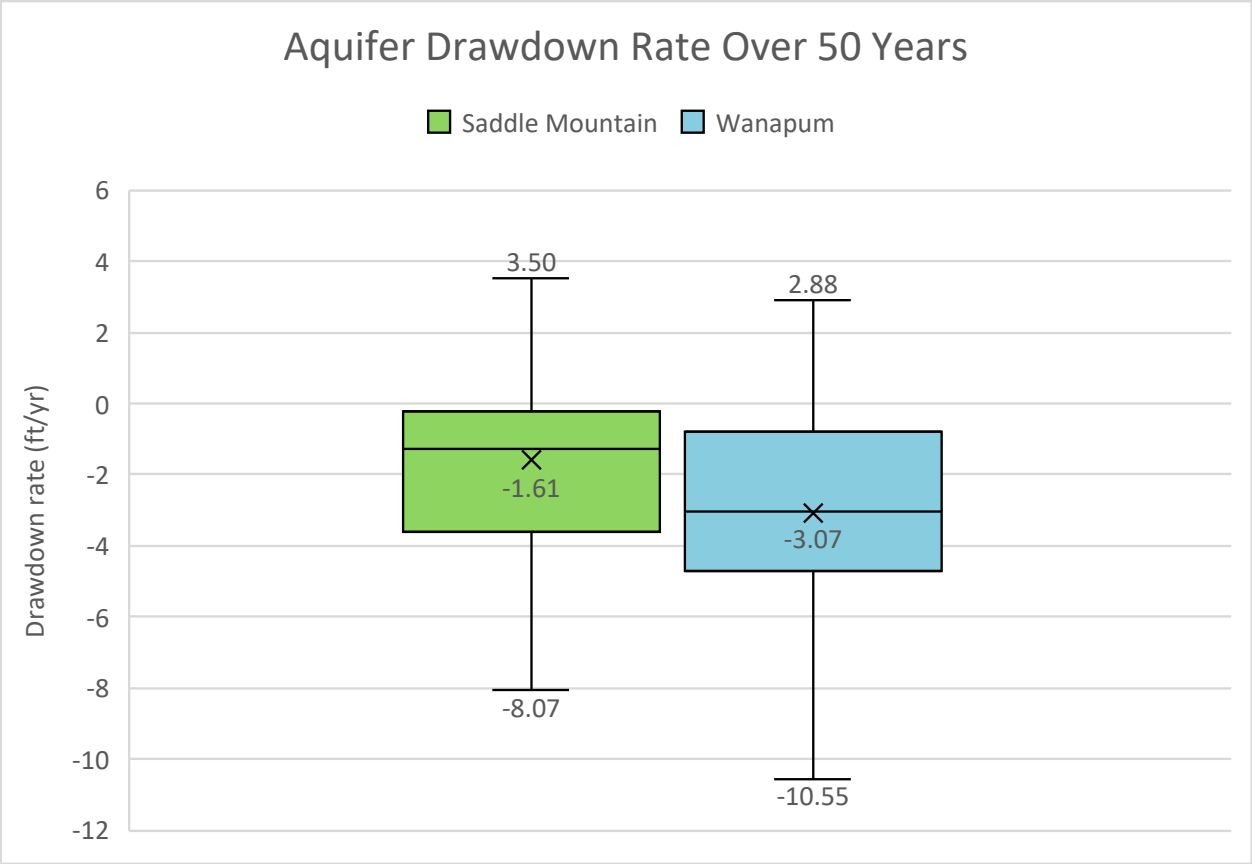


Figure 19. Box and whisker plot of annual groundwater drawdown rate (ft/yr) in the Saddle Mountain (n = 27) and Wanapum (n = 20) aquifers. The graph is color-coded with the stratigraphy.

The water level monitoring wells analyzed in this study are mostly in the Lower Yakima Valley. Spatially, groundwater elevations are higher on Rattlesnake Ridge and in the northwestern parts of the valley, and lower on the valley floor and in the southeastern parts of the

valley (Figures 20 and 21), suggesting that the regional direction of groundwater flows towards the southeast in both the SDMB and WNB aquifers. We did not assess water levels or water level changes in the Moxee Valley, however, it is understood that groundwater flows are similar, as supported in early work by Kirk and Mackie (1993) in Moxee Valley.

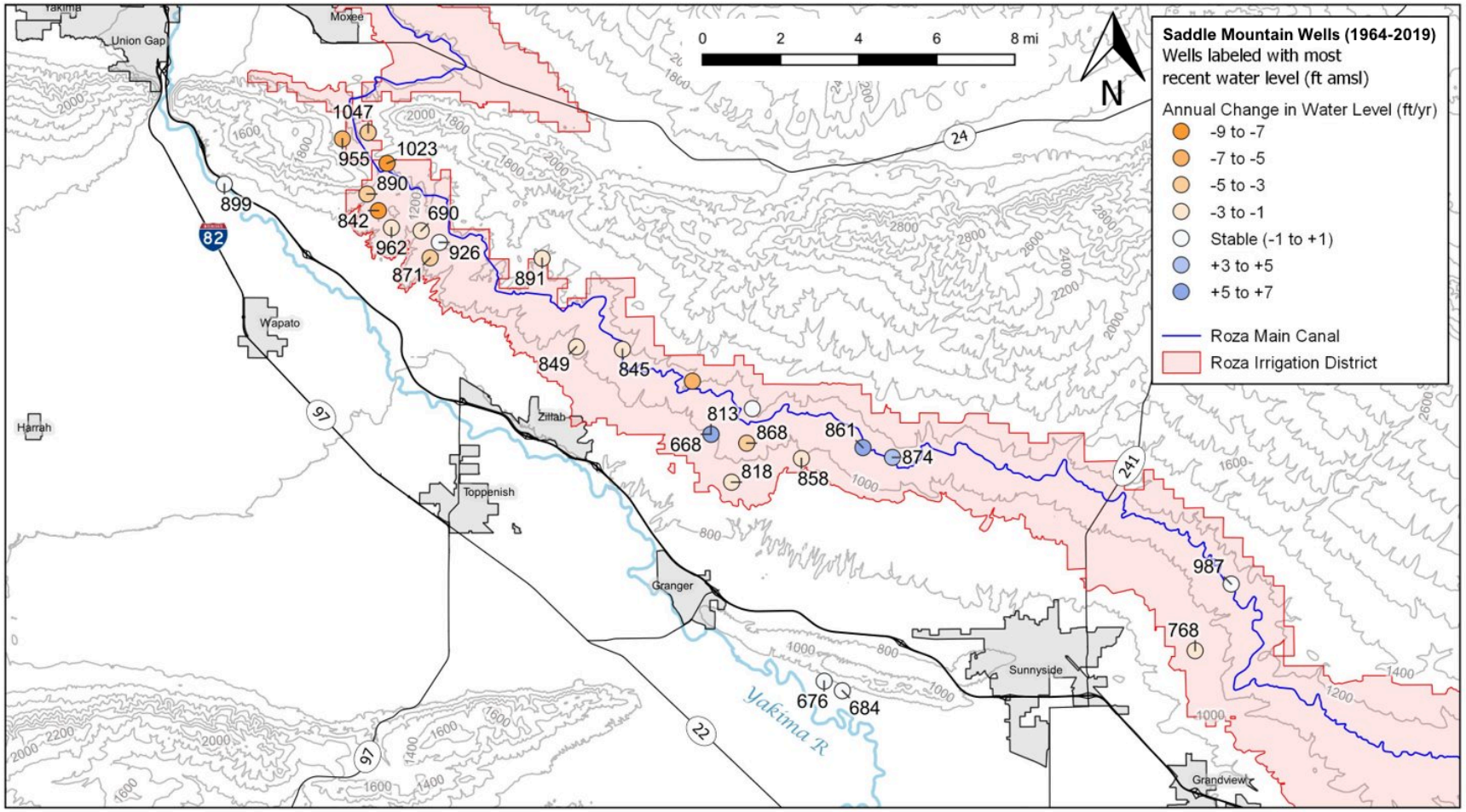


Figure 20. Map of groundwater level trends in the Saddle Mountain Basalt aquifer. The Roza Canal (blue) is within the Roza Irrigation District (shaded in red). The annual change in water level is represented by blue (increasing), white (stable), and orange (decreasing) circles. The recent water level measurement for each well is labeled in ft above mean sea level. Groundwater elevation trends from high in the northwest and steeper elevations, and low in the southeast and shallower regions of the Lower Yakima Valley.

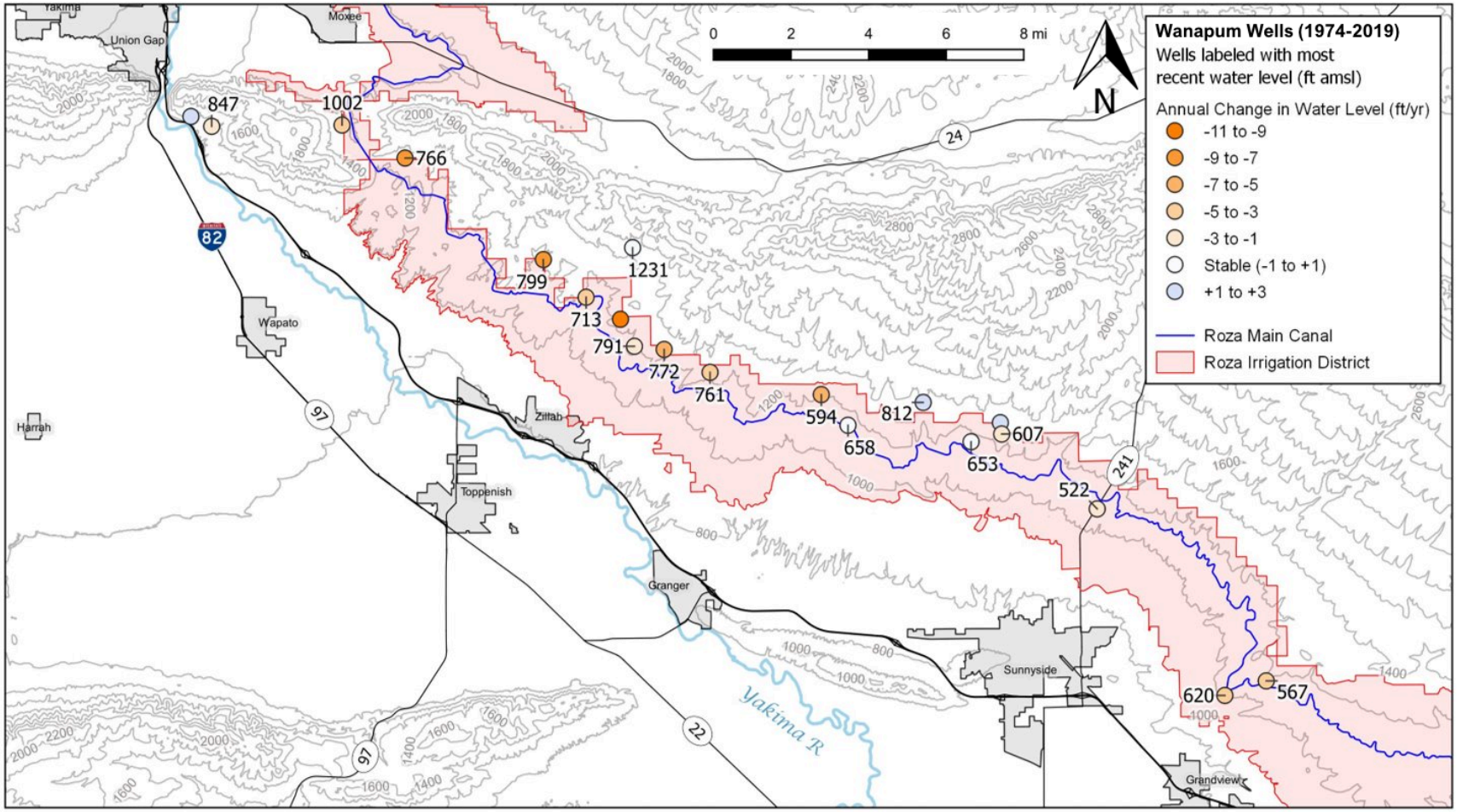


Figure 21. Map of groundwater level trends in the Wanapum Basalt aquifer. The Roza Canal (blue) is within the Roza Irrigation District (shaded in red). The annual change in water level is represented by blue (increasing), white (stable), and orange (decreasing) circles. The recent water level measurement for each well is labeled in ft above mean sea level. Groundwater elevation trends from high in the northwest and steeper elevations, and low in the southeast and shallower regions of the Lower Yakima Valley.

CHAPTER V

DISCUSSION

This chapter provides a hydrogeologic framework for assessing MAR suitability in the Wanapum and Saddle Mountain aquifers based on interpretations and calculations completed in this thesis. The discussion concludes with a review of three potential managed aquifer recharge locations within the study area.

Storage Availability

Compared to previously published estimations of member thickness in the CPRAS, the member thicknesses calculated in this study are comparable, although maximum estimates tend to be larger than prior values by several hundred feet (Table 5). The estimations calculated in this research do not replace previous calculations but provide a more detailed understanding of the study area, which is only a small geographic region of the greater CPRAS. Additionally, one notable limitation in interpreting the subsurface stratigraphy from driller notes is the depth of the well. If a well is only completed in the Pomona member of the SDMB, for example, there is no record available for the subsurface geology beyond that depth. Therefore, the thickness estimates of the deeper basalt and sedimentary members are less certain than the shallow members which are more often described by drillers.

Table 5. Comparisons of member thicknesses calculated in this study to previously published values

Formation	Member	Stratigraphic interpretations of driller notes			Previous estimations	
		Mean	Min	Max	Mean	Max
Overburden	Upper Ellensburg Formation and Quaternary sediments	305	1	1,292		2,000[*] 1,200[†]
Saddle Mountain	Elephant Mountain	64	10	160	98[§]	
	Pomona	233	23	447		
	Umatilla	268	19	670		
	Total	655	52	1,277	550[††]	400[#] 990[**] 1,110[††]
Wanapum	Priest Rapids	218	84	376	98-164[§] 200[§§]	220[#]
	Roza	339	134	609		200[#]
	Frenchman Springs	467	175	751		375[#]
	Total	1,023	393	1,736	600[††]	1,200[**] 1,180[††]
Lower Ellensburg	Rattlesnake Ridge	169	9	353		
	Selah	80	2	252		
	Mabton	44	2	195	50[*] 40-80[§§] 70[††]	200[*] 520[**] 250[††]
	Squaw Creek	31	1	91		17[#]
	Vantage	81	31	176	30[††]	35[#] 320[**] 135[††]

[*]Drost et al. (1990)
[†]Hansen et al. (1994)
[§]Swanson and Wright (1978)
[#]Bingham and Grolier (1966)
[**]Kahle et al. (2009)
[††]Ely et al. (2011)
[§§]Germiat and Flynn (2005)

Member thicknesses (Figure 18) can be combined to estimate the thickness of aquifer units (Figure 22). This study differentiates between three basalt aquifers and the two valleys of the study area to draw comparisons and analyze results. The Upper Saddle Mountain Basalt aquifer contains the Elephant Mountain member of the CRBG and the upper two-thirds of the Rattlesnake Ridge interbed of the Lower Ellensburg Formation since Kirk and Mackie (1993) observe that the lower third is a clay-rich confining layer that divides the SDMB into two separate aquifers. The Lower Saddle Mountain Basalt aquifer consists of the Pomona and Umatilla members of the CRBG and the Selah interbed of the Lower Ellensburg Formation and is over three times thicker than the Lower Saddle Mountain aquifer (Figure 22). The Wanapum aquifer consists of the Priest Rapids, Roza, and Frenchman Springs basalt members of the CRBG, as well as the Squaw Creek interbed of the Lower Ellensburg Formation. The WNB aquifer is thicker than the Upper and Lower SDMB aquifers combined. With a small number of wells completed in the Grande Ronde Basalt within the study area, this aquifer was not analyzed.

Thicker aquifer units typically have higher storage capacities since there is more space for groundwater to be stored. This understanding assumes that basalt aquifers behave like homogeneous confined aquifers, such as a confined sandstone aquifer with consistent porosity and permeability. However, groundwater storage and movement differ within a single basalt flow, as outlined in Chapter I. A detailed analysis of individual basalt flows would provide a better depiction of the storage capacity of the basalt aquifers in the study area, but this would require more advanced research methods.

Figure 23 displays the change in groundwater levels in wells of the SDMB and WNB aquifers with records over ten years. The first measurements for every well had been set at zero ft and subsequent measurements were compared to the first to observe the change in water levels

over time. Some wells contained abnormal water levels for the first measurement because the water levels were measured when the wells were originally drilled, which was either many years in advance of the rest of the monitoring data and/or water levels had not equilibrated after drilling. Therefore, some initial measurements were removed from the dataset for this analysis. To remove seasonal fluctuations, only groundwater levels from January to April (before the irrigation season) were used.

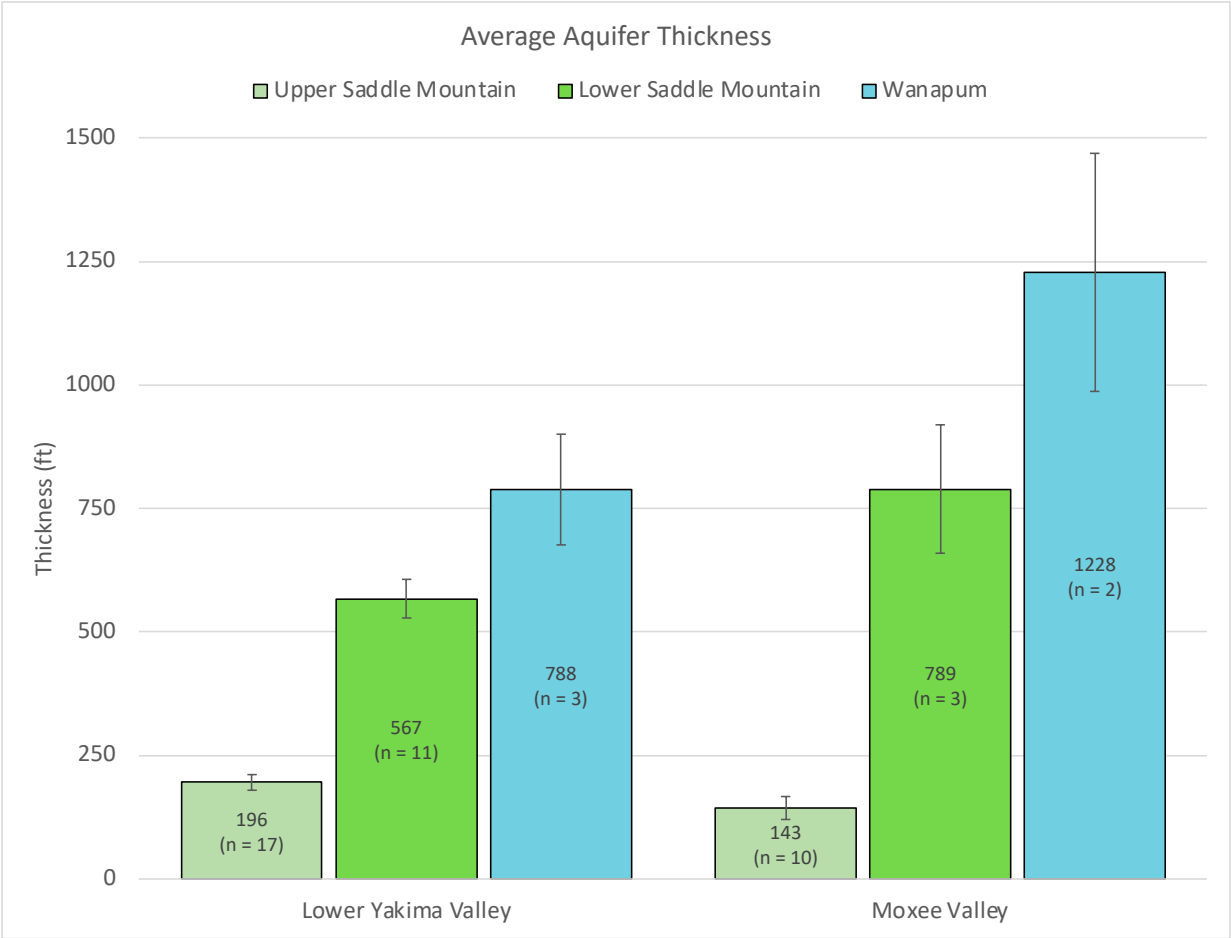
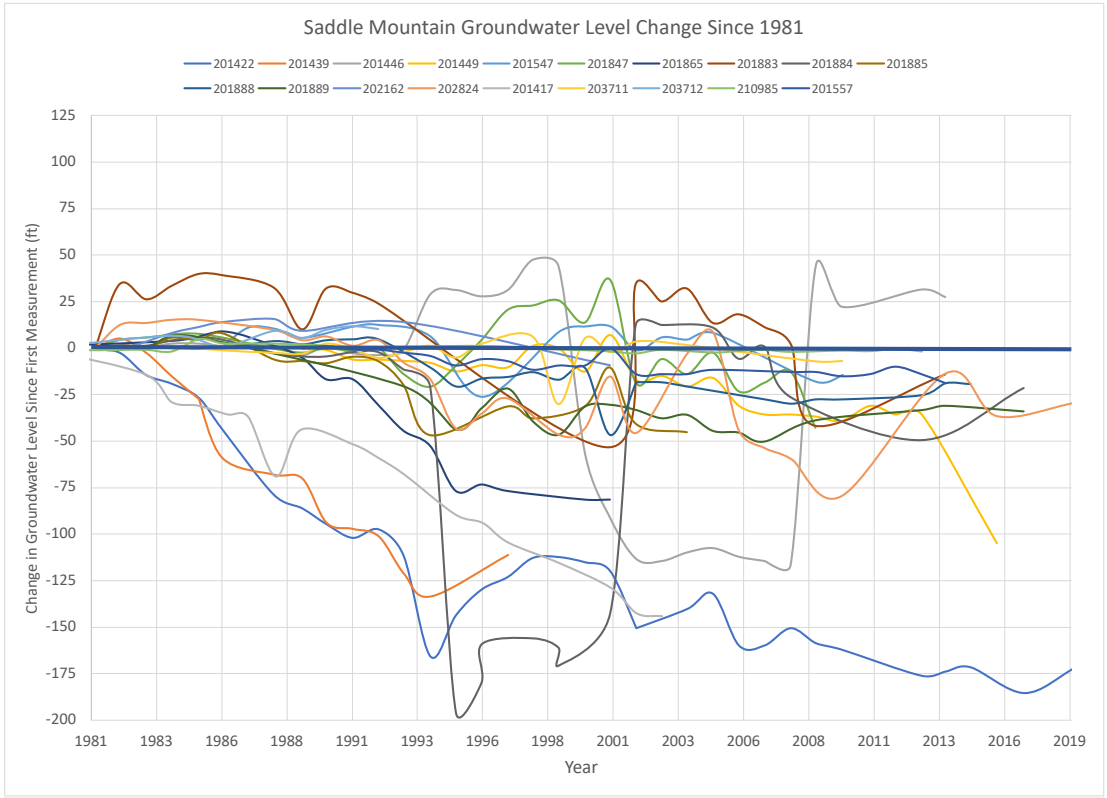


Figure 22. Average aquifer thickness (ft) of the basalt aquifers in the Lower Yakima and Moxee Valleys with standard error bars and the number of wells (n). Aquifers are color-coded with stratigraphy.



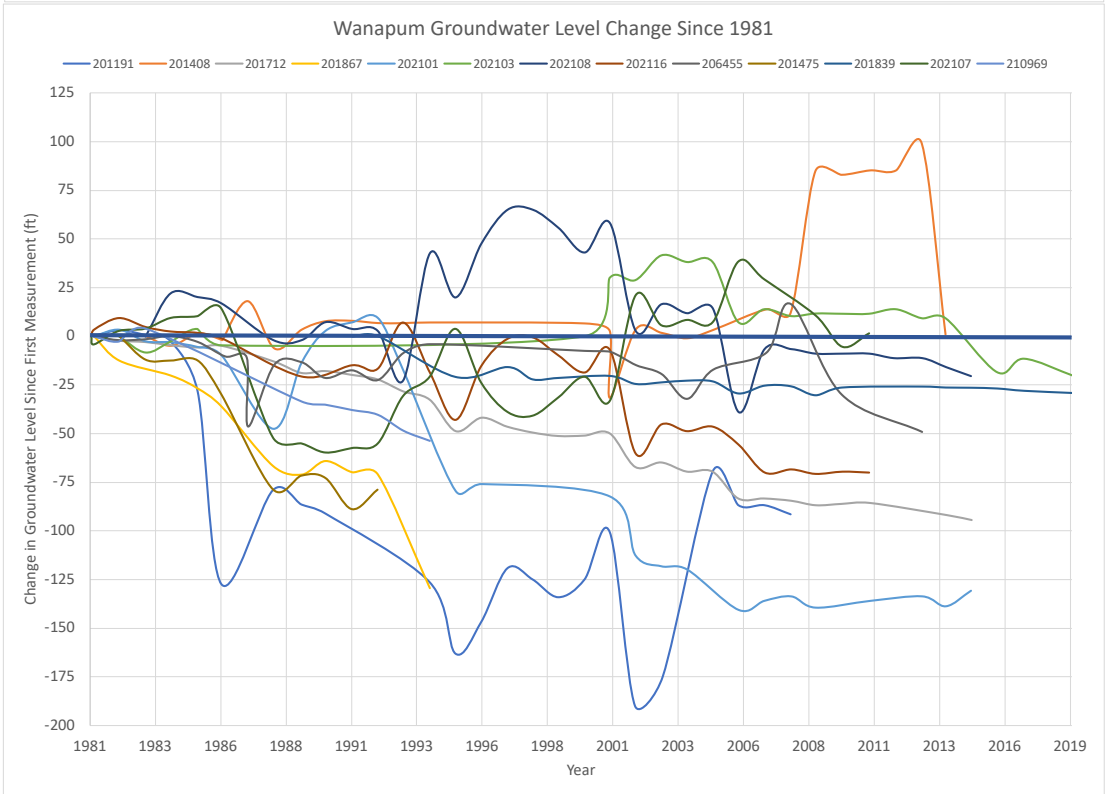


Figure 23. Groundwater level change since 1981 of the Saddle Mountain (n = 19) and Wanapum (n = 13) aquifers. Data normalized to zero ft. for the initial measurement, with the blue line representing zero ft over time.

Groundwater levels are variable over time due to the change in pumping from year to year, but many wells display a downward trend over time (Figure 23). In reviewing well reports and driller notes for this project, it was common to come across wells that have been deepened by 2010s, supporting the notion the groundwater levels have been declining in the study area. By the 2010s, some wells have been experiencing at least thirty years of groundwater depletion (Figure 23). The amount of annual storage loss can be calculated based on aquifer thickness and the rates of groundwater drawdown calculated in the previous chapter (Equation 1).

$$V_{sl} = S_s b A \frac{\overline{\Delta h}}{t}$$

Equation 1. Volume of annual storage loss (V_{sl}) in acre-feet/year as a product of an aquifer's specific storage (S_s) in ft^{-1}, saturated thickness (b) in ft, a surface area (A) in ft^2, and the average change in water level ($\overline{\Delta h}$) in ft per year (t) over the monitoring record.

In the last fifty years, the WNB aquifer has experienced the greatest storage loss compared to the SDMB aquifers at a rate of about 66,700 acre-feet/year (Table 6 and Figure 24). In total, the basalt aquifers have experienced about 96,500 acre-feet of storage loss every year (Table 6). Bob Anderson (Geosyntec, Inc.) estimated the amount of annual pumpage within the study area from the pumpage reported by Vaccaro et al. (2009) and found that from 1960 to 2001, there was an average of 68,700 acre-feet of groundwater pumped every year (Table 7). This value is comparable to annual storage loss in just the WNB aquifer alone, suggesting that pumping has increased since 2001.

Table 6. Storage loss calculations for the Upper and Lower Saddle Mountian Basalt aquifers and Wanapum Basalt aquifer for the Lower Yakima and Moxee Valleys

Upper Saddle Mountain Aquifer			
	Lower Yakima Valley	Moxee Valley	Study Area
Specific Storage (1/ft)	0.0001	0.0001	
Aquifer Thickness (ft)	196	143	
Water Level Decline (ft/yr)	1.61	1.61	
Area (acres)	120,000	100,000	
Storage Loss (AF/year)	**3,800**	**2,300**	**6,100**
Lower Saddle Mountain Aquifer			
	Lower Yakima Valley	Moxee Valley	Study Area
Specific Storage (1/ft)	0.0001	0.0001	
Aquifer Thickness (ft)	567	789	
Water Level Decline (ft/yr)	1.61	1.61	
Area (acres)	120,000	100,000	
Storage Loss (AF/year)	**11,000**	**12,700**	**23,700**
Wanapum Aquifer			
	Lower Yakima Valley	Moxee Valley	Study Area
Specific Storage (1/ft)	0.0001	0.0001	
Aquifer Thickness (ft)	788	1,228	
Water Level Decline (ft/yr)	3.07	3.07	
Area (acres)	120,000	100,000	
Storage Loss (AF/year)	**29,000**	**37,700**	**66,700**
All Basalt Aquifers			
	Lower Yakima Valley	Moxee Valley	Study Area
Total Storage Loss (AF/year)	**43,800**	**52,700**	**96,500**

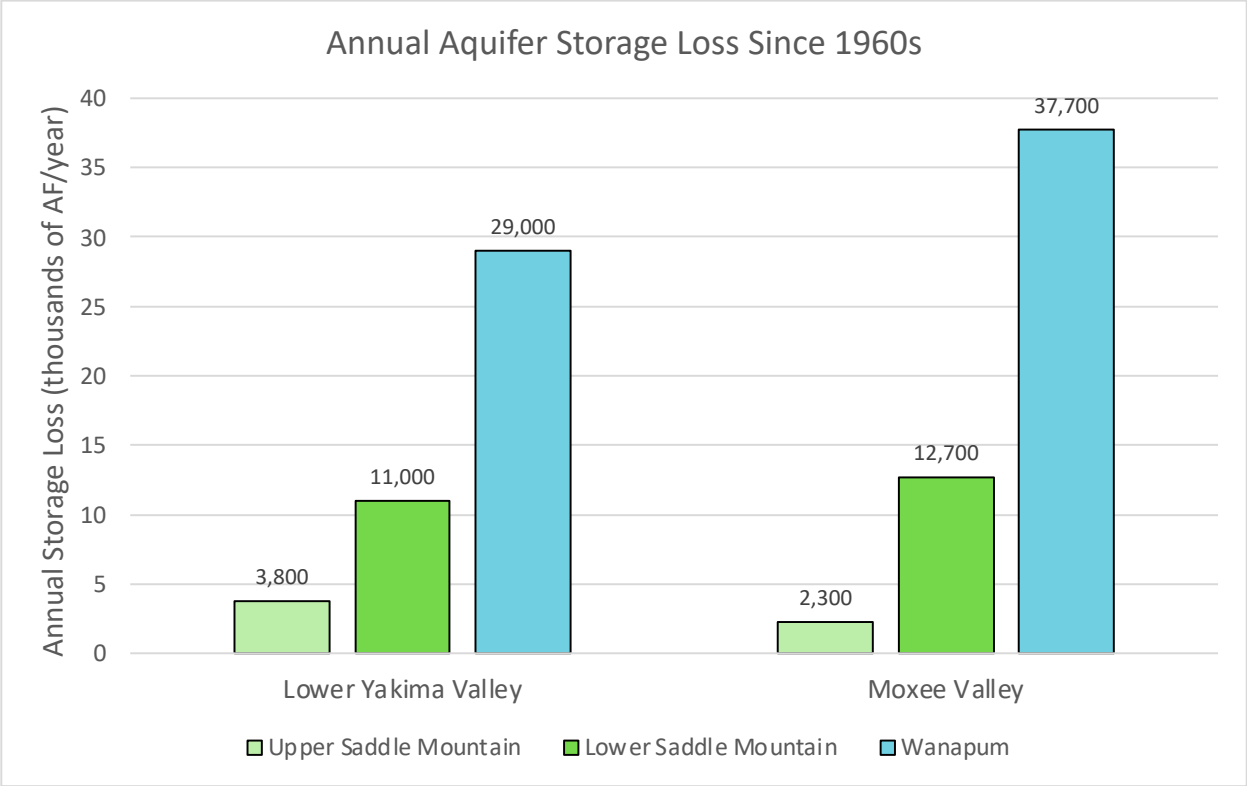


Figure 24. Annual storage loss (acre-feet/year) since the 1960s in the Lower Yakima Valley and Moxee Valley for the Upper Saddle Mountain, Lower Saddle Mountain, and Wanapum aquifers.

Table 7. Groundwater pumpage estimates in the study area from 1960-2001

	Low	High	Average
Estimated Cumulative Pumping (AF)	1,815,000	3,680,000	2,747,500
Estimated Annnual Pumping (AF/year)	45,400	92,000	68,700
Note: Calculations completed by Bob Anderson (Geosyntec Inc.) based on estimates reported by Vaccaro et al. (2009).			

Estimating storage loss as a function of the historical groundwater level changes and aquifer thickness is a useful way to interpret not only historical storage loss but also storage availability for MAR. Theoretically, the amount of groundwater depleted from an aquifer could be restored through MAR, assuming there has been no subsidence or compaction in the subsurface from the loss in groundwater storage over time. With this rationale, the greatest

storage opportunities for MAR are in the WNB aquifer, but all basalt aquifers have had significant groundwater storage loss.

In a scenario in which MAR was implemented in the study area, there could be about 12,000 acre-feet of water recharged into a basalt aquifer after three months of recharging at a rate of 1,000 gpm (Figure 25). This value is comparable to the annual storage loss/availability of the Lower SDMB in Moxee Valley. This hypothetical injection capacity shows that MAR would have a significant impact on groundwater enhancement, but many recharge sites are needed to have the greatest effects.

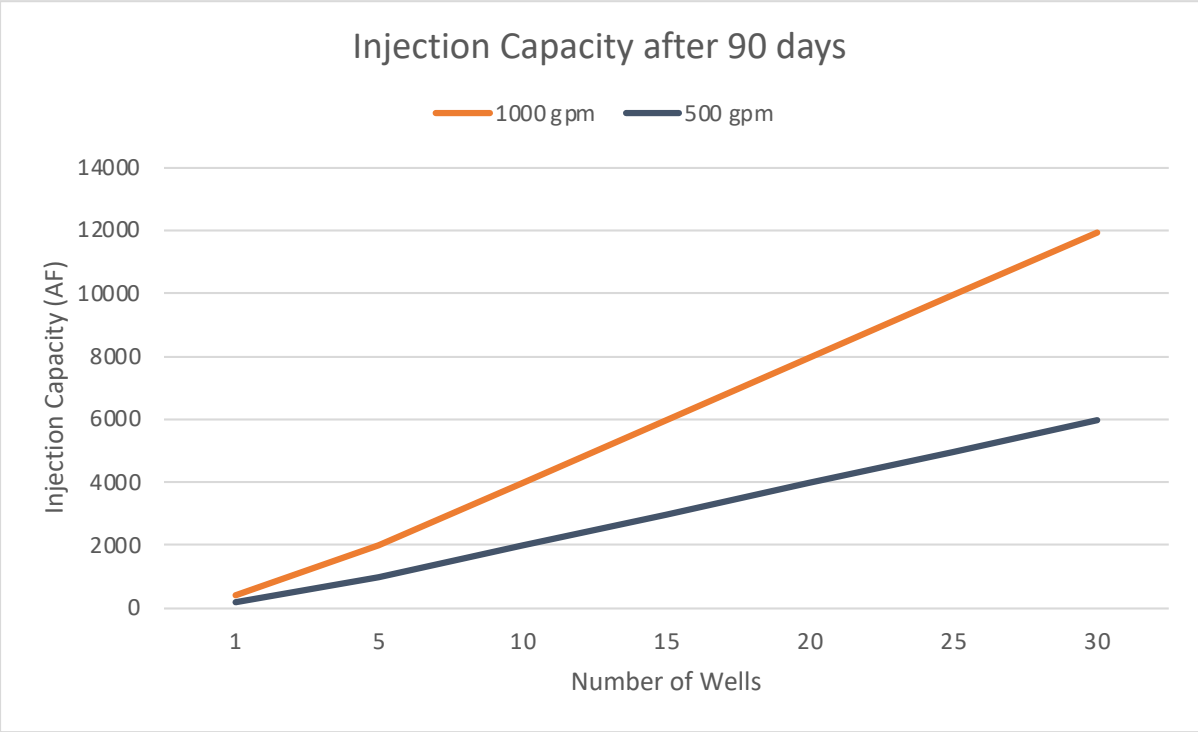


Figure 25. Injection capacity (acre-feet) for an ASR program with varying numbers of wells and injection rates (gpm).

Aquifer Suitability

Evaluating the MAR suitability of an aquifer involves an investigation into an aquifer's hydrogeologic properties. Generally, the recharge potential of an aquifer is dependent on the ability of water to move through the geologic formation. The hydraulic conductivity (ft/day) and transmissivity (ft^2/day) of an aquifer measure how easily water can move given the dimensions of the aquifer, and storativity (or storage coefficient) describes the volumetric response of an aquifer to pumping or recharge. Higher transmissivity and storativity values are best for MAR efforts because recharge water can efficiently spread out within an aquifer, avoiding excessive groundwater mounding (Gibson and Campana, 2018). Groundwater mounding occurs when groundwater remains concentrated at the recharge location for long periods of time and does not spread out within the aquifer. If recharging an aquifer through an infiltration pond as part of a shallow aquifer recharge (SAR) program, too much groundwater mounding around the pond would limit the recharge capacity of the aquifer. Likewise, groundwater mounding around injection wells as part of an aquifer storage and recovery (ASR) program would be unfavorable and suggest that the aquifer has a low transmissivity and storativity.

Germiat and Flynn (2005) summarize previously published aquifer properties of the Saddle Mountain and Wanapum Basalt aquifers as part of an ASR assessment in Kennewick, Washington, about sixty miles southeast of the study area. Table 8 includes the author's geometric mean of values for the hydraulic conductivity, transmissivity, and storativity of the SDMB and WNB aquifers. Table 8 also lists results from a pumping test by Repasky (1993) on the Yakima Indian reservation around fifteen miles east of the study area, which found similar values to those reported by Germiat and Flynn (2005) for the WNB aquifer. In combination with

other estimations, it is generally observed that the WNB aquifer has a higher hydraulic conductivity and transmissivity, but a lower storativity compared to the SDMB aquifers.

Table 8. Previously published estimates of hydraulic conductivity, transmissivity, and storativity

Estimates of Aquifer Properties				
Aquifer	**Hydraulic Conductivity (ft/day)**	**Transmissivity (ft^2/day)**	**Storativity (dimensionless)**	**Source**
Saddle Mountain	8	824	9.3×10^{-3}	Geometric mean of values by Germiat and
			2.5×10^{-3}	Summarized by Whiteman et al. (1994)
Wanapum	19	11,270	4.5×10^{-4}	Geometric mean of values by Germiat and
	30	9,680	8.9×10^{-4}	Pumping test by Repasky (1993)
			2.0×10^{-4}	Summarized by Whiteman et al. (1994)
			2.0×10^{-5} to 5.0×10^{-4}	Summarized by Anderson et al. (2009)
	1.6	1,920		Bouwer and Rice (1976) solution to recovery after Nillson Well Step Test

Additionally, Table 8 provides an estimate of hydraulic conductivity and transmissivity for the WNB aquifer based on the Nillson Well Step Test which is described in detail in Appendix E. The estimate of transmissivity, for example, is about five times less than the results from Germiat and Flynn (2005) and Repasky (1993). Due to complications during testing and the short duration of pumping, this estimation may not accurately represent the properties of the WNB aquifer. Nonetheless, the hydraulic conductivity value of 1.6 ft/day obtained from the Bouwer and Rice (1976) analysis of this test is near the 25th quartile of hydraulic conductivity values for the WNB aquifer (Figure 26) as reported by Hansen et al. (1994).

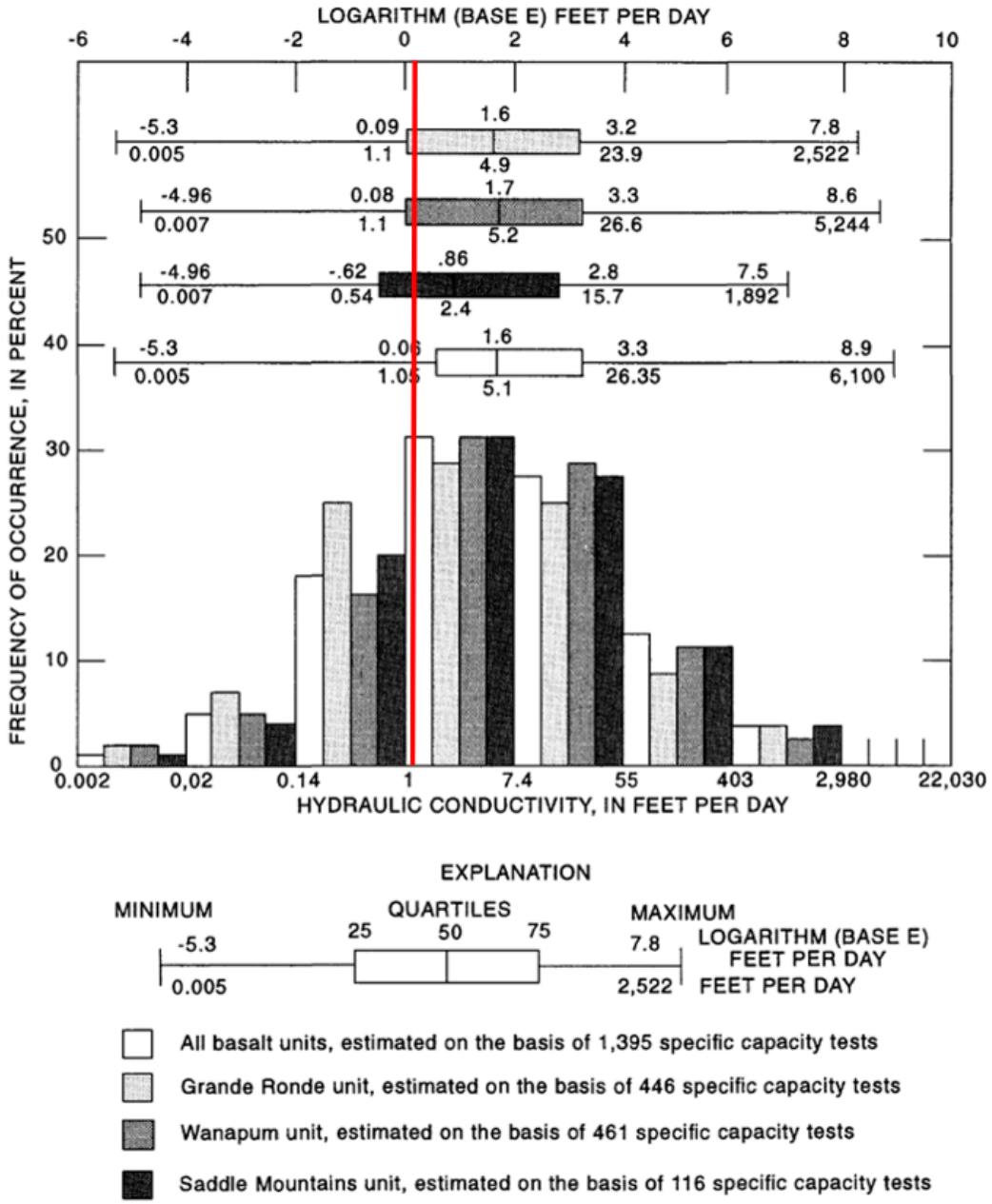


Figure 26. Distribution of hydraulic conductivity (ft/day) values for Columbia River Basalt Group formations with the Bouwer and Rice (1976) hydraulic conductivity solution of 1.562 ft/day from the Nillson Well Step Test (Appendix E) marked in red. Figure modified from Hansen et al. (1994).

Potential Managed Aquifer Recharge Locations

Promising recharge sites for MAR should target aquifers with substantial storage availability, desirable hydrogeologic properties, and structural controls to ensure that recharged water is available for later recovery and not discharged into streams or consumed by other water users (Anderson et al., 2009). While MAR prefers well-confined aquifers for optimal recharge water retention, these basalt aquifers are not usually confined in all directions and groundwater sometimes discharges to streams. While enhancing stream base flow can be a positive byproduct of MAR, it is not the main goal of MAR in this study. A target aquifer for MAR should be vertically and horizontally confined (Germiat and Flynn, 2005) to create a groundwater cell that can supply large volumes of water for recovery during dry years. Figure 27 shows the locations of three potential recharge locations that are discussed in detail below.

For shallow aquifer recharge (SAR), the target aquifer should be near the surface so recharge water can reach the aquifer. Most SDMB exposures in the study area are at the anticlinal ridges where fractures are common, representing the expansion during the rock's deformation. While expansion provides space for water to infiltrate into rock, the fractures can also be cemented or filled with weathered basalt rock fragments, inhibiting the ability for water to infiltrate efficiently. Moreover, it would be expensive and logistically difficult to transport water to anticlinal ridges because they can be over 1,000 ft higher in elevation than the valley floor.

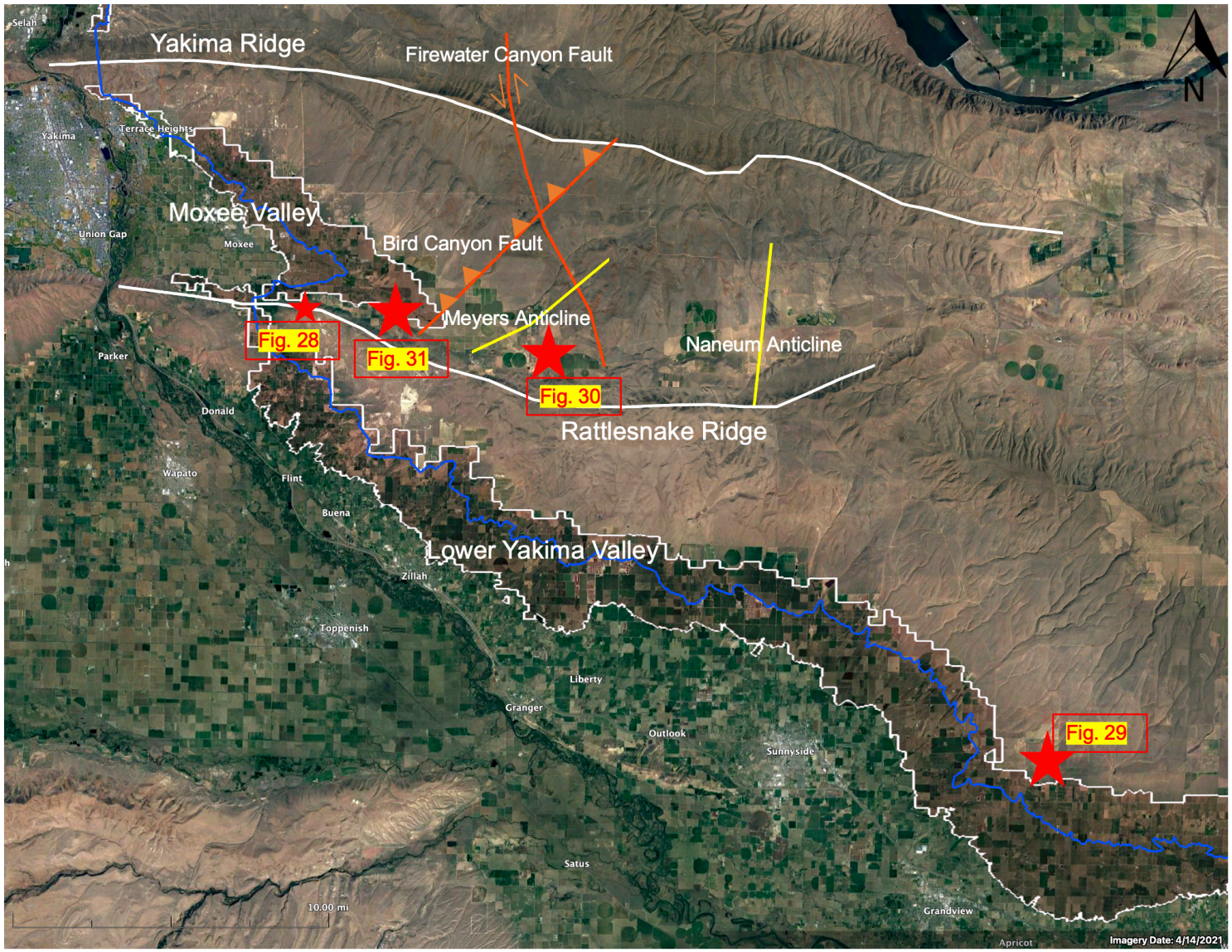


Figure 27. Map of potential recharge locations with locations of Figures 28 through 32. The Roza Canal (blue) is within the Roza Irrigation District (outlined in white). Notable regions of the study area and faults and folds are labeled. Imagery from Google Earth.

However, the valleys pose other problems for SAR. The overburden is thick in both valleys but can be over 1,000 ft in Moxee Valley (Figure 28), making it challenging to construct an infiltration pond targeting the SDMB aquifers. An unmapped fault on the northern flank of Rattlesnake Ridge may be responsible for producing the abrupt difference in overburden thickness between the two valleys. Moxee Valley is particularly disadvantageous for SAR targeting the SDMB aquifers because the overburden is in contact with the lower members of the SDMB suggesting that erosion has occurred prior to the emplacement of the overburden. Schmidt et al. (2007) observed that the Elephant Mountain member is nearly absent to the east of Moxee Valley, which is supported by stratigraphic interpretations of driller notes and represented in the C-C' cross-section (Figure 17). The absence of the Elephant Mountian member may be an indication of the erosion that occurred in the younger members of the SDMB in Moxee Valley. This erosion limits the thickness, and therefore recharge potential, of the SDMB aquifer.

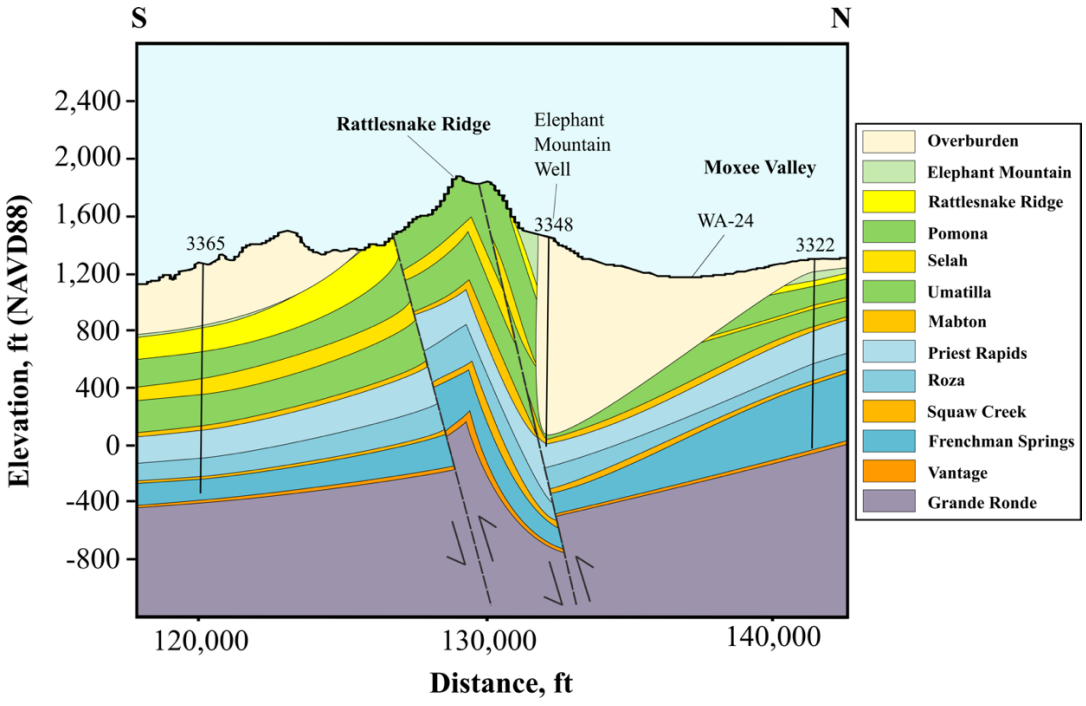


Figure 28. The Rattlesnake Ridge and Moxee Valley region of the A-A' cross-section, horizontally exaggerated with color-coded stratigraphic legend. See Figure 27 for the specific location of this feature.

The Lower Yakima Valley, on the other hand, would be a better location for SAR because the overburden is less thick and there has been less erosion of the SDMB. Figure 29 is a potential recharge location for SAR targeting the Upper SDMB aquifer. This location was chosen because the Elephant Mountain member of the SDMB is exposed and more accessible for MAR. An infiltration pond can be constructed here to take advantage of the exposure and absence of a thick overburden overlying the target aquifer. Additionally, this location is only about 2 to 3 miles away from the Roza Canal, which is the proposed source water for recharge. This recharge location is effective, but the storage availability of the Upper SDMB is much less than the other basalt aquifers in the study area. Additionally, MAR for long-term storage is ideal where there are structural boundaries to create a reliable underground storage site with vertical and horizontal confinement (Germiat and Flynn, 2005). While structual boundaries are not necessary for MAR success, they help ensure that recharge water remains in a known location for later recovery. Because there are no mapped folds or faults that inhibit groundwater movement in the Lower Yakima Valley, there may be more leakage of recharge water over time.

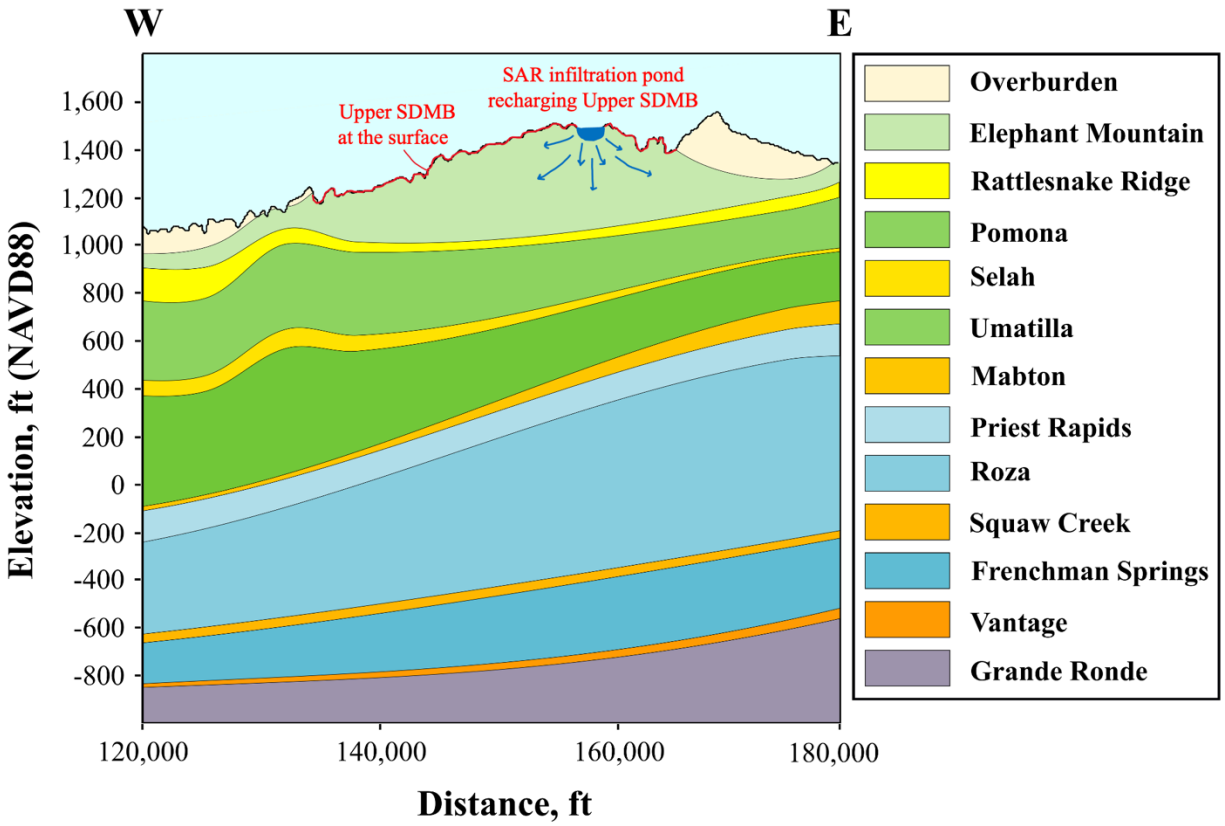


Figure 29. Potential SAR location targeting the Upper SDMB aquifer in the Lower Yakima Valley, a part of the B-B' cross-section, with color-coded stratigraphic legend. This location is slightly upslope on Rattlesnake Ridge (Figure 27) and 2 to 3 miles north of the Roza Canal.

If SAR is pursued in Moxee Valley, the western side should be avoided due to the thick overburden. A potential recharge location for SAR in the Lower SDMB of Moxee Valley would be toward the east of the valley and east of the Meyers Anticline (Figure 30). Kirk and Mackie (1993) presented evidence that the Meyes Anticline and Hog-Ranch Anticline (further to the east of the C-C' cross-section) affects groundwater movement, suggesting that there are structural boundaries to create an effective groundwater reservoir. The Firewater Canyon Fault is located between these folds, but Kirk and Mackie (1993) observe that it only has a moderate effect on groundwater movement. This potential recharge location is advantageous because there is relatively minimal overburden and the overburden is in contact with the Lower SDMB aquifer.

This location is 6 to 8 miles from the Roza Canal, which is further than the previous potential recharge location.

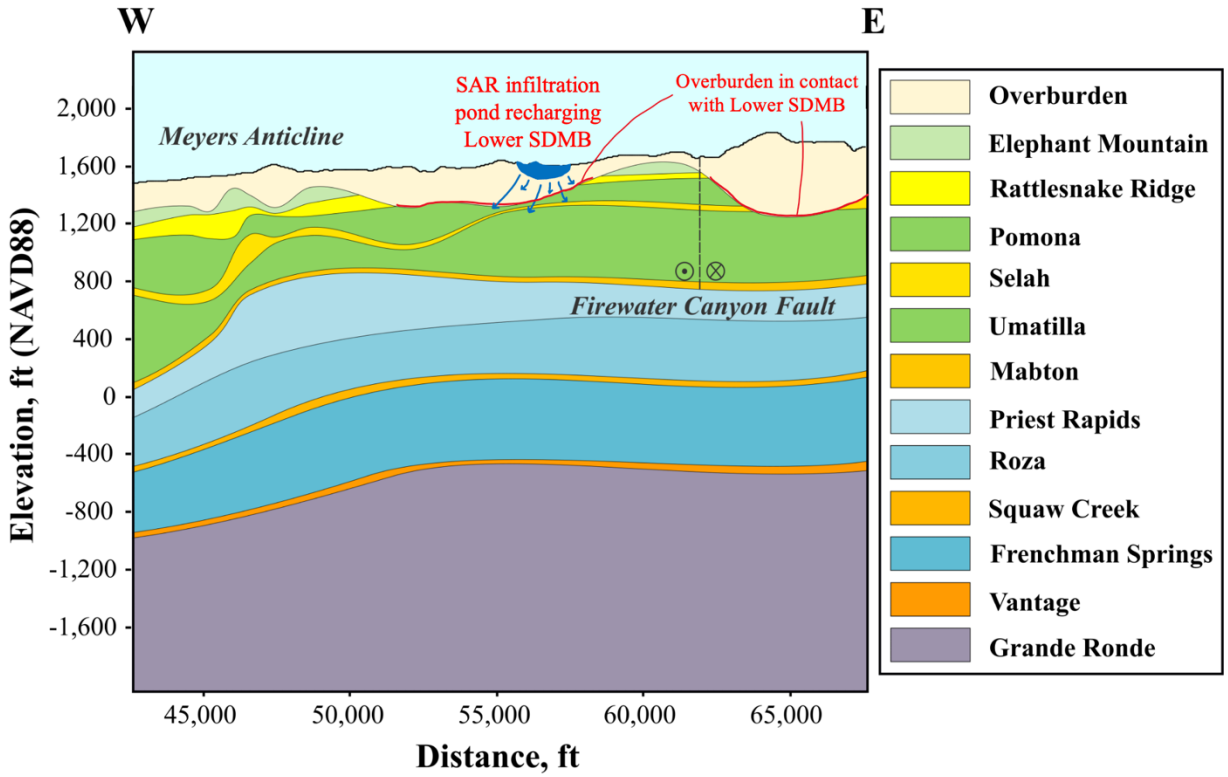


Figure 30. Potential SAR location targeting the Lower SDMB aquifer in Moxee Valley, a part of the C-C' cross-section, with color-coded stratigraphic legend. The Firewater Canyon fault is a strike-slip fault. This location is around 6 to 8 miles east of the Roza Canal. See Figure 27 for the specific location.

The final potential recharge location is for aquifer storage and recovery (ASR) targeting the WNB aquifer (Figure 31). The WNB aquifer is most suitable for ASR because it is the deepest aquifer and not accessible from the ground surface within the study area. Additionally, the WNB aquifer is particularly attractive for MAR because of its high storage availability. ASR is ideal in Moxee Valley where the Bird Canyon Fault could be used strategically. This reverse fault serves as a boundary for groundwater flow (Kirk and Mackie, 1993) and could assist with maintaining high storage volumes for recovery in the WNB if water is recharged on the west side

of the fault (Figure 31) where the fault would stop water from moving east. This location is toward the center of Moxee Valley and is about 4 miles from the Roza Canal.

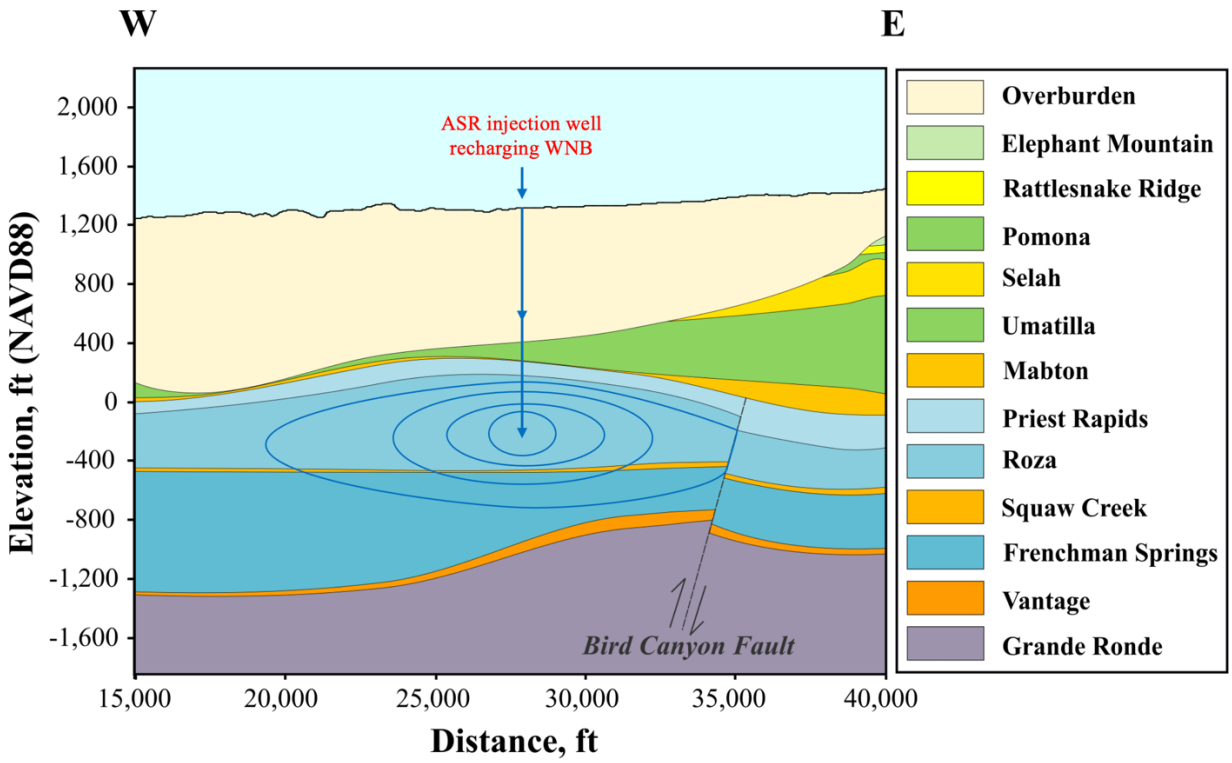


Figure 31. Potential ASR location targetting the WNB aquifer in Moxee Valley, a part of the C-C' cross-section, with color-coded stratigraphic legend. The blue concentric circles illustrate the propogation of recharge water into the aquifer over the duration of injection. This location is 4 miles east of the Roza Canal. See Figure 27 for the specific location.

CHAPTER VI

CONCLUSION

This thesis investigated managed aquifer recharge (MAR) potential in basalts of the lower Yakima River Basin as a method for supplementing water supply for proratable users. Stratigraphic reconstructions based on driller notes combined with analyses of historic water level changes have yielded estimates of basalt aquifer storage availability and isolated potential recharge locations for a successful MAR program.

The basalt aquifers of the study area are suitable for MAR storage due to their thickness, historical storage loss, and hydrogeologic properties. The aquifers range in thickness from 140 to 1,230 ft, and the Wanapum aquifer is typically thicker than the Upper and Lower Saddle Mountain aquifers. In the last fifty years, the Wanapum and Saddle Mountain aquifers have had nearly 100,000 total acre-feet of storage loss every year in the study area. This annual loss in groundwater storage suggests that large volumes of water can be restored through MAR, although the degree of compaction in the subsurface, if any, is unknown. Previous literature suggests that the aquifers have high transmissivity and storativity values, indicating that the aquifers are suitable to accommodate large quantities of recharge water through MAR.

Based on the framework provided in this thesis, the potential for MAR success in the study area is high. Table 9 summarizes the MAR potential for basalt aquifers in the Lower Yakima and Moxee Valleys using two recharge methods: shallow aquifer recharge (SAR) and aquifer storage and recovery (ASR). Of all the potential recharge locations and methods discussed in this thesis, ASR targeting the Wanapum aquifer in Moxee Valley appears to be the most promising prospect, although all scenarios would yield positive outcomes for MAR (Table 9). The Wanapum aquifer has the greatest amount of storage available for MAR in Moxee Valley

where the aquifer is thickest and experienced the greatest relative storage loss in the last fifty years. Additionally, Moxee Valley contains structural boundaries, like the Bird Canyon Fault, that could be used to create a groundwater cell where charged groundwater is available for later recovery.

Table 9. Summary table of managed aquifer recharge potential in the Upper and Lower Saddle Mountain Basalt aquifers and Wanapum Basalt aquifer in the Lower Yakima and Moxee Valleys

Recharge Method	Target Aquifer(s)	Location	Relative Aquifer Thickness	Relative Storage Loss	Structural Boundaries?
Shallow Aquifer Recharge	Upper and Lower Saddle Mountain	Lower Yakima Valley	Low to Medium	Low	Unmapped
Shallow Aquifer Recharge	Upper and Lower Saddle Mountain	Moxee Valley	Low to Medium	Low	Yes
Aquifer Storage and Recovery	Wanapum	Lower Yakima Valley	High	High	Unmapped
Aquifer Storage and Recovery	Wanapum	Moxee Valley	High	High	Yes

Note: Cells are highlighted in orange to represent low to medium relative MAR potential, or green to represent high relative MAR potential.

This framework contributes useful information for moving on to the next stages of MAR investigation in the study area. Future work involves water quality assessments, aquifer testing, and pilot testing. Water quality research is necessary for evaluating the compatibility of surface water with groundwater. The findings of this research could have significant implications for the future of MAR in the study area if the two waters are incompatible. Aquifer testing will yield estimations of the hydrogeologic properties specific to the aquifers of the study area. This information will provide more detailed assessments of aquifer suitability for MAR. If water quality and aquifer testing investigations find that MAR is suitable in the study area, MAR pilot testing will be performed.

Finally, the techniques used in this study can be applied to other regions of the world where MAR is being considered to enhance local water storage. This research serves as an example that stratigraphy can be extracted from driller notes, especially with subsurface geology that contains continental flood basalts with interbeds like the Columbia River Basalt Group. Constructing cross-sections and analyzing groundwater elevation levels and changes in the study area has been a vital step in analyzing storage capabilities in the Saddle Mountain and Wanapum aquifers. Future investigations of MAR in the Yakima River Basin and other watersheds should incorporate these methods.

REFERENCES

Anderson, R., Pitre, C., and Neir, A., 2009, Technical Report on Groundwater Storage Alternatives for Yakima River Basin Storage Assessment: Golder Associates Inc. Yakima River Basin Water Storage Feasibility Study Draft Planning Report/Environmental Impact Statement 08-12–001.

Atwater, T., 1970, Implications of Plate Tectonics for the Cenozoic Tectonic Evolution of Western North America: Geological Society of America Bulletin, v. 81, p. 3513.

Bentley, R.D., Campbell, N.P., and Powell, J.E., 1993, Geologic Maps of Part of the Yakima Fold Belt, Northeastern Yakima County, Washington: Washington State Department of Natural Resources Division of Geology and Earth Resources Open File Report 93–3.

Bingham, J.W., and Grolier, M.J., 1966, The Yakima Basalt and Ellensburg Formation of South-Central Washington: Geological Survey Bulletin, 1224-G,.

Bouwer, H., and Rice, R.C., 1976, A slug test for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells: Water Resources Research, v. 12, p. 423–428, doi:10.1029/WR012i003p00423.

Bureau of Reclamation, 2012, Yakima River Basin Integrated Water Resource Management Plan: Framework for Implementation Report.

Bureau of Reclamation, 1999, Yakima River Basin Water Enhancement Project, Washington: Final Programmatic Environmental Impact Statement FES-99-3.

Burns, E.R., Morgan, D.S., Peavler, R.S., and Kahle, S.C., 2011, Three-Dimensional Model of the Geologic Framework for the Columbia Plateau Regional Aquifer System, Idaho, Oregon, and Washington: U.S. Geological Survey Scientific Investigations Report.

Camp, V.E., Reidel, S.P., Ross, M.E., Brown, R.J., and Self, S., 2017, Field-Trip Guide to the Vents, Dikes, Stratigraphy, and Structure of the Columbia River Basalt Group, Eastern Oregon and Southeastern Washington: U.S. Geological Survey Scientific Investigations Report Scientific Investigations Report.

Casanova, J., Devau, N., and Pettenati, M., 2016, Managed aquifer recharge: an overview of issues and options, *in* Integrated groundwater management: Concepts, approaches and challenges, Springer International Publishing, p. 413–434.

Department of Natural Resources, 2016, Surface Geology 100k: Department of Natural Resources Washington Division of Geology and Earth Resources Digital Data Series DS-18 GIS data.

Dillon, P., 2005, Future management of aquifer recharge: Hydrogeology Journal, v. 13, p. 313–316, doi:10.1007/s10040-004-0413-6.

Dillon, P. et al., 2019, Sixty years of global progress in managed aquifer recharge: Hydrogeology Journal, v. 27, p. 1–30, doi:10.1007/s10040-018-1841-z.

Dillon, P., Alley, W., Zheng, Y., and Vanderzalm, J., 2022, Managed Aquifer Recharge: Overview and Governance: IAH Special Publication, https://recharge.iah.org/ISBN978-1-3999-2814-4.

Drost, B.W., and Whiteman, K.J., 1986, Surficial geology, structure, and thickness of selected geohydrologic units in the Columbia Plateau, Washington: U.S. Geological Survey Water Investigations Report 84–4326, doi:10.3133/wri844326.

Drost, B.W., Whiteman, K.J., and Gonthier, J.B., 1990, Geologic framework of the Columbia Plateau Aquifer System, Washington, Oregon, and Idaho: Water-Resources Investigations Report 87–4238, doi:10.3133/wri874238.

Ely, D.M., Bachmann, M.P., and Vaccaro, J.J., 2011, Numerical Simulation of Groundwater Flow for the Yakima River Basin Aquifer System, Washington: Scientific Investigations Report Scientific Investigations Report 2011–5155.

Fienen, M.N., and Arshad, M., 2016, The international scale of the groundwater issue, *in* Integrated groundwater management: concepts, approaches and challenges, Springer International Publishing, p. 21–48.

Germiat, S.J., and Flynn, T.J., 2005, Aquifer Storage and Recovery Assessment, City of Kennewick: Aspect Consulting LLC WRIA 31 Planning Unit.

Gibson, M.T., and Campana, M.E., 2018, Groundwater Storage Potential in the Yakima River Basin: A Spatial Assessment of Shallow Aquifer Recharge and Aquifer Storage and Recovery: 19-12-003, https://apps.ecology.wa.gov/publications/documents/1912003.pdf.

Halford, K.J., and Kuniansky, E.L., 2002, Spreadsheets for the Analysis of Aquifer-Test and Slug-Test Data, Version 1.2: U.S. Geological Survey Open-File Report Open-File Report 02–197.

Hansen, A.J., Vaccaro, J.J., and Bauer, H.H., 1994, Ground-water flow simulation of the Columbia Plateau regional aquifer system, Washington, Oregon, and Idaho: U.S. Geological Survey, doi:10.3133/wri914187.

Harpaz, Y., 1971, Artificial ground-water recharge by means of wells in Israel: American Society of Civil Engineers Journal of the Hydraulics Division, v. 97, doi:10.1061/JYCEAJ.0003163.

Jakeman, A.J., Barreteau, O., Hunt, R.J., Rinaudo, J.-D., and Ross, A. (Eds.), 2016, Integrated Groundwater Management: Concepts, Approaches and Challenges: Cham, Springer International Publishing, doi:10.1007/978-3-319-23576-9.

Kahle, S.C., Olsen, T.D., and Morgan, D.S., 2009, Geologic setting and hydrogeologic units of the Columbia Plateau Regional Aquifer System, Washington, Oregon, and Idaho: U.S. Geological Survey Scientific Investigations Map 3088.

Kasbohm, J., and Schoene, B., 2018, Rapid eruption of the Columbia River flood basalt and correlation with the mid-Miocene climate optimum: Science Advances, v. 4, doi:10.1126/sciadv.aat8223.

Kent, M., 1978, Stratigraphy and petrography of the Selah member of the Ellensburg formation in south-central Washington and north-central Oregon, doi:10.15760/etd.2875.

Kirk, T.K., and Mackie, T.L., 1993, Black Rock – Moxee Valley Groundwater Study: Washington State Department of Ecology 93–1.

Konikow, L.F., 2011, Contribution of global groundwater depletion since 1900 to sea-level rise: Geophysical Research Letters, v. 38, p. n/a-n/a, doi:10.1029/2011GL048604.

McKinley, C., and Sandison, D.I., 2012, Yakima River Basin Integrated Water Resource Management Plan: Washington State Department of Ecology 12-12–002.

McMillan, K., Long, P.E., and Cross, R.W., 1989, Vesiculation in Columbia River basalts, *in* Reidel, S.P. and Hooper, P.R. eds., GSA Special Papers: Volcanism and Tectonism in the Columbia River Flood-Basalt Province, Geological Society of America, v. 239, doi:10.1130/SPE239-p157.

Myers, C.W., and Price, S.M., 1981, Subsurface Geology of the Cold Creek Syncline: Rockwell Hanford Operations Energy Systems Group RHO-BWI-ST-14.

Office of Columbia River, 2018, Yakima River Basin Integrated Water Resource Management Plan Implementation Status Report 2017: Department of Ecology 18-12–005.

Parker, G.L., and Storey, F.B., 1913, Water powers of the Cascade Range, Part III, Yakima River Basin: U.S. Geological Survey Water-Supply Paper 369.

Pfaff, C., 2001, Harvest of Plenty: A History of the Yakima Irrigation Project, Washington: Bureau of Reclamation, Technical Service Center.

Price, D., Hart, D.H., and Foxworthy, B.L., 1965, Artificial Recharge in Oregon and Washington 1962: Geological Survey Water Supply Paper,.

Razack, M., and Huntley, D., 1991, Assessing Transmissivity from Specific Capacity in a Large and Heterogeneous Alluvial Aquifer: Groundwater, v. 29.

Reidel, S., Camp, V., Tolan, T., and Martin, B., 2013, The Columbia River flood basalt province: Stratigraphy, areal extent, volume, and physical volcanology: Special Paper of the Geological Society of America, v. 497, p. 1–43, doi:10.1130/2013.2497(01).

Reidel, S.P., Martin, B.S., and Petcovic, H.L., 2003, The Columbia River flood basalts and the Yakima fold belt, *in* GSA Field Guide 4: Western Cordillera and Adjacent Areas, Geological Society of America, v. 4, p. 87–105, doi:10.1130/0-8137-0004-3.87.

Repasky, T.R., 1993, Data Analysis of the Kays Road Pumping Test: Yakama Indian Nation Water Programs Pumping Test Report.

Sakthivadivel, R., 2007, The Groundwater Recharge Movement in India, *in* The agricultural groundwater revolution: opportunities and threats to development, CABI, p. 195–210.

Schmidt, R.D., Johnson, J., and Didricksen, K., 2007, Modeling Groundwater Hydrologic Impacts of the Potential Black Rock Reservoir: U.S. Department of the Interior, Bureau of Reclamation Technical Series No. TS-YSS-19.

Shellenberger, J., 2023, Understanding Indigenous Landscapes on the Columbia Plateau: Central Washington University Geological Sciences Speaker Series, https://www.youtube.com/watch?v=xDf00qLA4UE.

Sleeper, S., 2020, A Geochemical Assessment of Potential Groundwater Storage Locations within the Yakima River Basin: Central Washington University Master's Thesis, 187 p.

Sprenger, C., Hartog, N., Hernández, M., Vilanova, E., Grützmacher, G., Scheibler, F., and Hannappel, S., 2017, Inventory of managed aquifer recharge sites in Europe: historical development, current situation and perspectives: Hydrogeology Journal, v. 25, p. 1909–1922, doi:10.1007/s10040-017-1554-8.

Sun, R.J., and Johnston, R.H., 1994, Regional Aquifer-System Analysis Program of the U.S. Geological Survey, 1978-1992: U.S. Geological Survey Circular 1099.

Swanson, D.A., and Wright, T.L., 1978, Bedrock Geology of The Northern Columbia Plateau and Adjacent Areas, *in* The Channeled Scabland: a guide to the geomorphology of the Columbia Basin, Washington, NASA.

Theis, C.V., 1963, Estimating the transmissivity of a water-table aquifer from the specific capacity of a well: U.S. Geological Survey Water Supply Paper 1536–I, 332–336 p.

Theis, C.V., 1935, The relation between the lowering of the Piezometric surface and the rate and duration of discharge of a well using ground-water storage: Eos, Transactions American Geophysical Union, v. 16, p. 519–524, doi:10.1029/TR016i002p00519.

Vaccaro, J.J., Jones, M.A., Ely, D.M., Keys, M.E., Olsen, T.D., Welch, W.B., and Cox, S.E., 2009, Hydrogeologic Framework of the Yakima River Basin Aquifer System, Washington: U.S. Geological Survey Scientific Investigations Report Scientific Investigations Report 2009–5152.

Vaccaro, J.J., and Olsen, T.D., 2007, Estimates of Ground-Water Recharge to the Yakima River Basin Aquifer System, Washington, for Predevelopment and Current Land-Use and Land-Cover Conditions: U.S. Geological Survey Scientific Investigations Report Scientific Investigations Report 2007–5007.

Vaccaro, J.J., and Sumioka, S.S., 2006, Estimates of Ground-Water Pumpage from the Yakima River Basin Aquifer System, Washington, 1960-2000: U.S. Geological Survey Scientific Investigations Report Scientific Investigations Report 2006–5205.

Vano, J.A., Scott, M.J., Voisin, N., Stöckle, C.O., Hamelt, A.F., Mickelson, K.E.B., Elsner, M.M., and Lettenmaier, D.P., 2010, Climate change impacts on water management and irrigated agriculture in the Yakima River Basin, Washington, USA: Climate Change, v. 102, p. 287–317.

Vlassopoulos, D.J., Goin, M., Zeliff, J., and Porcello, C., 2009, Groundwater geochemistry of the Columbia River basalt group aquifer system.: Columbia Basin Groundwater Management Area of Adams, Franklin, Grant, and Lincoln Counties, Othello, Washington. Technical Report.

Washington State Department of Ecology, 2023a, Environmental Information Management System Search:, https://apps.ecology.wa.gov/eim/search/Default.aspx.

Washington State Department of Ecology, 2023b, Washington State Well Report Viewer:, https://apps.ecology.wa.gov/eim/search/Default.aspx.

Wester, B.L., 2014, Land Divided by Law: The Yakama Indian Nation as Environmental History, 1840-1933: Quid Pro Books.

Whiteman, K.J., Vaccaro, J.J., Gonthier, J.B., and Bauer, H.H., 1994, The Hydrogeologic Framework and Geochemistry of the Columbia Plateau Aquifer System, Washington, Oregon, and Idaho: U.S. Geological Survey U.S. Geological Survey Professional Paper 1413.

Wrone, D.R., 1986, Indian Treaties and the Democratic Idea: Wisconsin Magazine of History, 83–106 p., https://search.library.wisc.edu/catalog/9910114821402121 (accessed April 2023).

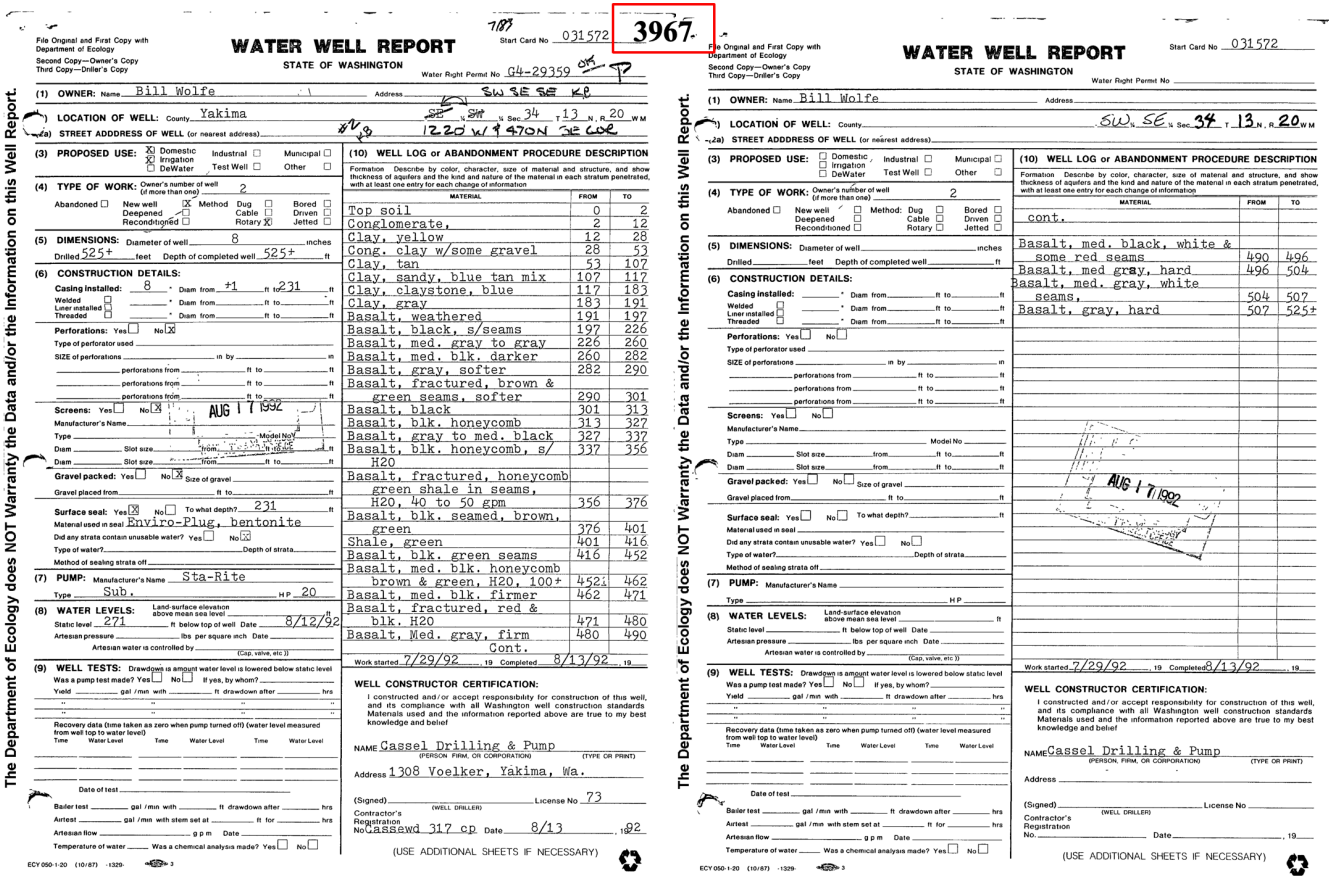
Zakharova, N.V., Goldberg, D.S., Sullivan, E.C., Herron, M.M., and Grau, J.A., 2012, Petrophysical and geochemical properties of Columbia River flood basalt: Implications for carbon sequestration: Geochemistry, Geophysics, Geosystems, v. 13, doi:10.1029/2012GC004305.

APPENDICES

APPENDIX A

WELL REPORTS AND STRATIGRAPHIC INTERPRETATIONS

Figures A1-A8. Well reports and stratigraphic interpretations of wells in the A-A' cross-section. The abbreviations used to denote stratigraphic members are as follows: OVB = overburden, EM = Elephant Mountain, RR = Rattlesnake Ridge, PM = Pomona, SEL = Selah, UMA = Umatilla, MBTN = Mabton, PR = Priest Rapids, RZ = Roza, SQC = Squaw Creek, FS = Frenchman Springs, VTG = Vantage, and GRB = Grande Ronde.



WATER WELL REPORT
STATE OF WASHINGTON

Start Card No 031572 — 3967

(1) OWNER: Name Bill Wolfe — Address SW SE SE KP

(2) LOCATION OF WELL: County Yakima — SE ¼ SW ¼ Sec 34 T 13 N, R 20 W M

(2a) STREET ADDDRESS OF WELL (or nearest address) 1220 W Nelson SE COR

(3) PROPOSED USE: Domestic X, Irrigation X, DeWater; Industrial, Test Well, Municipal, Other

(4) TYPE OF WORK: Owner's number of well (if more than one) 2
Abandoned; New well X, Deepened, Reconditioned; Method: Dug, Cable, Rotary X, Bored, Driven, Jetted

(5) DIMENSIONS: Diameter of well 8 inches
Drilled 525+ feet Depth of completed well 525+ ft

(6) CONSTRUCTION DETAILS:
Casing installed: 8 " Diam from +1 ft to 231 ft
Welded; Liner installed; Threaded
Perforations: Yes; No X
Type of perforator used
SIZE of perforations in by in
perforations from ft to ft
Screens: Yes; No X
Manufacturer's Name
Type Model No
Diam Slot size from ft to ft
Gravel packed: Yes; No X Size of gravel
Gravel placed from ft to ft
Surface seal: Yes X; No; To what depth? 231 ft
Material used in seal Enviro-Plug, bentonite
Did any strata contain unusable water? Yes; No X
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name Sta-Rite
Type Sub. H P 20

(8) WATER LEVELS: Land-surface elevation above mean sea level ft
Static level 271 ft below top of well Date 8/12/92
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 /mn 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 /mn with ft drawdown after hrs
Airtest gal /mn 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	0	2
Conglomerate,	2	12
Clay, yellow	12	28
Conc. clay w/some gravel	28	53
Clay, tan	53	107
Clay, sandy, blue tan mix	107	117
Clay, claystone, blue	117	183
Clay, gray	183	191
Basalt, weathered	191	197
Basalt, black, s/seams	197	226
Basalt, med. gray to gray	226	260
Basalt, med. blk. darker	260	282
Basalt, gray, softer	282	290
Basalt, fractured, brown & green seams, softer	290	301
Basalt, black	301	313
Basalt, blk. honeycomb	313	327
Basalt, gray to med. black	327	337
Basalt, blk. honeycomb, s/ H20	337	356
Basalt, fractured, honeycomb green shale in seams, H20, 40 to 50 gpm	356	376
Basalt, blk. seamed, brown, green	376	401
Shale, green	401	416
Basalt, blk. green seams	416	452
Basalt, med. blk. honeycomb brown & green, H20, 100+	452	462
Basalt, med. blk. firmer	462	471
Basalt, fractured, red & blk. H20	471	480
Basalt, Med. gray, firm Cont.	480	490

Work started 7/29/92 Completed 8/13/92

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 Cassel Drilling & Pump (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address 1308 Voelker, Yakima, Wa.
(Signed) License No 73 (WELL DRILLER)
Contractor's Registration No Cassewd 317 cp Date 8/13 19 92

(USE ADDITIONAL SHEETS IF NECESSARY)

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

ECY 050-1-20 (10/87) -1329

AUG 17 1992

WATER WELL REPORT
STATE OF WASHINGTON

Start Card No 031572

(1) OWNER: Name Bill Wolfe — Address

(2) LOCATION OF WELL: County — SW ¼ SE ¼ Sec 34 T 13 N, R 20 W M

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

(3) PROPOSED USE: Domestic, Irrigation, DeWater; Industrial, Test Well, Municipal, Other

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

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

(6) CONSTRUCTION DETAILS:
Casing installed: " Diam from ft to ft
Welded; Liner installed; Threaded
Perforations: Yes; No
Type of perforator used
SIZE of perforations in by in
perforations from ft to ft
Screens: Yes; No
Manufacturer's Name
Type Model No
Diam Slot size from ft to ft
Gravel packed: Yes; No Size of gravel
Gravel placed from ft to ft
Surface seal: Yes; No; To what depth? ft
Material used in seal
Did any strata contain unusable water? Yes; No
Type of water? Depth of strata
Method of sealing strata off

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

(8) WATER LEVELS: Land-surface elevation above mean sea level ft
Static level ft below top of well Date
Artesian pressure lbs per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes; No; If yes, by whom?
Yield gal /mn 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 /mn with ft drawdown after hrs
Airtest gal /mn 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
cont.		
Basalt, med. black, white & some red seams	490	496
Basalt, med gray, hard	496	504
Basalt, med. gray, white seams,	504	507
Basalt, gray, hard	507	525+

Work started 7/29/92 Completed 8/13/92

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 Cassel Drilling & Pump (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address
(Signed) License No (WELL DRILLER)
Contractor's Registration No. Date 19

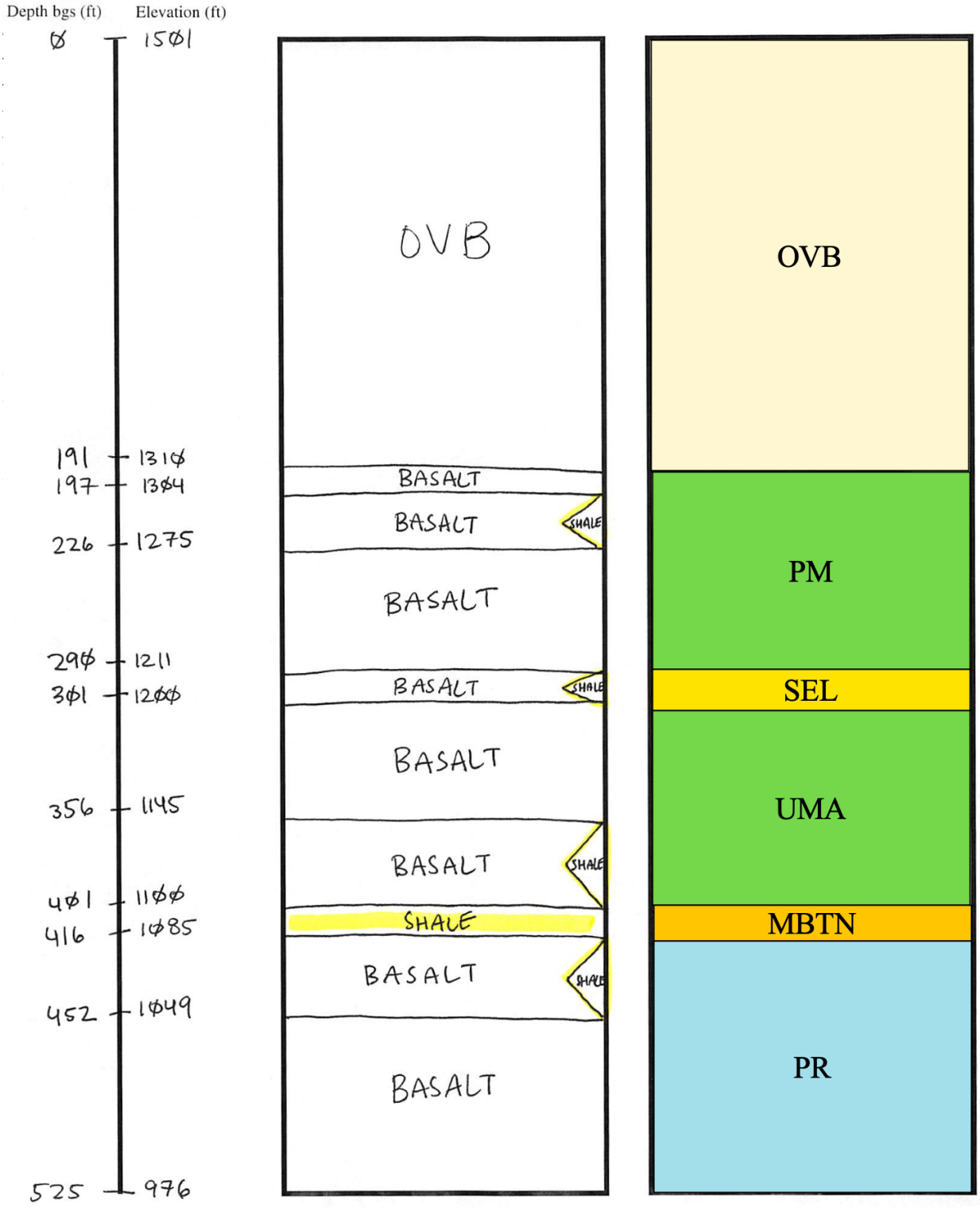
(USE ADDITIONAL SHEETS IF NECESSARY)

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

ECY 050-1-20 (10/87) -1329

AUG 17 1992

Well ID: 3967	Well Name:	Cross Section: A-A'
Surface Elevation: 1501 ft	Well Depth: 525 ft	Aquifer: WNB



3963

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

WATER WELL REPORT
STATE OF WASHINGTON

Application No. /
Permit No

(1) OWNER: Name Ralph Lamb Address 314 Nth. 5th, Selah, Wa. 98942

(2) LOCATION OF WELL: County Yakima — NE¼ SE¼ Sec. 34 T. 13 N., R. 20 E. W.M.
Bearing and distance from section or subdivision corner Lot 1

(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 520 ft. Depth of completed well 520 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6 " Diam. from 0 ft. to 197 ft.
Threaded ☐ " Diam. from ft. to ft.
Welded ☒ " Diam. from ft. to ft.

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

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

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

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

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

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 340 ft. below top of well Date 6-23-77
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

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

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

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test 15 gal./min. with 175 ft. drawdown after 1 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG:
Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Soil, Brn.	0	1
Boulders, Lrg, Hrd, Blk,	1	6
Clay, Brn,	6	35
Clay, Brn, Gravel, Small	35	53
Clay, Lt, Brn, Med.	53	81
Gravel, Cemented, Clay, Hrd,	81	87
Clay, Lt, Brn, Med.	87	95
Sandstone, Lt, Brn, Soft	95	147
Clay, Lt, Brn, Soft	147	165
Basalt, Blk, Med, Soft	165	292
Basalt, Vesicular, Shale	292	363
Shalestone, Blue, Med.	363	369
Basalt, Blk, Med, Hrd,	369	411
Shale, Blue, Fractured, WB	411	417
Basalt, Brn, Fractured, WB	417	443
Basalt, Grey, Med, Hrd,	443	520

RECEIVED
AUG 5 1977
DEPARTMENT OF ECOLOGY
CENTRAL REGIONAL OFFICE

Work started 6-21-77, 19 Completed 6-23-77, 19

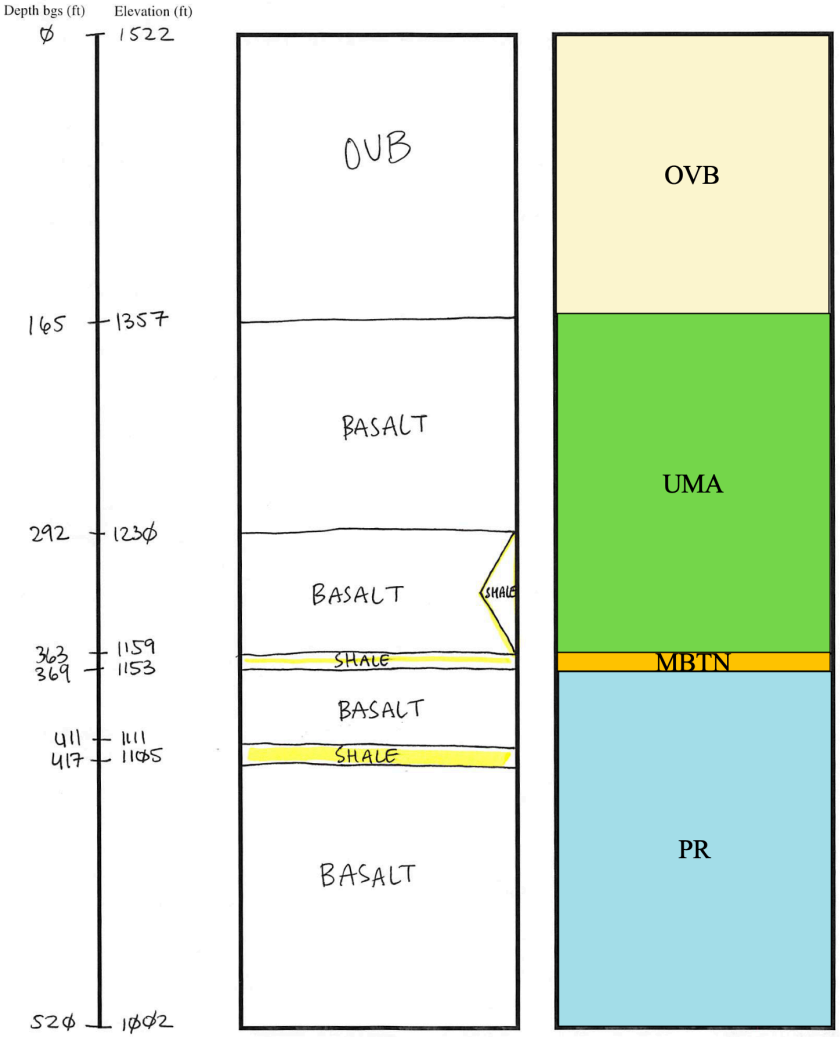
WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME B & B Well Drilling (Person, firm, or corporation) (Type or print)
Address Rt 7 Box 600-A, Yakima, Wa. 9890[illegible]
[Signed] Harvey Blackman (Well Driller)
License No. 0037 Date 7-13-77, 19

(USE ADDITIONAL SHEETS IF NECESSARY) OR

ECY 050-1-20

Well ID: 3963 Well Name: Cross Section: A-A'
Surface Elevation: 1522ft Well Depth: 520ft Aquifer: WNB



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

3961

WATER WELL REPORT

STATE OF WASHINGTON

Application No. Unused
Permit No. 93-20604 P

(1) **OWNER:** Name Harry Billestine Address Yakima 98908 GA-30419 Jot

(2) **LOCATION OF WELL:** County Yakima NE ¼ NE ¼ Sec 34 T 13 N., R 20 W.M.
Give 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 8 inches.
Drilled 687 ft. Depth of completed well 687 ft.

(6) **CONSTRUCTION DETAILS:**
Casing installed: 8" O.D. " Diam. from +1 ft. to 134 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? 134 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 382 ft. below top of well Date 10/2/80
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

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

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

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test 200+ gal./min. with OFF CASING ft. drawdown after 2 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☒

(10) **WELL LOG:** A

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
TOPSOIL, Boulders Brown.	0	9
SANDSTONE, TAN	9	21
Conglomerate, Brown	21	109
BASALT, Fractured, Gray M.H	109	127
BASALT, Gray Hard	127	179
BASALT, Black, Porous M.H	179	217
BASALT, Gray Hard	217	258
BASALT, BLACK, Shale Interbed M.H	258	295
BASALT, Gray Hard	295	378
BASALT, Gray Fractured Hard	378	397
BASALT, Gray Hard	397	462
BASALT, Black Porous W.B	462	472
BASALT, Gray Hard	472	522
BASALT, Black Porous w/ WB, Green shale interbed	522	536
BASALT, Black H.	536	554
BASALT BLACK Fractured w/Green shale —	554	561
BASALT, Gray H.	561	600
BASALT, BLACK H.	600	629
BASALT, BLACK, Gray Shale interbedded M.H, WB	629	633
Shale, Gray SOFT	633	634
SANDSTONE, Brown, SOFT WB	634	640
LAVA BLACK	640	648
BASALT, BLK. Fractured	648	657
BASALT, Porous, Brown M.H W.B	657	666
BASALT, Brown M.H,	666	673
BASALT, Brown, Porous WB	673	679
BASALT, Gray H.	679	687

RECEIVED
OCT 13 1980
DEPARTMENT OF ECOLOGY
CENTRAL OFFICE

Work started 9/26, 1980 Completed 10/2, 1980

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 Cassel Well Drilling (Person, firm, or corporation) (Type or print)

Address 1303 Voelker Ave Yakima

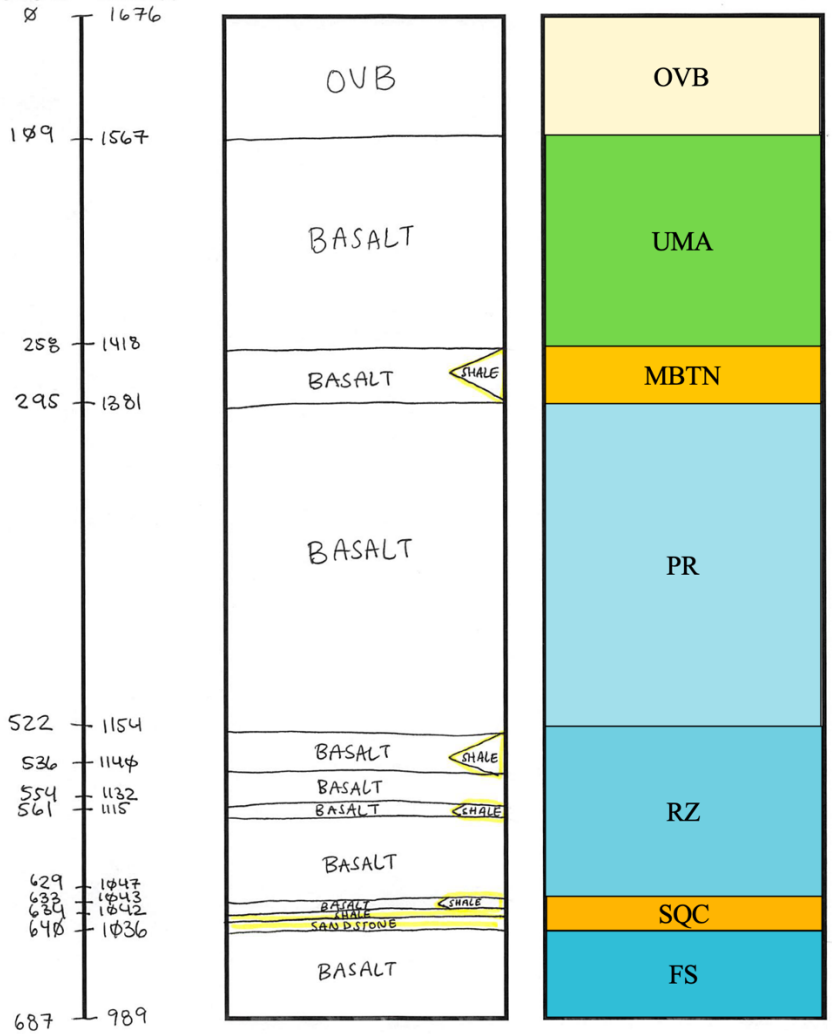
[Signed] (Well Driller)

License No. 0073 Date 10-2, 1980

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

Well ID: 3961 Well Name: Cross Section: A-A'
Surface Elevation: 1676ft Well Depth: 687ft Aquifer: WNB



3348 Elephant Mountain Well

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

RECEIVED JUL 15 1981 DEPARTMENT OF ECOLOGY CENTRAL REGION

Application No. Permit No. G4-25817P

(1) OWNER: Name Dept of Nat. Resources Address

(2) LOCATION OF WELL: County Yakima SE¼ NE¼ Sec. 16 T. 12 N., R. 20 W.M.
Bearing and distance from section or subdivision corner

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

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

(5) DIMENSIONS: Diameter of well 16 inches.
Drilled 1376 ft. Depth of completed well 1369 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 16 " Diam. from +1 ft. to 1296 ft.
Threaded ☐ 12 " Diam. from 1262 ft. to 1322 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? 30 ft.
Material used in seal Cement
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 204 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: 390 ± gal./min. with 21.2 ft. drawdown after 3 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.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG: Elephant MT #1

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
SEE ATTACHED SHEET		
REMARKS:		
Cemented TOP & Bottom of 12 Inch Liner		
Cemented hole TO 1335'		

Work started 19 Completed 19

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Cassel Well Drilling (Person, firm, or corporation) (Type or print)
Address 1308 Voelker Ave Yakima
[Signed] Larry L Cassel (Well Driller)
License No. 0093 Date 5-13 19 81

(USE ADDITIONAL SHEETS IF NECESSARY)

DK 7.15.81

ECY 050-1-20

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

CASSEL WELL DRILLING
Domestic and Irrigation

LARRY CASSEL — 1308 SOUTH VOELKER AVENUE, YAKIMA, WASHINGTON 98902 — PHONE 453-2560

Dept. of Natural Resources — Permit # G4-25817P
Elephant Mt. Well # 1

Location SW¼ NE¼ SE¼ NE¼ SEC.16 T.12 R.20

FROM	TO	THICKNESS	FORMATION
0	3	3	Top Soil
3	12	9	Boulder,sand,clay,conglomerate
12	282	270	Clay,sandy w/sm gravel,brown
270	362	92	Clay,brown w/large gravel
362	392	30	Clay,gray, w/large gravel
392	426	32	Clay,brown, w/sm gravel
426	462	36	Clay,brown, very sticky
462	492	30	Clay, brown, sandy,w/sm gravel
492	595	103	Shale,green
595	602	7	Clay,gray,w/sm gravel,sticky
602	617	10	Clay,brown,sticky
617	634	17	Clay,green w/gravel
634	683	51	Clay,brown w/sm gravel,sticky
683	782	99	Shale,green
782	906	124	Shale,green w/gravel
906	923	17	Shale,green,sand lenses
923	928	5	Shale,green,very sticky
928	943	15	Shale,green w/small gravel
943	1020	77	Shale,green w/sand lenses
1020	1073	53	Clay,green,sticky
1073	1106	33	Clay,gray, sand lenses
1106	1138	32	Clay,green,very sticky
1138	1159	21	Clay,green,very sticky w/s gravel
1159	1185	26	Clay,green,sandy
1185	1218	33	Clay,green,very sticky
1218	1292	74	Clay,green,sandy
1292	1302	10	Decomposed,basaltw/dark clay hard
1302	1311	9	Basalt,broken w/clay,black
1311	1328	17	Compacted sand,sandy clay caving
1328	1360	32	Basalt,redish to black some honeycomb

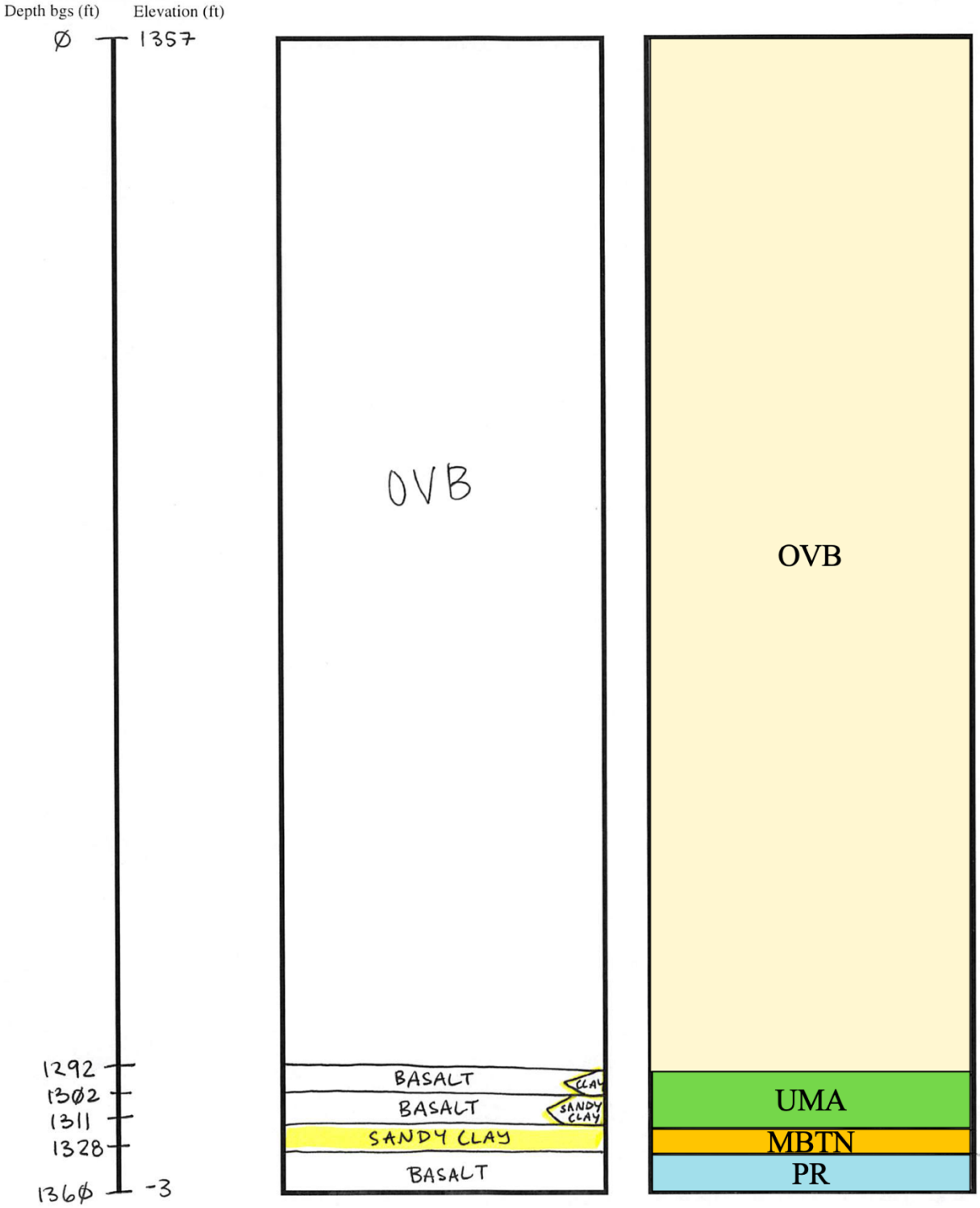
Static: 226

Casing: 16" + 1 to 1296'
12" 1322'

RECEIVED FEB 25 1981 DEPARTMENT OF ECOLOGY CENTRAL REGION

accept as well report
2.26.81 DK

Well ID: 3348	Well Name: Elephant Mountain	Cross Section: A-A' & C-C'
Surface Elevation: 1357ft	Well Depth: 1360ft	Aquifer: WNB



3375

WATER WELL REPORT

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

Construction/Decommission ("x" in circle)
(X) Construction 188295
( ) Decommission *ORIGINAL CONSTRUCTION Notice of Intent Number*

DEPT. OF ECOLOGY Received JAN 18 2005 CENTRAL REGION OFFICE

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

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

DIMENSIONS: Diameter of well 12 inches, drilled 460 ft.
Depth of completed well 460 ft.

CONSTRUCTION DETAILS
Casing Installed: ☒ Welded 12" Diam. from +1 ft. to 240 ft.
☒ Liner installed 10" Diam. from 220 ft. to 460 ft.
☐ Threaded ___" Diam. from ___ ft. to ___ ft.

Perforations: ☒ Yes ☐ No
Type of perforator used torch-cut 10 inch liner
SIZE of perfs 1/8 in. by 6 in. and no. of perfs 580 from 240 ft. to 420 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 cement
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 75 ft. below top of well Date 7/28/05
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (cap,valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level.
Was a pump test made? ☐ Yes ☒ No If yes, by whom?
Yield: 1000 gal./min. with 125 ft. drawdown after 24 hrs.
Yield: gal./min. with ft. drawdown after hrs.
Yield: gal./min. with ft. drawdown after hrs.
Recovery data (time taken as zero when pump turned off)(water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

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

CURRENT
Notice of Intent No. W183363
Unique Ecology Well ID Tag No. ALF 431
Water Right Permit No. Proving Water Permit G4-32988-05
Property Owner Name Waco Orchard
Well Street Address 490 Vista ridge road
City Wapato County: Yakima
Location NE 1/4- 1/4 NE 1/4 Sec 32 Twn 12N R 20E (EWM or WWM) *circle one*
Lat/Long: (s,t,r still REQUIRED) Lat Deg Lat Min/Sec
Long Deg Long Min/Sec
Tax Parcel No.

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
clay w/sand	0	25
soft & hard sandrock	25	47
sand, clay w/sand	47	80
soft sandstone, water	80	92
clay, clay rock	92	150
sand w/gray clay	150	160
sandstone	160	170
hard green clay	170	178
black sandstone	178	195
clay w/silt	195	215
hard sand	215	223
hard pan, very hard	223	242
brown clay, clay	242	300
sand w/clay, water	300	320
hard clay stone, light color	320	348
clay w/small gravel	348	353
soft, hard, broken basalt	353	375
sandstone, gray clay	375	395
clay, blue clay	395	410
sandstone, tan clay	410	435
blue clay with sand	435	460
12" w/a casing	+1	240
10" slotted steel liner	220	460

DEPT. OF ECOLOGY Received NOV 15 2005 CENTRAL REGION OFFICE

Start Date 5/15/2005 Completed Date 7/28/2005

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.

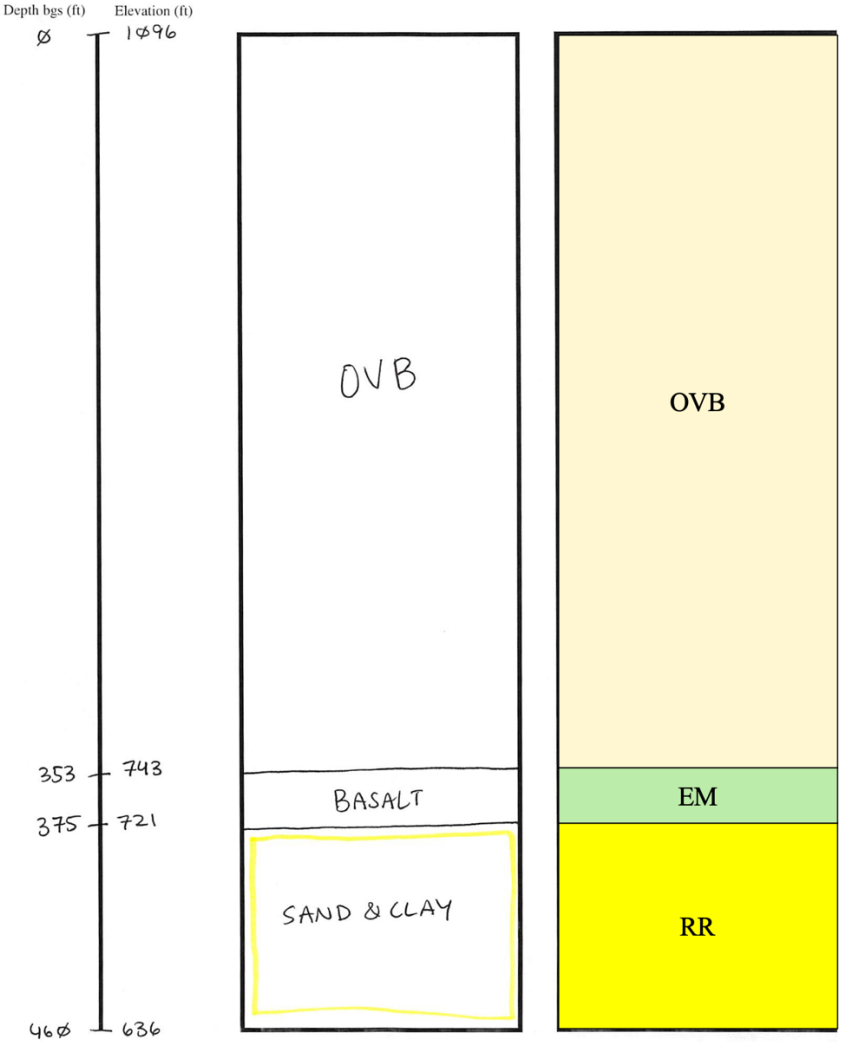
☒ Driller ☐ Engineer ☐ Trainee Name (Print) MIKE BACH
Driller/Engineer/Trainee Signature Mike Bach
Driller or Trainee License No. 22

Drilling Company Bach Well Drilling
Address 3340 W. Ilson Creek road
City, State, Zip Ellensburg WA 98926
Contractor's Registration No. MIKEBDC133N4 Date 7/28/2005

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

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

Well ID: 3375 Well Name: Cross Section: A-A'
Surface Elevation: 1096 ft Well Depth: 460 ft Aquifer: upper SDMB



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

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

WATER WELL REPORT
STATE OF WASHINGTON

Application No. ______
Permit No ______

(1) OWNER: Name Maple Leaf Farm, Inc. Address ______

(2) LOCATION OF WELL: County Yakima — SW ¼ NE ¼ Sec. 29 T. 12 N., R. 20 W.M.
Bearing and distance from section or subdivision corner

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

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

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

(6) CONSTRUCTION DETAILS:
Casing installed: 12" Diam. from 0 ft. to 370 ft.
Threaded ☐ 10" Diam. from 370 ft. to 550 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? ______ ft.
Material used in seal ______
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? ______ Depth of strata ______
Method of sealing strata off ______

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

(8) WATER LEVELS: Land-surface elevation above mean sea level ...... ft.
Static level 193 ft. below top of well Date 4/22/77
Artesian pressure ______ lbs. per square inch Date ______
Artesian water is controlled by ______ (Cap, valve, etc.)

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

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

Time	Water Level	Time	Water Level	Time	Water Level

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

(10) WELL LOG:
Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
TopSoil	0	4
Sand with a little Clay	4	22
Sand Rock yellow with small Grey Layers – 150' Water 20GPM	22	170
Sand Rock – Green – Picking up H2O	170	182
Sand Rock – yellow Cemented layers 40-50GPM	182	195
Cemented Sand (Water)	195	205
Sand Rock yellow Less Water	205	211
Cemented Sand (Water)	211	222
Sand rock yellow Cemented Sand layers	222	235
Clay yellow Little Sand No Water	235	268
Sandy Clay yellow No Water	268	289
Clay blue No Water	289	305
Clay blue Grey No Water	305	322
Sand rock Grey Blue Water 71-86GPM	322	371
Brown Red Basalt	371	373
Sandstone	373	400
Sandstone – Interbed of Sand liquid (H2O)	400	425
Sandstone Hard	425	433
Brown Basalt	433	439
Sandstone (water)	439	450
Sandstone Hard	450	475
Sandstone	[illegible]	[illegible]
Black soft Basalt (water)	[illegible]	[illegible]
Sandstone Hard	[illegible]	[illegible]
Sandstone Hard	[illegible]	[illegible]
Sandstone Soft Water	530	[illegible]

Work started ______ 19__ Completed ______

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 [illegible] (Person, firm, or corporation) (Type or print)
Address [illegible]
[Signed] [illegible]
License No. [illegible]

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

Application No. ______
Permit No. ______

(1) OWNER: Name Maple Leaf Farms Inc Address 20E

(2) LOCATION OF WELL: County Yakima — SW ¼ NE ¼ Sec 29 T. 12 N., R. 20 E W.M.
Bearing and distance from section or subdivision corner

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

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

(5) DIMENSIONS: Diameter of well 10" inches.
Drilled 280 ft. Depth of completed well 830 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 10" Diam. from 0 ft. to 541 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? ______ ft.
Material used in seal Natural clay
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? ______ Depth of strata ______
Method of sealing strata off ______

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

(8) WATER LEVELS: Land-surface elevation above mean sea level ...... ft.
Static level 170 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: 450 gal./min. with 240 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.
Artesian flow ______ g.p.m. Date ______
Temperature of water 76 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
soft Brown Basalt	550	570
hard Gray Basalt	570	575
soft Blue Basalt	575	580
hard Gray Basalt	580	590
soft Black Basalt	590	620
hard Blue Basalt	620	680
Medium Black Basalt	680	700
hard Gray Basalt	700	745
soft Black with Blue shale mixed water bearing	745	825
Medium hard Basalt	825	830

RECEIVED [illegible] DEPARTMENT OF ECOLOGY CENTRAL REGION OFFICE

Work started ______ 19__ Completed 3-28 1986

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 Rt. 5, Box 101C, Ellensburg, WA.
[Signed] Mike Bach (Well Driller)
License No. 22 Date 4-4, 1986

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

3365

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
110936

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. W 28133

Water Right Permit No.

(1) OWNER: Name Maple Leaf Address P.O. Box 1588 Yakima, WA 98907

(2) LOCATION OF WELL: County Yakima SW ¼ NE ¼ Sec. 29 T. 12 N. R. ~~26~~ 20 W.M.

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

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

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

(5) DIMENSIONS: Diameter of well 10 inches. Drilled 714 feet. Depth of completed well 1550 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: n/a " Diam. from ft. to ft.
Welded ☐ Liner installed ☐ Threaded ☐ " Diam. from ft. to ft.
" 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? ft.
Material used in seal Previously done
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 same ft. below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

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

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Airlift 250 gal./min. with stem set at 1500 ft. for 1 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☐

ECY 050-1-20 (10/87) -1329-

(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
Black basalt PSI 185	836	1050
Broken basalt PSI 205	1050	1053
Green & White clay	1053	1068
Med black basalt	1068	1127
Brown clay	1127	1129
Med black - broken seams	1129	1220
Med grey basalt	1220	1270
Black broken	1270	1339
Med grey	1339	1408
Broken basalt	1408	1410
Med grey	1410	1420
Cemented sand little water blue clay	1420	1428
Med grey basalt	1428	1550
Deepened with 7 7/8" bit.		

FEB - 8 1994

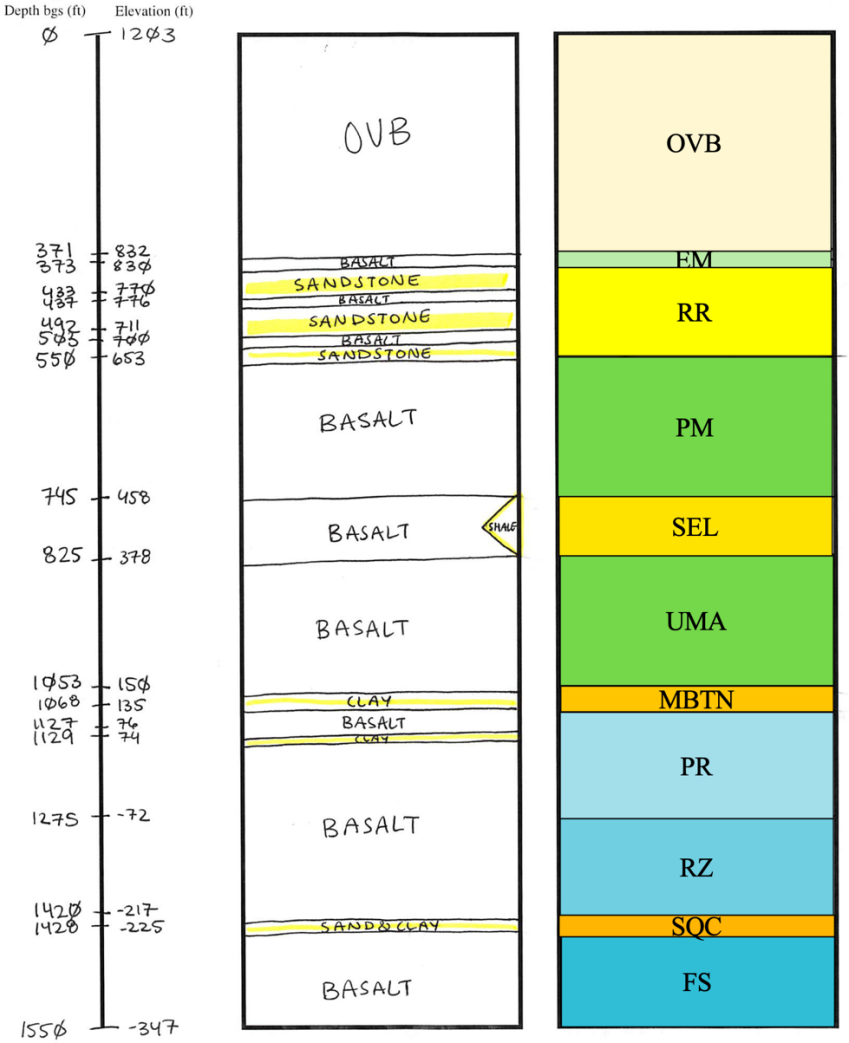
Work started 12/9/93 19. Completed 12/19/93 19.

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 BJ ExplorationCo., Inc. (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address Rt 4 Box 4517 Kennewick, WA 99337
(Signed) (WELL DRILLER) License No. 0337
Contractor's Registration No. BJEXPCI132QK Date 1/20/94 19

(USE ADDITIONAL SHEETS IF NECESSARY)

Well ID: 3365 Well Name: Cross Section: A-A'
Surface Elevation: 1203 ft Well Depth: 1550 ft Aquifer: WNB



3365

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 31357
Second Copy — Owner's Copy
Third Copy — Driller's Copy Gamache

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. W024300 Plot
UNIQUE WELL I.D. AAM 735
Water Right Permit No. G4-31364E

(1) OWNER: Name Garnache Farms Address 310 Benudry Rd. Moxee, WA

(2) LOCATION OF WELL: County Yakima NOV 23 1994 W½ NE 1/4 1/4 Sec. 3 T. 12 N. R. 20E W.M. B

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

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

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

(5) DIMENSIONS: Diameter of well inches. Drilled feet. Depth of completed well 1368' ft.

(6) CONSTRUCTION DETAILS:
Casing Installed: 16" Diam. from 0 ft. to 310 ft.
Welded ☑ 12" Diam. from +1 ft. to 708 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
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? 708 ft.
Material used in seal
Did any strata contain unusable water? Yes ☐ No ☑
Type of water? Depth of strata
Method of sealing strata off

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

(8) WATER LEVELS: Land-surface elevation above mean sea level ± 200 ft.
Static level ft. below top of well Date
Artesian pressure N/A lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

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

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Airtest 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
Soil	m.	0	5
Brown clay cobels and boulders	h.	5	20
Tan clay	m.	27	34
Sand stone tan	m.	34	52
Sand stone brown	m.	52	84
Sand stone brown	m.	84	112
Clay s/m/p green	m.	112	132
Clay shale dark green	h.	132	140
Clay shale green	mh.	140	155
Fractured basalt	h.	155	189
Basalt and shale	h.	189	208
Gray green sandy clay	ms.	208	247
Porous basalt red & black	mh.	247	270
Gray basalt	h.	270	294
Black basalt	vh.	294	332
Burnt basalt	mh.	332	342
Porous basalt	mh.	342	368
Blue green clay	m.	368	447
Fractured basalt w/ clay	mh.	447	457
Basalt w/ black sand	mh.	457	470
Gray basalt	h.	470	485
Basalt w/ clay shale	mh.	485	503
Fractured basalt	m.	503	556
Blue green sand and clay	s.	556	530
Gray fractured basalt	vh.	530	600
Gray basalt	h.	600	
Hard gray fractured	h.	600	718
Basalt gray	h.	718	782
Basalt w/ clay streaks	mh.	782	786
Basalt gray	h.	786	796
Soft black basalt w/ wood		796	809
Black basalt med hard		809	849
Baslat gray	h.	849	893

Work Started 8/16/94 19. Completed 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 Aqua Drilling & Engeneering (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address 120 Crestview Dr., Colville, WA
(Signed) Doug Gallagher (WELL DRILLER) License No. 2175
Harry Hathaway #1532
Contractor's Registration No. AQUADEL00603 Date 11/23 1994

(USE ADDITIONAL SHEETS IF NECESSARY)

ECL 050-1-20 (2/93) * * 1

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 31357
Second Copy — Owner's Copy
Third Copy — Driller's Copy Gamache

WATER WELL REPORT

STATE OF WASHINGTON

pg #2 of 2
Start Card No. W024300
UNIQUE WELL I.D. #
Water Right Permit No.

(1) OWNER: Name Jeff Garnache Farms Address

(2) LOCATION OF WELL: County NOV 23 1994 W½ NE 1/4 1/4 Sec. 3 T. 12 N. R. 20 W.M. B

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

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

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

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

(6) CONSTRUCTION DETAILS:
Casing Installed: " Diam. from ft. to ft.
Welded ☐ " Diam. from ft. to 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
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? ft.
Material used in seal
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? Depth of strata
Method of sealing strata off

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

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level ft. below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

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

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test 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
Soft black basalt shale	s.	893	928 *
Basalt black clay shale	m.	928	930
Gray basalt fine	h.	930	965
Black, brown, green basalt	s.	965	974 *
Basalt black	mh.	974	990
Gray hard basalt	h.	990	1075
Black & red & green basalt	s.	1075	1082 *
Med hard black basalt	mh.	1082	1100
Black basalt	h.	1100	1163
Black oesicular basalt	s.	1163	1183 *
Black basalat new bit	s.	1183	1193
Med soft black basalt	m.	1193	1250
Hard gray basalt	mh.	1250	1350
Soft black, gray fracture		1350	1360 *
Gray basalt	mh.	1360	1388
			1388
		KB.	TD

Work Started 8/10/94 19. Completed 19

WELL CONSTRUCTOR CERTIFICATION:

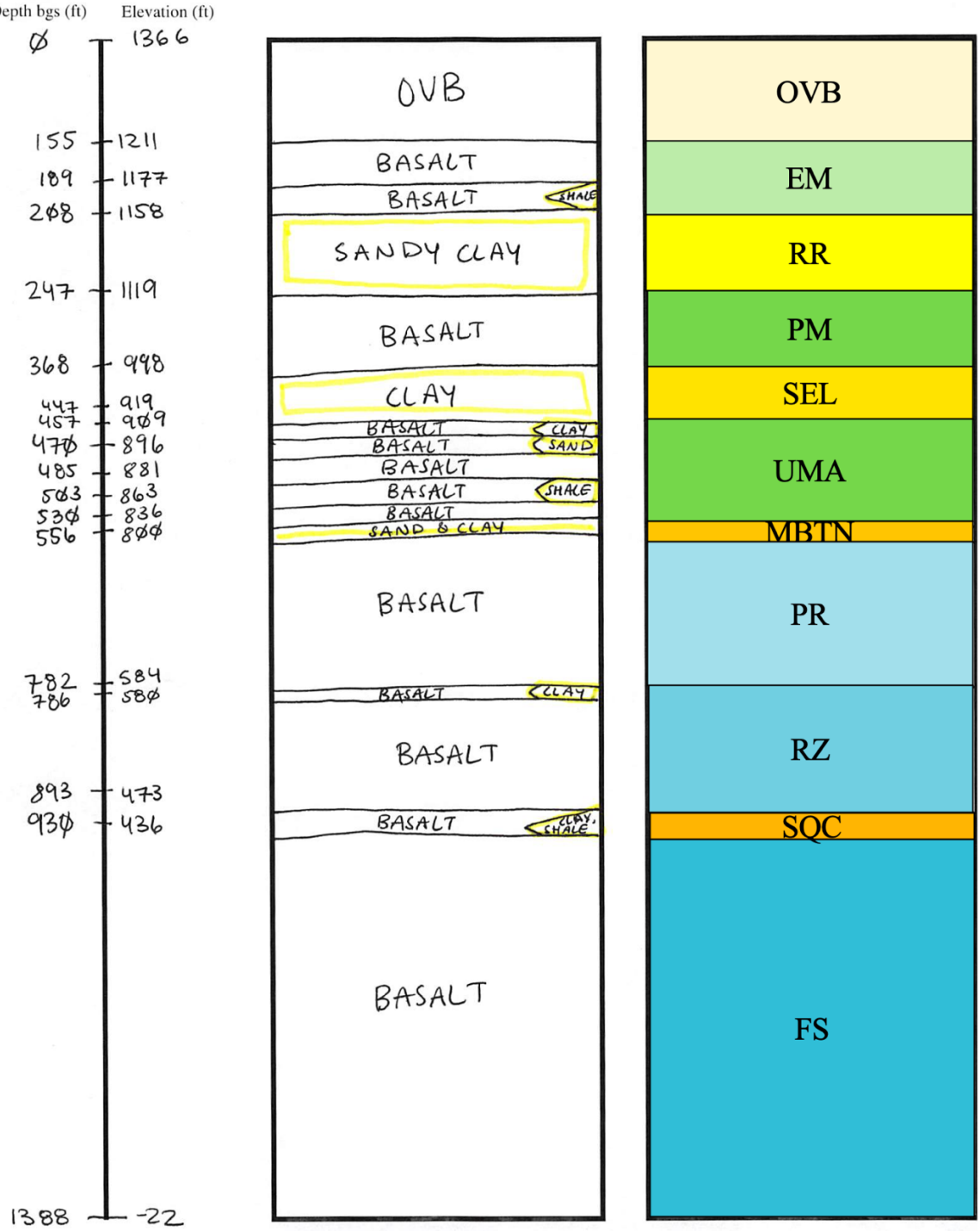
I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Aqua Drilling & Engeneering (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address 120 Crestview Dr., Colville, WA
(Signed) (WELL DRILLER) License No.
Contractor's Registration No. Date 19

(USE ADDITIONAL SHEETS IF NECESSARY)

ECL 050-1-20 (2/93) * * 1

Well ID: 3322	Well Name:	Cross Section: A-A'
Surface Elevation: 1366ft	Well Depth: 1388ft	Aquifer: WNB



2763

WATER WELL REPORT

STATE OF WASHINGTON

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

1669 Start Card No. 083535
APPL. 64-31160 for
Water Right Permit No. R

(1) OWNER: Name CHARLES FAUCHER Address 11 Riggins RD. WAPATO

(2) LOCATION OF WELL: County YAKIMA NW¼ NE¼ Sec 5 T. 11 N. R. 20 W.M.

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

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

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

(5) DIMENSIONS: Diameter of well 8 inches. Drilled 315 feet. Depth of completed well 315 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 8 " Diam. from 0 ft. to 250 ft.
Welded ☒ 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.
Screens: Yes ☐ No ☐
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Gravel packed: Yes ☐ No ☐ Size of gravel
Gravel placed from ft. to ft.
Surface seal: Yes ☒ No ☐ To what depth? ft.
Material used in seal Bentonite & Cement
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 21 ft. below top of well Date 7-29-92
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

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

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Airtest 4x gal./min. with stem set at 310 ft. for 2 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
SANDSTONE & CLAY	0	18
SANDSTONE & GRAVEL	18	25
HEAVY GRAVEL	25	65
SANDSTONE & GRAVEL	65	110
SANDSTONE & WATER	110	160
CLAY & SANDSTONE	160	188
HARD SANDSTONE	188	205
HARD CLAY CLAY	205	225
HARD BROWN SANDROCK	225	255
BROKEN BLACK BASALT	255	315

OCT 2 2 1992

Work started 7-24 19 92 Completed 7-29 19 92

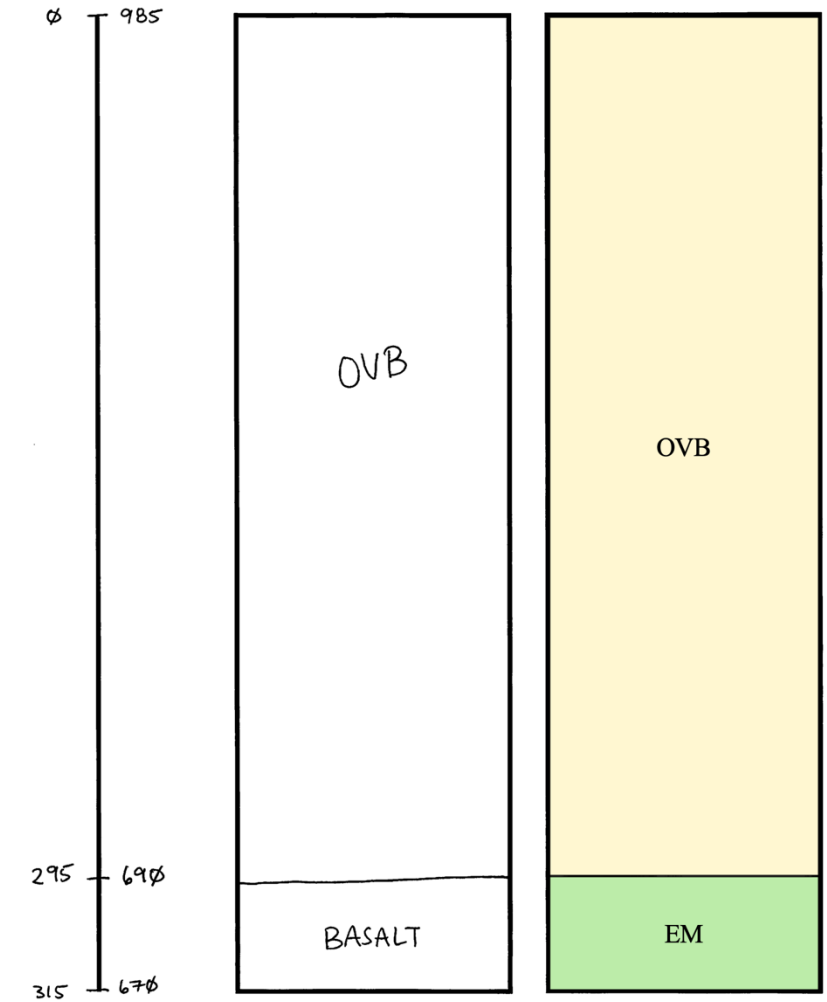
WELL CONSTRUCTOR CERTIFICATION:
I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Bigot Drilling Co (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address Rt 5 Box 1010 - E Burg
(Signed) (WELL DRILLER) License No. 936
Contractor's Registration No. BIGOTD*133MH Date 7-29 19 92

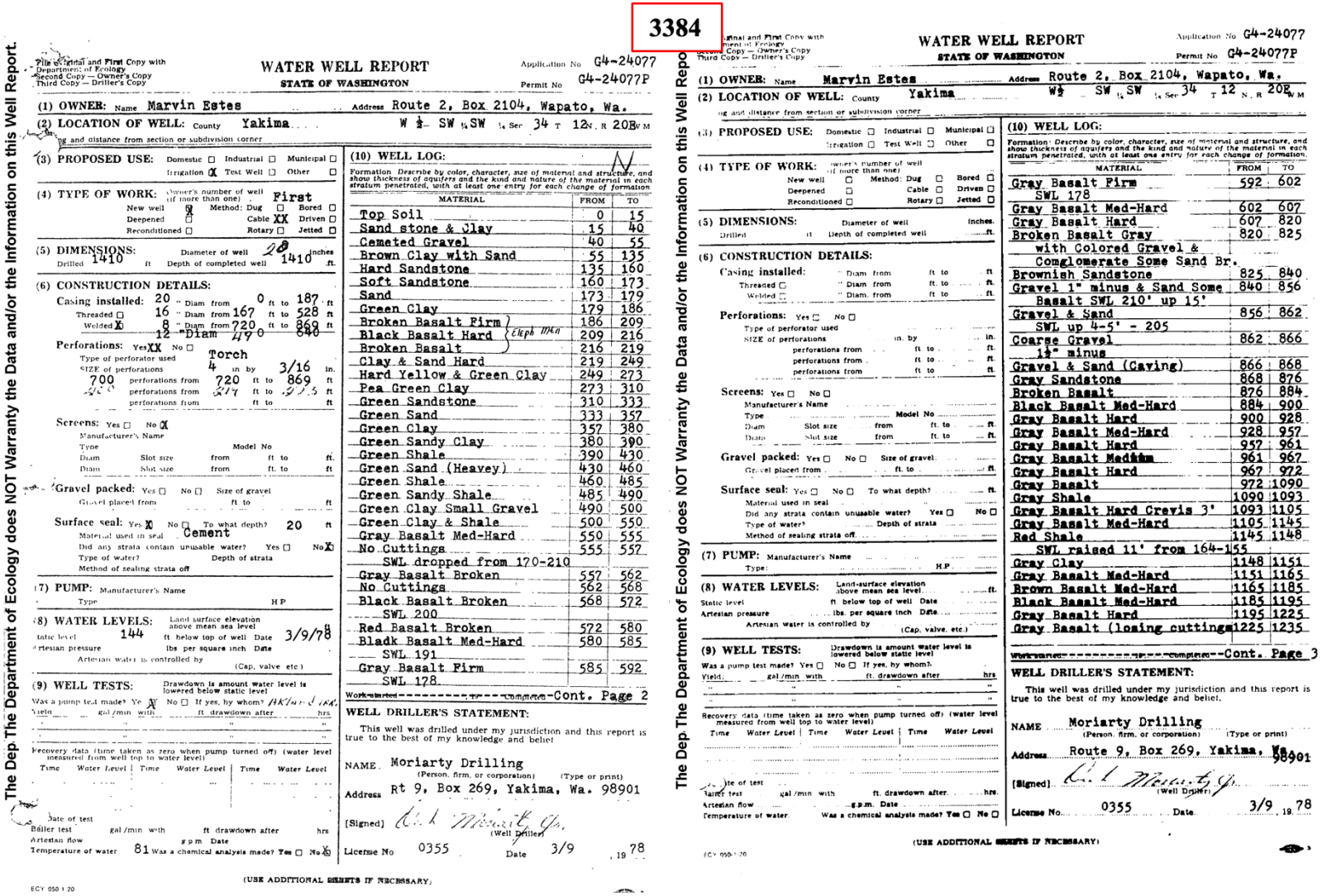
(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20 (10/87) -1329

Well ID: 2763	Well Name:	Cross Section: A-A'
Surface Elevation: 985ft	Well Depth: 315ft	Aquifer: UPPER SDMB



Figures A9-A26. Well reports and stratigraphic interpretations of wells in the B-B' cross-section. The abbreviations used to denote stratigraphic members are as follows: OVB = overburden, EM = Elephant Mountain, RR = Rattlesnake Ridge, PM = Pomona, SEL = Selah, UMA = Umatilla, MBTN = Mabton, PR = Priest Rapids, RZ = Roza, SQC = Squaw Creek, FS = Frenchman Springs, VTG = Vantage, and GRB = Grande Ronde.



3384

WATER WELL REPORT
STATE OF WASHINGTON

Application No G4-24077
Permit No G4-24077P

(1) OWNER: Name Marvin Estes Address Route 2, Box 2104, Wapato, Wa.

(2) LOCATION OF WELL: County Yakima W ½ SW ¼ SW ¼ Sec 34 T 12 N. R 20E W M

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

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

(5) DIMENSIONS: Drilled 1410 ft Diameter of well 20 inches Depth of completed well 1410 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 20 " Diam from 0 ft to 187 ft
Threaded ☐ 16 " Diam from 167 ft to 528 ft
Welded ☒ 8 " Diam from 720 ft to 869 ft
12 " Diam 479 to 840
Perforations: Yes ☒ No ☐
Type of perforator used Torch
SIZE of perforations 4 in by 3/16 in.
700 perforations from 720 ft to 869 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 Cement
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 144 ft below top of well Date 3/9/78
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☒ No ☐ If yes, by whom? HK/[illegible]
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
Artesian flow g.p.m. Date
Temperature of water 81 Was a chemical analysis made? Yes ☐ No ☒

(10) WELL LOG:
Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Top Soil	0	15
Sand stone & Clay	15	40
Cemeted Gravel	40	55
Brown Clay with Sand	55	135
Hard Sandstone	135	160
Soft Sandstone	160	173
Sand	173	179
Green Clay	179	186
Broken Basalt Firm } Elephant Mtn	186	209
Black Basalt Hard }	209	216
Broken Basalt	216	219
Clay & Sand Hard	219	249
Hard Yellow & Green Clay	249	273
Pea Green Clay	273	310
Green Sandstone	310	333
Green Sand	333	357
Green Clay	357	380
Green Sandy Clay	380	390
Green Shale	390	430
Green Sand (Heavey)	430	460
Green Shale	460	485
Green Sandy Shale	485	490
Green Clay Small Gravel	490	500
Green Clay & Shale	500	550
Gray Basalt Med-Hard	550	555
No Cuttings	555	557
SWL dropped from 170-210		
Gray Basalt Broken	557	562
No Cuttings	562	568
Black Basalt Broken	568	572
SWL 200		
Red Basalt Broken	572	580
Bladk Basalt Med-Hard	580	585
SWL 191		
Gray Basalt Firm	585	592
SWL 178		

Work started ---------- completed ---------- Cont. Page 2

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 Moriarty Drilling (Person, firm, or corporation) (Type or print)
Address Rt 9, Box 269, Yakima, Wa. 98901
[Signed] [illegible] (Well Driller)
License No 0355 Date 3/9 19 78

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

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

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

WATER WELL REPORT
STATE OF WASHINGTON

Application No G4-24077
Permit No G4-24077P

(1) OWNER: Name Marvin Estes Address Route 2, Box 2104, Wapato, Wa.

(2) LOCATION OF WELL: County Yakima W ½ SW ¼ SW ¼ Sec 34 T 12 N. R 20E W M

(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: Drilled ft Diameter of well inches. Depth of completed well ft.

(6) CONSTRUCTION DETAILS:
Casing installed: Diam from ft to ft
Threaded ☐ Diam from ft to ft
Welded ☐ Diam from ft to ft
Perforations: Yes ☐ No ☐
Type of perforator used
SIZE of perforations in. by in.
perforations from ft to ft
perforations from ft to ft
perforations from ft to ft
Screens: Yes ☐ No ☐
Manufacturer's Name
Type Model No
Diam Slot size from ft to ft
Diam Slot size from ft to ft
Gravel packed: Yes ☐ No ☐ Size of gravel
Gravel placed from ft to ft
Surface seal: Yes ☐ No ☐ To what depth? ft
Material used in seal
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? Depth of strata
Method of sealing strata off

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

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level ft below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☐ If yes, by whom?
Yield: gal/min with ft. drawdown after hrs
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)
Time | Water Level | Time | Water Level
Date of test
Bailer test gal/min with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG:
Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Gray Basalt Firm	592	602
SWL 178		
Gray Basalt Med-Hard	602	607
Gray Basalt Hard	607	820
Broken Basalt Gray	820	825
with Colored Gravel &		
Comglomerate Some Sand Br.		
Brownish Sandstone	825	840
Gravel 1" minus & Sand Some	840	856
Basalt SWL 210' up 15'		
Gravel & Sand	856	862
SWL up 4-5' - 205		
Coarse Gravel	862	866
1½" minus		
Gravel & Sand (Caving)	866	868
Gray Sandstone	868	876
Broken Basalt	876	884
Black Basalt Med-Hard	884	900
Gray Basalt Hard	900	928
Gray Basalt Med-Hard	928	957
Gray Basalt Hard	957	961
Gray Basalt Medium	961	967
Gray Basalt Hard	967	972
Gray Basalt	972	1090
Gray Shale	1090	1093
Gray Basalt Hard Crevis 3'	1093	1105
Gray Basalt Med-Hard	1105	1145
Red Shale	1145	1148
SWL raised 11' from 164-155		
Gray Clay	1148	1151
Gray Basalt Med-Hard	1151	1165
Brown Basalt Med-Hard	1165	1185
Black Basalt Med-Hard	1185	1195
Gray Basalt Hard	1195	1225
Gray Basalt (losing cuttings	1225	1235

Work started ---------- completed ---------- Cont. Page 3

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 Moriarty Drilling (Person, firm, or corporation) (Type or print)
Address Route 9, Box 269, Yakima, Wa. 98901
[Signed] [illegible] (Well Driller)
License No 0355 Date 3/9 19 78

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

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

3384

WATER WELL REPORT
STATE OF WASHINGTON

Application No G4-24077
Permit No G4-24077P

(1) OWNER: Name Marvin Estes Address Route 2, Box 2104, Wapato, Wa.

(2) LOCATION OF WELL: County Yakima W½ SW ¼ SW ¼ Sec 34 T 12 N., R. 20E W.M.
ng 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 inches.
Drilled ft Depth of completed well ft.

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

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

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

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

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

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

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level ft. below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

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

Time	Water Level	Time	Water Level	Time	Water Level

Type of test
Bailer test gal. min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG:
Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Gray Basalt Extra Hard	1235	1295
Gray Basalt Hard	1295	1406
Gray Basalt Hard with water (Losing Cuttings)	1406	1410

HOLE DIMENSIONS:
0- 219--20"
219- 607--16"
607-640 --14"
640- 720--12"
720-1410-- 8"

Liner pipe installed
446 ft. Slots 16" to 12" Perf

Work started March 2 19 77 Completed March 13 19 78

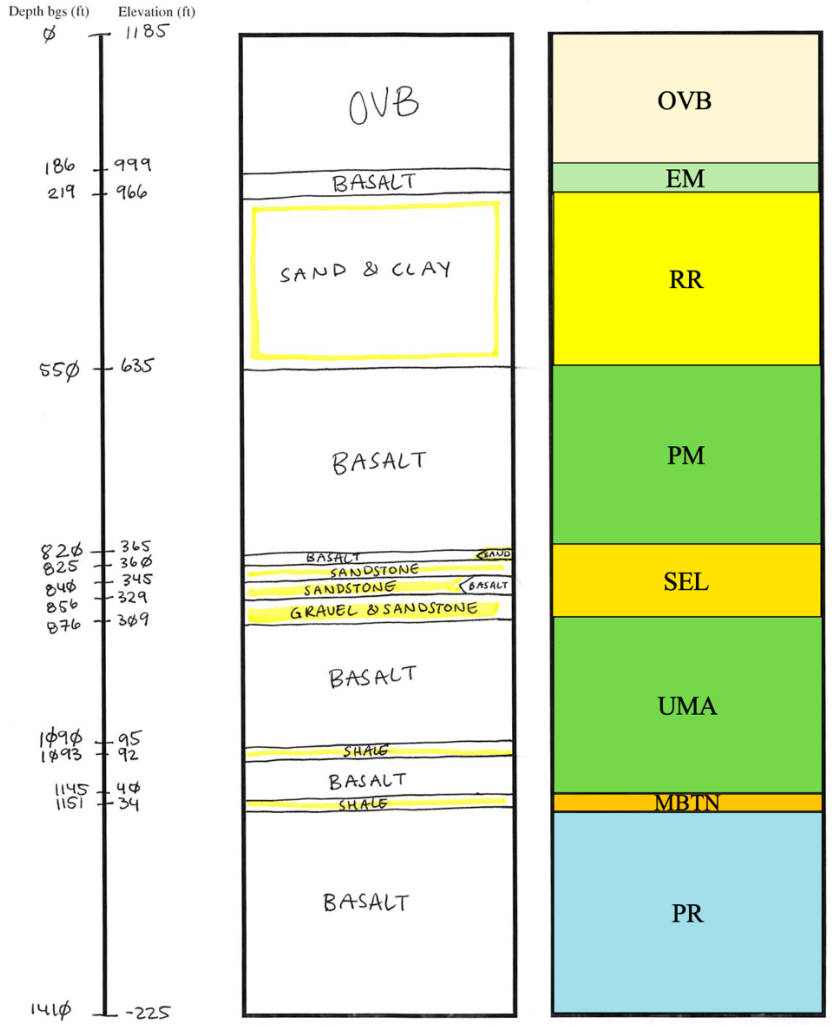
WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Moriarty Drilling (Person, firm, or corporation) (Type or print)
Address Route 9, Box 169, Yakima, Wa. 9890

[Signed] (Well Driller)
License No. 0355 Date 3/13 19 78

(USE ADDITIONAL SHEETS IF NECESSARY)

Well ID: 3384 Well Name: Cross Section: B-B'
Surface Elevation: 1185 ft Well Depth: 1410 ft Aquifer: WNB



DOE

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

2880

WATER WELL REPORT
STATE OF WASHINGTON

Application No G4-27805 / G4-27730Z / G4-27349
Permit No G3-00715

(1) OWNER Name Bill Evans Address Evans Rattlesnake Ranch

(2) LOCATION OF WELL County Yakima X NW ¼ NW ¼ Sec 22 T 11 N R 35 WM
ring and distance from section or subdivision corner 35 11 22

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

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

(5) DIMENSIONS Diameter of well 16" to 740', 9 7/8" to 1000' inches
Drilled 1000 ft Depth of completed well 1000 ft

(6) CONSTRUCTION DETAILS
Casing installed 18 Diam from +1 ft to 40 ft
Threaded ☐ 16 Diam from +1 ft to 740 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? 40 ft
Material used in seal Cement
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 388 ft below top of well Date 3/16/81
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? Akland
Yield 2400 gal/min with 181 ft drawdown after 24 hrs

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

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
r test gal/min with ft drawdown after hrs
Artesian flow g p m Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG DOE

Formation *Describe by color character size of material and structure and show thickness of aquifers and the kind and nature of the material in each stratum penetrated with at least one entry for each change of formation*

MATERIAL	FROM	TO
Gravel and boulders	0	37
Brown clay soft	37	68
Tan clay	68	153
Gravel	153	216
Sandstone brown	216	226
Brown sandy clay	226	290
Gravel multi-color	290	300
Tan slicky clay	300	311
Soft brn rock, hard yellow clay	311	344
Medium gray/black basalt	344	410
Basalt hard gray fractured	410	445
Blk & brn basalt, med soft clay	445	449
Blk & brn basalt, tr of grn clay	449	460
Basalt hard gray	460	637
Clay hard gray	637	640
Gray and brown clay	640	648
Green and gray clay	648	708
Basalt soft black	708	714
Basalt med gray black	714	718
Basalt med gray black	718	729
Basalt med hard gray	729	790
Basalt medium black	790	793
Basalt broken black	793	798
Basalt hard gray	798	805
Basalt gray fractured	805	808
Basalt hard gray	808	814
Basalt medium black	814	818
Basalt medium soft gray w/clay	818	825
Basalt hard gray	825	876
Basalt medium black fractured	876	907
Basalt medium black	907	929
Basalt porous black	929	958
Basalt hard black	958	971
Basalt soft black fractured	971	976
Basalt soft blk, brn, gray	976	980
Basalt medium black	980	1000

Work started 2/16 19 81 Completed 3/13 19 81

WELL DRILLER'S STATEMENT

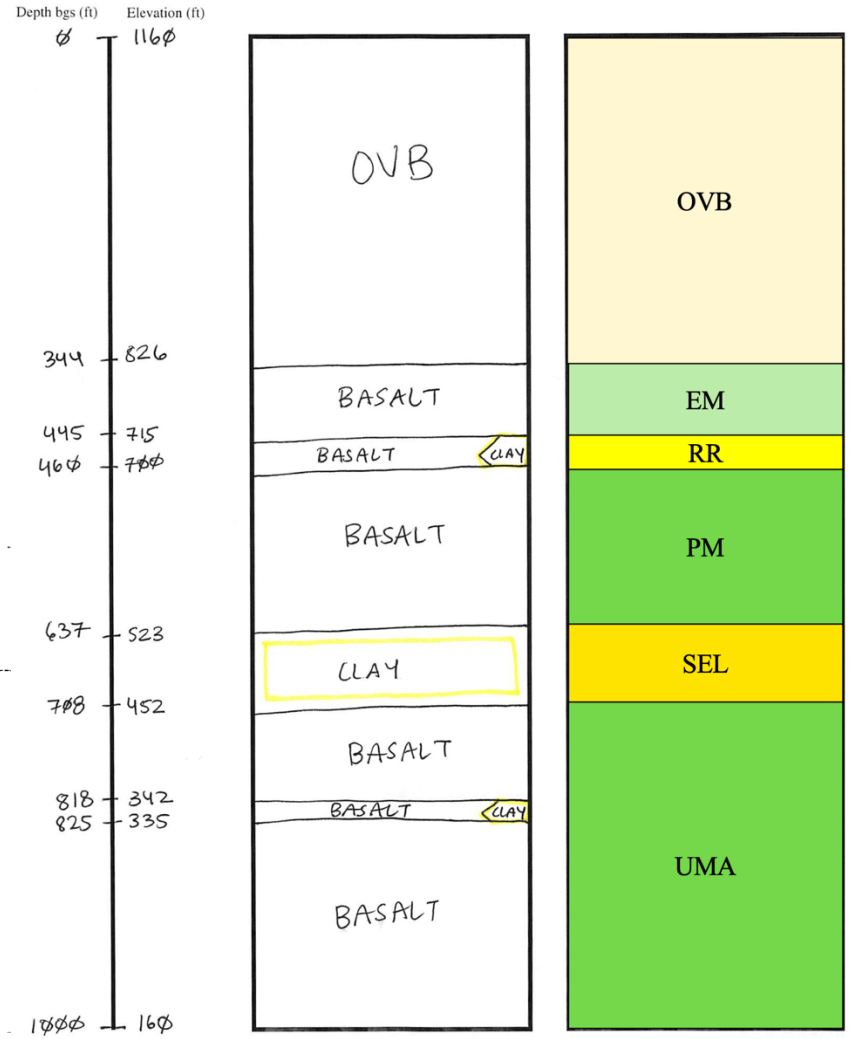
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief

NAME MOORE DRILLING, INC (Person firm or corporation) (Type or print)
Address P O Drawer P, Moses Lake, Wa 98837
[Signed] Dave McKinney (Well Driller)
License No ~~XXX~~ 0840 Date 7/6 19 81

(USE ADDITIONAL SHEETS IF NECESSARY) OK EP 9-16-81

ECY 050-1 20

Well ID: 2880 Well Name: Cross Section: B-B'
Surface Elevation: 1160ft Well Depth: 1000ft Aquifer: Lower SDMB



2865

WATER WELL REPORT

STATE OF WASHINGTON

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

Start Card No. W49151
Unique Well I.D. #
Water Right Permit No. Drought Permit # G4-31502

(1) OWNER Name MARIO MARTINEZ Address 1710 MOORE RD YAKIMA WA

(2) LOCATION OF WELL County YAKIMA NE 1/4 SE 1/4 Sec. 30 T. 22E N. R. HW T11N R.22E.

(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) SEP 14 PM 28

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

(5) DIMENSIONS Diameter of well 10" + 12" inches. Drilled 901 feet. Depth of completed well 901 ft.

(6) CONSTRUCTION DETAILS

Casing installed 12" Diam from +2 ft to 440 ft
Welded ☐ 10" Diam from +2 ft to 824 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 STAINLESS Model No
Diam 10" Tele Slot size .020 from 824 ft to 895 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? 440 ft
Material used in seal PTD Com
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 1200 ft
Static level 339 ft below top of well Date 8-16-94
Artesian pressure lbs per square inch Date
Artesian water is controlled by (Cap valve etc.)

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

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

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal/min with ft drawdown after hrs
Airtest gal/min with stem set at ft for hrs
Artesian flow g.p.m. Date
Temperature of water 74° 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
Soil & Boulders	0	41
Sand	41	53
Clay	53	97
sand & Gravel	97	148
Black Basalt	148	188
~~Gray~~ Gray Soapstone	188	214
tan clay	214	265
sandstone	265	283
clay	283	292
sandstone	292	298
clay	298	316
sandstone	316	386
clay	386	397
sandstone	397	420
Black Basalt	420	468
Gray Basalt	468	535
sandstone	535	540
Black Basalt	540	545
Gray Basalt	545	820
soft Gray Basalt	820	840
Brown clay Heaving	840	848
hard sand Heaving	848	888
hard Brown Basalt	888	901

RECEIVED SEP 19 94 P 3 03 WASHINGTON STATE DEPT. OF ECOLOGY YAKIMA REGIONAL OFFICE

SEP 23 1994

Work started 19 Completed 8-18-94 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 Larry Burd Well Drilling (PERSON, FIRM OR CORPORATION) (TYPE OR PRINT)

Address 5543 SW Douglas Redmond OR

(Signed) Larry Burd (WELL DRILLER) License No 0062

Contractor's Registration No LARRYBW132DF Date 8-23 19 94

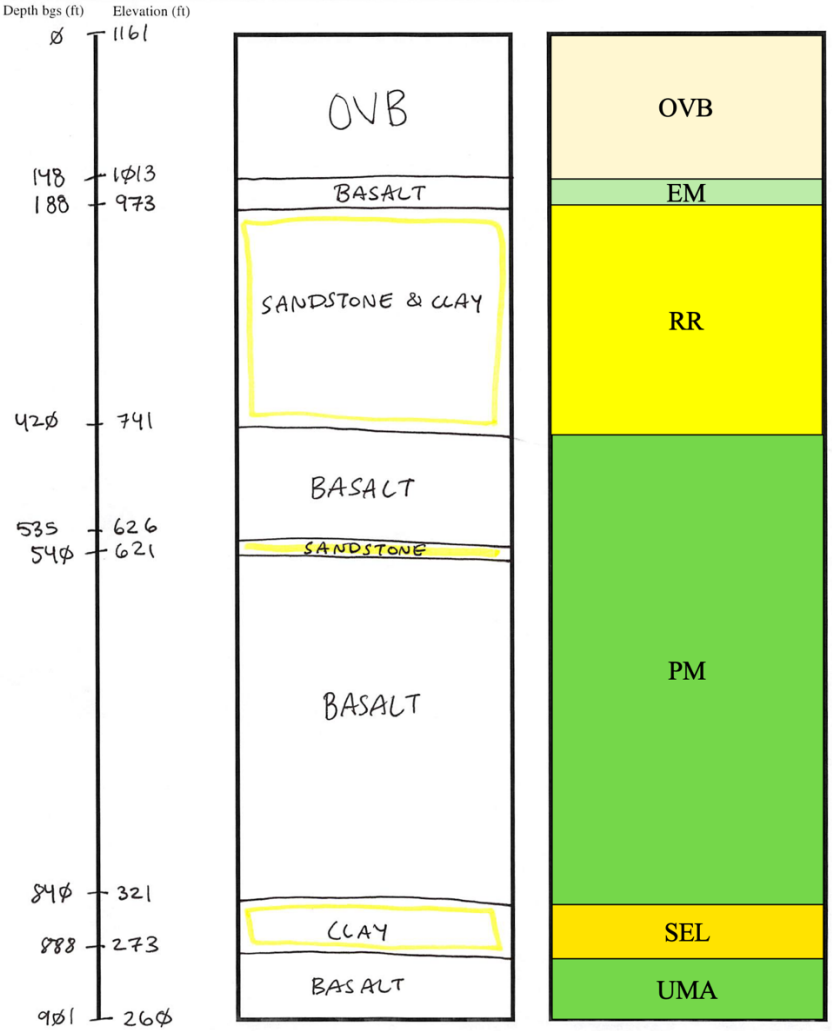
(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20 (10/87) 1329

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

Well ID: 2865 Well Name: Cross Section: B-B'

Surface Elevation: 1161 ft Well Depth: 901 ft Aquifer: LOWERSPMB



PAGE 1

2862

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

WATER WELL REPORT

STATE OF WASHINGTON

Application No. G4-24648
Permit No. G4-24648P G4-26355

(1) OWNER: Name Charles de La Chapelle Address 3206 Home Drive, Yakima, WA 98902

(2) LOCATION OF WELL: County Yakima 7 C's Orchard — SE ¼ NW ¼ Sec. 30 T. 11 N., R. 22 W.M.
Bearing and distance from section or subdivision corner 750 feet west and 600 feet north from center of Sec. 30

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

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

(5) DIMENSIONS: Diameter of well 16"10"9-7/8" inches.
Drilled 2715 ft. Depth of completed well 2715 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 16" Diam. from 0 ft. to 1115 ft.
Threaded ☐ 10" Diam. from 1041 ft. to 2049 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? 1115 ft.
Material used in seal Neat Cement
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? Depth of strata
Method of sealing strata off

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

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 520 ft. below top of well Date 11/12/80
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? Layne Pumps
Yield: gal./min. with ft. drawdown after hrs.
" " " " "
" " " " "
No Conclusive Information
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

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

(10) WELL LOG:

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Conglomerate-sandstone, caliche, small rocks	0	12
Sandstone, large rocks	12	54
Small gravel	54	74
Sandrock	74	85
Sandstone, clay, small gravel	85	91
Basalt, black fractured	91	162
Sandy clay, brown, green sticky	162	367
Sandstone, soapstone, siltstone, clay	367	380
Sandstone, soapstone, siltstone	380	394
Soapstone, siltstone, streaks of basalt	394	408
Siltstone	408	420
Basalt, black fractured	420	541
Black basalt, streaks of clay	541	550
Basalt, siltstone clay-sandy brown	550	569
Basalt & siltstone	569	781
Siltstone with streaks of blue green sandy clay	781	795
Blue green sandy clay	795	853
Blue green sandy clay with streaks of siltstone	853	879
Siltstone	879	952
Black silty sand	952	968
Soft siltstone	968	1019
Siltstone with black silty sand	1019	1033
Siltstone with redish rock brown basalt, water bearing	1033	1055
Siltstone, shale fragments, clay-stone particles, basalt hard	1055	1122
Siltstone, shale particles, clay-stone, wood particles, water br.	1122	1153
Shales green in siltstone rock (some water)	1153	1235
(CONTINUED)		

Work started 9-12, 19 80 Completed 2-4, 19 81

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 Layne-Western Company, Inc. (Person, firm, or corporation) (Type or print)
Address P.O. Box 336, Moses Lake, WA 98837
[Signed] (Well Driller)
License No. 1167 Date February 25, 19 81

(USE ADDITIONAL SHEETS IF NECESSARY) DK 3.03.81

ECY 050-1-20

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

PAGE 2

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WATER WELL REPORT

STATE OF WASHINGTON

Application No. G4-24648
Permit No. G4-24648P

(1) OWNER: Name Charles de La Chapelle Address 3206 Home Drive, Yakima, WA 98902

(2) LOCATION OF WELL: County Yakima — SE ¼ NW ¼ Sec. 30 T. 11 N., R. 22 W.M.
Bearing and distance from section or subdivision corner 750 feet west and 600 feet north from center of Sec. 30

(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 inches.
Drilled ft. Depth of completed well ft.

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

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

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

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

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

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

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level ft. below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

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

Time	Water Level	Time	Water Level	Time	Water Level

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

(10) WELL LOG:

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

(CONTINUED) MATERIAL	FROM	TO
Soft black basalt with green shale (Some water)	1235	1252
Medium hard basalt, rough	1252	1317
Soft black basalt, traces of water	1317	1333
Medium hard black basalt, rough	1333	1501
Siltstone	1501	1537
Soft red black basalt (wood chunks)	1537	1569
Medium hard black basalt	1569	1660
Soft black basalt with wood chunks water bearing	1660	1665
Medium hard black basalt	1665	1686
Soft brown shales (woody particles)	1686	1704
Black basalt medium hard	1704	1727
Medium gray basalt	1727	1835
Silty - clay black dark stones	1835	1841
Harder basalt, gray/black	1841	1852
Medium hard black basalt (traces of mica)chuncks black silty sand	1852	1879
Soft clayish sand(chunks of wood) mica quartz particles(Blk. & Gry)	1879	1883
Rough drilling, fractured materials basalts and sandy clays	1883	1906
Black silty clayish material, woody grained material	1906	1950
Sandy clayish mica mixed greenish sand, black and silty particles	1950	2030
Clayish black & brown, large chunks	2030	2055
Basalt, rough drilling, gray	2055	2062
Soft basalt black, red rock, volcanic pourous, some water bear.	2062	2073
Fractured, rough drilling, hard gray basalt	2073	2221
Medium hard basalt, some shales present, some water	2221	2230
Harder black basalt, smoothe drlg.	2230	2240
(CONTINUED)		

Work started 9-12, 19 80 Completed 2-4, 19 81

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 Layne-Western Company, Inc. (Person, firm, or corporation) (Type or print)
Address P.O. Box 336, Moses Lake, WA 98837
[Signed] (Well Driller)
License No. 1167 Date February 25, 19 81

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

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

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WATER WELL REPORT
STATE OF WASHINGTON

Application No. ~~G4-24648~~
Permit No. ~~G4-24648P~~

(1) OWNER: Name Charles de La Chapelle Address 3206 Home Drive, Yakima, WA 98902

(2) LOCATION OF WELL: County Yakima — SE ¼ NW ¼ Sec. 30 T. 11 N., R. 22 W.M.
Bearing and distance from section or subdivision corner 750 feet west and 600 feet north from center of Sec. 30

(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 ..... inches. Drilled ..... ft. Depth of completed well ..... ft.

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

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

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

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

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

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

(8) WATER LEVELS: Land-surface elevation above mean sea level .... ft.
Static level ..... ft. below top of well Date .....
Artesian pressure ..... lbs. per square inch Date .....
Artesian water is controlled by ..... (Cap, valve, etc.)

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

Time	Water Level	Time	Water Level	Time	Water Level

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

(10) WELL LOG:
Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
(CONTINUED)		
Hard black basalt, fractured	2240	2251
Soft basalt (some water)	2251	2254
Medium Hard black basalt	2254	2267
Soft basalts, black (some water) vesicular	2267	2348
Soft basalts black & brown (some water) vesicular	2348	2361
Hard black basalt	2361	2417
Black vesicular basalt - water bearing fair	2417	2436
Medium hard black basalt	2436	2456
Red rock vesicular, water bearing, black basalt soft	2456	2483
Medium hard black basalt	2483	2490
Rough black hard basalt	2490	2647
Rough black hard basalt with red basalt	2647	2671
Rough black basalt hard	2671	2715

RECEIVED
FEB 27 1981
DEPARTMENT OF ECOLOGY
CENTRAL REGION

Work started 9-12 1980 Completed 2-4 1981

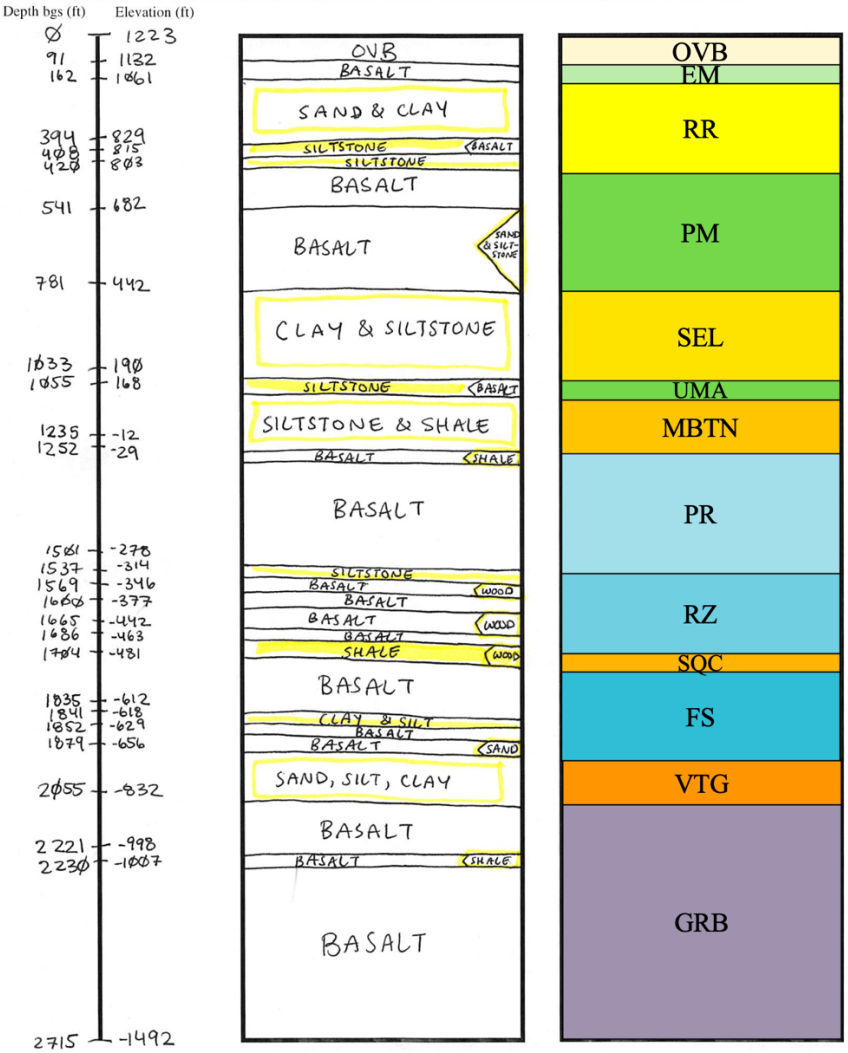
WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Layne-Western Company, Inc. (Person, firm, or corporation) (Type or print)
Address .....
[Signed] ..... (Well Driller)
License No. 1167 Date February 25, 1981

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

Well ID: 2862 Well Name: Cross Section: B-B'
Surface Elevation: 1223 ft Well Depth: 2715 ft Aquifer: [redacted] GRB



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2827

WATER WELL REPORT
STATE OF WASHINGTON

Application No. ~~G4-26819~~
Permit No. G4-24469P

(1) OWNER: Name Sandlin Farms, Inc. Address Route 2, Box 69 Zillah, WA 98953

(2) LOCATION OF WELL: County Yakima — SW ¼ NE ¼ Sec. 22 T. 11 N., R. 21 W.M.
and distance from section or subdivision corner

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

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

(5) DIMENSIONS: Diameter of well 16" to 1128 & 11" to 1808 inches.
Drilled 1808 ft. Depth of completed well 1808 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 12" I. D. Diam. from +1 ft. to 1128 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? 1128 ft.
Material used in seal Cement top & bot.; Benzonite mid
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? N/A Depth of strata N/A
Method of sealing strata off N/A

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

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 434 ft. below top of well Date 6-5-80
Artesian pressure N/A 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? by others
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 N/A
Bailer test N/A gal./min. with 30 ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water 80°F 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
Sand & topsoil	0	5
Sand & gravel	5	30
Gravel with streaks of clay	30	81
Clay, brown, soft	81	83
Clay, streaks of gravel	83	130
Clay, brown & green - sticky	130	250
Basalt, black, weathered	250	253
Basalt, black, hard	253	297
Clay, sand, streaks of gravel	297	607
Basalt, black, hard	607	780
Basalt, brown with streaks of clay	780	782
Clay, grey with some black sand	782	807
Basalt, black, fractured	807	821
Basalt, black, hard	821	1037
Clay, green with sand	1037	1088
Basalt, red & brown, soft	1088	1112
Basalt, grey, medium hard	1112	1177
Basalt, grey, med. hard, frac.w.b.	1177	1180
Basalt, grey, med. hard	1180	1192
Basalt, black, soft, w.b.	1192	1215
Basalt, black, hard	1215	1359
Basalt, black, soft, w.b.	1359	1377
Basalt, black, hard	1377	1473
Basalt, black, soft, w.b.	1473	1506
Basalt, black, medium hard	1506	1519
Basalt, black, hard	1519	1717
Basalt, black, frac.	1717	1747
Basalt, black, med. to soft, w.b.	1747	1760
Basalt, black, hard	1760	1772
Basalt, black & red, soft with some wood, w.b.	1772	1798
Basalt, black, hard	1798	1808

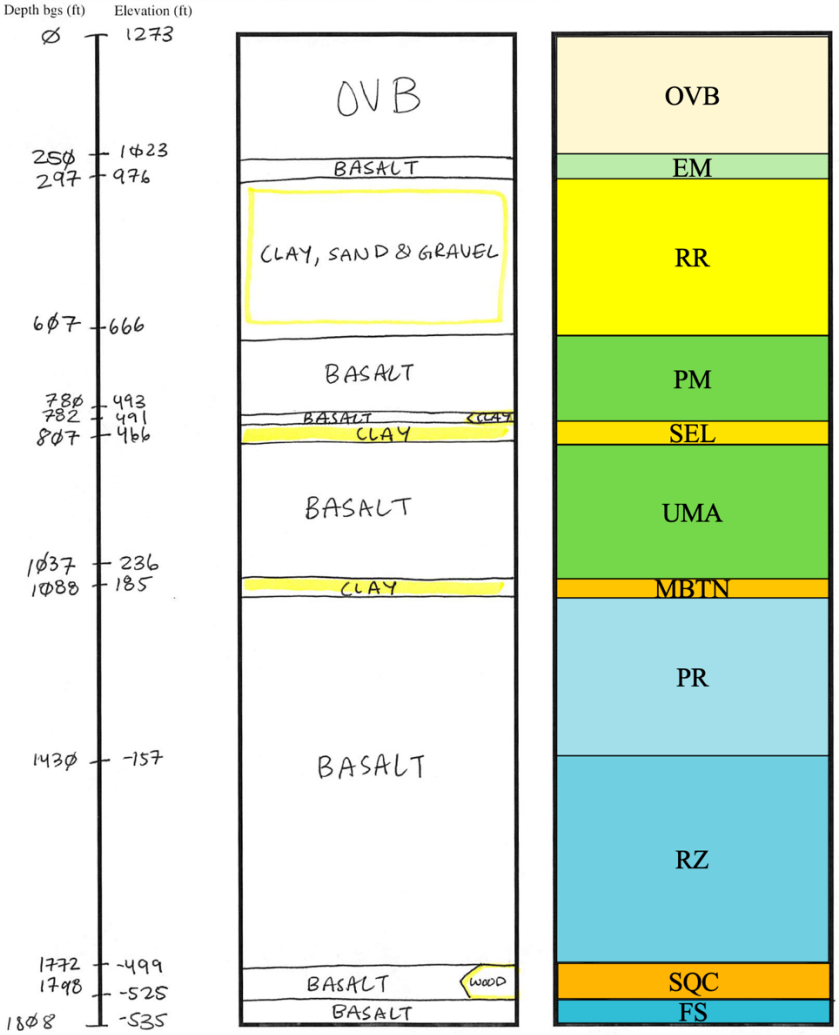
Work started March 13, 19 80 Completed June 5, 19 80

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
William A. Gustavson
NAME Layne-Western Company, Inc. (Person, firm, or corporation) (Type or print)
Address P.O. Box 336; Moses Lake, WA 98837
[Signed] William A. Gustavson (Well Driller)
License No. 0733 Date June 30, 19 80

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

Well ID: 2827 Well Name: Cross Section: B-B'
Surface Elevation: 1273ft Well Depth: 1808ft Aquifer: WNB



2801

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WATER WELL REPORT
STATE OF WASHINGTON

RECEIVED
1980

Application No. [redacted]
Permit No. G426387

(1) OWNER: Name William Gammie (Lloyd Garretson Co.) Address P.O. [redacted] .1552 Yakima, WA 98907

(2) LOCATION OF WELL: County Yakima [redacted] Sec. 17 T. 11 N., R. 21E W.M.
Bearing and distance from section or subdivision corner NW NW

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

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

(5) DIMENSIONS: Diameter of well 16" x 12½" inches.
Drilled 1945 ft. Depth of completed well 1945 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 16 " Diam. from +1 ft. to 1319 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? 1319 ft.
Material used in seal Neat cement grout
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? N/A Depth of strata N/A
Method of sealing strata off N/A

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

(8) WATER LEVELS: Land-surface elevation above mean sea level * 1500 ft.
Static level 415 ft. below top of well Date 11-6-80
Artesian pressure N/A lbs. per square inch Date
Artesian water is controlled by N/A (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? Layne
Yield: 680 gal./min. with 94 ft. drawdown after 10 Min hrs.
" 680 " 164 " 60 Min. "
" 680 " 171 " 180 Min. "

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

Time	Water Level	Time	Water Level	Time	Water Level
1 Min.	531	30 Min.	510	60 Min.	501
10 Min.	517	40 Min.	505		
Min.	515	50 Min.	501		

Date of test November 6, 1980
Bailer test N/A gal./min. with ft. drawdown after hrs.
Artesian flow N/A g.p.m. Date
Temperature of water 97°F Was a chemical analysis made? Yes ☐ No ☒

(10) WELL LOG:
Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Gravel & rocks	0	20
Gravel (pea size) & sand	20	45
Gravel with clay seams	45	85
Sands with gravel & clay seams	85	195
Sand & small gravel	195	220
Clay, sandy, brown	220	328
Clay, brown, hard	328	380
Basalt, black, hard, fractured	380	430
Clay, blue with sand	430	460
Clay, brown, sticky	460	503
Clay, brown, sandy	503	518
Clay, blue	518	574
Sandstone with clay	574	658
Sand	658	661
Sandstone with clay	661	731
Basalt, black, rough	731	913
Basalt, black, Med. hard, fractured	913	919
Basalt, black, hard	919	944
Basalt, gray, with clay seams	944	963
Clay, blue-green	963	974
Clay, blue w/ gray basalt, rough	974	1006
Basalt, med. hard	1006	1253
Clay, blue with sand	1253	1272
Basalt, gray, med. hard	1272	1306
Basalt, gray, med. hard	1306	1362
Basalt, black, med. hard	1362	1452
Basalt, med. hard, fractures	1452	1500
Basalt, black, fractured, W.B. (820° F)	1500	1526
Basalt, black, soft, W.B.	1526	1540
Siltstone	1540	1631
Basalt, Black, soft, W.B.	1631	1658
(CONTINUED)		

Work started June 13, 1980 Completed November 6, 1980

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 Layne-Western Company, Inc. (Person, firm, or corporation) (Type or print)
Address P.O. Box 336, Moses Lake, WA 98837
[Signed] J. R. Baker (Well Driller)
License No. 1167 Date November 12, 1980

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

SID 201846

File Original and First Copy with Department of Ecology
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WATER WELL REPORT (CONT.)
STATE OF WASHINGTON

Application No.
Permit No. G426387

(1) OWNER: Name William Gammie (Lloyd Garretson Co.) Address P.O. Box 1552, Yakima, WA 98907

(2) LOCATION OF WELL: County Yakima — NE ¼ NW ¼ Sec. 17 T. 11 N., R. 21E W.M.
Bearing and distance from section or subdivision corner

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

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

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

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

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

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

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

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

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

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level ft. below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

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

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

Time	Water Level	Time	Water Level	Time	Water Level

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

(10) WELL LOG:
Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
(CONTINUED)		
Basalt, black, fractured	1658	1680
Basalt, black, med. hard	1680	1881
Basalt, black, vesicular, W.B. (890 F)	1881	1899
Basalt, black, hard	1899	1905
Basalt, red, soft vesicular, w/wood (910 F)	1905	1914
Basalt, black, Med. hard (T.D.)	1914	1945
Bottom of Well Near 350 feet to Grande Ronde Basalt		

Work started June 13, 1980 Completed November 6, 1980

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

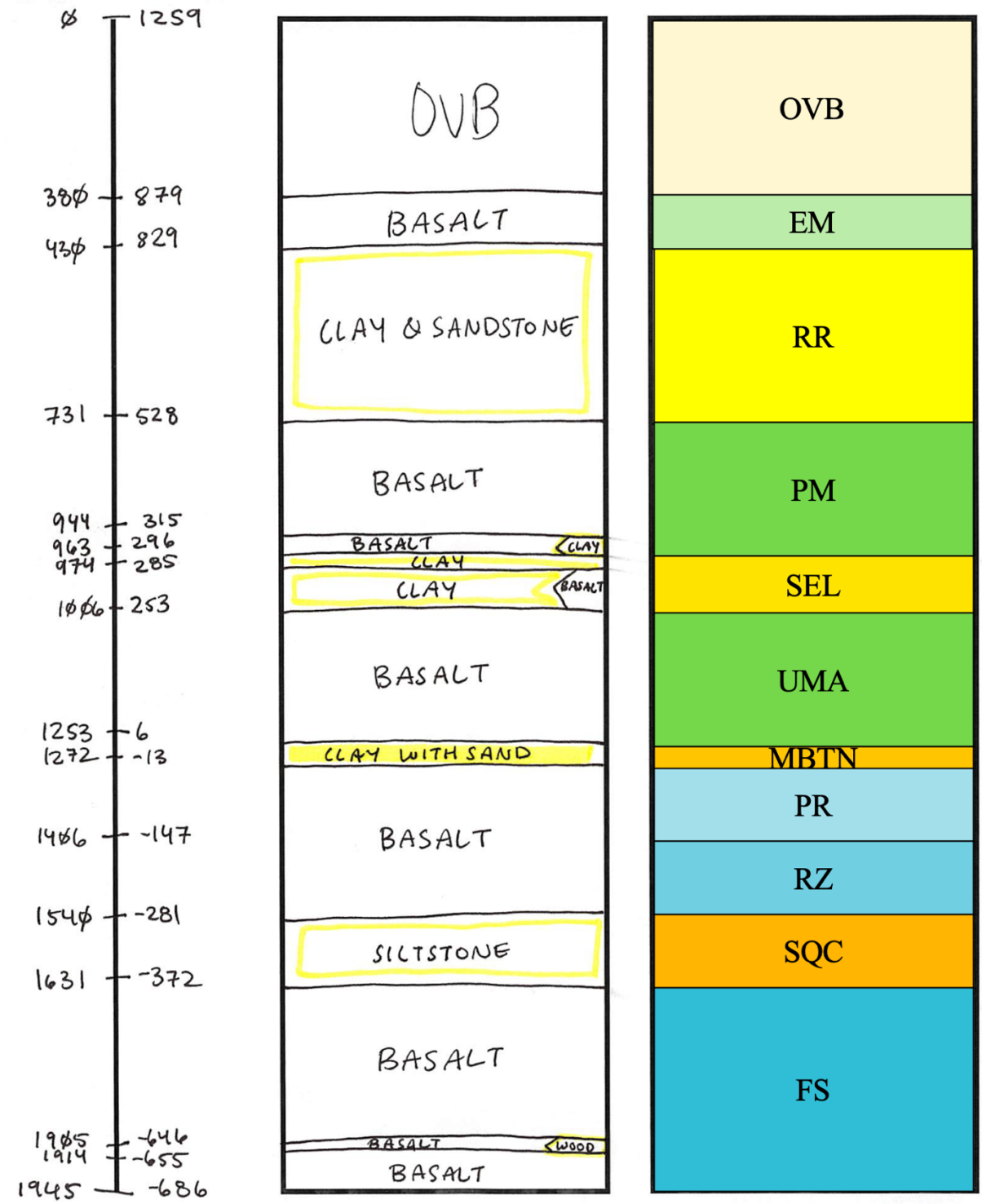
NAME Layne-Western Company, Inc. (Person, firm, or corporation) (Type or print)
Address P.O. Box 336, Moses Lake, WA 98837
[Signed] J. R. Baker (Well Driller)
Licen. No. 1167 Date November 12, 1980

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

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

Well ID: 2801	Well Name:	Cross Section: B-B'
Surface Elevation: 1259ft	Well Depth: 1945ft	Aquifer: WNB



WATER WELL REPORT

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

2799

Construction/Decommission ("x" in circle) 368039

☒ Construction

☐ Decommission *ORIGINAL INSTALLATION*

Notice of Intent Number

CURRENT

Notice of Intent No. W242794

Unique Ecology Well ID Tag No. AHP736

Water Right Permit No. G4-24192

Property Owner Name Department of Natural Resources

Well Street Address PO Box 190

City Selah County Yakima

Location SE 1/4-1/4 SW 1/4 Sec 16 Twn 11 R 21 EWM or WWM ☐ Check One

(s, t, r Still REQUIRED)

Lat/Long Lat Deg _____ Lat Min/Sec _____

Long Deg _____ Long Min/Sec _____

Tax Parcel No. (Required) 21111611900

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 16 inches, drilled 2016,12 & 9 7/8

Depth of completed well 2,540' ft.

CONSTRUCTION DETAILS

Casing: ☒ Welded 16" Diam. from +1 ft. to 1206 ft.

Installed: ☐ Liner installed 12" Diam. from +1 ft. to 441 ft.

☐ Threaded _____ Diam. From _____ ft. to _____ ft.

Perforations: ☒ Yes ☐ No

Type of perforator used Torch Cut

SIZE of perfs 6" in. by 1/2" in. and no. of perfs 25 from 1381 ft. to 1386 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? 1205 ft.

Material used in seal Cement

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 710 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 _____

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

Airtest 800 gal./min. with stem set at 2200 ft. for 1 hrs.

Artesian flow _____ g.p.m. Date _____

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

CONSTRUCTION OR DECOMMISSION PROCEDURE

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

MATERIAL	FROM	TO
Sand, gravel & cobbles	0	39
Sandy clay brown & gravel	39	60
Cemented gravel	60	70
Sandstone brown	70	86
Gray Clay	86	114
Sticky brown clay	114	129
Sandstone & Clay layers	129	315
Broken basalt & brown clay	315	321
Med soft black to brown basalt	321	334
Hard gray basalt	334	371
Brown Clay	371	435
Green clay	435	468
Gray silty clay	468	486
Gray silty clay & sandstone layers	486	503
Gray sand clay trace of black sand	503	513
Clay to sandstone layers	513	585
Green clay	585	633
Broken-black basalt w/ black & green clay	633	678
Black & brown basalt trace of green clay	678	682
Very hard gray basalt	682	875
Gray clay	875	883
Green clay	883	893
Broken basalt & green clay	893	918
Broken black basalt	918	924
Med hard black porous basalt trace of green clay	924	938
Hard fractured gray & brown basalt	938	955
Hard gray basalt	955	1043
Broken dark gray basalt	1043	1048
Hard dark gray basalt	1048	1152
Med hard black basalt	1152	1175
Green clay & gray sandstone	1175	1188

Start Date 8-20-09 Completed Date 12-22-09

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) Larry Mc Lanahan

Driller/Engineer/Trainee Signature _____

Driller or trainee License No. 0337

IF TRAINEE: Driller's License No: _____

Driller's Signature: _____

Drilling Company BJ Exploration & Drilling Co., INC

Address 404 N Conway St

City, State, Zip Kennewick WA 99336

Contractor's Registration No. BJEXPCI132QK Date _____

RECEIVED JAN 22 2010

DEPARTMENT OF ECOLOGY - CENTRAL REGIONAL OFFICE

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

WATER WELL REPORT

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

Construction/Decommission ("x" in circle) 368039

☒ Construction

☐ Decommission *ORIGINAL INSTALLATION*

Notice of Intent Number

CURRENT

Notice of Intent No. W242794

Unique Ecology Well ID Tag No. AHP736

Water Right Permit No. G4-24192

Property Owner Name Department of Natural Resources

Well Street Address PO Box 190

City Selah County Yakima

Location SE 1/4-1/4 SW 1/4 Sec 16 Twn 11 R 21 EWM or WWM ☐ Check One

(s, t, r Still REQUIRED)

Lat/Long Lat Deg _____ Lat Min/Sec _____

Long Deg _____ Long Min/Sec _____

Tax Parcel No. (Required) 21111611900

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 16 inches, drilled 2016,12 & 9 7/8

Depth of completed well 2,540' ft.

CONSTRUCTION DETAILS

Casing: ☒ Welded 16" Diam. from +1 ft. to 1206 ft.

Installed: ☐ Liner installed 12" Diam. from +1 ft. to 441 ft.

☐ Threaded _____ Diam. From _____ ft. to _____ ft.

Perforations: ☒ Yes ☐ No

Type of perforator used Torch Cut

SIZE of perfs 6" in. by 1/2" in. and no. of perfs 25 from 1381 ft. to 1386 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? 1205 ft.

Material used in seal Cement

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 710 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 _____

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

Airtest 800 gal./min. with stem set at 2200 ft. for 1 hrs.

Artesian flow _____ g.p.m. Date _____

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

CONSTRUCTION OR DECOMMISSION PROCEDURE

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

MATERIAL	FROM	TO
Hard black basalt	1188	1278
Soft porous black trace of basalt trace of water	1278	1298
Med hard porous black	1298	1312
Hard fractured black basalt	1312	1322
Hard black	1322	1335
Soft porous black basalt 170 psi little water	1335	1352
Med hard black basalt	1352	1364
Hard black basalt	1364	1405
Hard gray basalt	1405	1459
Soft porous black basalt little water 180 psi	1459	1480
Med hard black basalt	1480	1559
Soft porous black basalt	1559	1563
Hard black basalt	1563	1575
Soft gray siltstone & trace of green clay some black basalt	1575	1590
Wood & some clay	1590	1599
Med soft broken black & some brown basalt	1599	1610
Med hard black basalt	1610	1702
Hard gray basalt	1702	1762
Med hard gray basalt fractured	1762	1772
Med soft gray basalt fractured	1772	1778
Hard broken gray basalt	1778	1783
Hard gray basalt	1783	1845
Med soft fractured black basalt	1845	1860
Med hard porous gray basalt	1860	1874
Hard gray basalt	1874	1887
Broken porous black basalt 330 psi 100deg	1887	1905
Hard gray basalt	1905	1919
Med hard porous dark gray basalt	1919	1937
Soft black porous basalt	1937	1953
Med hard black basalt	1953	1961

Start Date 8-20-09 Completed Date 12-22-09

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) Larry Mc Lanahan

Driller/Engineer/Trainee Signature _____

Driller or trainee License No. 0337

IF TRAINEE: Driller's License No: _____

Driller's Signature: _____

Drilling Company BJ Exploration & Drilling Co., INC

Address 404 N Conway St

City, State, Zip Kennewick WA 99336

Contractor's Registration No. BJEXPCI132QK Date _____

RECEIVED JAN 22 2010

DEPARTMENT OF ECOLOGY - CENTRAL REGIONAL OFFICE

ECY 050-1-20 (Rev 06/08) If you need this document in an alternate format, please call the Water Resources Program at 360-407-6600. Persons with hearing loss can call 711 for Washington Relay Service. Persons with a speech disability can call 877-833-6341.

Pg 2

WATER WELL REPORT

2799

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

Construction/Decommission ("x" in circle) 368039

[X] Construction

[ ] Decommission *ORIGINAL INSTALLATION*

Notice of Intent Number

PROPOSED USE: [ ] Domestic [ ] Industrial [ ] Municipal [ ] DeWater [X] Irrigation [ ] Test Well [ ] Other

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

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

DIMENSIONS: Diameter of well 16 inches, drilled 20" to 12" ft. 9 7/8"

Depth of completed well 2,540' ft.

CONSTRUCTION DETAILS

Casing [X] Welded 16" Diam. from +1 ft. to 1206 ft.

Installed: [ ] Liner installed 12" Diam. from +1 ft. to 441 ft.

[ ] Threaded " Diam. From ft. to ft.

Perforations: [X] Yes [ ] No

Type of perforator used Torch Cut

SIZE of perfs 6 in. by 1/2 in. and no. of perfs 25 from 1381 ft. to 1386 ft.

Screens: [ ] Yes [X] 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 [X] No Size of gravel/sand

Materials placed from ft. to ft.

Surface Seal: [X] Yes [ ] No To what depth? 1205 ft.

Material used in seal Cement

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 710 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

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

Airtest 800 gal./min. with stem set at 2200 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. W242794

Unique Ecology Well ID Tag No. AHP736

Water Right Permit No. G4-24192

Property Owner Name Department of Natural Resources

Well Street Address PO Box 190

City Selah County Yakima

Location SE 1/4-1/4 SW 1/4 Sec 16 Twn 11 R 21 EWM [X] Check Or WWM [ ] One

(s, t, r Still REQUIRED)

Lat/Long Lat Deg Lat Min/Sec

Long Deg Long Min/Sec

Tax Parcel No. (Required) 21111611900

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
Soft black porous basalt	1961	1977
Med hard black porous basalt	1977	2015
Soft broken porous black & some brown basalt	2015	2024
Hard dark gray basalt 2166-2170 broken	2024	2198
Med soft black porous basalt trace of quartz and green clay	2198	2229
Hard dark gray basalt	2229	2310
Hard dark gray basalt	2310	2347
Broken dark gray basalt trace of green clay	2347	2353
Hard dark gray basalt	2353	2385
Soft porous dark gray basalt trace of quartz	2385	2412
Med hard dark gray basalt	2412	2465
Med soft black basalt	2465	2472
Hard gray basalt	2472	2540
230 psi 100 deg.	2540	
16" casing 1,206'		
12" casing liner from 1,182' to 1,622'		
9 7/8" hole from 1,622' to 2,231'		
Hole plugged with cement from 2,231' to 2,540'		

Start Date 8-20-09 Completed Date 12-22-09

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

[X]Driller[ ]Engineer[ ]Trainee Name (Print) Larry Mc Lanahan

Driller/Engineer/Trainee Signature

Driller or trainee License No. 0337

IF TRAINEE: Driller's License No:

Driller's Signature:

Drilling Company BJ Exploration & Drilling Co., INC

Address 404 N Conway St.

City, State, Zip Kennewick WA

Contractor's Registration No. BJEXPCI132QK

Date JAN 22 2010

RECEIVED

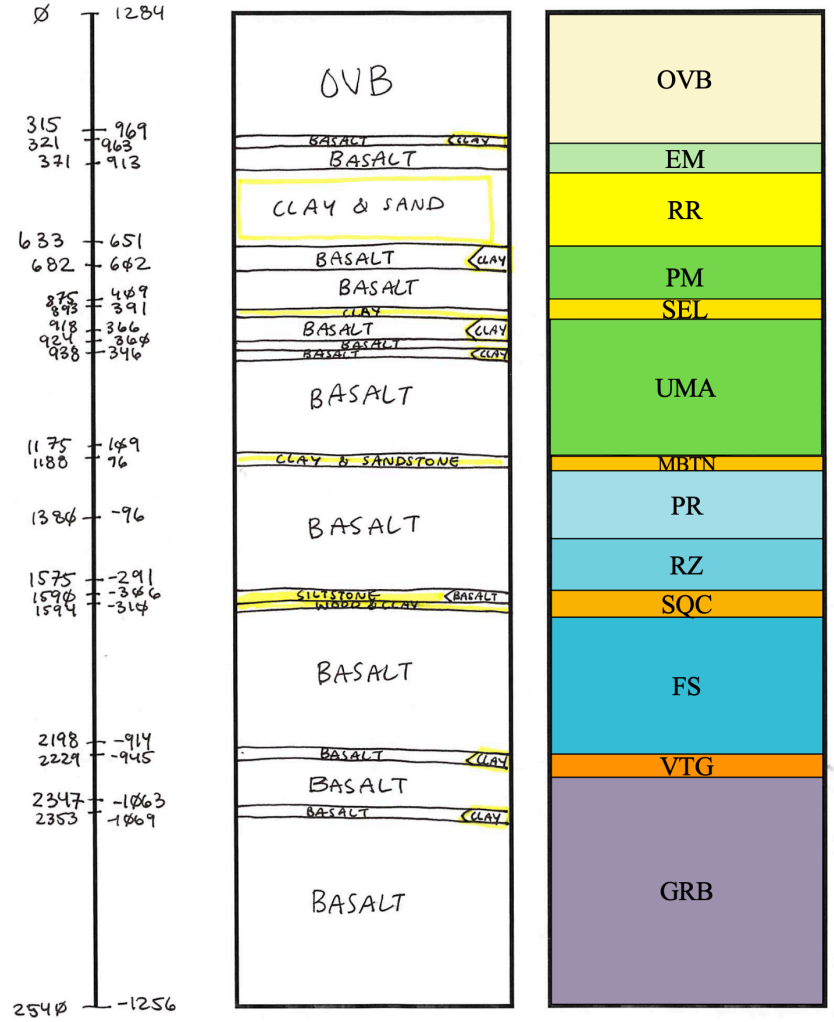
ECY 050-1-20 (Rev 06/08) If you need this document in an alternate format, please call the Water Resources Program at 360-407-6600. Persons with hearing loss can call 711 for Washington Relay Service. Persons with a speech disability can call 877-833-6341.

DEPARTMENT OF ECOLOGY - CENTRAL REGIONAL OFFICE

Pg 3

Well ID: 2799 Well Name: Cross Section: B-B'

Surface Elevation: 1284ft Well Depth: 2540ft Aquifer: GRB



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

WATER WELL REPORT
STATE OF WASHINGTON

Application No. 64285
Permit No. 74-25316

(1) OWNER: Name Pat Clyde Address

(2) LOCATION OF WELL: County Yakima NE¼ of NW¼ of SW¼ Sec 16 T. 11 N., R. 21 E.W.M.
Bearing and distance from section or subdivision corner

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

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

(5) DIMENSIONS: Diameter of well 6 inches. Drilled 744 ft. Depth of completed well 744 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6 " Diam. from 1 ft. to 650 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? 25 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 475 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? air lift
Yield: 35 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.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG: M

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
Cement Gravel	0	40
Sand + Clay brown	40	120
Sandstone	120	240
Clay brown	240	300
Sandstone Clay	300	339
Basalt Broken	339	378
Clay Yellow	378	414
" " + some Gravel	414	424
" " + sand	424	440
" "	440	478
Clay Blue + sand	478	510
" " + sand	510	580
Sand light Colored	580	588
Clay Blue + sand	588	620
Blend light colored	620	633
Clay Blue + sand	633	640
Clay Blue shale	640	650
Basalt Solid gas Blue shale	650	710
Basalt Very Solid	710	718
Basalt Weathered Yellow shale clay	718	740
Basalt solid rock	740	744

Work started Sept 5, 1978 Completed April 31, 1979

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 Yonkin Drilling Co. (Person, firm, or corporation) (Type or print)
Address Rt 3 Box 3356
[Signed] Rob York (Well Driller)
License No. 974 Date April 31, 1979

ECY 050-1-20

(USE ADDITIONAL SHEETS IF NECESSARY)

2798

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

WATER WELL REPORT
STATE OF WASHINGTON

Application No.
Permit No.

(1) OWNER: Name PAUL PORTTEUS Address P.O. BOX 1444 ZILLAH, WA. 98953

(2) LOCATION OF WELL: County YAKIMA SW¼ SW¼ Sec 16 T 11 N., R 21 W.M.
Bearing and distance from section or subdivision corner N

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

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

(5) DIMENSIONS: Diameter of well 8x 6 inches. Drilled 299 ft. Depth of completed well 1189 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6 " Diam. from 868 ft. to 948 ft.
Threaded ☐ " Diam. from ft. to ft.
Welded ☒ " Diam. from ft. to ft.

Perforations: Yes ☒ No ☐
Type of perforator used TORCH
SIZE of perforations 1/8 in. by 6 in.
90 perforations from 873 ft. to 888 ft.
perforations from ft. to ft.
perforations from ft. to ft.

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

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

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

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

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 498 ft. below top of well Date 3/31/87
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.
" EST. 600 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
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☒

(10) WELL LOG:

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL		FROM	TO
BLACK BASALT BLUE SHALE	H	700	775
blue clay shale	H	890	900
BLUE CLAY SHALE	S	900	905
FINE BLUE GREEN SAND	S	905	920
CONGLOMERANT STREAKS OF SAND		920	940
BLUE SAND	M	940	945
BLACK BASALT	VVH	945	948
FRAC. BLACK BASALT	VVVH	948	1028
GREY BASALT	VVVH	1028	1153
FRAC BASALT SOME WATER	VVVH	1153	1187
BROKEN BASALT BLUE SHALE WATER		1187	1189

300 GPM by AIR

RECEIVED
APR 23 1987
DEPARTMENT OF ECOLOGY
CENTRAL REGION OFFICE

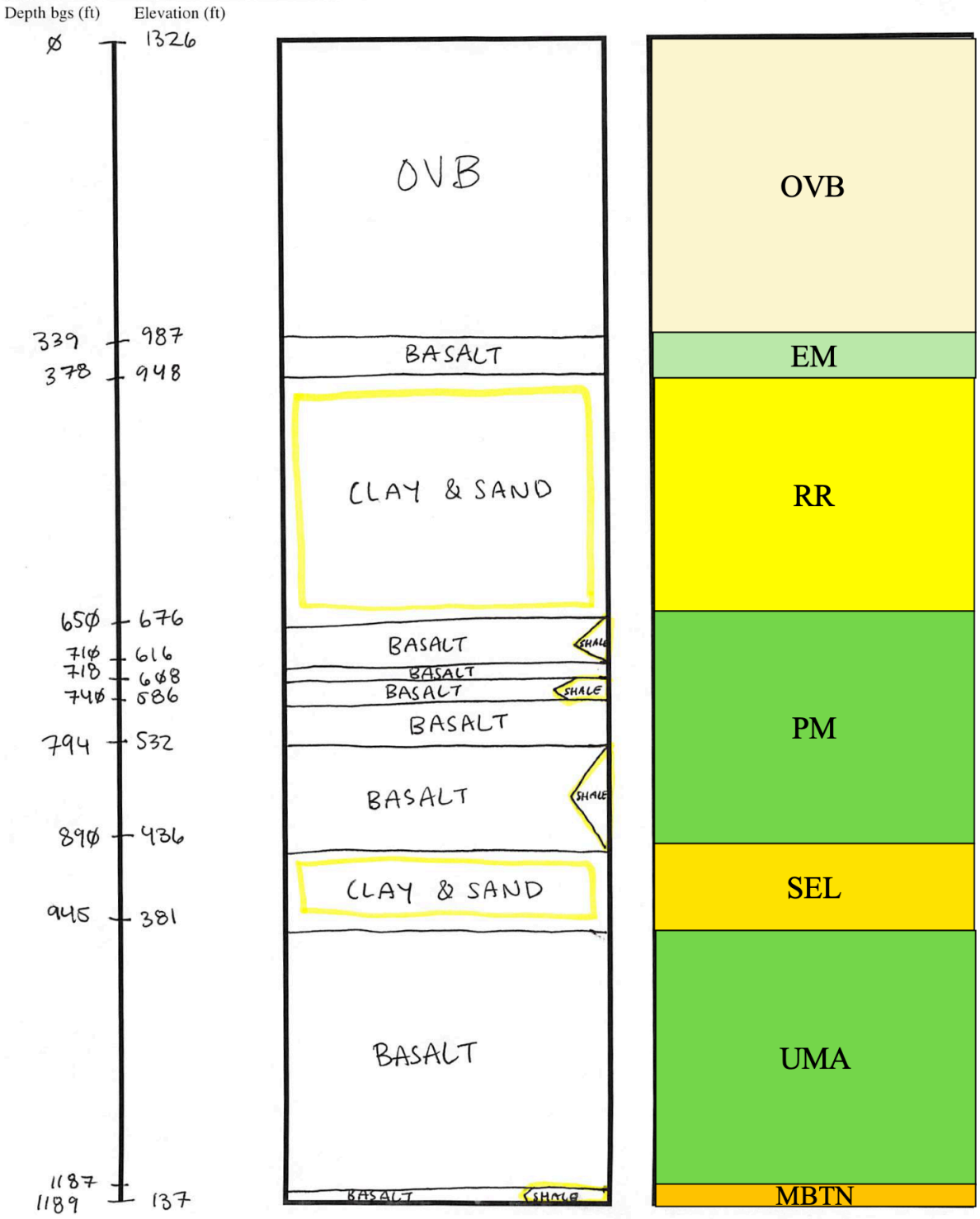
Work started 3/6/87 Completed 3/31/87

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 RIEBE WELL DRILLING INC.
(Person, firm, or corporation) (Type or print)
Address P.O.10866 Yakima, 98909-1866
[Signed] BOB BRITTON (Well Driller)
License No. 0043 Date 4/1/87

(USE ADDITIONAL SHEETS IF NECESSARY)

Well ID: 2798	Well Name:	Cross Section: B-B'
Surface Elevation: 1326 ft	Well Depth: 1189 ft	Aquifer: WNB



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

2792

WATER WELL REPORT

STATE OF WASHINGTON

Application No. .....
Permit No. 7-01-26-15-5

(1) OWNER: Name Roza Investment Co. Address Yakima, Washington

(2) LOCATION OF WELL: County Yakima SE ¼ NW ¼ Sec 27 T 11 N., R 21 E.W.M.
¼ and distance from section or subdivision corner Center of ~~SE¼ NW¼~~ N½ of 287

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

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

(5) DIMENSIONS: 12" to 690'; 10" to 1220'
Drilled 1620 ft. Depth of completed well 1620 ft. Diameter of well 8" to 1620 inches

(6) CONSTRUCTION DETAILS:

Casing installed: 12" Diam. from +1 ft. to 702 ft.
Threaded ☐ 10" Diam. from 690 ft. to 1220 ft.
Welded ☒ 8" Diam. from 1512 ft. to 1595 ft.

Perforations: Yes ☒ No ☐
Type of perforator used Machine
SIZE of perforations 3/16 in. by 2 in.
640 perforations from 1575 ft. to 1595 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? 702 ft.
Material used in seal Cement
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 488 ft. below top of well Date 5/25/80
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? Akland
Yield: 420 gal./min. with 40 ft. drawdown after 4 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 Bailing gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☐

DEPARTMENT OF ECOLOGY

(10) WELL LOG:

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Top soil	0	9
Gravel sand	9	21
Sandy clay yellow	21	140
Sandstone brown	140	171
Clay tan, shale	171	282
Basalt hard black EM	282	325
Clay white	325	340
Sand white	340	348
Shale tan	348	357
Clay sticky white	357	368
Clay green	368	383
Clay sticky white	383	385
Clay green	385	415
Clay sandy green	415	480
Clay green	480	620
Clay green and blk w/sediments	620	655
Basalt hard gray Pomona	655	685
Clay hard gray	685	695
Basalt hard black Umatilla	695	705
Basalt hard gray	705	864
Clay hard gray, soft gray basalt	864	902
Gravel large green black gray	902	937
Basalt medium black Umatilla	937	1182
Clay hard gray & black & brkn bas	1182	1189
Basalt medium black PR	1189	1310
Basalt med soft gray	1310	1317
Basalt medium black	1317	1350
Basalt hard gray	1350	1440
Basalt med hard gray & brn frac.	1440	1538
Brkn rock & clay hard gray & grn	1538	1565
Hard clay black	1565	1570
Basalt hard gray	1570	1596
Basalt broken gray	1596	1598
Basalt hard gray	1598	1620

Work started 4/2 19 80 Completed 6/25 19 80

WELL DRILLER'S STATEMENT:

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

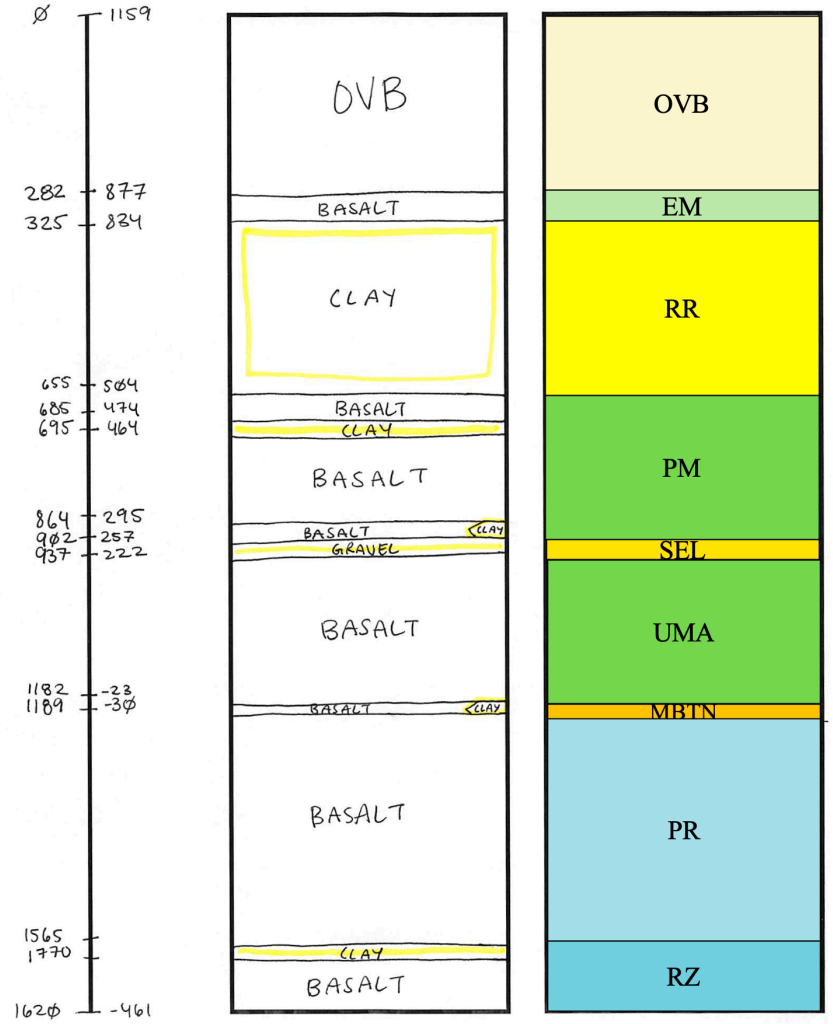
NAME Moore Drilling, Inc.
(Person, firm, or corporation) (Type or print)
Address P. O. Drawer P, Moses Lake, Wa. 98837

[Signed] Steven Moore (Well Driller)
License No. 0317 Date 7/1 19 80

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

Well ID: 2792 Well Name: Cross Section: B-B'
Surface Elevation: 1159ft Well Depth: 1620ft Aquifer: WNB



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

2773

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* 15278 2

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

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

DIMENSIONS Diameter of well 12 inches drilled 2004 ft.
Depth of completed well 2004 ft.

CONSTRUCTION DETAILS
Casing Installed ☐ Welded Diam. from ____ ft. to ____ ft.
☐ Liner installed Diam. from ____ ft. to ____ ft.
☐ Threaded Diam. from ____ ft. to ____ ft.

Perforations ☐ Yes ☑ No
Type of perforator used
SIZE of perfs ____ in. by ____ in. and no of perfs ____ from ____ ft. to ____ ft.

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

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

Surface Seal ☑ Yes ☐ No To what depth? 1060 ft.
Material used in seal cement
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 543 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
Bailer test ____ gal./min. with ____ ft. drawdown after ____ hrs
Airtest 600 gal./min. with stem set at 1995 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 W150735
Unique Ecology Well ID Tag No AHP790
Water Right Permit No G4-23620P
Property Owner Name Valley Fruit Orchard LLC
Well Street Address 12 Hoffer Rd.
City Wapato County Yakima
Location NE1/4 1/4 SE 1/4 Sec 12 Twn 11 R 20 ☑ EWM ☐ WWM ☐ circle one
Lat/Long (s, t, r still REQUIRED) Lat Deg ____ Lat Min/Sec ____ Long Deg ____ Long Min/Sec ____
Tax Parcel No

DEPT OF ECOLOGY Received JUL 27 2004 CENTRAL REGIONAL OFFICE

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
Brown clay & broken rock	0	4
Gray Sandstone silt	4	25
Brown Sandy silt	25	33
Gray sand & fine gravel	33	38
Brown Silt Stone	38	69
Brown siltstone & sandstone layers	69	83
Fine gravel multi-colored	83	110
Tan clay	110	145
Brown Sandstone & clay layers	145	172
Fine Gravel	172	179
Tan Claystone & Sandstone Layers	179	206
Dark brown clay	206	248
Tan Sandy Clay	248	270
Brown Clay	270	315
Green Clay	325	335
Brown Clay	335	376
Broken Black Porus basalt	376	382
Hard black basalt	382	423
Gray clay	423	428
Brown clay	428	476
Blue green clay	476	534
Gray Clay	534	543
Gray Sandstone	543	579
Green Clay	579	590
Gray Clay	590	663
Hard green clay	663	685
Gray Clay Soft	685	705
Green & Gray clay layers	705	742
Broken Black basalt & green clay	742	752
Med. soft black & brown basalt	752	785
Very hard gray basalt	785	936

Start Date 12-11-03 Completed Date 2-5-04

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

Driller/Engineer/Trainee Name (Print) Larry McLanahan
Driller/Engineer/Trainee Signature
Driller or trainee License No 0337
Drilling Company BJ Exploration Co. Inc.
Address 404 North Conway Street
City State Zip Kennewick, WA 99336
Contractor's Registration No BJEXPCI1320K Date 3/4/04

If TRAINEE
Driller's Licensed No
Driller's Signature

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

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

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 15278 2
PROPOSED USE ☐ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☑ Irrigation ☐ Test Well ☐ Other
TYPE OF WORK Owner's number of well (if more than one)
☑ New well ☐ Reconditioned Method ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☐ Cable ☑ Rotary ☐ Jetted
DIMENSIONS Diameter of well 12 inches drilled 2004 ft.
Depth of completed well 2004 ft.
CONSTRUCTION DETAILS
Casing Installed ☑ Welded 12 Diam. from +1 ft. to 1060 ft.
☐ Liner installed Diam. from ____ ft. to ____ ft.
☐ Threaded Diam. from ____ ft. to ____ ft.
Perforations ☐ Yes ☑ No
Type of perforator used
SIZE of perfs ____ in. by ____ in. and no of perfs ____ from ____ ft. to ____ ft.
Screens ☐ Yes ☑ No ☐ K Pac Location
Manufacturer's Name
Type Model No
Diam. ____ Slot size ____ from ____ ft. to ____ ft.
Diam. ____ Slot size ____ from ____ ft. to ____ ft.
Gravel/Filter packed ☐ Yes ☑ No Size of gravel/sand
Materials placed from ____ ft. to ____ ft.
Surface Seal ☑ Yes ☐ No To what depth? 1060 ft.
Material used in seal CEMENT
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 543 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
Bailer test ____ gal./min. with ____ ft. drawdown after ____ hrs
Airtest 600 gal./min. with stem set at 1995 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 W150735
Unique Ecology Well ID Tag No AHP790
Water Right Permit No G4-23620P
Property Owner Name Valley Fruit Orchard LLC
Well Street Address 12 Hoffer Rd.
City Wapato County Yakima
Location NE1/4 1/4 SE 1/4 Sec 12 Twn 11 R 20 ☑ EWM ☐ WWM ☐ circle one
Lat/Long (s, t, r still REQUIRED) Lat Deg ____ Lat Min/Sec ____ Long Deg ____ Long Min/Sec ____
Tax Parcel No

DEPT OF ECOLOGY Received JUL 27 2004 CENTRAL REGIONAL OFFICE

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
Hard gray basalt some fractures	936	975
Clay gray	975	999
Hard green clay some broken basalt	999	1046
Med. hard broken basalt	1046	1050
Hard fractured gray basalt	1050	1083
Very broken gray basalt water 180 psi 100gpm	1083	1085
Hard fractured gray basalt	1085	1196
Med. hard basalt	1196	1118
Hard fractured basalt	1118	1140
Med. hard basalt	1140	1312
Hard black clay	1312	1315
Green Clay	1315	1322
Med. soft black basalt	1322	1334
Hard dark gray basalt	1334	1396
Soft black porus basalt Little water 200psi 74 degrees	1396	1404
Med. hard dark gray basalt	1404	1448
Hard fractured basalt	1448	1456
Very hard gray basalt	1456	1505
Hard gray basalt some fracture	1505	1575
Med. soft black porus basalt Trace of hard green clay	1575	1585
Soft black porus basalt Trace of white crystal water 225psi	1585	1604
Hard light gray basalt some fracture	1604	1675
Med. hard black basalt	1675	1685
Soft black basalt water 250psi	1685	1712
Med. hard black basalt	1712	1733
Soft black porus basalt Trace of green & gray clay 78 degrees Water 260psi	1733	1752
Med. hard gray basalt	1752	1825
Hard gray basalt	1825	1941
Med. hard fractured gray basalt	1941	1953

Start Date 12-11-03 Completed Date 2-5-04

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

Driller/Engineer/Trainee Name (Print) Larry McLanahan
Driller/Engineer/Trainee Signature
Driller or trainee License No 0337
Drilling Company BJ EXPLORATION CO. INC.
Address 404 North Conway Street
City State Zip Kennewick, WA 99336
Contractor's Registration No BJEXPCI1320K Date 3-4-04

If TRAINEE
Driller's Licensed No
Driller's Signature

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

Please print sign and return to the Department of Ecology

2773

Water Well Report

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

Construction/Decommission

☑ Construction ☐ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* 152782

Current Notice of Intent No W150735

Unique Ecology Well ID Tag No AHP790

Water Right Permit No G4-23620P

Property Owner Name Valley Fruit Orchard LLC

Well Street Address 12 Hoffer Rd

City Wapato County Yakima

Location NE 1/4 1/4 SE 1/4 Sec 12 Twn 11 R 20 (EWM / WWM)

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

Tax Parcel No _____

DEPT OF ECOLOGY Received JUL 27 2004 CENTRAL REGIONAL OFFICE

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

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

DIMENSIONS: Diameter of well 12 inches drilled 2004 ft. Depth of completed well 2004 ft.

CONSTRUCTION DETAILS: Casing ☑ Welded 12 Diam from +1 ft. to 1060 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 _____ Dia Slot size from ft. to ft. Dia 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? 1060 ft. Material used in seal CEMENT 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 543 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 _____ Bailer test _____ gal/min. with _____ ft. drawdown after _____ hrs. Airtest 600 gal/min with stem set at 1995 ft. for 1 hrs. Artesian flow _____ g.p.m. Date _____ Temperature of water _____ Was a chemical analysis made? ☐ Yes ☐ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation. (USE ADDITIONAL "WELL TEST" RECEIVED)

MATERIAL	FROM	TO
Soft Water 350ppm 85 degrees		
Black porus basalt Trace of green clay & quartz	1953	1971
Wood to black clay	1968	1971
Med. hard black basalt	1971	1976
Med. soft porus black basalt Trace of quartz	1976	1982
Hard dark gray basalt	1982	1988
Soft red basalt & red clay	1988	1990
Soft black porus basalt 360 ppm	1990	1996
Hard dark gray basalt	1996	2004

12" Casing to 1060'
12" Rock hole to 1660'
9 7/8 hole from 1660 - 2004

Start Date 12-11-03 Completed Date 2-5-04

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

Driller/Engineer/Trainee Name (Print) Larry McLanahan

Driller/Engineer/Trainee Signature _____

Driller or trainee License No 0337

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

Drilling Company BJ EXPLORATION CO. INC

Address 404 North Conway Street

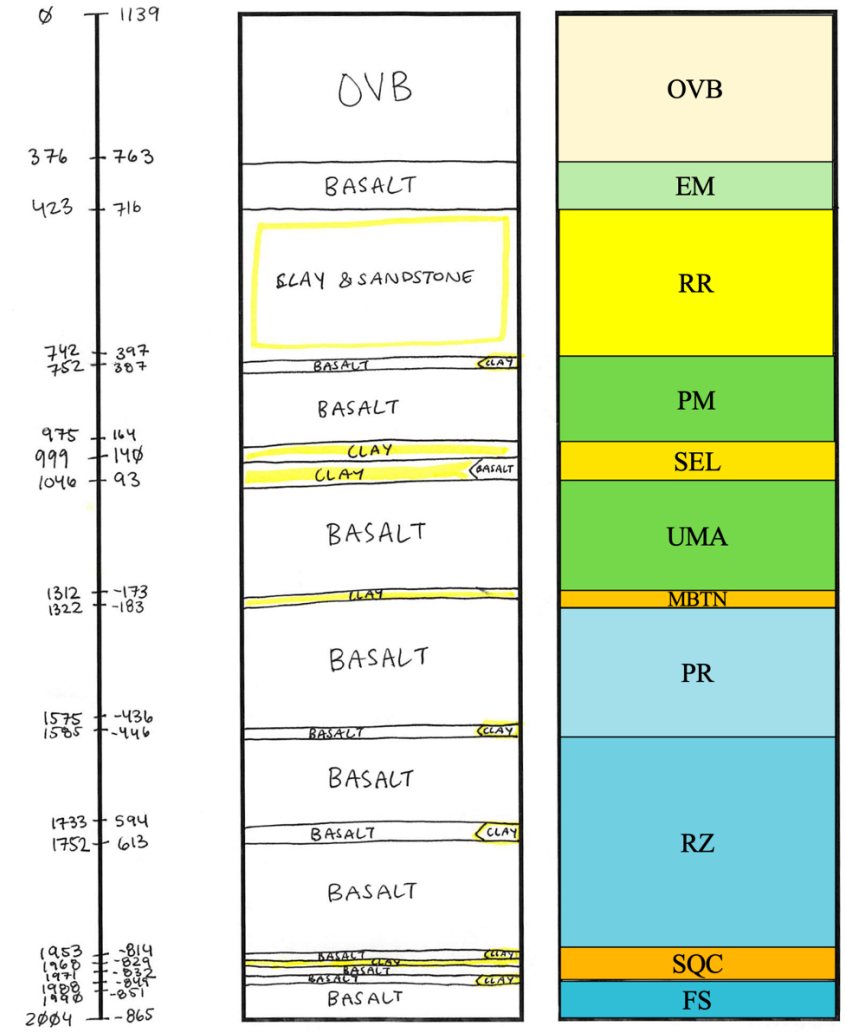
City State Zip Kennewick WA 99336

Contractor's Registration No BJEXPCI132OK Date 3-4-04

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

Well ID: 2773 Well Name: Cross Section: B-B'

Surface Elevation: 1139ft Well Depth: 2004ft Aquifer: WNB



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

2743

WATER WELL REPORT
STATE OF WASHINGTON

Application No. .....
Permit No. G4-24132

(1) OWNER: Name Forrest Johnson Address Rt. #1, Box 247 Zillah, Washington 98953

(2) LOCATION OF WELL: County Yakima NW ¼ SW ¼ Sec. 1 T. 11 N., R. 20 W.M.
ing and distance from section or subdivision corner

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

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

(5) DIMENSIONS: Diameter of well 17-1/2 inches. Drilled 1500 ft. Depth of completed well 1400 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 20 " Diam. from +1 ft. to 41 ft.
Threaded ☐ 16 " Diam. from +1 ft. to 686 ft.
Welded ☒ 10-3/4 Diam. from 800 ft. to 1400 ft.

Perforations: Yes ☒ No ☐
Type of perforator used Factory Cut
SIZE of perforations 1/8 in. by 2-1/2 in.
M111 perforations from 800 ft. to 1400 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? 41 ft.
Material used in seal Cement grout
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? N/A Depth of strata N/A
Method of sealing strata off N/A

(7) PUMP: Manufacturer's Name Luhdorff Test Pump
Type: Diesel Driven H.P. 700

(8) WATER LEVELS: Land-surface elevation above mean sea level 1180 ft.
Static level 300 ft. below top of well Date 8-15-77
Artesian pressure N/A 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? Luhdorff
Yield: 800 gal./min. with 224 ft. drawdown after 1 hrs.
" 800 " 224 " 12 "
" 800 " 224 " 24 "

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

Time	Water Level	Time	Water Level	Time	Water Level
1 min	524	5 min	300	60 min	300
2 min	350	10 min	300		
3 min	300	30 min	300		

Date of test 9-5-77
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☒

(10) WELL LOG: M

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Top Soil	0	40
Gravel & sand	40	98
Sand	98	143
Sand & clay	143	220
Sand, clay, basalt	220	262
Basalt	262	293
Basalt with clay stringers	293	314
~~314~~ Sand	314	330
Clay	330	368
Clay & sand	368	667
Clay & basalt	667	692
Basalt	692	693
Basalt, fractured	693	705
Basalt & clay	705	717
Basalt, grey and black	717	841
Clay & sand;thin streaks of basalt	841	934
Rough fractured basalt, light black, yellow, green	934	981
Rough & fractured basalt	981	1000
Rough & hard basalt	1000	1030
Clay, grey & black basalt	1030	1050
Rough basalt, black & grey	1050	1084
Black & grey basalt	1084	1120
Grey clayish sand, basalt	1120	1163
Black, grey basalt, red rock, clay	1163	1170
Black, grey basalt, Blue clay	1170	1183
Black, grey basalt	1183	1200
Black, brown, white, Grey basalt	1200	1220
Black,brown basalt; sand, clay	1220	1240
Sand shale with fine quartz	1240	1250
Sandy grey basalt	1250	1268
Black brown basalt	1268	1341
Green shale & sand	1341	1378
Black brown basalt (hard)	1378	1403
Black basalt, green clay stringers	1403	1438
Green clay, stringers blk & brn bas	1438	1468
Black, brn, grey basalt, very hard	1468	1500

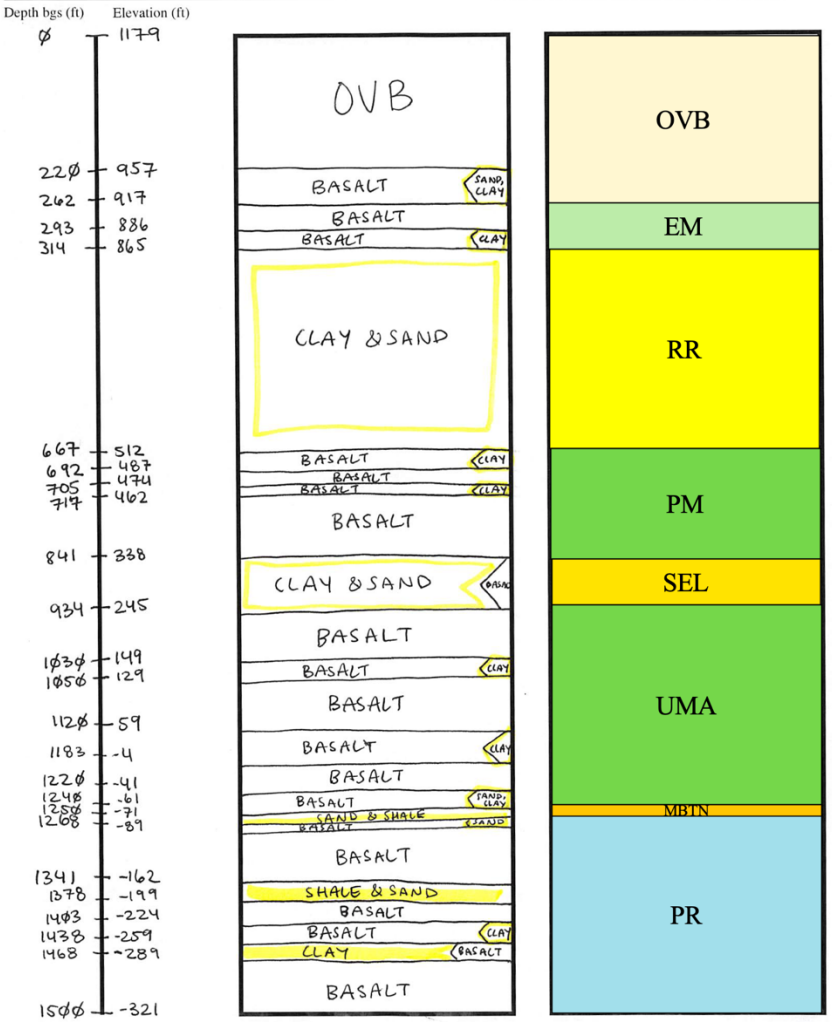
Well started 19 Completed 19
April 4 1977 May 24, 1977

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
E. E. Luhdorff Company
NAME Layne-Western Co., Inc. Division of Layne-Western Co., Inc.
(Person, firm, or corporation) (Type or print)
Address P.O. Box 356, Moses Lake, Wash. 98837
[Signed] John P. Goodell (Well Driller)
License No. 0162 Date September 19, 77

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

Well ID: 2743 Well Name: Cross Section: B-B'
Surface Elevation: 1179 ft Well Depth: 1500 ft Aquifer: WNB



2470

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 086754

UNIQUE WELL I D #

Water Right Permit No GU29605P

(1) OWNER Name Waren E Hazen Address P O Box 302, Sunnyside, WA 98944

(2) LOCATION OF WELL County Yakima SE ¼ NW ¼ Sec 24 T 10 N R 23 W M

(2a) STREET ADDDRESS OF WELL (or nearest address) Holmason Rd-7

(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 18x16x12x10 inches
Drilled 848 feet Depth of completed well 848 ft

(6) CONSTRUCTION DETAILS
Casing installed 12" Diam from +2 ft to 223 ft
Welded ☒ Liner installed ☒ Threaded ☐ 10" Diam from +2 ft to 618 ft
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? 618 ft
Material used in seal Cement
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 535 ft below top of well Date 4/29/93
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 500+ gal /min with ft drawdown after hrs
Estimated air lift 500+ 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
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	0	1
Light brown rotten basalt	1	12
Hard gray basalt	12	30
Brown rotten basalt	30	39
Black basalt	39	45
Rotten basalt	45	55
Layers of solid & rotten basalt	55	79
Layers of clay & rotten basalt	79	124
Layers of brown clay & gravel	124	170
Rotten brown basalt	170	185
Black basalt	185	195
Yellow shale brown & black basalt	195	209
Brown & gray basalt fractured	209	214
Hard black basalt	214	232
Fractured black basalt	232	309
Gray basalt	309	317
Red/brown pouris basalt water	317	331
Fractured brown black basalt	331	340
Rotten brown basalt	340	362
Fractured black basalt	362	370
Yellow clay brown & black basalt	370	380
Layers of black/red/brown basalt	380	470
Fractured gray basalt	470	514
Blue conglomerate	514	525
Brown shale	525	530
Soupy brown sand w/mica	530	550
Brown sandy clay & shale	550	566
Blue clay	566	570
Layers of blue & brown clay	570	574
Blue clay and shale	574	578
Hard black basalt	578	618
Hard gray basalt	618	635
Medium black basalt	635	650

Work started 4/12/93 19 Completed 4/29 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 (WELL DRILLER) (Bob Britton) License No 0043

Contractor s Registration No PO-ND-EI*248JE Date 4/30 19 93

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050 1 20 (10/87) 1329 ○ 18

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

2 8477

Start Card No 086754

UNIQUE WELL I D #

Water Right Permit No 64-29605P

(1) OWNER Name Waren Hazen Address

(2) LOCATION OF WELL County Yakima SE ¼ NW ¼ Sec 24 T 10 N R 23 W M

(2a) STREET ADDDRESS 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 inches
Drilled feet Depth of completed well ft

(6) CONSTRUCTION DETAILS
Casing installed Diam from ft to ft
Welded ☐ Liner installed ☐ Threaded ☐ Diam from ft to ft
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? ft
Material used in seal
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP Manufacturer s Name
Type H P

(8) WATER LEVELS Land surface elevation above mean sea level ft
Static level 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 500+ gal /min with ft drawdown after hrs
Estimated air lift 500+ 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
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
Hard gray basalt	650	750
Pouris black basalt w/water	750	760
Hard black basalt	760	767
Soft black basalt	767	777
Hard black basalt	777	805
Hard gray basalt	805	837
Pouris black basalt black glass	837	846
Hard black basalt	846	848
Note water at 750' has a lot of gas in it		

Work started 4/12/93 19 Completed 4/29 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 (WELL DRILLER) (Bob Britton) License No 0043

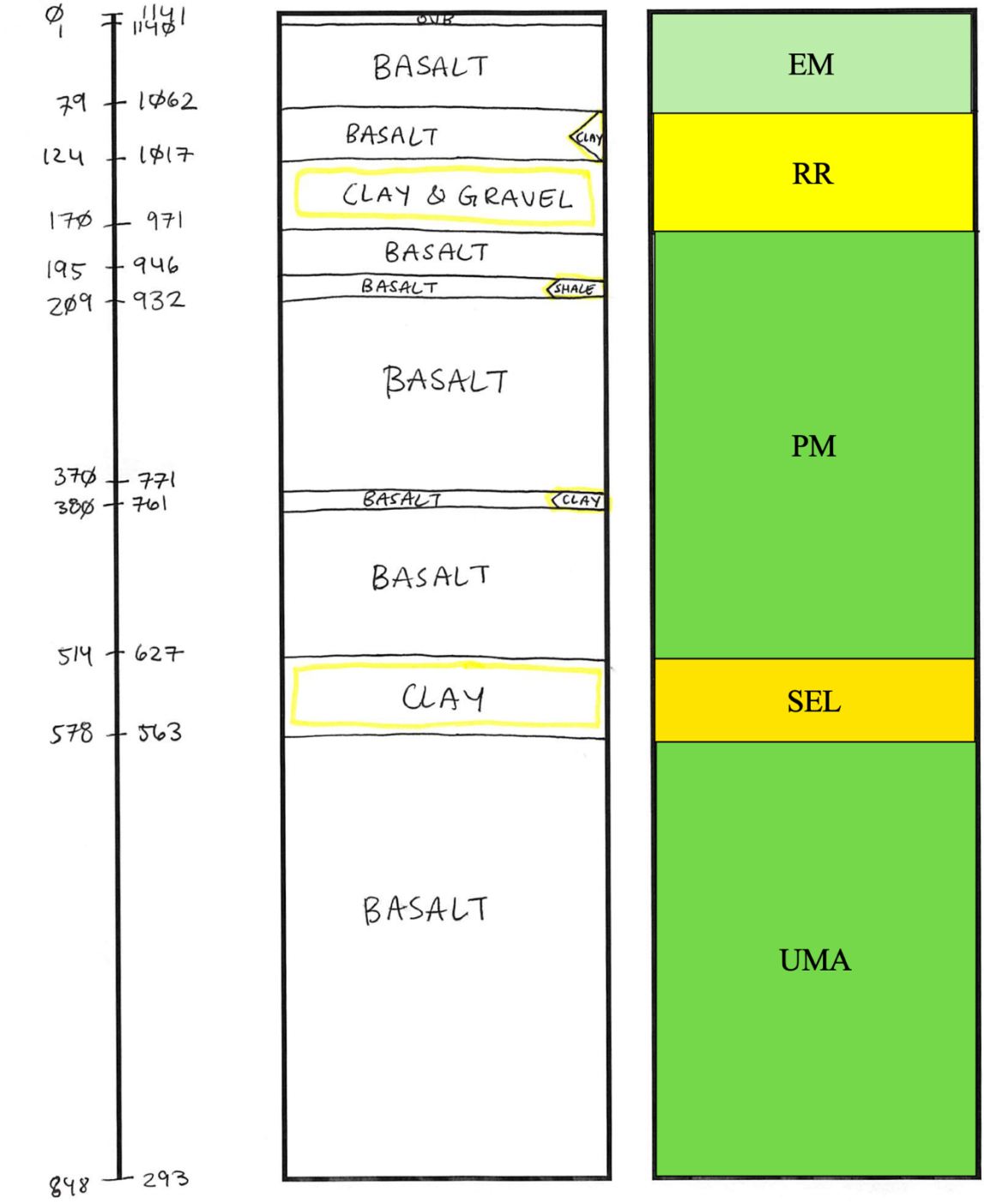
Contractor s Registration No PO-ND-EI*248JE Date 4/30 19 93

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050 1 20 (10/87) 1329 ○ 18

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

Well ID: 2470	Well Name:	Cross Section: B-B'
Surface Elevation: 1141 ft	Well Depth: 848 ft	Aquifer: Lower SDMB



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

WATER WELL REPORT
STATE OF WASHINGTON

2455

Application No. 9 4250 52
Permit No.

(1) OWNER: Name William Visser Address Sunnyside, Washington

(2) LOCATION OF WELL: County Yakima S.E.¼ N.E.¼ Sec 15 T. 10 N., R. 23 W.M. H
Bearing and distance from section or subdivision corner

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

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

(5) DIMENSIONS: Diameter of well 18-14-16 inches
Drilled 985 ft. Depth of completed well 985 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 18" Diam. from +1 ft. to 20 ft
Threaded ☐ 14" Diam. from 9 ft. to 229 ft
Welded ☒ 10" Diam. from 524 ft. to 625 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 Cement
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 280' ft below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc)

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

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

Time	Water Level	Time	Water Level	Time	Water Level

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

(10) WELL LOG:
Formation. Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Soil (Overburden)	0	11
Black Hard Basalt	11	59
Porous Black Hard Basalt	59	75 EL
Black Hard Basalt	75	101 MTN
Sand Clay and Gravel	101	121
Black Hard Basalt	121	130 EPM
Sandy Interbed	130	151
Sandstone	151	162
Interbed (Brown Sand)	162	191
Sandstone	191	215
Black Hard Basalt	215	350
Porous Black Hard Basalt	350	371 PM
Black Hard Basalt	371	543
Porous Black Basalt & Clay	543	610 MAB
Black Hard Basalt	610	965
Porous Black Basalt	965	980 PM
Black Hard Basalt	980	985

RECEIVED
DEC 8 - 1977
DEPARTMENT OF ECOLOGY
CENTRAL REGIONAL OFFICE

Work started 6/2 19 77 Completed 7/5 19 77

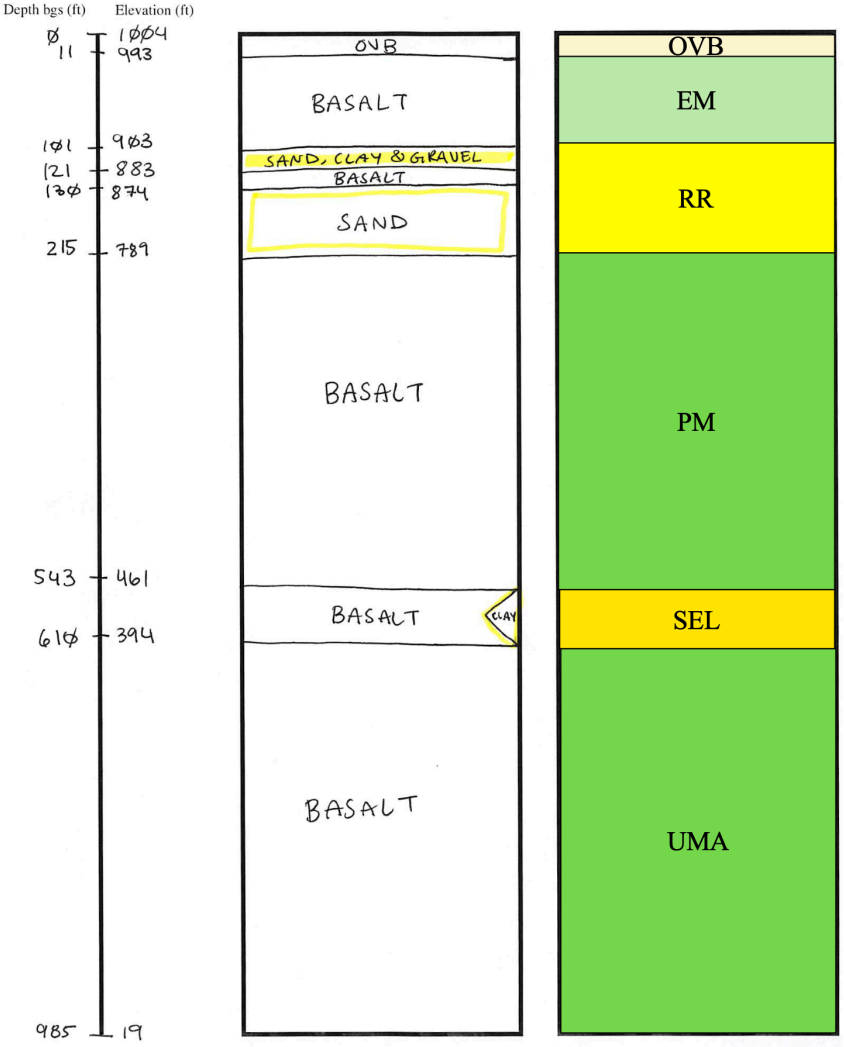
WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

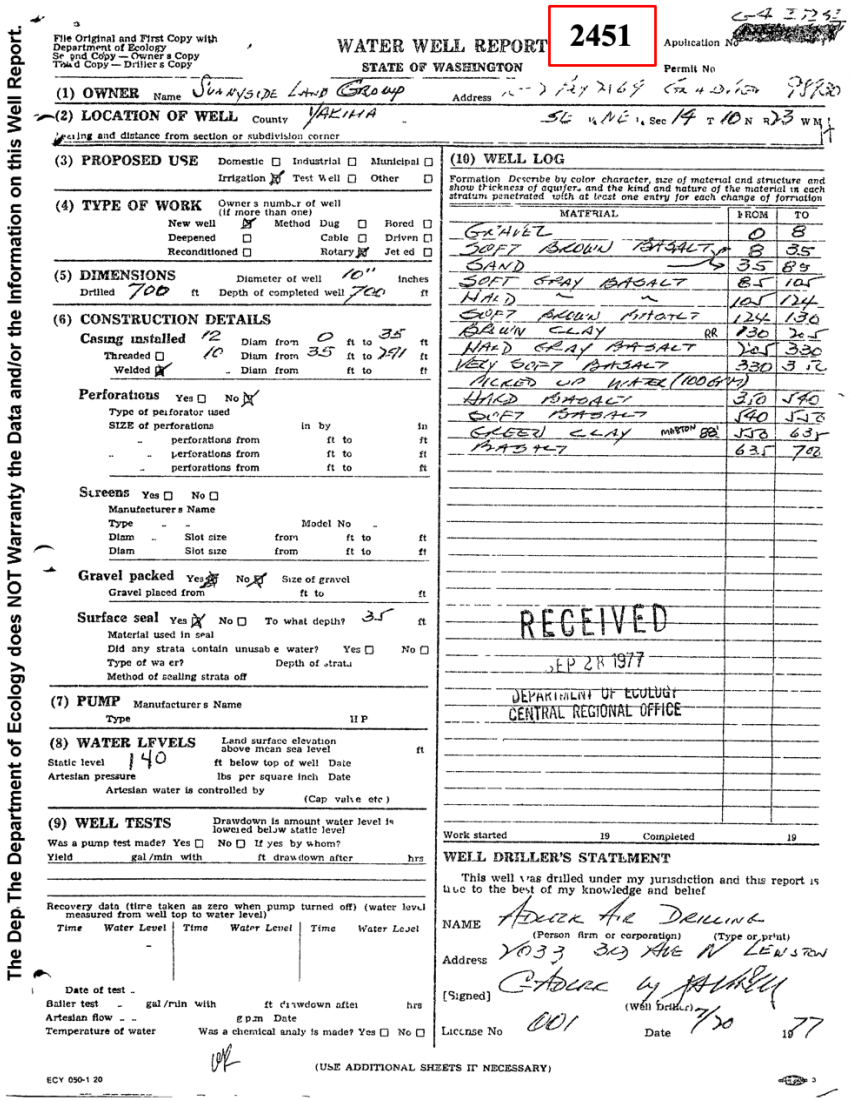
NAME Adcock Air Drilling (Person, firm, or corporation) (Type or print)
Address 2033 3rd Avenue North Lewiston, Idaho
[Signed] (Well Driller)
License No. 001 Date October 28, 1977

(USE ADDITIONAL SHEETS IF NECESSARY)

S. F. No. 7356—OS—(Rev. 4-71).

Well ID: 2455 Well Name: Cross Section: B-B'
Surface Elevation: 1004 ft Well Depth: 985ft Aquifer: LOWER SDMB





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

2451

Application No. G4-21725

Permit No. 78132

(1) OWNER Name SUNNYSIDE LAND GROUP Address [illegible] 98932

(2) LOCATION OF WELL County YAKIMA
Legal and distance from section or subdivision corner
SE ¼ NE ¼ Sec 14 T 10 N R 23 WM

(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 10" inches
Drilled 700 ft Depth of completed well 700 ft

(6) CONSTRUCTION DETAILS
Casing installed 12 Diam from 0 ft to 35 ft
Threaded ☐ 10 Diam from 35 ft to 691 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? 35 ft
Material used in seal
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP Manufacturer's Name
Type H P

(8) WATER LEVELS Land surface elevation above mean sea level ft
Static level 140 ft below top of well Date
Artesian pressure lbs per square inch Date
Artesian water is controlled by (Cap valve etc.)

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

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

Time	Water Level	Time	Water Level	Time	Water Level

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

(10) WELL LOG
Formation: Describe by color, character, size of material and structure and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
GRAVEL	0	8
SOFT BROWN BASALT	8	35
SAND	35	85
SOFT GRAY BASALT	85	105
HARD ~ ~	105	124
SOFT BROWN BASALT	124	130
BROWN CLAY RR	130	205
HARD GRAY BASALT	205	330
VERY SOFT BASALT	330	340
PICKED UP WATER (1000 GPM)		
HARD BASALT	340	540
SOFT BASALT	540	558
GREEN CLAY MARTON 88	558	635
BASALT	635	700

RECEIVED
SEP 28 1977
DEPARTMENT OF ECOLOGY
CENTRAL REGIONAL OFFICE

Work started 19 Completed 19

WELL DRILLER'S STATEMENT
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief

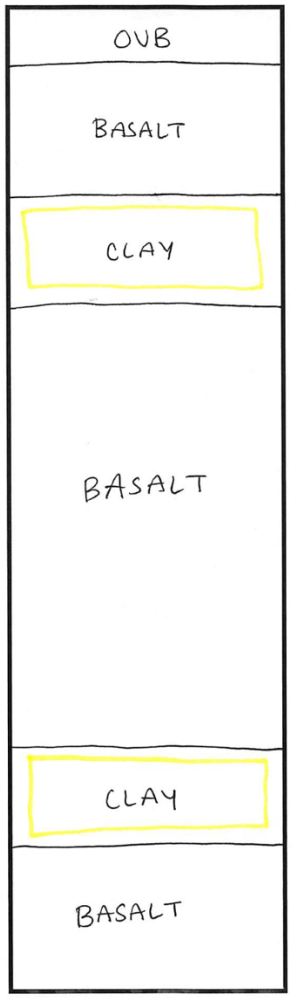
NAME ADLER AIR DRILLING
(Person, firm or corporation) (Type or print)
Address Y033 3RD AVE N LEWISTON
[Signed] C. ADLER by [illegible]
(Well Driller)
License No 001 Date 7/30 19 77

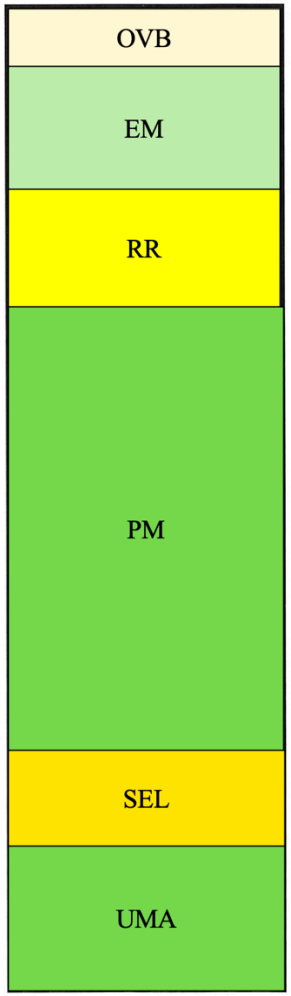
ECY 050-1 20 (USE ADDITIONAL SHEETS IF NECESSARY)

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

Well ID: 2451 Well Name: Cross Section: B-B'
Surface Elevation: 1208ft Well Depth: 700 ft Aquifer: LOWER SDMB

Depth bgs (ft)	Elevation (ft)
0	1208
35	1173
130	1078
205	1003
550	658
625	573
700	508





2439

WATER WELL REPORT

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

Construction/Decommission ("x" in circle) 175906

(x) Construction

( ) Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

CURRENT
Notice of Intent No. W150756

Unique Ecology Well ID Tag No. AHP776

Water Right Permit No. G4-34953

Property Owner Name Art DenHoed

Well Street Address 62002 N. Missimer Rd

City Grandview County Yakima

Location Sw 1/4-1/4 Se 1/4 Sec 5 Twn 10N R 23 EWM (x) or WWM ( ) circle one

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

Tax Parcel No. _____

DEPT OF ECOLOGY Received JUN 24 2005 CENTRAL REGION OFFICE

PROPOSED USE: ( ) DeWater (x) Irrigation ( ) Domestic ( ) Industrial ( ) Test Well ( ) Municipal ( ) Other

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

DIMENSIONS: Diameter of well 12" inches, drilled 1718' ft.
Depth of completed well 1718 ft.

11-78 - 9-78

CONSTRUCTION DETAILS
Casing Installed: (x) Welded 24" Diam from +1 ft to 105' ft; (x) Liner installed 16" Diam from +1 ft to 323' ft; ( ) Threaded 12" Diam from +1 ft to 725' ft

Perforations: ( ) Yes (x) No
Type of perforator used _____
SIZE of perfs _____ in by _____ in. and no. of perfs _____ from _____ ft. to _____ ft.

Screens: ( ) Yes (x) 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 (x) No ( ) Size of gravel/sand _____
Materials placed from _____ ft. to _____ ft.

Surface Seal: (x) Yes ( ) No To what depth? 725' ft
Material used in seal cement
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 531' 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 _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airtest 2000 gal./min. with stem set at 1700 ft. for 1 hrs.
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? ( ) Yes ( ) No

CONSTRUCTION OR DECOMMISSION PROCEDURE

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

MATERIAL	FROM	TO
Brown Silt	0	3
Brown Silt Gravel & cobbles	3	14
Brown clay & gravel	14	28
Brown sitty clay	28	66
Brown sandstone	66	96
Med hard brown gray basalt	96	103
Hard gray basalt	103	112
Soft tan claystone	112	114
Sand gravel & cobbles Little water	114	123
Med hard dark gray basalt	123	139
Very hard gray basalt	139	169
Mud hard fractured dark gray basalt	169	178
Reddish brown sandstone	178	183
Soft brown clay	183	206
Tan clay	206	234
Tan clay & sandstone layers	234	272
Tan clay	272	292
Basalt med. hard gray	292	326
Med. hard gray & reddish brown basalt		
Little water 10 gpm	326	337
Soft	337	340
Hard gray basalt	340	351
Soft broken gray basalt Little water 30 gpm	351	353
Hard dark gray basalt	352	423
Med. hard	423	438
Med. soft fractured gray & brown basalt		
water 50 gpm	438	446
Med. hard gray basalt	446	467
Hard light gray basalt	467	642
Med. soft gray porus basalt some hard gray clay	642	648
Reddish brown siltstone	648	659

Start Date 4-8-05 Completed Date 5-25-05

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) Larry McLanahan
Driller/Engineer/Trainee Signature Larry McL
Driller or trainee License No. 0337

Drilling Company BJ Exploration Co., Inc
Address 404 N. Conway Street
City, State, Zip Kennewick, WA 99336
Contractor's Registration No BJEXPCI132QK Date 6-23-05

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

Ecology is an Equal Opportunity Employer.

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

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

WATER WELL REPORT

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

Construction/Decommission ("x" in circle)

(x) Construction

( ) Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

CURRENT
Notice of Intent No. W150756

Unique Ecology Well ID Tag No. AHP776

Water Right Permit No. G4-34953

Property Owner Name Art DenHoed

Well Street Address 62002 N. Missimer Rd

City Grandview County Yakima

Location Sw 1/4-1/4 Se 1/4 Sec 5 Twn 10N R 23 EWM (x) or WWM ( ) circle one

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

Tax Parcel No. _____

DEPT OF ECOLOGY Received JUN 24 2005 CENTRAL REGION OFFICE

PROPOSED USE: ( ) DeWater (x) Irrigation ( ) Domestic ( ) Industrial ( ) Test Well ( ) Municipal ( ) Other

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

DIMENSIONS: Diameter of well 12" inches, drilled 1718' ft.
Depth of completed well 1718 ft.

11-78 - 9-78

CONSTRUCTION DETAILS
Casing Installed: (x) Welded 24" Diam from +1 ft to 105' ft; (x) Liner installed 16" Diam from +1 ft to 323' ft; ( ) Threaded 12" Diam from +1 ft to 725' ft

Perforations: ( ) Yes (x) No
Type of perforator used _____
SIZE of perfs _____ in by _____ in. and no. of perfs _____ from _____ ft. to _____ ft.

Screens: ( ) Yes (x) 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 (x) No ( ) Size of gravel/sand _____
Materials placed from _____ ft. to _____ ft.

Surface Seal: (x) Yes ( ) No To what depth? 725' ft
Material used in seal cement
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 531 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 _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airtest 2000 gal./min. with stem set at 1700 ft. for 1 hrs.
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? ( ) Yes ( ) No

CONSTRUCTION OR DECOMMISSION PROCEDURE

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

MATERIAL	FROM	TO
Brown Claystone	659	662
Greeen Sandstone	662	665
Green clay	665	691
Green & Brown clay	691	705
Brown clay & broken basalt	705	707
Black porus basalt	707	710
Hard dark gray basalt (736-737 void)	710	870
Soft black visicular basalt some black & green clay		
water 300-400	870	878
Dark gray porus basalt Med. hard	878	928
Hard gray basalt	928	942
Very broken gray basalt some visicular water 198 psi	942	944
Hard gray basalt	944	963
Med. soft black basalt	963	987
Med. hard dark gray basalt	987	1026
Med. soft dark gray & reddish brown basalt	1026	1032
Med. hard dark gray	1032	1036
Med. soft reddish brown & dark gray basalt	1036	1043
Med. hard dark gray porus	1043	1053
Med. soft dark gray porus basalt	1053	1079
Soft broken black visicular basalt Water 260 psi 77de	1079	1083
Med. hard porus black	1083	1089
Broken porus black basalt 270psi 280psi-1092	1089	1092
Hard dark gray basalt	1109	1148
Med. soft black porus basalt	1148	1172
Hard gray basalt	1172	1185
Med. soft black porus basalt	1185	1187
Hard gray basalt	1187	1198
Soft black porus basalt some hard dark green clay		
water 300 psi	1198	1217
Hard dark gray basalt	1217	1242

Start Date 4-8-05 Completed Date 5-25-05

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) Larry McLanahan
Driller/Engineer/Trainee Signature Larry McL
Driller or trainee License No. 0337

Drilling Company BJ Exploration Co., Inc
Address 404 N. Conway Street
City, State, Zip Kennewick, WA 99336
Contractor's Registration No BJEXPCI132QK Date 6-23-05

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

Ecology is an Equal Opportunity Employer.

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

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

2439

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 12" inches, drilled 1718' ft. 1174 - 974
Depth of completed well 1718 ft.

CONSTRUCTION DETAILS
Casing Installed: ☑ Welded 24" Diam from +1 ft to 105' ft
☑ Liner installed 16" Diam from +1 ft to 323' ft
☐ Threaded 12" Diam from +1 ft to 725' 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? 725' ft
Material used in seal cement
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 531' 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 _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airtest 2000 gal./min. with stem set at 1700 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. W150756
Unique Ecology Well ID Tag No. AHP776
Water Right Permit No. G4-34953
Property Owner Name Art DenHoed
Well Street Address 62002 N. Missimer Rd
City Grandview County Yakima
Location Sw 1/4-1/4 Se 1/4 Sec 5 Twn 10N R 23 EWM or WWM ☑ circle one
Lat/Long (s, t, r Still **REQUIRED**) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____
Tax Parcel No. _____

DEPT OF ECOLOGY Received JUN 14 2005 CENTRAL REGION OFFICE

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
Very hard light gray basalt	1242	1360
Med. soft gray green claystone	1360	1361
Soft porus dark gray basalt 310psi	1361	1368
Med. hard dark gray basalt	1368	1376
Hard gray basalt	1376	1405
Black & some reddish brown visicular basalt soft water 410 psi 80 deg	1405	1439
Hard gray basalt some fractured	1439	1524
Med. soft dark gray porus basalt 430 psi 88deg	1524	1543
Med. hard dark gray porus basalt	1543	1573
Hard gray basalt	1573	1633
Med. soft black porus basalt trace of white quartz	1633	1647
Med. hard dark gray basalt	1647	1665
Soft black porus basalt trace of some quartz water 500gpm	1665	1700
Hard gray basalt	1700	1718
1718 TD - 500 psi 90degrees		
12" pipe 725'		
11 7/8" to 945'		
9 7/8" to 1718		

Start Date 4-8-05 Completed Date 5-25-05

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) Larry McLanahan
Driller/Engineer/Trainee Signature Larry McL
Driller or trainee License No 0337

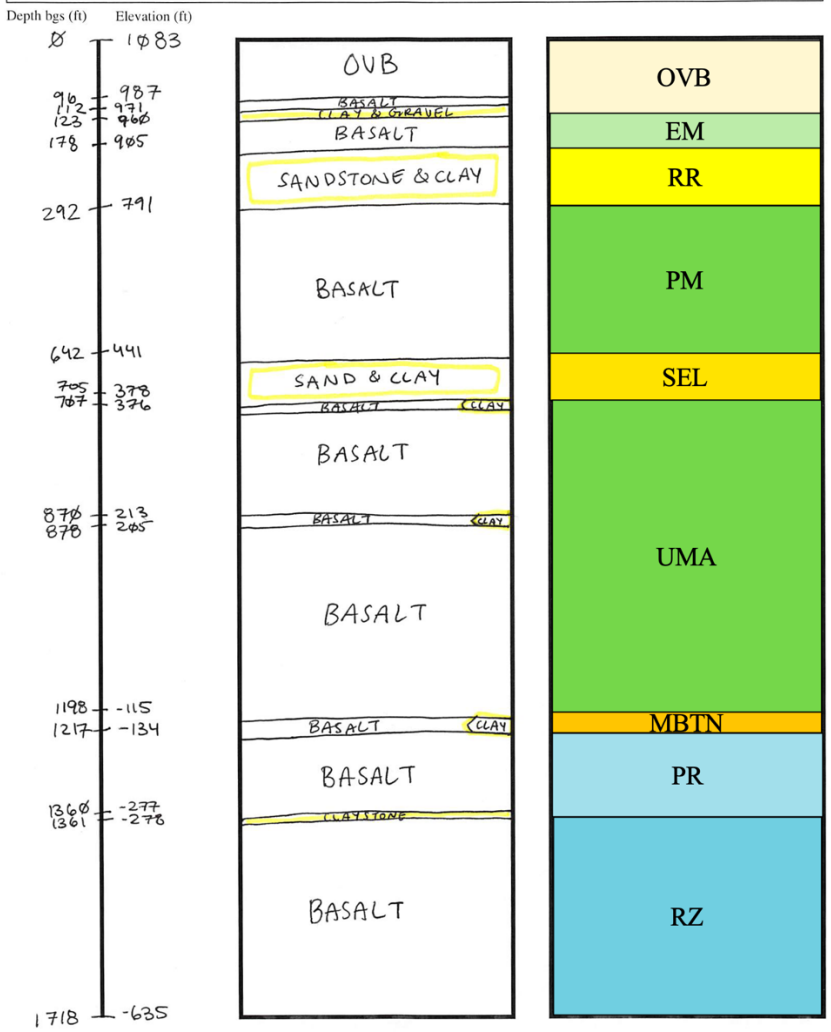
Drilling Company BJ Exploration Co., Inc
Address 404 N. Conway Street
City, State, Zip Kennewick, WA 99336
Contractor's Registration No BJEXPCI132QK Date 6-23-05

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

Ecology is an Equal Opportunity Employer

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

Well ID: 2439 Well Name: Cross Section: B-B'
Surface Elevation: 1083ft Well Depth: 1718 ft Aquifer: WNB



4391

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. 081104

Water Right Permit No. G4-30163P

(1) OWNER: Name Alice Oosterhof Address 1659 Bladgett Rd. Mt. Vernon WA 98273

(2) LOCATION OF WELL: County Yakima SW¼, NE¼ & (NE ¼ NE) ¼ Sec. 2 T. 10 N., R. 22 W.M.

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

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

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

(5) DIMENSIONS: Diameter of well 14 x 10 x 8 inches. Drilled 783 feet. Depth of completed well 770 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 10 " Diam. from 0 ft. to 455 ft.
Welded ☒ Liner installed ☐ Threaded ☐ 8 " Diam. from +2 ft. to 770 ft.
" Diam. from ft. to ft.
Perforations: Yes ☒ No ☐
Type of perforator used Torch
SIZE of perforations 1/4 in. by 6 in.
128 perforations from 720 ft. to 750 ft.
1/8 x 6 78 perforations from 750 ft. to 770 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? 455 ft.
Material used in seal Cement
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 198 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: 100 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.
Airlest 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
Hard pan & boldedrs	0	3
Caliche & bolders	3	9
cemented gravel	9	16
Brown clay & sand	16	24
Cement gravel	24	31
Stickey brown clay	31	70
Layers of brown clay & gravel	70	105
Brown clay	105	155
Hard cemented gravel w/ st of clay	155	290
Hard cemented gravel & sand	290	296
Hard bolders	296	298
Brown clay	298	301
Gravel & clay	301	305
Clay w/ st of sand	305	376
Layers of gravel clay & sand	376	393
Hard sand w/ mica	393	397
Broken basalt, brown	397	410
Fractured basalt, black	410	430
Basalt, black hard	430	545
Clevus	545	546
Basalt, weathered	546	560
Basalt, black, hard	560	710
Fractrued basalt, hard	710	753
Broken basalt w/blue sand & clay	753	783

RECEIVED FEB 4 DEPARTMENT OF ECOLOGY CENTRAL REGION OFFICE

Work started 11/27/90 19. Completed 1/16/91 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 BROADWYA, SPOKANE WA 99212

(Signed) Robert R. Britton License No. 0043 (WELL DRILLER) (robert Britton)

Contractor's Registration No. DO-ND-EI *248JE Date 1/21/91 19

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20 (10/87) -1329-

2394

99378

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No W130762
Unique Well I D # AFN494
Water Right Permit No G4-30163P

A

(1) OWNER Name DEGROOT, DAN Address 4701 SCOON RD SUNNYSIDE, WA

(2) LOCATION OF WELL County YAKIMA - NE 1/4 NE 1/4 Sec 2 T 10 N R 22 WM
(2a) STREET ADDRESS OF WELL (or nearest address) 4701 SCOON RD , SUNNYSIDE

(3) PROPOSED USE INDUSTRIAL

(4) TYPE OF WORK Owner's Number of well (If more than one) 1
DEEPENED Method ROTARY

(5) DIMENSIONS Diameter of well 8 inches
Drilled 97 ft. Depth of completed well 880 ft.

CONSTRUCTION DETAILS
Casing installed " Dia from ft to ft
" Dia from ft to ft
" Dia from ft to ft
Perforations NO
Type of perforator used
SIZE of perforations in by in
perforations from ft to ft
perforations from ft to ft
perforations from ft to ft
Screens NO
Manufacturer's Name
Type Model No
Diam Slot size from ft to ft
Diam Slot size from ft to ft
Gravel packed NO Size of gravel
Gravel placed from ft to ft
Surface seal YES To what depth? ft
Material used in seal EXISTING
Did any strata contain unusable water? NO
Type of water? Depth of strata ft
Method of sealing strata off

(7) PUMP Manufacturer's Name
Type H P

(8) WATER LEVELS Land-surface elevation above mean sea level ft
Static level 198 ft below top of well Date 09/06/01
Artesian Pressure lbs per square inch Date
Artesian water controlled by

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

Recovery data
Time Water Level Time Water Level Time Water Level

Date of test / /
Bailer test gal/min ft drawdown after hrs
Airlest 40 gal/min w/ stem set at 420 ft for 1 hrs
Artesian flow g p m Date
Temperature of water Was a chemical analysis made? NO

MATERIAL	FROM	TO
SOFT BASALT GREEN	83	825
CLAY	825	
MEDIUM HARD BASALT	825	860
BASALT HARD	860	880
	880	

(10) WELL LOG

Formation Describe by color, character size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change in formation

DEPT OF ECOLOGY Received SEP 10 2001 CENTRAL REGION OFFICE

Work started 09/05/01 Completed 09/06/01

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

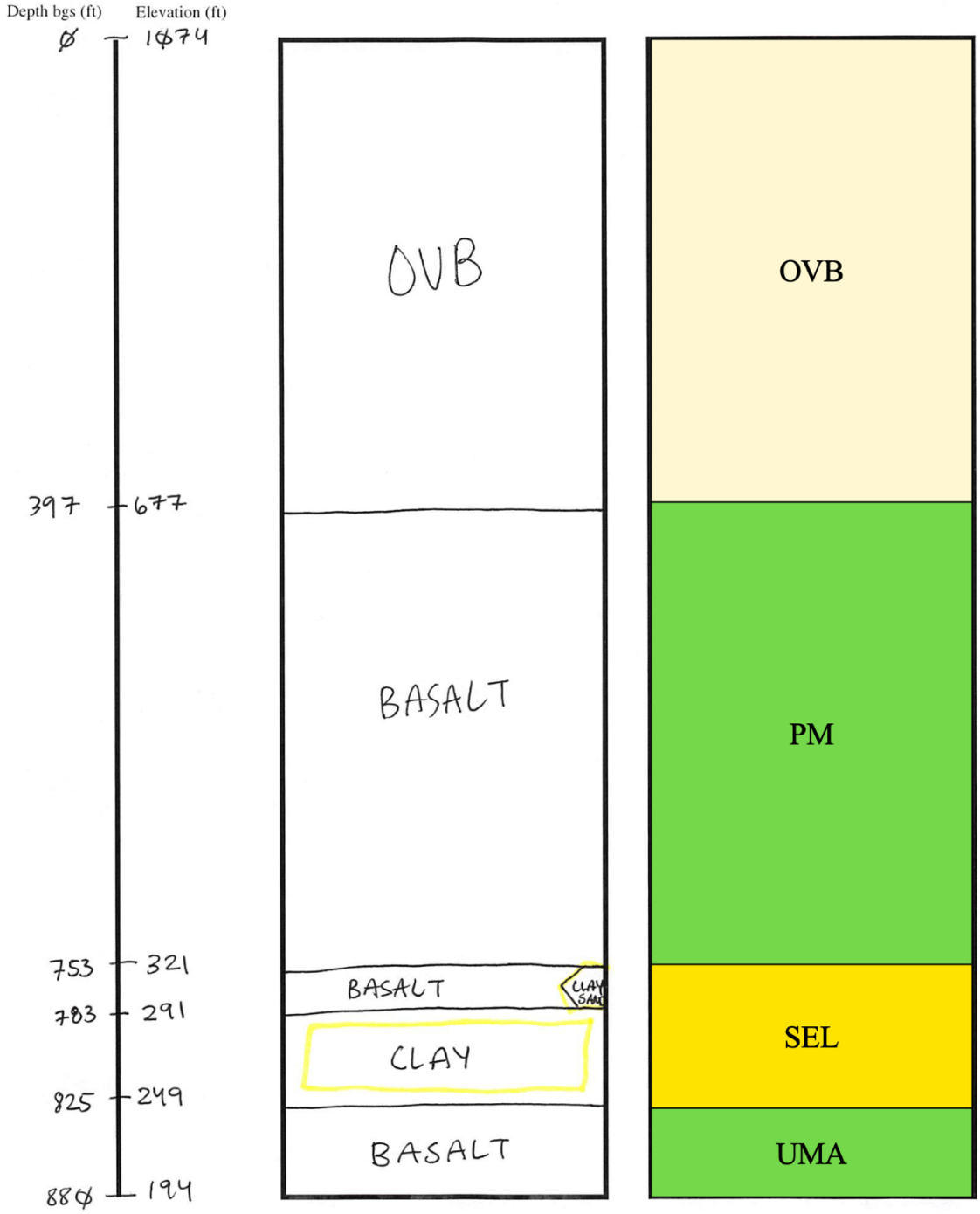
NAME FOGLE PUMP & SUPPLY, INC
(Person, firm, or corporation) (Type or print)

ADDRESS POB 1450, AIRWAY HTS WA

[SIGNED] Marty Rugolak License No 2038

Contractor's Registration No FOGLEPS095L4 Date 09/07/01

Well ID: 2394	Well Name:	Cross Section: B-B
Surface Elevation: 1074 ft	Well Depth: 880 ft	Aquifer: Lower SDMB



2391

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

WATER WELL REPORT
STATE OF WASHINGTON

Application No. 64
Permit No. 0253[illegible]

(1) OWNER: Name Glen M. Shearer Address Rt 2 Box 3116 Sunnyside

(2) LOCATION OF WELL: County Yakima SW ¼ NW ¼ Sec. 1 T. 10 N., R. 22 W.M.
Bearing and distance from section or subdivision corner

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

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

(5) DIMENSIONS: Diameter of well 16" inches.
Drilled 970 ft. Depth of completed well ft.

(6) CONSTRUCTION DETAILS:
Casing installed: " Diam. from ft. to ft.
Threaded ☐ 8" Diam. from 370 ft. to 450 ft.
Welded ☑ 12" Diam. from 0 ft. to 370 ft.

Perforations: Yes ☑ No ☐
Type of perforator used Cutting + Torch
SIZE of perforations ½ in. by in.
3 perforations from 370 ft. to 810 ft.
perforations from 880 ft. to 950 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? 360 ft.
Material used in seal Cement
Did any strata contain unusable water? Yes ☑ No ☐
Type of water? Domestic Depth of strata 810
Method of sealing strata off Cement

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

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 26 ft. below top of well Date 11-22-77
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

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

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

Time	Water Level	Time	Water Level	Time	Water Level

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

(10) WELL LOG:
Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
over Burden	0	10
White Clay + Sand	10	40
Clay Brown + Sand	40	260
Basalt	260	287
Sand + Clay	287	360
Broken Basalt	360	400
Broken Basalt (Grey)	400	460
Very Hard Black Basalt	460	600
" "	600	730
" "	730	750
Broken Basalt	750	760
Broken Basalt	760	807
Green Clay, Sand + Red Rock	807	850
Red Rock + Blue Clay + Basalt	850	870
Basalt Broken + Solid	870	950

Work started 19 Completed 19

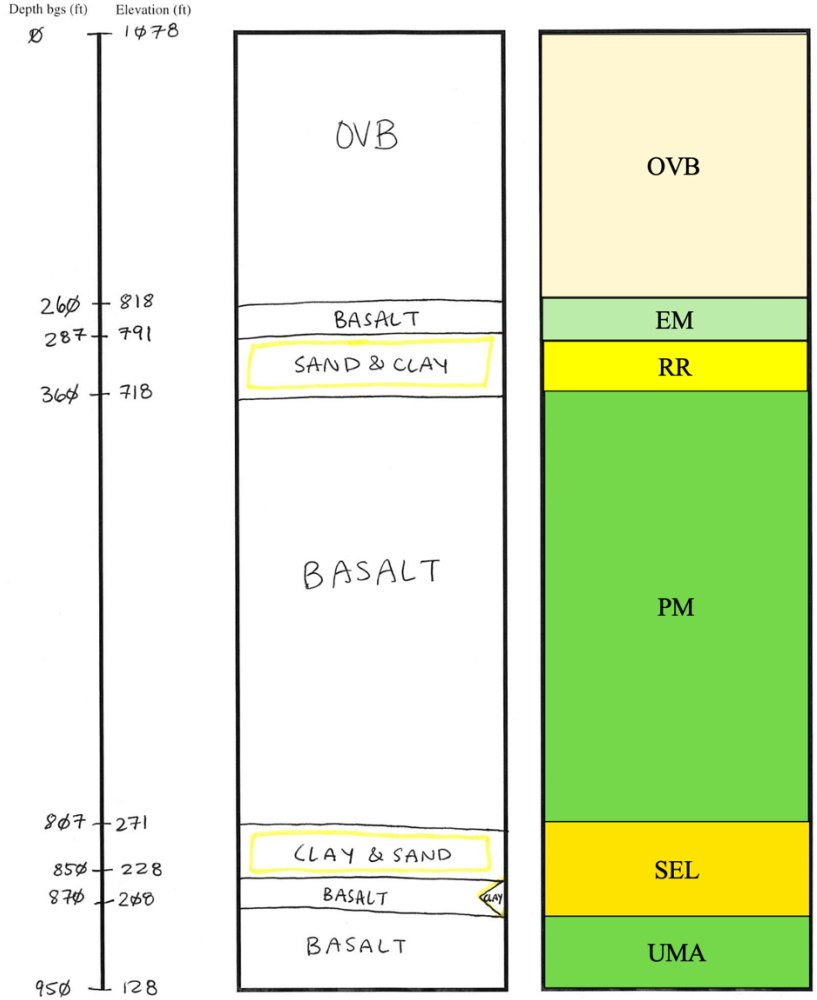
WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME D+R Well Drilling (Person, firm, or corporation) (Type or print)
Address Rt 3 Box 3721
[Signed] (Well Driller)
License No. 389 Date 9-25, 1977

OK

(USE ADDITIONAL SHEETS IF NECESSARY)

Well ID: 2391 Well Name: Cross Section: B-B'
Surface Elevation: 1078ft Well Depth: 950ft Aquifer: Lower SDMB



PAGE #1

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 017724

Water Right Permit No G4-29493P

(1) OWNER: Name Claude P. Minick & John Suhadolnik Address Snipes Road Prosser, WA 99350

(2) LOCATION OF WELL: County Benton NW ¼ 1 ¼ Sec 2 T 9N N. R 24 W M

(2a) STREET ADDDRESS OF WELL (or nearest address) Snipes Road

(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 12 inches. Drilled 655 feet Depth of completed well 985 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 20 " Diam from 0 ft to 20 ft.
Welded ☐ Liner installed ☐ 12 " Diam from 0 ft. to 355 ft.
Threaded ☐ 10 " Diam from 464 ft to 647 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? 355 ft.
Material used in seal cement
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 630 ft. below top of well Date 6/12/88
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
JUN 28 1988
Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Airtest 500 gal./min. with stem set at 970 ft. for 1 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
Soil	0	1
Broken Basalt	1	9
Medium Basalt	9	26
Hard Basalt	26	67
Brown clay and sandstone	67	122
Medium Basalt	122	136
Brown Basalt	136	186
Medium Basalt	186	192
Broken Basalt	192	198
Medium basalt	198	204
Hard Grey Basalt	204	299
Brown Basalt	299	308
Sandstone and clay	308	338
medium basalt	338	355
hard grey basalt	355	360
broken basalt	360	372
brown broken basalt	372	418
hard grey basalt	418	428
brwon broken	428	436
medium basalt	436	472
hard grey basalt	472	528
mahton innerbed	528	628
medium basalt	628	655
medium basalt - broken areas	655	680
broken basalt	680	686
medium basalt	686	691
hard grey	691	699
broken basalt	699	703
hard grey	703	709
broken basalt	709	714
pourous basaltwater	714	721
broken basalt	721	750
wood	750	755
green clay	755	759

Work started 4/27/88 19 Completed 5/28/88 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 BJ EXPLORATION CO., INC. (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address 910 TORO PLACE KENNEWICK, WA 99337
(Signed) (WELL DRILLER) License No 0337
Contractor's Registration No BJEXPC1132QK Date 6-24 19 88

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20 (10/87) -1329- 3

1812

SID 201986

PAGE #2

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

Water Right Permit No G4-29493P

(1) OWNER: Name C. Minick Address

(2) LOCATION OF WELL: County ¼ Sec 2 T 9 N, R 24 W M

(2a) STREET ADDDRESS 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 inches
Drilled feet Depth of completed well ft

(6) CONSTRUCTION DETAILS:
Casing installed: " Diam from ft to ft
Welded ☐ 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? ft
Material used in seal
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? Depth of strata
Method of sealing strata off

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

(8) WATER LEVELS: Land-surface elevation above mean sea level ft
Static level ft below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☐ If yes, by whom?
Yield gal./min with ft drawdown after hrs
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)
Time | Water Level | Time | Water Level | Time | Water Level
Date of test
Bailer test 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
Hard grey basalt	759	765
medium basalt	765	778
hard grey basalt	778	818
hard grey fractured	818	821
hard grey	821	836
broken basalt little water	836	847
medium basalt broken seams	847	866
hard basalt	866	949
black pourous water	949	967
medium basalt	967	985

28 1985

Work started 19 Completed 19

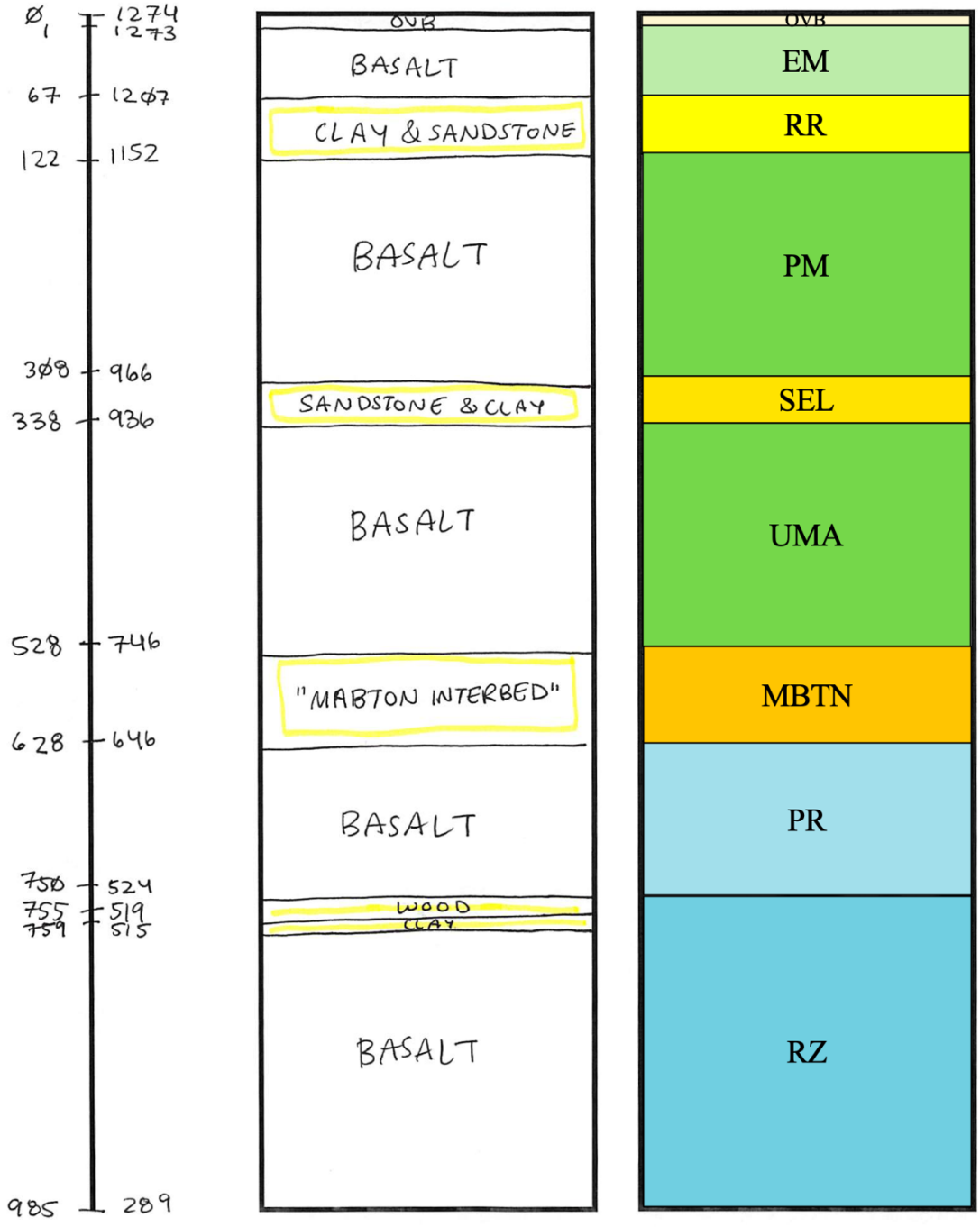
WELL CONSTRUCTOR CERTIFICATION:
I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief

NAME (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address
(Signed) (WELL DRILLER) License No
Contractor's Registration No Date 19

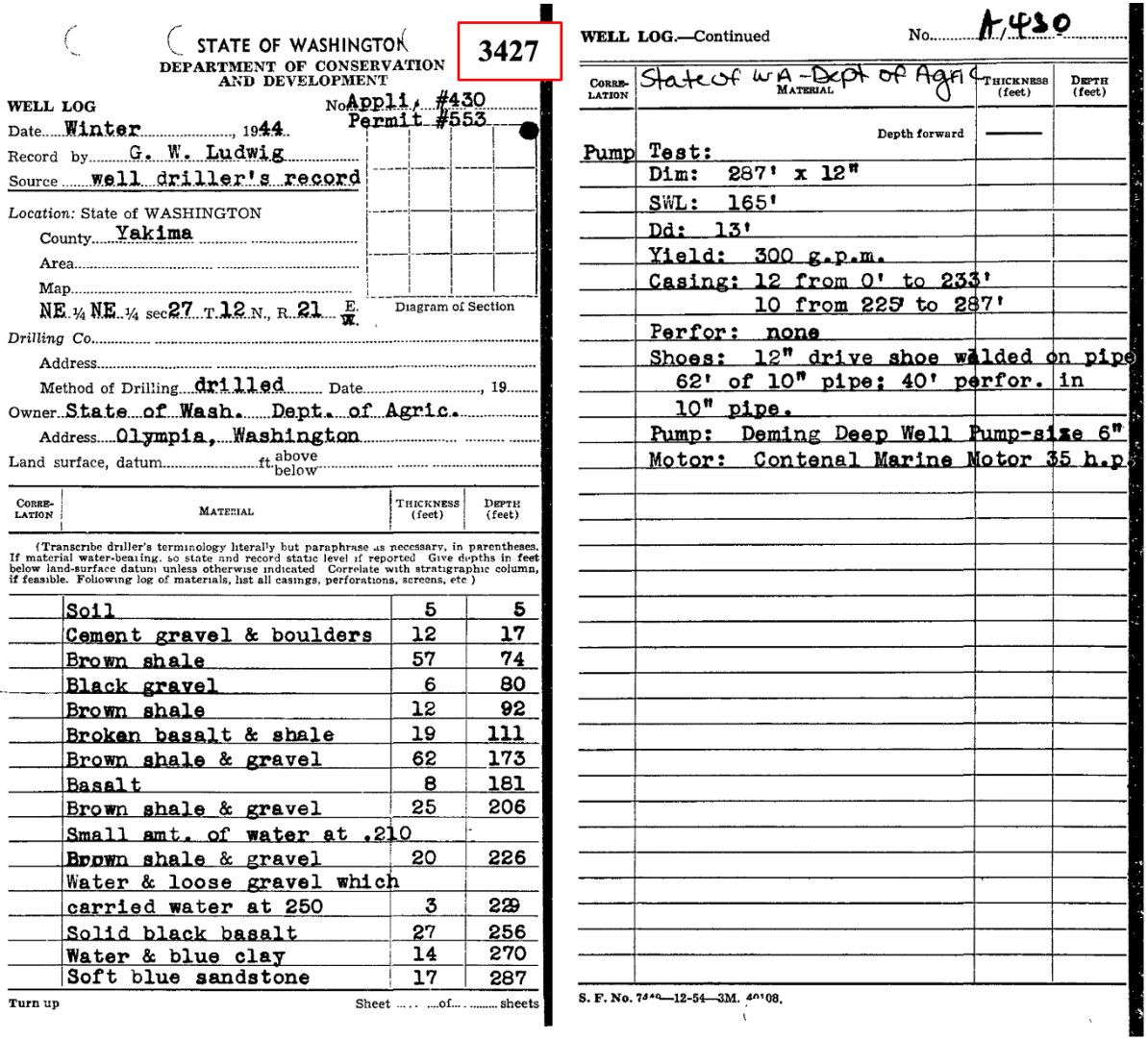
(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20 (10/87) -1329- 3

Well ID: 1812	Well Name:	Cross Section: B-B'
Surface Elevation: 1274ft	Well Depth: 985ft	Aquifer: WNB



Figures A27-A45. Well reports and stratigraphic interpretations of wells in the C-C' cross-section. The abbreviations used to denote stratigraphic members are as follows: OVB = overburden, EM = Elephant Mountain, RR = Rattlesnake Ridge, PM = Pomona, SEL = Selah, UMA = Umatilla, MBTN = Mabton, PR = Priest Rapids, RZ = Roza, SQC = Squaw Creek, FS = Frenchman Springs, VTG = Vantage, and GRB = Grande Ronde.



STATE OF WASHINGTON
DEPARTMENT OF CONSERVATION AND DEVELOPMENT

3427

WELL LOG

No. Appli. #430 Permit #553

Date Winter, 1944.

Record by G. W. Ludwig

Source well driller's record

Location: State of WASHINGTON

County Yakima

Area

Map

NE ¼ NE ¼ sec. 27 T. 12 N., R. 21 E. W.

Diagram of Section

Drilling Co.

Address

Method of Drilling drilled Date , 19

Owner State of Wash. Dept. of Agric.

Address Olympia, Washington

Land surface, datum ft. above / below

CORRELATION	MATERIAL	THICKNESS (feet)	DEPTH (feet)
	(Transcribe driller's terminology literally but paraphrase as necessary, in parentheses. If material water-bearing, so state and record static level if reported. Give depths in feet below land-surface datum unless otherwise indicated. Correlate with stratigraphic column, if feasible. Following log of materials, list all casings, perforations, screens, etc.)		
	Soil	5	5
	Cement gravel & boulders	12	17
	Brown shale	57	74
	Black gravel	6	80
	Brown shale	12	92
	Broken basalt & shale	19	111
	Brown shale & gravel	62	173
	Basalt	8	181
	Brown shale & gravel	25	206
	Small amt. of water at 210		
	Brown shale & gravel	20	226
	Water & loose gravel which carried water at 250	3	229
	Solid black basalt	27	256
	Water & blue clay	14	270
	Soft blue sandstone	17	287

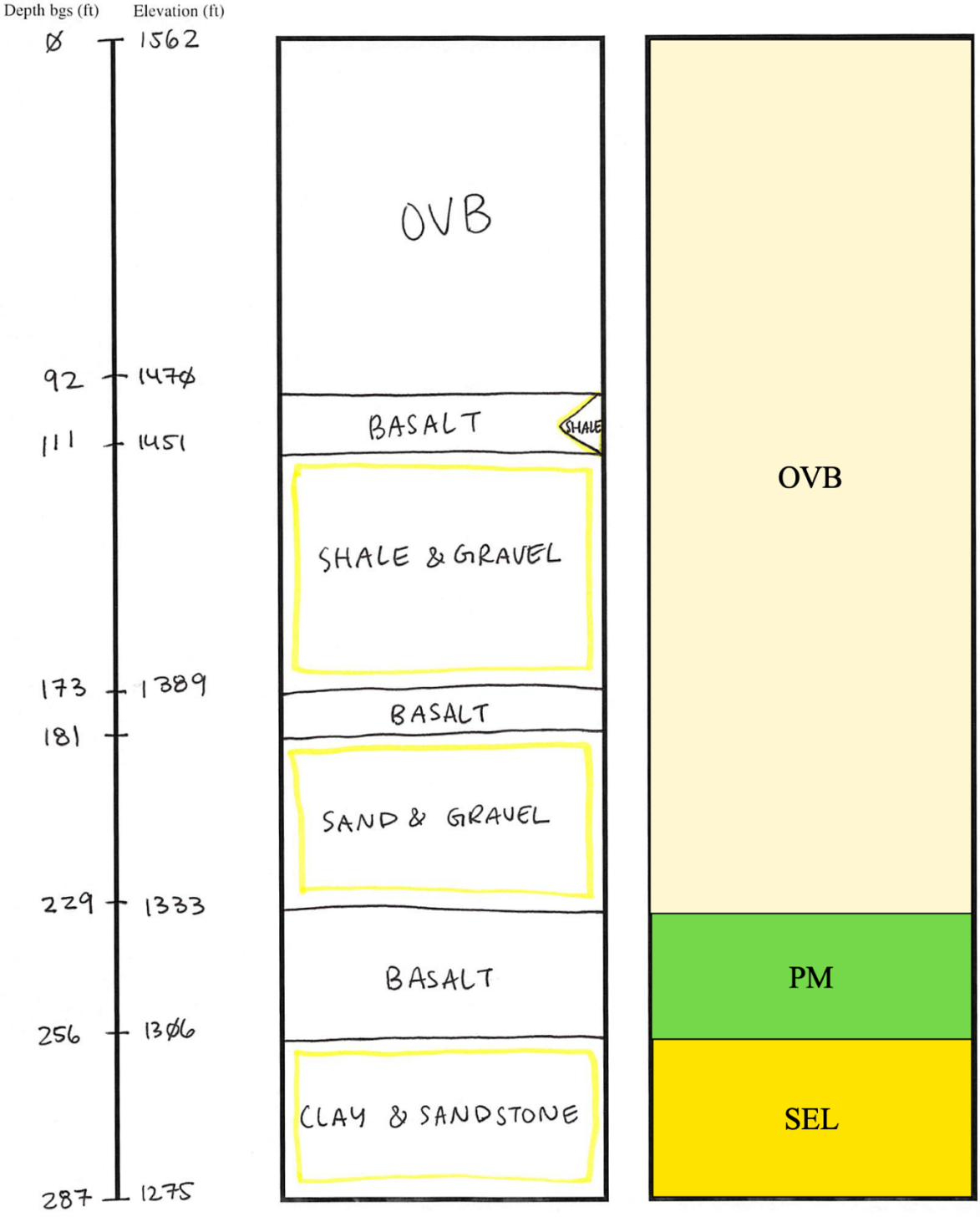
Turn up Sheet ... of ... sheets

WELL LOG.—Continued No. A-430

CORRELATION	MATERIAL	THICKNESS (feet)	DEPTH (feet)
	State of WA - Dept of Agric		
	Depth forward	—	
Pump	Test:		
	Dim: 287' x 12"		
	SWL: 165'		
	Dd: 13'		
	Yield: 300 g.p.m.		
	Casing: 12 from 0' to 233'		
	10 from 225 to 287'		
	Perfor: none		
	Shoes: 12" drive shoe welded on pipe		
	62' of 10" pipe; 40' perfor. in 10" pipe.		
	Pump: Deming Deep Well Pump-size 6"		
	Motor: Contenal Marine Motor 35 h.p.		

S. F. No. 7[illegible]—12-54—3M. [illegible]08.

Well ID: 3427	Well Name:	Cross Section: C-C'
Surface Elevation: 1562ft	Well Depth: 287ft	Aquifer: Lower SDMB



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

File Original with Department of Ecology 35186
Second Copy - Owner's Copy
Third Copy - Driller's Copy

WATER WELL REPORT 3426

STATE OF WASHINGTON

Notice of Intent W044824
UNIQUE WELL I.D. # AEQ606
Water Right Permit No.

(1) OWNER: Name Peter Optekar Address 18170 Hwy 24 Moxee

(2) LOCATION OF WELL: County Yakima SW 1/4 NE 1/4 Sec 25 T 12 N.R. 21 WM

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

TAX PARCEL NO.: 6

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

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

(5) DIMENSIONS: Diameter of well 8 inches
Drilled 429 feet. Depth of completed well 429 ft.

(6) CONSTRUCTION DETAILS
Casing Installed: 8" Diam. from +2 ft. to 390½ ft.
[ ] Welded
[ ] Liner installed " Diam. from ft. to ft.
[ ] Threaded " Diam. from ft. to ft.

Perforations: [ ] Yes [X] No
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.

Screens: [ ] Yes [X] 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 [X] No [ ] Size of gravel/sand
Material placed from ft. to ft.

Surface seal: [X] Yes [ ] No To what depth? 300 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 290 ft. below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? [ ] Yes [ ] No If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
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 75 gal./min. with 390 ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? [ ] Yes [ ] No

ECY 050-1-20 (11/98)

(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	6
Gravel + Boulders	6	26
Sandstone	26	61
Clay + Gravel	61	72
Sandy Clay	72	130
Clay + Gravel	130	154
Sandy Clay	154	157
Clay + Gravel	157	217
Shale Clay Green + Gravel	217	326
Sand Green	326	333
Sand + Gravel	333	375
Basalt Soft	375	378
Basalt	378	429

Work Started 9-13-99 Completed 9-20-99

WELL CONSTRUCTION CERTIFICATION:

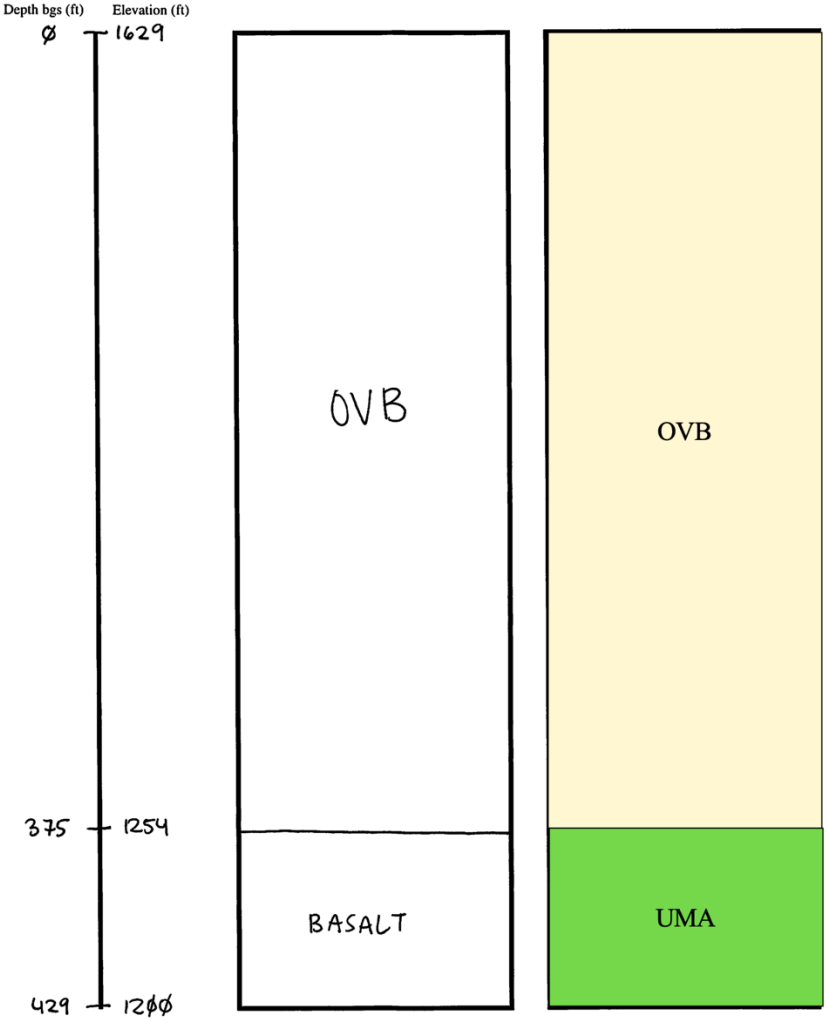
I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Type or Print Name License No.
(Licensed Driller/Engineer)
Trainee Name License No.
Drilling Company Rick Poulin Drilling
(Signed) Rick Poulin License No. 942
(Licensed Driller/Engineer)
Address 1301 Lancaster Selah
Contractor's Registration No. RICKPWD042J2 Date 9-21-99

(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) 407-6600. The TDD number is (360) 407-6006.

Well ID: 3426 Well Name: Cross Section: C-C'
Surface Elevation: 1629ft Well Depth: 429ft Aquifer: LOWER SDMB



[redacted] and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

10125 App# 10125P

WATER WELL REPORT
STATE OF WASHINGTON

GWP# 10558 Application No. G3-00456-P
Permit No.

(1) OWNER: Name Simon Martinez Address

(2) LOCATION OF WELL: County Yakima ¼ ¼ Sec 24 T 12N, R 21E W.M.
ing 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 12 inches.
Drilled ft. Depth of completed well 609 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 16" Diam. from 0 ft. to 196 ft.
Threaded ☐ 12" Diam. from 0 ft. to 320 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? ft.
Material used in seal
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? Depth of strata
Method of sealing strata off

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

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level ft. below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

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

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

Time	Water Level	Time	Water Level	Time	Water Level

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

(10) WELL LOG:
Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Top Soil	0	5
Coarse gravel	5	7
Broken Blk Basalt & Clay	7	8
Sand, Clay, with gravel	8	18
Broken Blk Basalt w/Colitche	18	31
Broken Blk Basalt & Clay	31	35
Broken Blk Basalt Green Shale	35	37
" " " "	37	65
Broken Blk Basalt Grey clay	65	78
Grey Sticky Clay	78	86
Broken Blk Basalt & Grey Clay	86	105
~~Broken Blk Basalt~~ Grey clay	105	108
Broken Blk Basalt Grey clay	108	114
Broken Blk Basalt Green Shale	114	145
Black Basalt	145	152
Black Basalt Green Shale	152	160
Broken Black Basalt (water)	160	162
Blk & Green Basalt	162	164
Broken Blk Basalt	164	215
Black Basalt Hard	215	217
Broken Blk Basalt	217	222
Black Basalt Hard	222	255
Blk Basalt Grey Shale	255	262
Grey clay	262	270
Sandy clay	270	279
Grey clay Sticky	279	282
Grey Sandy clay	282	300
Green Sticky clay	300	325
Broken Blk Basalt (Water)	325	327
Black Basalt	327	339
Dark Grey Basalt Hard	339	367
Grey Basalt Hard	367	514
Red Basalt	514	516
Grey Basalt	516	576
Red Basalt	576	588

Work started 12/23, 19 75 Completed, 19

Stuck

WELL DRILLER'S STATEMENT:

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

Head = 177

NAME (Person, firm, or corporation) (Type or print)
Address
[Signed] (Well Driller)
License No. Date, 19

Copied from daily work sheet by A. L. King DK 5.06.81

ECY 050-1-20 (USE ADDITIONAL SHEETS IF NECESSARY)

Orig—al and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

3424

Page 2

WATER WELL REPORT
STATE OF WASHINGTON

Application No.
Permit No

(1) OWNER: Name SIMON MARTINEZ Address

(2) LOCATION OF WELL: County ¼ ¼ Sec 24 T 12 N, R 21 W.M.
ing 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 inches.
Drilled ft. Depth of completed well ft.

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

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

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

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

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

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

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level ft. below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

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

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

Time	Water Level	Time	Water Level	Time	Water Level

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

(10) WELL LOG:
Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Grey Basalt	588	603
No Cuttings	603	605
Grey Basalt Hard	605	606
No cuttings	606	609

Work started, 19 Completed, 19

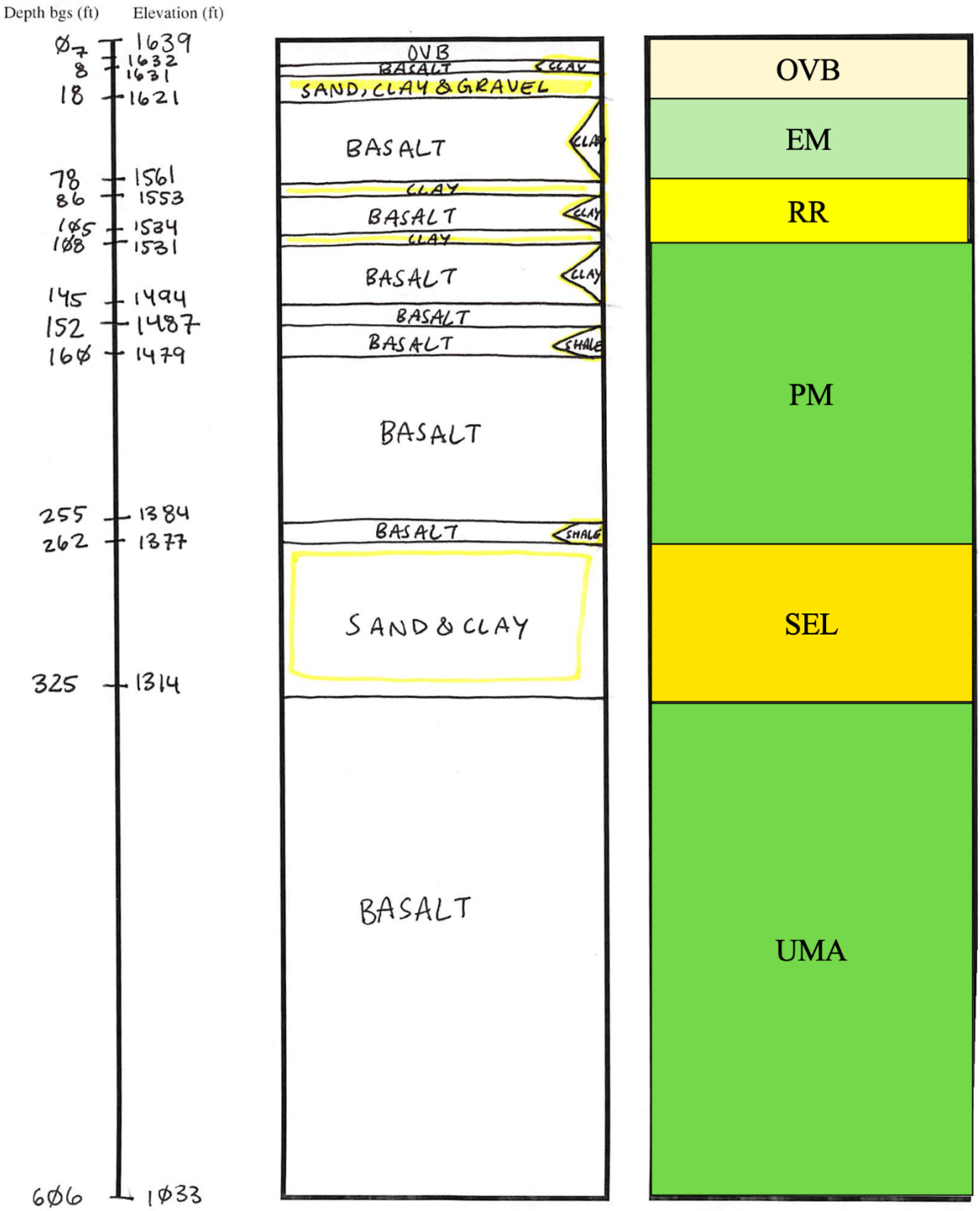
WELL DRILLER'S STATEMENT:

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

NAME (Person, firm, or corporation) (Type or print)
Address
[Signed] (Well Driller)
License No. Date, 19

(USE ADDITIONAL SHEETS IF NECESSARY)

Well ID: 3424	Well Name:	Cross Section: C-C'
Surface Elevation: 1639ft	Well Depth: 606 ft	Aquifer: LOWER SDMB



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

Page (1) Martinez

WATER WELL REPORT
STATE OF WASHINGTON

Application No.
Permit No. G3211158P

(1) OWNER: Name Simon Martinez Address Moxee - Rt 1 Box 2405A 98936

(2) LOCATION OF WELL: County Yakima NW ¼ SE ¼ Sec 22 T. 12 N., R 21 E.W.M.
Bearing and distance from section or subdivision corner All of Sec 23 T 12N R 21 E.W.M.

(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 20 (16 liner) inches. Drilled 662 ft. Depth of completed well 662 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 24 liner " Diam. from 0 ft. to 2015 ft.
Threaded ☐ 20 " Diam. from 0 ft. to 2405 ft.
Welded ☒ 16 " Diam. from 0 ft. to 491 ft.
12 Diam from 460 662
Perforations: Yes ☒ No ☐
Type of perforator used Torch
SIZE of perforations ¼ to ½ in. by 6-8 in.
577 ft. to 617 ft. perforations from
perforations from ft. to ft.
perforations from ft. to ft.
Screens: Yes ☐ No ☒
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.
Gravel packed: Yes ☐ No ☒ Size of gravel:
Gravel placed from ft. to ft.
Surface seal: Yes ☒ No ☐ To what depth? 18 ft.
Material used in seal Bentonite - Plug cement Casing
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 86 ft. below top of well Date 10-30-80
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? Agri Service
Yield: 2159 gal./min. with 170 ft. drawdown after 4 hrs.
" Pump Set 340' 10" Bowls 10' Column "
" " " "
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
	Immediate Recovery				

Date of test 10-30-80
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water 70° Was a chemical analysis made? Yes ☐ No ☒

(10) WELL LOG: L

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Topsoil	0	2
Rocks, Boulders	2	7
Cemented Gravel	7	27
Caved Brown Clay	27	31.5
Blue Clay w/ Interbedded gravel	31.5	41
Hard Gravel/Broken Rock	41	42
Blue Shale/Gravel	42	46
Gravel	46	48.5
Black Broken Rock (Basalt)	48.5	51
Shale/gravel, Sand, Some Black Rock	51	62
Gravel, Blue clay, Shale, Black Rock	62	72
Blue clay, Shale, Broken Rock	72	92
Blue clay, gravel	92	100
Sticky Blue/Green clay, gravel	100	106
Clay, Gravel, Black Broken Rock	106	114
Black Sand, Gravel, Black Broken Rock	114	125
Black Broken Basalt	125	126
Green Clay	126	144
Blue Sand	144	157
Green Sand/Shale	157	170
Dark grey Sand, Gravel	170	173
Blue Sand, gravel	173	178
Gravel w/ some Sand	178	182
Black Broken Rock	182	183.5
Gravel w/ Sand	183.5	189
Green/Blue Shale w/ Sand	189	194
Blue Sand	194	200
Sand, gravel	200	201
Sand, gravel, Boulders	201	216
White Shale, gravel, Limestone	216	241
Black Broken Rock (water) Basalt 76	241	254
Black Basalt	254	273
Black Broken Basalt	273	277.5
Black Basalt	277.5	298
Dark Grey Basalt	298	309
Black Broken Basalt	309	332

Work started 19 Completed 19

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Sauk Well Drilling (Person, firm, or corporation) (Type or print)
Address Rt 1 Box 2905 Zillah Wa. 98953
[Signed] Tom Shipman (Well Driller)
License No. 0934 Date 10-31 1980

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

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

3421

Page (2) Martinez

WATER WELL REPORT
STATE OF WASHINGTON

Application No.
Permit No.

(1) OWNER: Name S. Martinez Address

(2) LOCATION OF WELL: County NE ¼ SW ¼ Sec 22 T. 12 N., R 21 W.M.
Bearing and distance from section or subdivision corner

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

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

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

(6) CONSTRUCTION DETAILS:
Casing installed: " Diam. from ft to ft
Threaded ☐ " Diam. from ft to ft
Welded ☐ " Diam. from ft to ft
Perforations: Yes ☐ No ☐
Type of perforator used
SIZE of perforations in by in.
perforations from ft to ft
perforations from ft to ft
perforations from ft to ft
Screens: Yes ☐ No ☐
Manufacturer's Name
Type Model No.
Diam Slot size from ft to ft
Diam Slot size from ft to ft
Gravel packed: Yes ☐ No ☐ Size of gravel
Gravel placed from ft to ft
Surface seal: Yes ☐ No ☐ To what depth? ft.
Material used in seal
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? Depth of strata
Method of sealing strata off

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

(8) WATER LEVELS: Land-surface elevation above mean sea level ft
Static level ft below top of well Date
Artesian pressure lbs per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

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

Time	Water Level	Time	Water Level	Time	Water Level

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

(10) WELL LOG:

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Black Broken Basalt	309	332
Black Broken Basalt (water) Static 62'	332	346
Black Broken Basalt w/ Blue green clay	346	367
Sticky Green Clay	367	378.5
Blue/green clay w/ Black Broken Basalt	378.5	381.5
Black Broken Basalt	381.5	437
Blue/Green Clay	437	441
Black Broken Basalt, Boulders, Blue Clay and Shale	441	457
Black Broken Basalt w/ some green clay	457	459
Sticky Green Clay	459	472
Black Broken Basalt	472	473
Sand, Gravel, Broken Basalt	473	475.5
Green Caving shale	475.5	481
Black Broken Basalt (some water?)	481	495
Black Basalt Static 62'	496	510
Grey Sandstone	510	514
Black Broken Rock	514	517.5
Boulders w/ Blue shale partially cemented	517.5	523
Light green clay w/ Blue green shale	523	539
Dk green shale w/ gravel	539	543
Dk green/Black Sticky clay	543	545
Black Broken Rock	545	554
Brown and Black Broken Rock w/ Blue green Shale	554	562
Black Broken Rock w/ Blue/green shale	562	570
Black Broken Rock - some vesicular water (Static 90')	570	594
Black Broken Rock w/ some Blue/green Shale	594	597
Black Broken Rock	597	599
Black Broken Rock some vesicular (Static 90')	599	602
Black Broken Rock w/ Blue/green shale	602	603.5
Black Broken Rock, some vesicular heavy with Pyrites and some quartz	603.5	605
Large Boulders (Black Basalt) Broken well	605	611
Weathered, vesicular w/ quartz crust 10' dia		
Work started 19 Completed 875) 19		

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME (Person, firm, or corporation) (Type or print)
Address
[Signed] (Well Driller)
License No. Date , 19

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

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

3421

WATER WELL REPORT

Page (3) Martinez

STATE OF WASHINGTON

Application No

Permit No.

(1) OWNER: Name S. Martinez Address

(2) LOCATION OF WELL: County — NE ¼ SW ¼ Sec. 22 T 12 N, R 21 WM

Bearing and distance from section or subdivision corner

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

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

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

(6) CONSTRUCTION DETAILS:

Casing installed: " Diam. from ft. to ft.
Threaded ☐ " Diam. from ft. to ft.
Welded ☐ " Diam. from ft. to ft.

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

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

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

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

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

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level ft below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

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

Time	Water Level	Time	Water Level	Time	Water Level

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

(10) WELL LOG:

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Brown Broken Rock-well bonded vesicular	611	617
Black Broken Rock-some vesicular small amount blue/green clay		
Static 87'	617	621
Brown Broken Rock-vesicular Static 87'	621	622
Brown and Black Broken Rock-highly vesicular w/some quartz and pyrites-extremely weathered and irregular - Static 87	622	628
Black and Brown Broken Rock - vesicular - Static 86.5'	628	634.5
Black Broken Rock-harder, but Partly vesicular	634.5	643
Black Broken Rock-some vesicular w/small amount blue/green Shale Static 86.5	643	647
Black Broken Rock chunks of Rounded Shale (green) Static 87'	647	649
Green Shale w/Black Broken Rock Fragments vesicular Soft	649	651
Black Broken Rock w/some Blue/green shale	651	654
Blue/green Shale	654	659
Black Broken Rock w/Some Blue/green shale - Static 86'	659	662

Work started, 19 Completed, 19

WELL DRILLER'S STATEMENT:

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

NAME (Person, firm, or corporation) (Type or print)

Address

[Signed] (Well Driller)

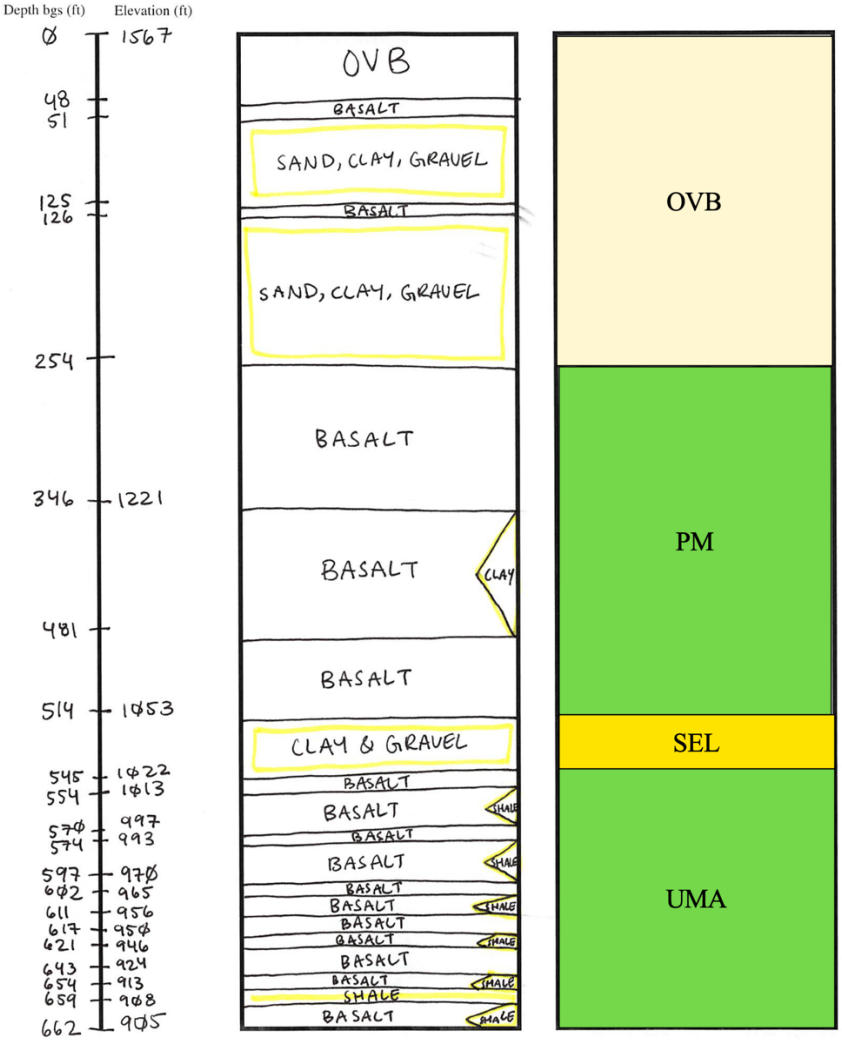
License No. Date, 19

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

Well ID: 3421 Well Name: Cross Section: C-C'

Surface Elevation: 1567ft Well Depth: 662ft Aquifer: LOWER SDMB



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3420

WATER WELL REPORT
STATE OF WASHINGTON

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

(1) **OWNER:** Name Kim Stiles Address 620 So 15th Ave Yakima 9890

(2) **LOCATION OF WELL:** County Yakima SW ¼ NE ¼ Sec. 22 T. 12 N., R. 21 E W.M.
Bearing and distance from section or subdivision corner

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

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

(5) **DIMENSIONS:** Diameter of well 6 inches.
Drilled 252 ft. Depth of completed well 252 ft.

(6) **CONSTRUCTION DETAILS:**
Casing installed: 6 " Diam. from 0 ft. to 203 ft.
Threaded [ ] " Diam. from ft. to ft.
Welded [X] " Diam. from ft. to ft.

Perforations: Yes [ ] No [X]
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes [ ] No [X]
Manufacturer's Name
Type Model No
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes [ ] No [X] Size of gravel:
Gravel placed from ft. to ft.

Surface seal: Yes [X] No [ ] To what depth? 190 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes [ ] No [X]
Type of water? Depth of strata
Method of sealing strata off

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

(8) **WATER LEVELS:** Land-surface elevation above mean sea level .... ft.
Static level 112 ft. below top of well Date Dec 19, 78
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) **WELL TESTS:** Drawdown is amount water level is lowered below static level
Was a pump test made? Yes [X] No [ ] If yes, by whom? Eastwood
Yield: 10 Ft Cas gal./min. with ft. drawdown after hrs.
" 75 " from 252 " "
" 50 " " 175 " "
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 Dec 18, 78
bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes [ ] No [X]

(10) **WELL LOG:** G

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Topsoil	0	10
Clay & Gravel layers	10	45
Shale & Gravel	45	195
Gravel	195	198
Basalt, Block	198	255

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JAN 31 1979
DEPARTMENT OF ECOLOGY
CENTRAL REGIONAL OFFICE

Work started Dec 15, 19 78 Completed Dec 19, 19 78

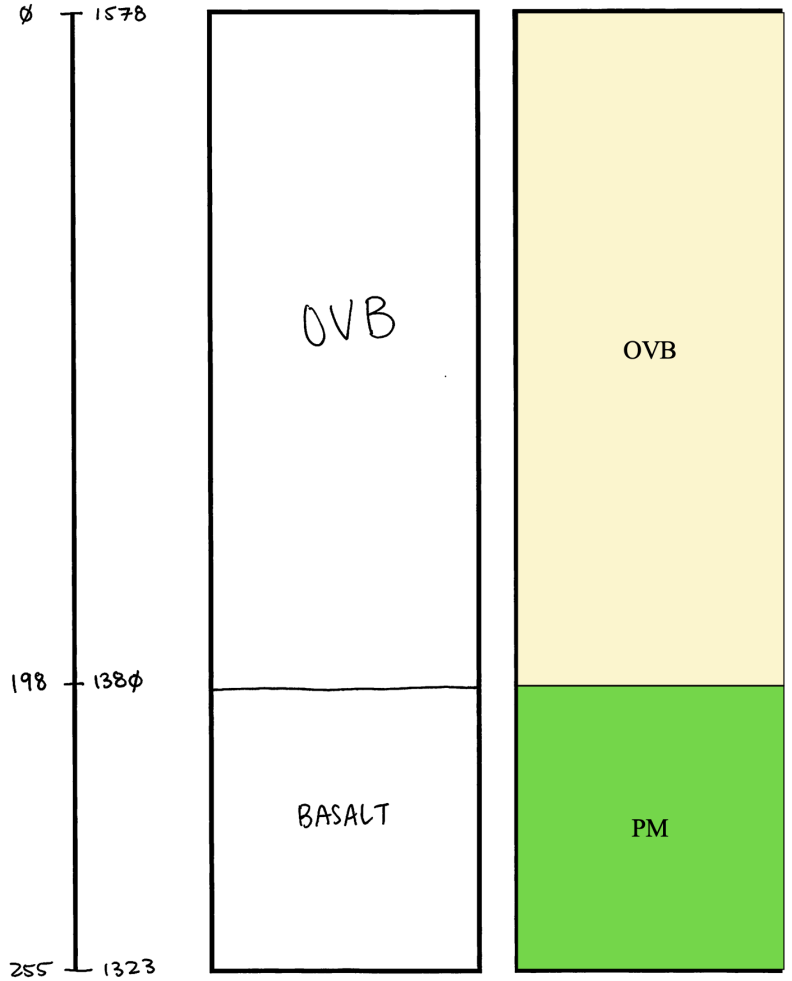
WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Eastwood Drilling Inc. (Person, firm, or corporation) (Type or print)
Address 2202 River Road - Yakima
[Signed] Clyde M Eastwood (Well Driller)
License No. 0413 Date Dec 21, 1978

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

Well ID: 342ϕ Well Name: Cross Section: C-C'
Surface Elevation: 1578ft Well Depth: 255ft Aquifer: Lower SDMB



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3411

WATER WELL REPORT

STATE OF WASHINGTON

Application No. 54-26362

Permit No. ....

(1) OWNER: Name ROGER HART Address RT 1 BOX 205 H

(2) LOCATION OF WELL: County YAKIMA NE ¼ SW ¼ Sec 21 T 12 N., R 21E W.M.

ring and distance from section or subdivision corner

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

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

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

(5) DIMENSIONS: Diameter of well 8 inches. Drilled 782 ft. Depth of completed well 782 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 10 " Diam. from +1 ft. to 20 ft.
Threaded ☐ 8 " Diam. from +2 ft. to 561 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 ☐ (RAN ON 60' OF 7")
Manufacturer's Name JOHNSON
Type 25 SLT.S.S. WIRE Model No 8" TELESC.
Diam. 6 7 5/8 Slot size 25 from 772 ft. to 782 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 CEMENT (10")
Did any strata contain unusable water? Yes ☒ No ☐
Type of water? SANDY Depth of strata 21
Method of sealing strata off CASED

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

(8) WATER LEVELS: Land-surface elevation above mean sea level ....
Static level 86 ft. below top of well Date 8/31/79 ft.
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

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

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

Time	Water Level	Time	Water Level	Time	Water Level

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

RECEIVED
DEPARTMENT OF ECOLOGY
CENTRAL REGIONAL OFFICE

(10) WELL LOG: L

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
TOP SOIL	0	6
CLECHE TYPE CEMENT GRAVEL	6	8
MOXEE SILT,SAND,GRAVEL,CONGLOMERATE	8	21
DEC. ROCK & BLDRS.	21	35
CEMENT GRAVEL & BLDRS.	35	63
HD.TAN CLAY & GRAVEL & BLDR LNS.	63	90
CREV. BROKEN GRAY BASALT	90	128
GRAY ANDESITIC CREV,BASALT & SCOR.	128	170
GRAY & BLACK SHALE. SLOUGHING BADLY	170	188
LIGHT TAN CONGLOMERATE " "	188	202
GRAY CREV. BASALT & BLK SHALE	202	212
GRAY CREV. BASALT (V.H. & FAULTED	212	368
LITE TAN SANDY CLAY(P.U.W. FR.300)	368	398
BLUE SANDSTONE & SAND T.R. WATER	398	406
BLUE & TAN SAND,CLAY SHALE & GRAVEL	406	498
TAN CLAY,GRAVEL & SAND (400GPM)	498	556
GRAY BASALT & CLAY (BROKEN)(FRACT	556	558
BROKEN BASALT W. SHALE	558	602
FRACT. GRAY BASALT	602	727
BLUE SANDY CLAY SHALE	727	772
BLUE SAND & WATER	772	780
BLK BROKEN ROCK & SAND(COURSE)	780	782
10' OF		
SCREENS, SET HERE ON 60' OF .365 WALL 7" I.D.		
RISER & FACTORY PACKER & LEFT HAND BACK OFF		
NIPPLE.		
SEE DAY LOGS		
WELL ON DEVELOPING PROD. IN EXCESS OF 800 GPM		
@ 780' WITH AIR LIFT & APROX. 300 GPM @ 300'		

Work started 8/6/79 19 Completed 8/31/79 19

WELL DRILLER'S STATEMENT:

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

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

Address YAKIMA, WASH.

[Signed] John Riebe (Well Driller)

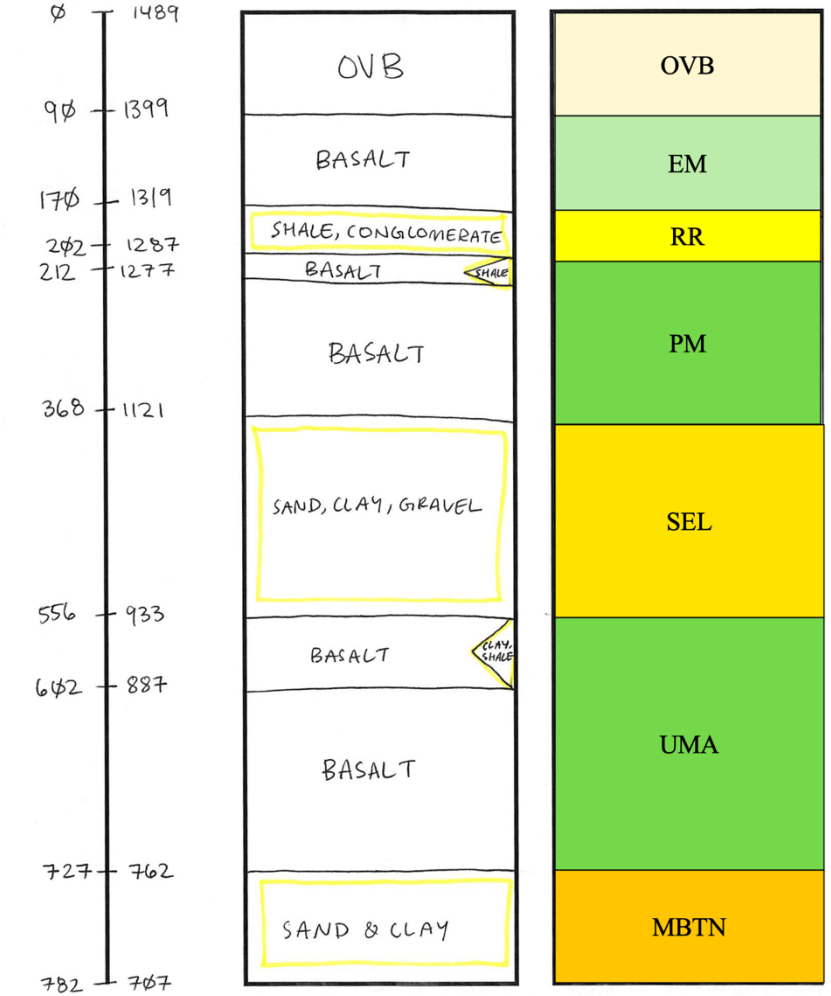
License No. 421 Date 9/5/79 19

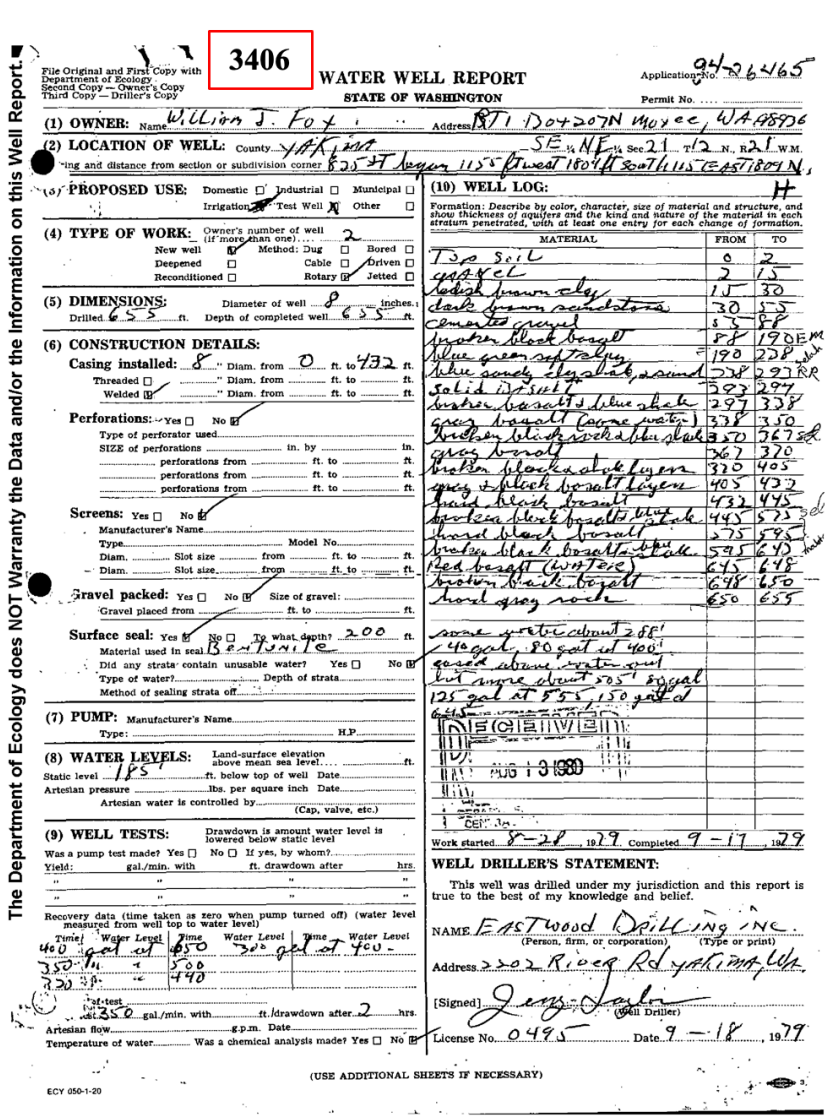
(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

Well ID: 3411 Well Name: Cross Section: C-C'

Surface Elevation: 1489ft Well Depth: 782ft Aquifer: WNB





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3406

WATER WELL REPORT
STATE OF WASHINGTON

Application No. 94-26465
Permit No.

(1) OWNER: Name William J. Fox Address RT 1 Box 207N Moxee, WA 98936

(2) LOCATION OF WELL: County Yakima SE ¼ NE ¼ Sec. 21 T. 12 N. R. 21 W.M.
Bearing and distance from section or subdivision corner 825 ft bogan 1155 ft west 1804 ft south 1155 ft east 1804 ft N.

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

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

(5) DIMENSIONS: Diameter of well 8 inches.
Drilled 655 ft. Depth of completed well 655 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 8 " Diam. from 0 ft. to 432 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? 200 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 185 ft. below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

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

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

Time	Water Level	Time	Water Level	Time	Water Level
460	gal at	450	300	gal at	460
350	"	500			
320	"	440			

Test data: 350 gal./min. with 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
Top soil	0	2
gravel	2	15
redish brown clay	15	30
dark brown sedistone	30	55
cemented gravel	55	88
broken black basalt	88	190 EM
blue green soft clay	190	228
blue sandy shale & sand	228	293 RR
solid basalt	293	297
broken basalt & blue shale	297	338
grey basalt (some water)	338	350
broken black rock & blue shale	350	367 SEL
grey basalt	367	370
broken black rock & clay layers	370	405
grey & black basalt layers	405	432
hard black basalt	432	445
broken black basalt & blue shale	445	575 UMA
hard black basalt	575	595
broken black basalt & blue shale	595	645
red basalt (water)	645	648
broken dark basalt	648	650
hard grey rock	650	655
some water about 288'		
40 gal. 80 gal at 400'		
gased above water sand		
but more about 505' 80 gal		
125 gal at 555', 150 gal at		

RECEIVED
AUG 13 1980

Work started 8-28 1979 Completed 9-17 1979

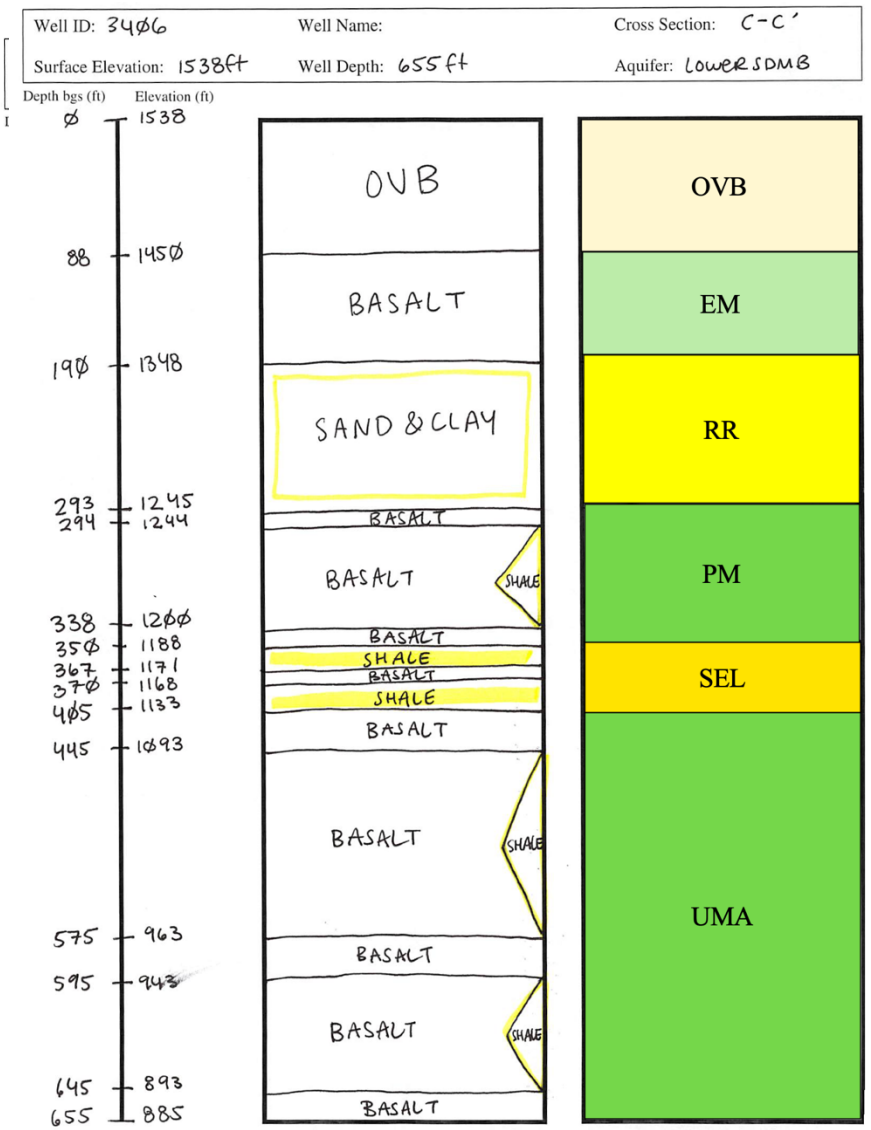
WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME EASTWOOD DRILLING INC. (Person, firm, or corporation) (Type or print)
Address 2202 River Rd Yakima, Wa
[Signed] (Well Driller)
License No. 0495 Date 9-18 1979

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

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



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3404

WATER WELL REPORT
STATE OF WASHINGTON

Application No. G3212698
Permit No.

(1) OWNER: Name Gary Guillemaud Address

(2) LOCATION OF WELL: County ... NW¼ NW¼ Sec. 9 T. 12 N. R. 20 E.
and distance from section or subdivision corner 21 12 21

(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 inches
Drilled 732 ft. Depth of completed well ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 8 " Diam. from 0 ft. to 482 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? 482 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 80 ft. below top of well Date 7-20-80
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
350 GPM	A 730				
100	" 300				
	" 200				

Test conducted by
Bailer test 350 gal/min with 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
0 SOIL	0	4
cemented GRAVEL	4	20
SAND STONE	20	37
cemented GRAVEL	37	45
SAND STONE	45	58
cemented gravel & clay LAYERS	58	113
cemented gravel	113	220
BLACK basalt (some water)	220	238
soft tan clay (15 gpm)	238	263
soft sand & clay	263	303
soft clay & gravel layers	303	313
gravel not cemented	313	338
soft clay sandy gravel loam	338	363
& sandstone layers	363	403
broken basalt	403	413
hard gray basalt	413	492
black basalt blue shale layers	492	705
h water 150 gpm at 680		
black basalt blue shale layers	705	725
black cracked basalt	725	732
picked up more water at 720		

RECEIVED JUL 14 1980 DEPT. OF ECOLOGY CENTRAL REGIONAL OFFICE

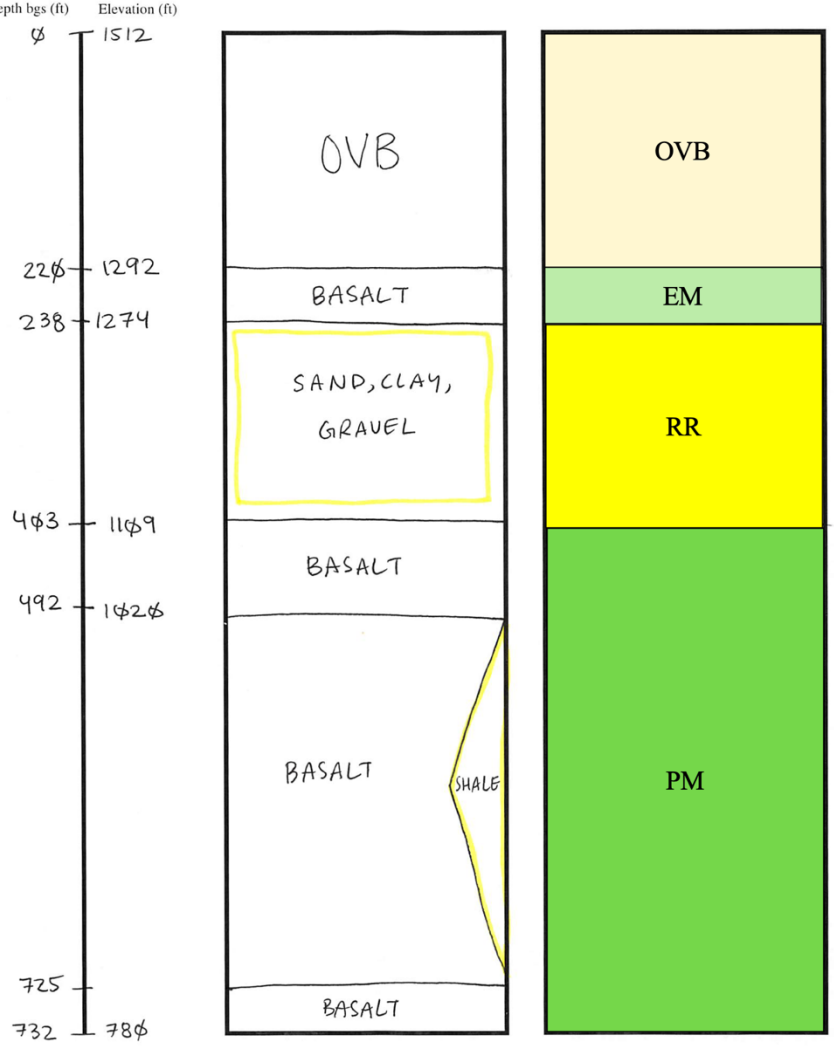
Work started 3-4 1980 Completed 3-20 1980

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 EAST WOOD DRILLING INC (Person, firm, or corporation) (Type or print)
Address 2202 RIVER RD YAKIMA WA
[Signed] (Well Driller)
License No. 0485 Date 7-20 1980

(USE ADDITIONAL SHEETS IF NECESSARY)

Well ID: 34Ø4 Well Name: Cross Section: C-C'
Surface Elevation: 1512ft Well Depth: 732 ft Aquifer: LOWERSOMB



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

3402

WATER WELL REPORT
STATE OF WASHINGTON

Application No. [illegible]
Permit No.

(1) OWNER: Name Tom Montgomery Address 804 E. West Viola, Yakima

(2) LOCATION OF WELL: County Yakima NE ¼ NW ¼ Sec 21 T 12 N. R. 21 E W.M.
Bearing and distance from section or subdivision corner

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

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

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 580 ft. Depth of completed well 580 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6 " Diam. from 0 ft. to 472 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 clay
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? Depth of strata
Method of sealing strata off

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

(8) WATER LEVELS: Land-surface elevation above mean sea level
Static level 450 ft. below top of well Date 5-27-77
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

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

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

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test 12 gal./min. with 125 ft. drawdown after 1 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☒

(10) WELL LOG:
Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Soil, Brn. Sandy	0	3
Soil, Dk Brn. Sandy	3	90
Clay, Dk. Brn.	90	130
Basalt, Blk., Fractured	130	260
Basalt, Brn. Med. Hard	260	275
Basalt, Blk. Hard	275	290
Sandstone, Brn, Soft	290	310
Sandstone, White	310	320
Sandstone, Gravel, Aggatized	320	377
Sandstone, Gravel, Small	377	390
Sand, Lt., Brn. Med.	390	466
Basalt, Blk., Hard	466	570
Basalt, Fractured, WB	570	580

RECEIVED
AUG 5 1977
DEPARTMENT OF ECOLOGY
CENTRAL REGIONAL OFFICE

Work started 5-17-77 19 Completed 5-27-77 19

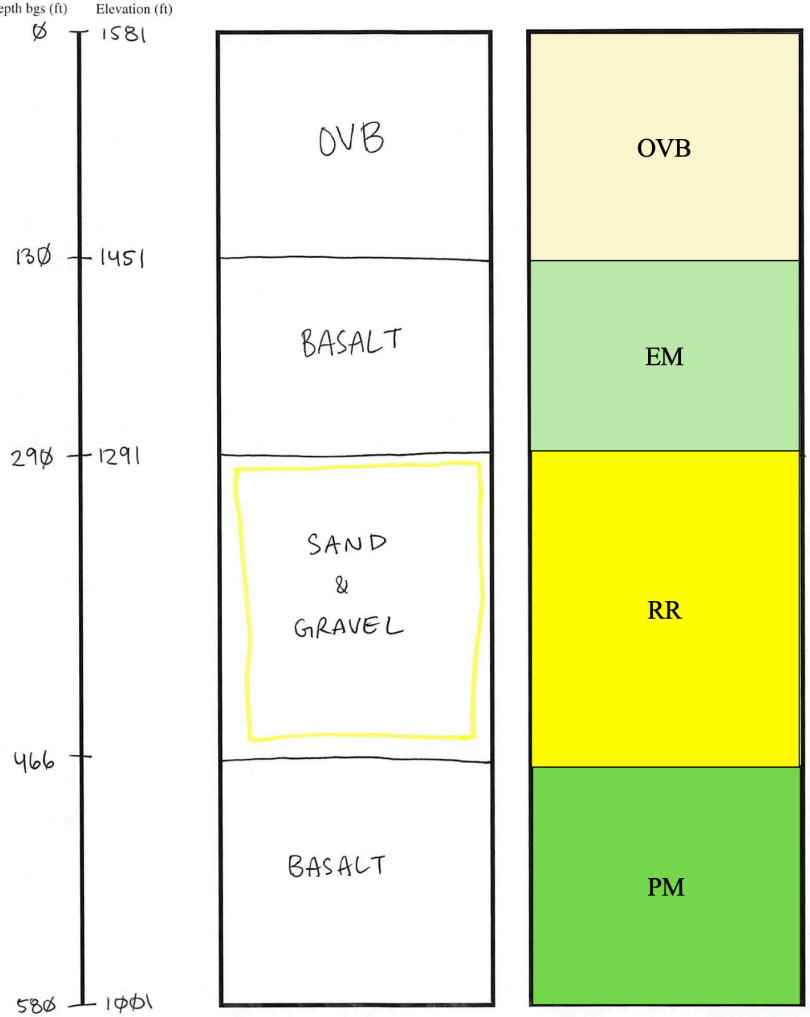
WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME B & B Well Drilling (Person, firm, or corporation) (Type or print)
Address Rt. 7 Box 600-A, Yakima, Wash. 989[illegible]
[Signed] Harvey Blackman (Well Driller)
License No. 0037 Date 6-3-77 19

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

Well ID: 3402 Well Name: Cross Section: C-C'
Surface Elevation: 1581 ft Well Depth: 580 ft Aquifer: Lower SDMB



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

3400

WATER WELL REPORT
STATE OF WASHINGTON

Application No. 63-20392
Permit No. 63-20392P

(1) OWNER: Name HENDERSON Address

(2) LOCATION OF WELL: County — NW¼ NE¼ Sec. 21 T. 12 N., R. 21 W.M.
ng and distance from section or subdivision corner B

(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 10" inches.
Drilled 624 ft. Depth of completed well 624 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 10" Diam. from 0 ft. to 285 ft.
Threaded ☐ 8" Diam. from 285 ft. to 405 ft.
Welded ☐ 6" Diam. from 576 ft. to 624 ft.

Perforations: Yes ☒ No ☐
Type of perforator used
SIZE of perforations in. by in.
perforations from 576 ft. to 624 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? ft.
Material used in seal
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? Depth of strata
Method of sealing strata off

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

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level ft. below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

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

Time	Water Level	Time	Water Level	Time	Water Level

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

(10) WELL LOG:
Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
DIRT & BOULDERS	0	150
GRAVEL	150	200
GRAVEL & SAND	200	250
CLAY & SAND	250	310
WHITE CLAY	310	318
Lt. BROWN CLAY & SAND	318	360
BASALT (WATER)	360	390
Tp FRACT. BLACK BASALT	390	406
BLACK BASALT W/ HARD BLUE CLAY	406	415
DARK GREY BASALT	415	440
DARK GREY BASALT (FIRM)	440	466
466 FRACT. GREY BASALT	466	515
HARD GREY BASALT	515	545
GNEISS	545	548
HARD GREY BASALT	548	567
GREY TO GREEN CLAY	567	624
SAND	624	

Work started 19 Completed 19

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME TAKEN FROM GRAPIC LOG WC
(Person, firm, or corporation) (Type or print)

Address

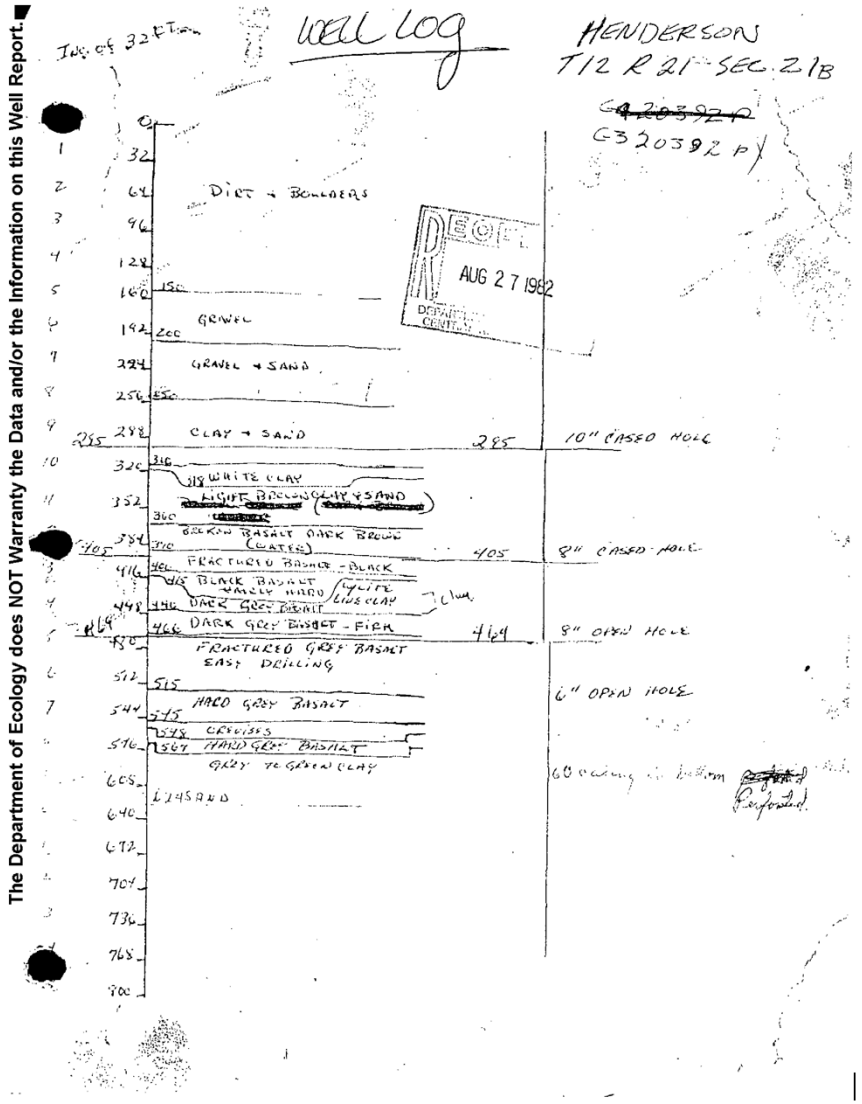
[Signed]
(Well Driller)

License No. Date 19

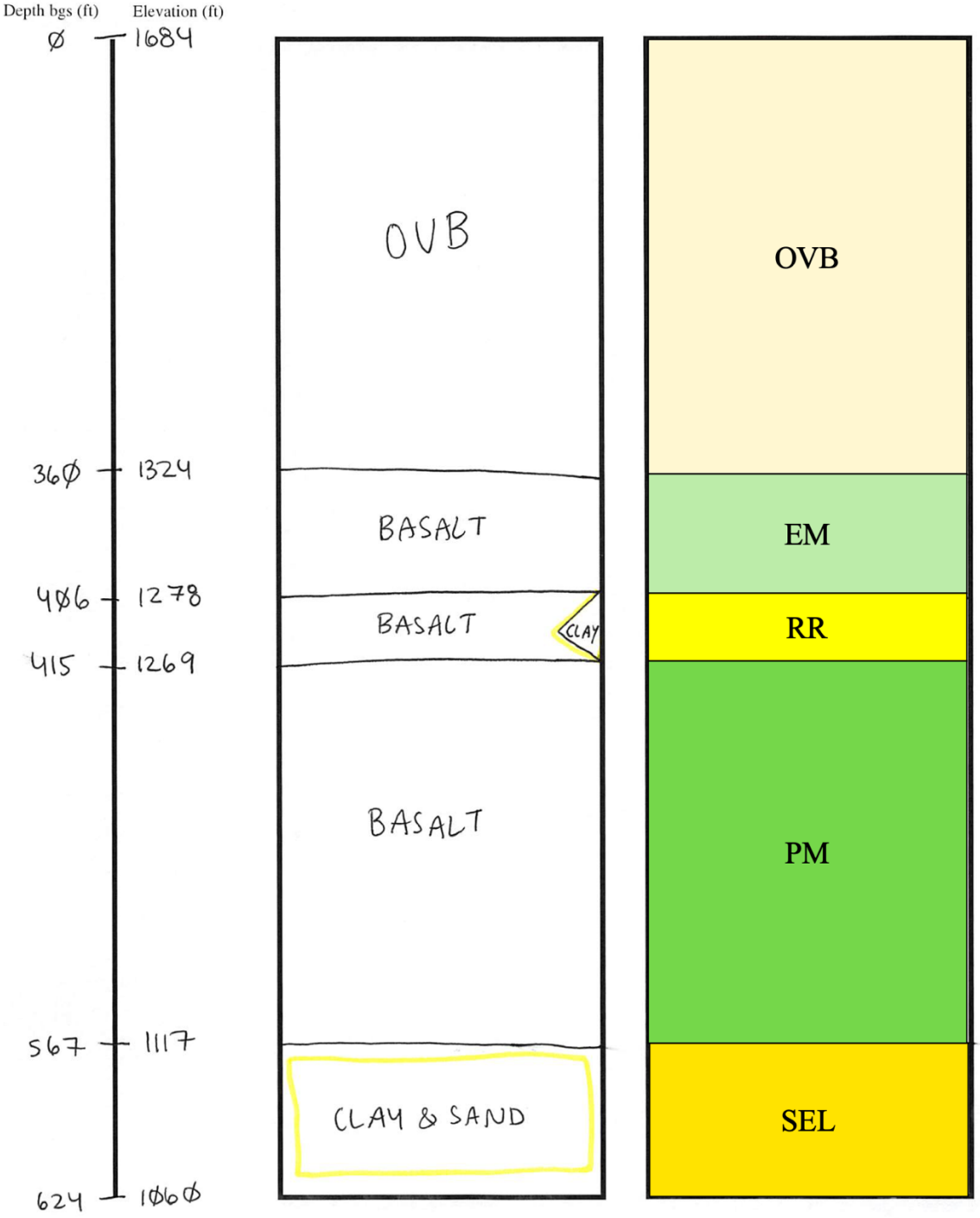
(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

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



Well ID: 3400	Well Name:	Cross Section: C-C'
Surface Elevation: 1684ft	Well Depth: 624 ft	Aquifer: Lower SDMB



3397

Martinez Well 4 3 (DOE)
Location NE¼ SE¼ Section 20 T12N R21E EWM
NW¼ NW¼

(1) OWNER: ✓ DAN MARTINEZ

(2) 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 inches
Drilled ft. Depth of completed well ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 16 " Diam. from 8 ft. to 14 ft.
Threaded ☐ 12 " Diam. from 0 ft. to 44 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? ft.
Material used in seal
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? Depth of strata
Method of sealing strata off

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

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 162 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: 1800 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
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☐

(USE ADDITIONAL SHEETS IF NECESSARY)

REPORT

Application No. 321114
Permit No. 321114

Rt 1 Box 205A MOXEE WA
CENTER ¼ NW ¼ NW Sec 20 T. 12N. R 21E W.M.

(10) WELL LOG: ALTA D

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
Overburden	0	170
Broken Brown Rock with Sand & Clay	170	240
Brown Sand	240	270
Brown Sand & Gravel	270	310
Brown Sand	310	330
Brown & Black Gravel	330	340
Broken Brown and Black Basalt	340	350 EM
Blue Sandy Clay	350	390
Gravel and Clay	390	410
Green Sandy Clay	410	425
Grey Basalt Hard ←	425	448 RR?
Blue Sandy Clay	448	552
Sand with Clay Veuses	552	672
Black Med Hard Basalt to Grey Hard Basalt	672	808
Green and Grey Clay	808	813 ←
Broken Grey Basalt	813	862

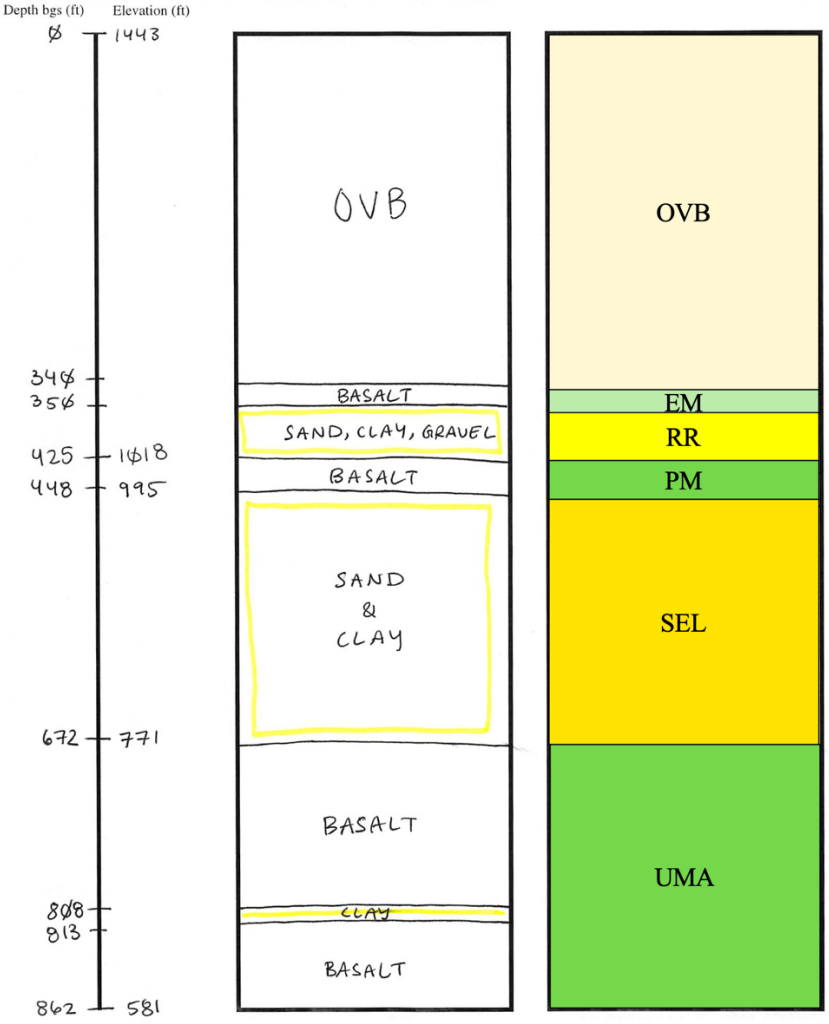
Work started June 15, 19 75 Completed Dec 10, 19 75

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 Ron Waggoner (Person, firm or corporation) (Type or print)
Address
[Signed] (Well Driller)
License No. Date, 19

RT 5-27-82

Well ID: 3397 Well Name: Cross Section: C-C'
Surface Elevation: 1443 ft Well Depth: 862 ft Aquifer: Lower SDMB



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

WATER WELL REPORT
STATE OF WASHINGTON

Application No. . . .
Permit No Cert 307-A

(1) OWNER: Name Ludwig, Wm F. Address Moxee, Washington

LOCATION OF WELL: County Yakima SE ¼ NE ¼ Sec. 19 T. 12 N., R 21 WM

ng 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 12 inches.
Drilled 1713 ft. Depth of completed well. . . ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 12 " Diam. from 0 ft. to 477 ft
Threaded ☐ 10 " Diam. from 377 ft. to 738 ft.
Welded ☐ 8 " Diam. from 725 ft. to 838 ft.
6⅝ 818 1138

Perforations: Yes ☒ No ☐
Type of perforator used . . .
SIZE of perforations . . . in. by . . . in.
. . . perforations from 357 ft. to 377 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? . . . ft.
Material used in seal . . .
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? . . . Depth of strata . . .
Method of sealing strata off . . .

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

(8) WATER LEVELS: Land-surface elevation above mean sea level . . . ft.
Static level . . . 48 . . . 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 300 gal/min with 170 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 . . .
Baller test . . . gal/min. with . . . ft. drawdown after . . . hrs.
Artesian flow . . . g.p.m. Date . . .
Temperature of water . . . Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG:

Formation. Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

. . . illiam F. Ludwig A 6941

Soil	6'	6'
Cement gravel	19	25
Sandy shale, yellow	26	50
Clay & gravel, yellow	44	94
Brown shale	26	120
Gray shale	10	130
Brown shale	18	148
Lime shell	2	150
Brown shale	10	160
Broken Basalt	8	168
Brown shale	10	178
Lime	6	184
Broken basalt	11	195
Brown shale	13	208
Gumbo	2	210
Brown shale	18	228
Broken basalt	6	234
Brown shale	8	242
Brown sandy shale	5	247
Brown shale	11	258
Brown sand	4	262
Brown shale	18	280
Lime shell	4	284
Broken basalt	4	288
Brown sandy shale	10	298
Broken basalt	8	306
Blue shale	2	308
Basalt	15	323
Blue shale	4	327
Gray sand	6	333
Basalt	7	340
Brown sahle	3	343
Blue shale	2	345

Work started . . . 19 . . . Completed 8/1 . . . 19 48

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 G.W. Ludwig
(Person, firm, or corporation) (Type or print)

Address 505 Ahtanum Rd Union Gap

[Signed] . . .
(Well Driller)

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

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

3395

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

WATER WELL REPORT
STATE OF WASHINGTON

Application No . . .
Permit No . . .

(1) OWNER: Name Wm F. Ludwig Address . . .

LOCATION OF WELL: County . . . SE ¼ NE ¼ Sec. 19 T. 12 N., R 21 WM

ng 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 . . . inches.
Drilled . . . ft Depth of completed well . . . ft.

(6) CONSTRUCTION DETAILS:

Casing installed: . . " Diam. from . . . ft. to . . . ft
Threaded ☐ . . . " Diam. from . . . ft. to . . . ft.
Welded ☐ . . . " Diam from . . . ft. to . . . ft.

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

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

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

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

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

(8) WATER LEVELS: Land-surface elevation above mean sea level . . . ft.
Static level . . . ft. below top of well Date . . .
Artesian pressure . . . lbs. per square inch Date . . .
Artesian water is controlled by . . . (Cap, valve, etc.)

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

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

Time	Water Level	Time	Water Level	Time	Water Level

Date of test . . .
Baller test . . . gal/min. with . . . ft. drawdown after . . . hrs.
Artesian flow . . . g.p.m. Date . . .
Temperature of water . . . Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG:

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Basalt	8	353
Blue clay	2	355
Green shale	8	363
Blue clay	25	388
Gray sand (water)	5	393
Green shale	13	406
Gray sand (water)	7	413
Green shale	27	440
Hard Shell	3	443
Gray sand	7	450
Green shale	20	470
Green sandy hard shale	5	475
Green shale	4	479
Hard Shell	2	481
Black basalt	28	509
Green shale	29	538
Blue sandy shale	10	548
Green shale	7	555
Hard sandy green shale	7	562
Green clay	16	578
Green sandy shale	10	588
Sandy shale streaks	53	641
Gray shale	9	650
Sandy shale streaks	8	658
Sandy gray shale	31	689
Gray sand & water	6	695
Shale & sand streaks	54	749
Hard shell	3	752
Gray shale	4	756
Broken basalt & creves'	26	782
Sand & boulders	3	785
Green shale	1	786
Hard black basalt	79	865
Column basalt, gray	38	903
Black basalt	9	912

Work started . . . 19 . . . Completed . . . 19 . . .

WELL DRILLER'S STATEMENT:

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

NAME . . .
(Person, firm, or corporation) (Type or print)

Address . . .

[Signed] . . .
(Well Driller)

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

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

3395

PAGE 3

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

WATER WELL REPORT
STATE OF WASHINGTON

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

(1) OWNER: Name Wm F. Ludwig . . . . . Address . . . . .

LOCATION OF WELL: County . . . . . SE ¼ NE ¼ Sec 19 T. 12 N., R. 21 W.M.
ng 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 . . . inches.
Drilled . . . ft Depth of completed well . . . . . ft.

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

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

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

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

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

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

(8) WATER LEVELS: Land-surface elevation above mean sea level . . . ft.
Static level . . . ft below top of well Date . . .
Artesian pressure . . . lbs. per square inch Date . . .
Artesian water is controlled by . . . (Cap, valve, etc.)

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

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

Time	Water Level	Time	Water Level	Time	Water Level

Date of test . . .
Baller test . . . gal/min. with . . . ft. drawdown after . . . hrs.
Artesian flow . . . g.p.m. Date . . .
Temperature of water . . . Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG:

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

Hard sandy shale	5	917
Black basalt & shale	83	1000
Shale with basalt streaks	85	1085
Hard black basalt	46	1131
Conglormant, basalt, water	19	1150
Sand, rock, black	62	1212
Hard basalt	95	1307
Sand, rock streaks & water	33	1340
Hard gray shell	3	1343
Gray sand & rock, water	12	1355
Brown sand & rock	59	1414
Gray shale, sand streaks, water	15	1429
Blue shale	21	1450
Hard gray rock	51	1501
Creves water raise	1	1502
Hard gray basalt	56	1558
Hard gray basalt, water, drilled like column rock	45	1603
Hard gray basalt	24	1627
Black sand	1	1628
Black broken lava	40	1668
Hard rock	4	1672
Green shale & oil showings	1	1673
Hard basalt, loosing water	12	1685
Hard basalt	24	1709
Large boulder	4	1713

Work started . . . 19 . . . Completed . . . 19 . . .

WELL DRILLER'S STATEMENT:

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

NAME . . . (Person, firm, or corporation) (Type or print)

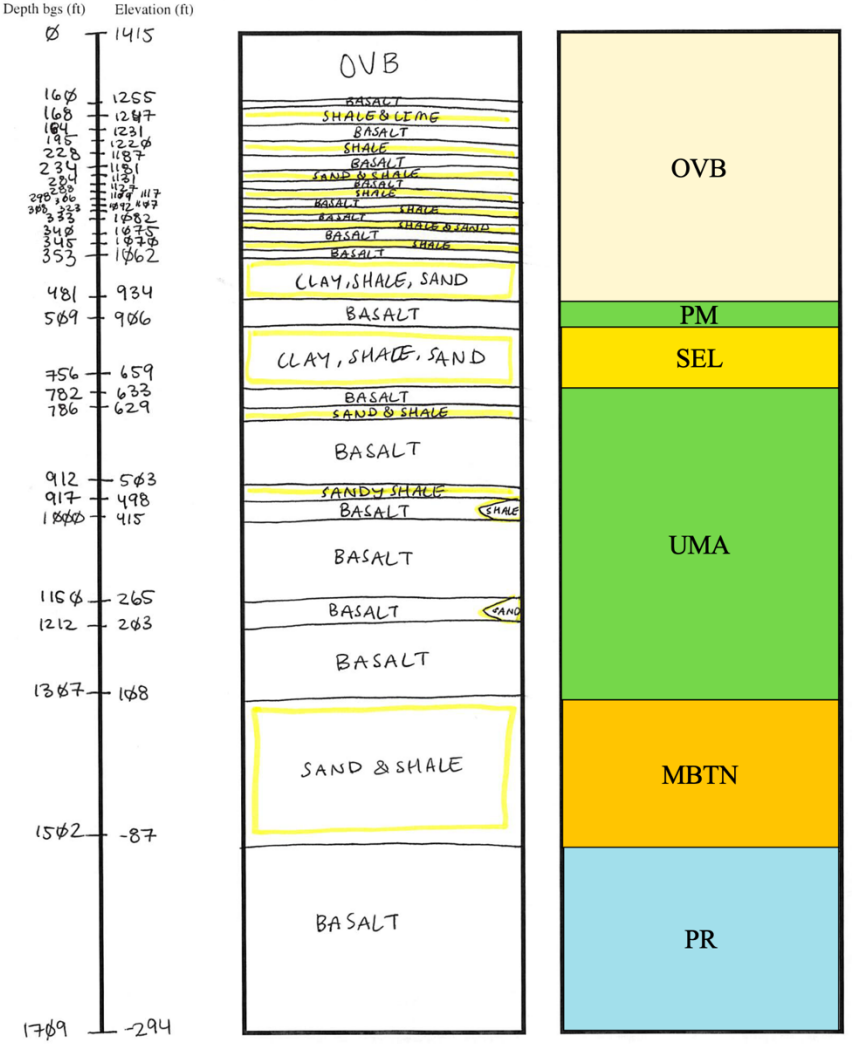
Address . . .

[Signed] . . . (Well Driller)

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

Well ID: 3395 Well Name: Cross Section: C-C'

Surface Elevation: 1415ft Well Depth: 1709ft Aquifer: WNB



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

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3394

WATER WELL REPORT

STATE OF WASHINGTON

#5142

Application No.

Permit No. G4013080

RECEIVED

JUL 27 1979

DEPARTMENT OF ECOLOGY
CENTRAL REGIONAL OFFICE

(1) OWNER: Name S. Martinez Livestock Inc. Address Rte. 1 Box 605 Moxee, Wa. 98936

(2) LOCATION OF WELL: County ... SW SE 17 T12 N. R21 W.M.
Bearing and distance from section or subdivision corner

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

(4) TYPE OF WORK: Owner's number of well (if more than one) No. 4
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☒ Jetted ☐

(5) DIMENSIONS: Diameter of well 17½ inches.
Drilled 800 ft. Depth of completed well 1551 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 20 " Diam. from 0 ft. to 23 ft.
Threaded ☐ 16 " Diam. from 0+2 ft. to 800 ft.
Welded ☐ 12 " Diam. from 795 ft. to 1551 ft.

Perforations: Yes ☒ No ☐ SEE BELOW
Type of perforator used mill slot
SIZE of perforations 3/16 in. by 2 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? 23 ft.
Material used in seal cement grout
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? Depth of strata
Method of sealing strata off

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

(8) WATER LEVELS: Land-surface elevation above mean sea level ~1480 ft.
Static level 16.6 ft. below top of well Date 7/10/79
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

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

Test
Water test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG:
Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO	
Overburden	0	23	
Clay & Gravel	23	45	sand
Clay, Gravel & Boulders	45	132	
Clay & Gravel	132	264	
Basalt & Clay	264	384	EM
Sand, Gravel & Clay	384	454	RR
Basalt-gray	454	542	
Basalt-black	542	582	
Basalt- gray	582	604	
Basalt-black	604	708	
Basalt-black & Clay	708	760	SEL
Basalt-gray & Clay	760	777	
Basalt-gray	777	800	
Basalt- gray	800	960	
Clay	960	962	
Basalt- black w/b	962	993	
Basalt-black	993	1056	
Basalt-black w/b	1056	1066	
Clay	1066	1083	
Basalt-gray & Gravel w/b	1083	1120	
Basalt-black	1120	1281	
Basalt-black w/b temp. chg.	1281	1308	
Basalt-gray	1308	1360	
Basalt-black w/b	1360	1391	
Basalt-black hard	1391	1447	
Basalt-blk.&/Gravel stc. 21'	1447	1531	w/
Basalt-black - TD	1531	1551	
12" Perforated Casing			
40 ft.	961	1001	
20 ft.	1041	1061	
40 ft.	1081	1121	
20 ft.	1281	1301	
20 ft.	1361	1381	
70 ft.	1441	1511	

Work started 5/ 2/79 19 Completed 5/31/79 19

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME HOLMAN DRILLING CORP.
(Person, firm, or corporation) (Type or print)
Address E. 3410 Ninth Ave. Spokane, Wa.9920

[Signed] John Goodall (Well Driller)

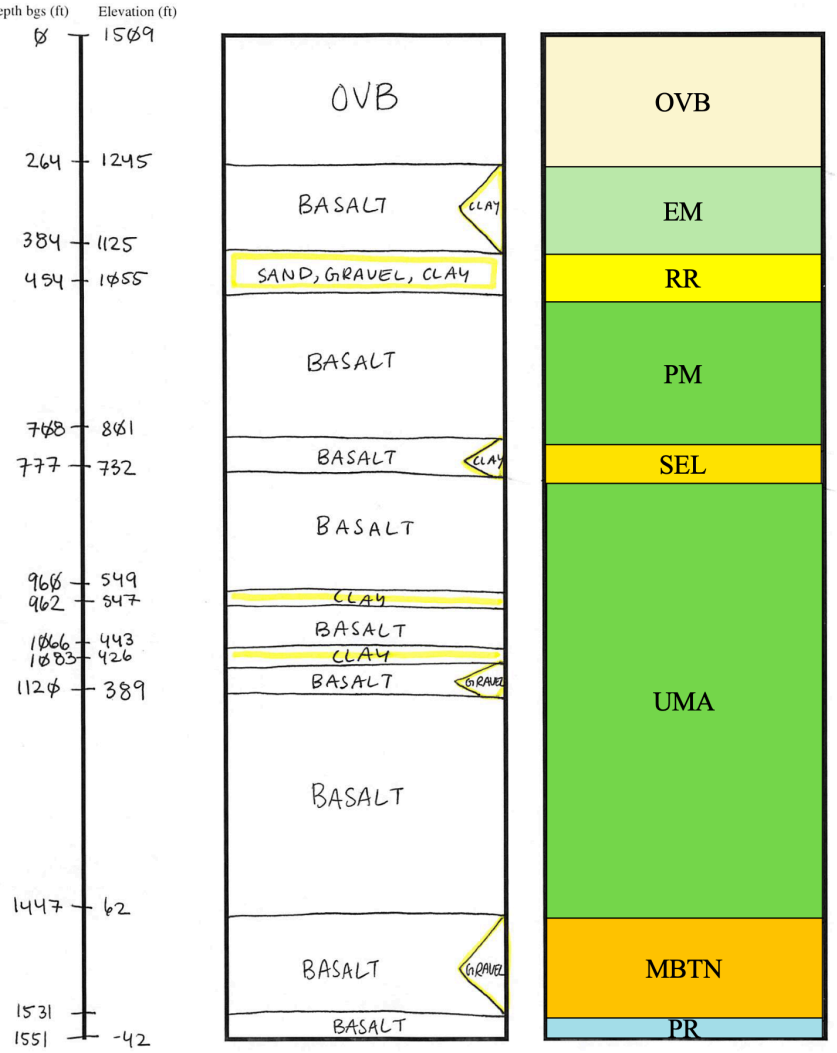
License No. 0162 Date 7/26/79 19

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

Well ID: 3394 Well Name: Cross Section: C-C'

Surface Elevation: 1509 ft Well Depth: 1551 ft Aquifer: WNB



DOE C-3

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WATER WELL REPORT
STATE OF WASHINGTON

Application No. **3392**
Permit No.

(1) OWNER: Name ... Address MOXEE

(2) LOCATION OF WELL: County YAKIMA ... SW ¼ SW ¼ Sec. 16 T. 12 N., R. 21 W.M.
Bearing and distance from section or subdivision corner N.

(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 784 ft. Depth of completed well 784 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6 " Diam. from 31 ft. to 380 ft.
Threaded ☐ 5 " Diam. from 360 ft. to 764 ft.
Welded ☐ " Diam. from ft. to ft.

Perforations: Yes ☑ No ☐ TORCH
Type of perforator used
SIZE of perforations 14 in. by 6 in.
1080 perforations from 640 ft. to 764 ft.
perforations from ft. to ft.
perforations from ft. to ft.

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

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

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

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

(8) WATER LEVELS: Land-surface elevation above mean sea level 1551 ft.
Static level 460 ft. below top of well Date 1/26/78
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

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

Time	Water Level	Time	Water Level	Time	Water Level

Date of test 1/26/78
Baller test 15 gal./min. with 280 ft. drawdown after 1 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☑

(10) WELL LOG:
Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
GRAVEL DECOMP / CLAY BRWN	5	215
BASALT BLACK MED	215	280
SAND BRWN MED / GRAVEL	280	380
CLAY GRAY MED	380	400
CLAYSTONE GRAY MED	400	420
BASALT BLACK HARD	420	430
SAND BRWN SOFT	430	435
BASALT BLACK HARD	435	530
BASALT GREY MED	530	550
SANDSTONE BRWN MED / W	550	640
BASALT BLK MED		
BASALT BLK MED HARD / WB	640	704
WITH SMALL AMOUNTS OF		
SHALE BLUE		

RECEIVED
JUN 1 1979
DEPARTMENT OF ECOLOGY
CENTRAL REGIONAL OFFICE

Work started 12/27/77 Completed 1/26/78

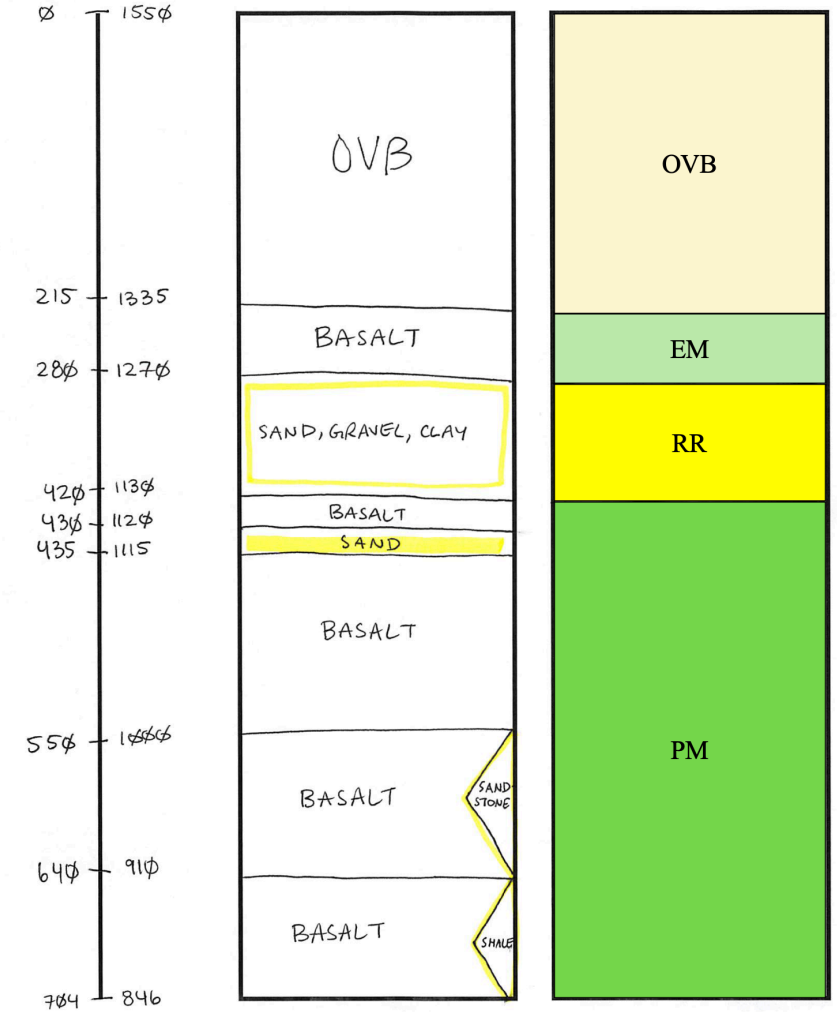
WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME B+B WELL DRILLING (Person, firm, or corporation) (Type or print)
Address RT 7 Box 600-A YAKIMA
[Signed] Ken H Blademan (Well Driller)
License No. 790 Date 1/26/78

(USE ADDITIONAL SHEETS IF NECESSARY)

FCY 050-1-20

Well ID: 3392 Well Name: Cross Section: C-C'
Surface Elevation: 1550ft Well Depth: 764ft Aquifer: LOWER SDMB



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WATER WELL REPORT
STATE OF WASHINGTON

RECEIVED DEC 2 1 1981 DEPARTMENT OF ECOLOGY CENTRAL REGION

Application No 63 21507
Permit No

(1) OWNER: Name Sebastian Charron Address

(2) LOCATION OF WELL: County Yakima SE ¼ SW ¼ Sec 13 T 12 N. R 20 W M
Bearing and distance from section or subdivision corner

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

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

(5) DIMENSIONS: Diameter of well 16 inches. Drilled 2213 ft. Depth of completed well 2205 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 16 " Diam from +1 ft to 524 ft Threaded ☐
10 " Diam from 505 ft to 851 ft Welded ☐
8 " Diam. from 487 ft to 1248 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? 55 ft
Material used in seal benronite
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name LAYNE
Type TURBINE HP 300

(8) WATER LEVELS: Land-surface elevation above mean sea level ft
Static level 171 ft below top of well Date 1/18/80
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? Layne
Yield 3024 gal/min with 280 ft drawdown after 47 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
Artesian flow g p m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG: P

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Top soil	0	2
silt, sandy, brown	2	15
conglomerate, brown, firm	15	19
clay, tan, soft	19	38
cong. br. firm	38	51
cong. clay w/ gravel, reddish br.	51	63
cong. brown	63	91
clay, light br. w/ small gravel	91	104
cong. lt. br. med. soft	104	137
cong. lt. br.	137	167
clay, sand, tan w/ sticky lenses	167	188
cong. lt. br.	188	216
clay, lt. br. w/ sand, gravel, and sticky lenses	216	318
clay, blue, very sticky	318	327
cong. blue, firm	327	338
clay, blue, w/ pea gravel, v. stick	338	343
clay, green, sticky to sandy	343	360
sandstone, graygreen, v. firm	360	370
clay, gray green, soft	370	372
clay, greenish, gravel, sand, stick	372	449
clay, sandy, dark gray	440	459
clay, with gravel, shale, sticky	459	479
sandstone, blue gray, v. firm	479	495
sand, silt, clay, blue green	495	515
clay, shale, w/ gravel, dark green	515	520
basalt, weathered, w/ dark clay	520	530
basalt, black, hard	530	532
basalt, crevice w/ dark clay	532	535
generally clay shale interbed w/ narrow sandstone, clay layers sandy layers, green to gray	535	770
clay, gray	770	828
basalt, red, fractured,	828	830
clay, gray, sticky	830	837
clay, black, w/ basalt fragments	837	847

Work started 11/17, 19 77 Completed 1/18, 1980

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 Cessel Well Drilling (Person, firm, or corporation) (Type or print)
Address 1308 Voelker Yakima, Wn.
[Signed] (Well Driller)
License No. 0073 Date 1/14/81, 19

R87 1/14/82

ECY 050-1-20 (USE ADDITIONAL SHEETS IF NECESSARY)

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

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3345

WATER WELL REPORT
STATE OF WASHINGTON

RECEIVED DEC 2 1 1981 DEPARTMENT OF ECOLOGY CENTRAL REGION

Application No.
Permit No. G4-21507

(1) OWNER: Name Sebastian Charron Address

(2) LOCATION OF WELL: County SE ¼ SW ¼ Sec. 13 T. 12 N., R. 20 W.M.
Bearing and distance from section or subdivision corner

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

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

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

(6) CONSTRUCTION DETAILS:
Casing installed: " Diam. from ft. to ft. Threaded ☐
" Diam. from ft. to ft. Welded ☐
" Diam. from ft. to ft.
Perforations: Yes ☐ No ☐
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.
Screens: Yes ☐ No ☐
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.
Gravel packed: Yes ☐ No ☐ Size of gravel:
Gravel placed from ft. to ft.
Surface seal: Yes ☐ No ☐ To what depth? ft.
Material used in seal
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? Depth of strata
Method of sealing strata off

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

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level ft. below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

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

Time	Water Level	Time	Water Level	Time	Water Level

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

(10) WELL LOG: P

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
basalt, black	847	856
basalt, gray, hard	856	947
basalt, brown, w/ brown clay	947	969
basalt, broken, w/ gray clay	969	979
basalt, black	979	985
basalt, black., broken w/ gray clay	985	1025
basalt, gray	1025	1041
basalt, broken, black w/ crevice	1041	1052
basalt, black, broken, w/ blk cly	1052	1112
basalt, black	1112	1118
basalt, black w/ green shale	1118	1127
basalt, black w/ gray shale	1127	1130
clay, gray, sticky	1130	1135
shale, green	1135	1138
basalt, static rose from 144 to 140 @1138 rose to 138 @ 1144	1138	1144
basalt, black, broken w/ gray clay	1144	1160
basalt, black, broken w/ red clay	1160	1192
basalt, blk, broken w/ gray clay	1192	1204
basalt, black broken w/ red clay	1204	1217
basalt, blk, broken, w/ gray clay	1217	1222
basalt, blk, firm	1222	1228
basalt, gray	1228	1325
basalt, gray black loss of cutings at 1325-1330	1325	1335
basalt, blk, hard	1335	1469
basalt, blk, fractured	1469	1490
basalt, blk, harder	1490	1690
basalt, gray, firmerq	1690	1747
basalt, blk	1747	1762
basalt, blk, s/ green clay, loss of cuttings, possibly s/ water	1762	1789
basalt, blk, med. hard	1789	1874
basalt, honeycomb;	1891	1898
basalt, burnt, reddish to blk	1898	

Work started, 19 Completed, 19

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME (Person, firm, or corporation) (Type or print)
Address
[Signed] (Well Driller)
License No. Date, 19

R87 1/14/82

ECY 050-1-20 (USE ADDITIONAL SHEETS IF NECESSARY)

File Original and First Copy with Department of Ecology
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3345

WATER WELL REPORT
STATE OF WASHINGTON

Application No.
Permit No.

(1) OWNER: Name Sebastian Charrol' Address

(2) LOCATION OF WELL: County – SE ¼ SW ¼ Sec. 13 T. 12 N., R. 20 W.M.
Bearing and distance from section or subdivision corner

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

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

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

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

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

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

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

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

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

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level ft. below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

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

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

Time	Water Level	Time	Water Level	Time	Water Level

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

(10) WELL LOG: P

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
basalt, brown, deteriorated, w/ honeycomb	1874	1898
basalt, burnt going to blk.	1898	1920
black basalt	1920	1970
basalt, gray	1970	1985
basalt, blk	1985	2079
basalt, blk, softer	2079	2083
basalt, soft blk burnt, loss of cuttings	2083	2101
basalt, blk	2101	2116
basalt, blk w/ green clay	2116	2125
green clay	2125	2131
clay, brown	2131	2165
clay, brown, w/ green shale, caving some	2165	2182
clay shale, brown	2182	2200
clay shale going to blk basalt,? caving badly cant get good sample	2200	2213

RECEIVED
DEPARTMENT OF ECOLOGY

Work started 19 Completed 19

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

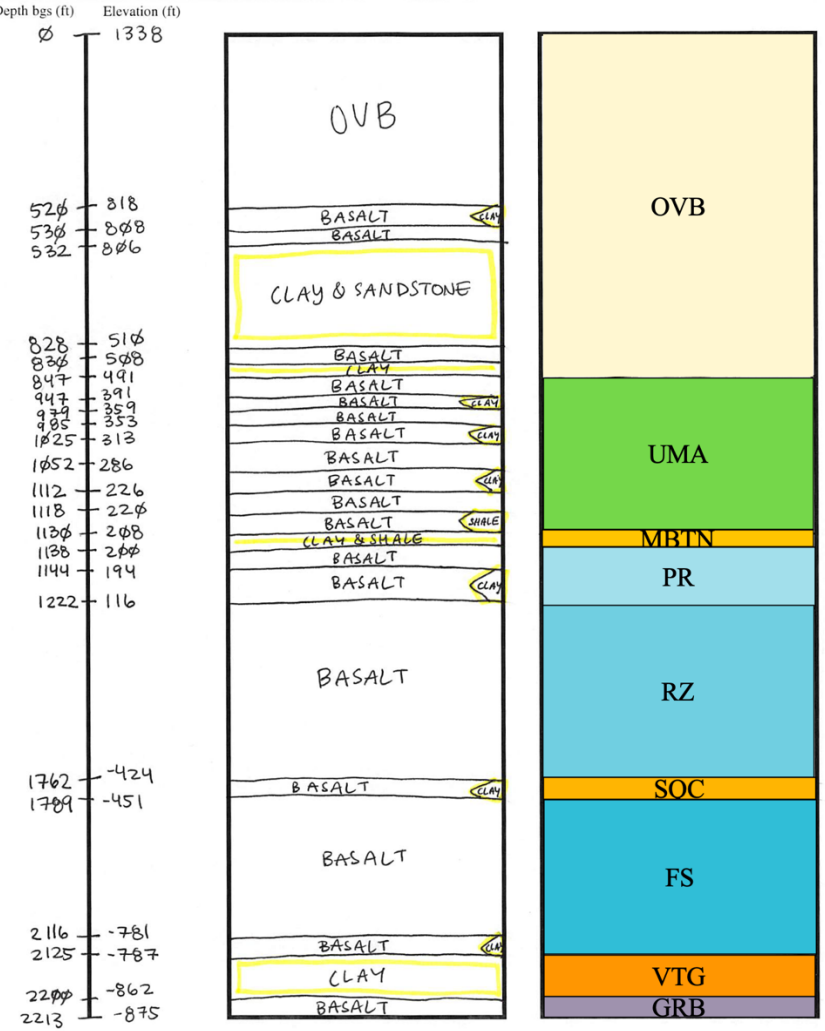
NAME (Person, firm, or corporation) (Type or print)
Address
[Signed] (Well Driller)
License No. Date 19

RJ 1/14/82

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

Well ID: 3345 Well Name: Cross Section: C-C'
Surface Elevation: 1338 ft Well Depth: 2213 ft Aquifer: GRB



WATER WELL REPORT

STATE OF WASHINGTON

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

RECEIVED MAY 31 1988

Application No. 3347
Permit No.

(1) OWNER: Name ROY FARMS INC Address 401 WALTERS ROAD MOXEE

(2) LOCATION OF WELL: County YAKIMA WA. SE ¼ SE ¼ Sec 15 T 12 N, R 20E W.M.
ing and distance from section or subdivision corner

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: 16" TO
Drilled 1786 ft. Diameter of well inches. Depth of completed well 1786 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 20 " Diam. from +2 ft. to -98 ft.
Threaded ☐ 16 " Diam. from +2 ft. to 626 ft.
Welded ☐ 12 " Diam. from 555 ft. to 1155 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? 100 ft.
Material used in seal PORTLAND CEMENT
Did any strata contain unusable water? Yes ☐ No ☑
Type of water? Depth of strata
Method of sealing strata off CEMENT 1155 TO 1135 LEAD PACKER BETWEEN TOP OF 12" + 16" CSG INC

(7) PUMP: Manufacturer's Name
Type:

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 236'9" ft. below top of well Date 5-16-88
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.
" " "
" 0 GPM ± ONE GALLON "
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

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

(10) WELL LOG: Page 1 of 2

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
SOIL	0	3
CALICHE	3	5
SAND	5	6
CLAY BROWN	6	8
SAND	8	40
CLAY	40	92
SAND	92	96
CLAY + SAND	96	150
GRAVEL + CLAY	150	265
CLAY	265	380
CLAY + SAND	380	450
CLAY HARD	450	520
CLAY + SAND MUD LOSS	520	525
CLAY BROWN	525	545
CLAY BLUE	545	575
BASALT W/ BLUE CLAY	575	610
BLUE CLAY W/ GRAVEL	610	650
BROWN CLAY	650	680
BLUE CLAY	680	690
BROWN CLAY	690	705
BLUE W/ BLACK BASALT	705	845
BROWN CLAY	845	851
BLUE SAND	851	940
SAND STONE	940	1040
BASALT BLACK	1040	1050
CLAY + SOAP STONE	1050	1065
CLAY	1065	1100
BASALT BLACH	1100	1124
BROWN CLAY	1124	1130
BLUE CLAY	1130	1148
BASALT BLACK	1148	1168
BASALT + CLAY STONE	1168	1200
RED SCORIA	1200	1230
BROWN SCORIA	1230	1255
GRAY BASALT	1255	1442
CONTINUED		

Work started 10-5 1987 Completed 5-17 1988

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 LARRY BURD WELL DRILLING INC (Person, firm, or corporation) (Type or print)
Address 5543 S.W. DOUGLAS PENDLETON ORE 97801
[Signed] Larry Burd (Well Driller)
License No. 0062 Date 5-20, 1988

S. F. No. 7356—OS—(Rev. 4-71). (USE ADDITIONAL SHEETS IF NECESSARY)

Page 1 of 2

JUN 9 1988

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

WATER WELL REPORT

STATE OF WASHINGTON

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

Application No
Permit No

(1) OWNER: Name ROY FARMS INC Address 401 WALTERS RD MOXEE WA

(2) LOCATION OF WELL: County Yakima WA SE ¼ SE ¼ Sec 15 T 12 N, R 20E W.M.
ing and distance from section or subdivision corner

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 inches
Drilled ft. Depth of completed well ft.

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

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

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

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

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

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

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level ft. below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

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

Time	Water Level	Time	Water Level	Time	Water Level

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

(10) WELL LOG: Page 2 of 2

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
BASALT SOFT GRAY	1442	1465
BASALT GRAY	1465	1490
BASALT GRAY SOFTER	1490	1500
BASALT GRAY	1500	1548
BASALT GRAY SOFTER	1548	1568
BASALT GRAY	1568	1573
BASALT BLACK	1573	1600
BASALT BLACH W/ SS	1600	1685
BASALT GRAY	1685	1730
BASALT BLACH	1730	1738
BASALT GRAY	1738	1786

Work started 19 Completed 19

WELL DRILLER'S STATEMENT:

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

NAME [Larry Burd Well Drilling, Inc] (Person, firm, or corporation) (Type or print)
Address 5543 S.W. Douglas Pendleton, OR 97801
[Signed] [Larry Burd] (Well Driller)
License No. 0062 Date 5-20, 1988

S. F. No. 7356—OS—(Rev. 4-71). (USE ADDITIONAL SHEETS IF NECESSARY)

Page 2 of 2

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

WATER WELL REPORT

STATE OF WASHINGTON

3347

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

Start Card No. 031257

Water Right Permit No. R

OWNER: Name Roy FARMS Address 401 WALTERS RD MOXEE WA 98936

(2) LOCATION OF WELL: County YAKIMA SE¼ SE¼ Sec. 15 T. 12 N. R. 20 W.M.

(2a) STREET ADDDRESS OF WELL (or nearest address) 401 WALTERS RD. MOXEE

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

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

(5) DIMENSIONS: Diameter of well 16X12 X 8 3/4 inches. Drilled 2802 feet. Depth of completed well 2610 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 9 5/8 OD Diam. from 1135 ft. to 1811 ft.
Welded ☒ 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.
Screens: Yes ☐ No ☒
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Gravel packed: Yes ☐ No ☒ Size of gravel
Gravel placed from ft. to ft.
Surface seal: Yes ☐ No ☐ To what depth? ft.
Material used in seal
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? Depth of strata
Method of sealing strata off

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

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 215 ft. below top of well Date 3-30-91
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

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

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Airtest 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
0 TO 1786FT DRILLED BY OTHERS		
[redacted] GRAY BASALT HARD	1786	1823
GRAY BASALT MED	1823	1864
BLK BASALT GRAVEL ★	1864	1865
GRAY BASALT HARD	1865	1881
BLK BASALT MED	1881	1985
BLK BASALT SOFT ★	1985	2015
BLK BASALT HARD	2015	2109
BLK BASALT SOFT ★	2109	2126
GRAY BASALT HARD	2126	2197
BLK BASALT SOFT ★	2197	2235
GRAY BASALT HARD	2235	2285
BLK BASALT SOFT ★	2285	2292
BLK BASALT MED	2292	2616
BLK & GRAY CLAY	2616	2647
GRAY GRAVEL SAND+CLAY	2647	2657
BLK BASALT MED	2657	2802
HOLE CEMENTED BACK TO 2610' WITH NEAT CEMENT PLUG		
Top & Bottom of 9 5/8" LINER CEMENTED WITH NEAT CEMENT GROUT		

MAY – 8 1991

Work started FEB 22, 19 91 Completed JUNE 2, 19 91

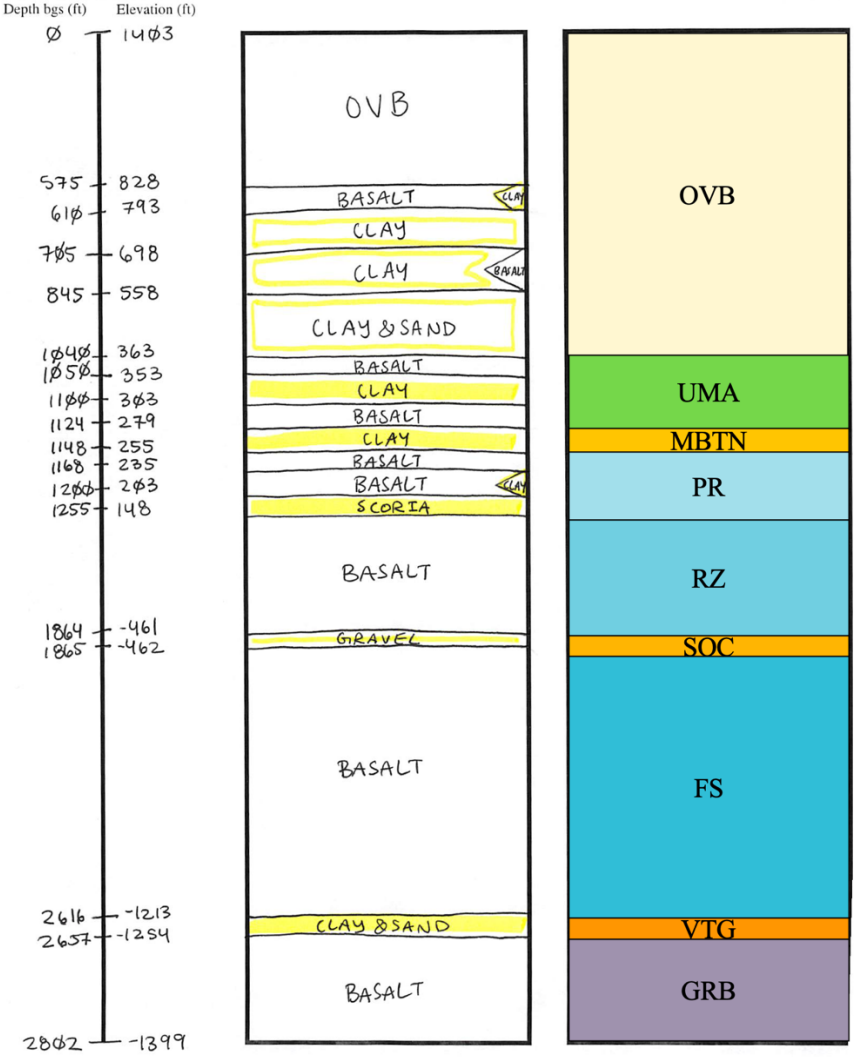
WELL CONSTRUCTOR CERTIFICATION:
I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME HOLMAN DRILLING CORP (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address E3410 9TH AVE SPOKANE WA
(Signed) Arnold E Holman (WELL DRILLER) License No. 0189
Contractor's Registration No. HOLMADC131N4 Date MAY 1, 19 91

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 060-1-20 (10/87) -1329-

Well ID: 3347 Well Name: Cross Section: C-C'
Surface Elevation: 1403 ft Well Depth: 2802 ft Aquifer: GRB



3348 Elephant Mountain Well

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

RECEIVED JUL 15 1981 DEPARTMENT OF ECOLOGY CENTRAL REGION

Application No. Permit No. G4-25817P

(1) OWNER: Name Dept of Nat. Resources Address

(2) LOCATION OF WELL: County Yakima SE¼ NE¼ Sec. 16 T. 12 N., R. 20 W.M.
Bearing and distance from section or subdivision corner

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

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

(5) DIMENSIONS: Diameter of well 16 inches.
Drilled 1376 ft. Depth of completed well 1369 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 16" Diam. from +1 ft. to 1296 ft.
Threaded ☐ 12" Diam. from 1262 ft. to 1322 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? 30 ft.
Material used in seal Cement
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 204 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: 390 ± gal./min. with 21.2" ft. drawdown after 3 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.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG: Elephant MT #1

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
SEE ATTACHED SHEET		
REMARKS:		
Cemented Top & Bottom of 12 Inch Liner		
Cemented hole TO 1335'		

Work started 19 Completed 19

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Cassel Well Drilling (Person, firm, or corporation) (Type or print)
Address 1308 Voelker Ave Yakima
[Signed] Larry L Cassel (Well Driller)
License No. 0093 Date 5-13 19 81

(USE ADDITIONAL SHEETS IF NECESSARY)

DK 7.15.81

ECY 050-1-20

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

CASSEL WELL DRILLING
Domestic and Irrigation

LARRY CASSEL — 1308 SOUTH VOELKER AVENUE, YAKIMA, WASHINGTON 98902 — PHONE 453-2560

Dept. of Natural Resources — Permit # G4-25817P
Elephant Mt. Well # 1

Location SW¼ NE¼ SE¼ NE¼ SEC.16 T.12 R.20

FROM	TO	THICKNESS	FORMATION
0	3	3	Top Soil
3	12	9	Boulder,sand,clay,conglomerate
12	282	270	Clay,sandy w/sm gravel,brown
270	362	92	Clay,brown w/large gravel
362	392	30	Clay,gray, w/large gravel
392	426	32	Clay,brown, w/sm gravel
426	462	36	Clay,brown, very sticky
462	492	30	Clay, brown, sandy,w/sm gravel
492	595	103	Shale,green
595	602	7	Clay,gray,w/sm gravel,sticky
602	617	10	Clay,brown,sticky
617	634	17	Clay,green w/gravel
634	683	51	Clay,brown w/sm gravel,sticky
683	782	99	Shale,green
782	906	124	Shale,green w/gravel
906	923	17	Shale,green,sand lenses
923	928	5	Shale,green,very sticky
928	943	15	Shale,green w/small gravel
943	1020	77	Shale,green w/sand lenses
1020	1073	53	Clay,green,sticky
1073	1106	33	Clay,gray, sand lenses
1106	1138	32	Clay,green,very sticky
1138	1159	21	Clay,green,very sticky w/s gravel
1159	1185	26	Clay,green,sandy
1185	1218	33	Clay,green,very sticky
1218	1292	74	Clay,green,sandy
1292	1302	10	Decomposed,basaltw/dark clay hard
1302	1311	9	Basalt,broken w/clay,black
1311	1328	17	Compacted sand,sandy clay caving
1328	1360	32	Basalt,redish to black some honeycomb

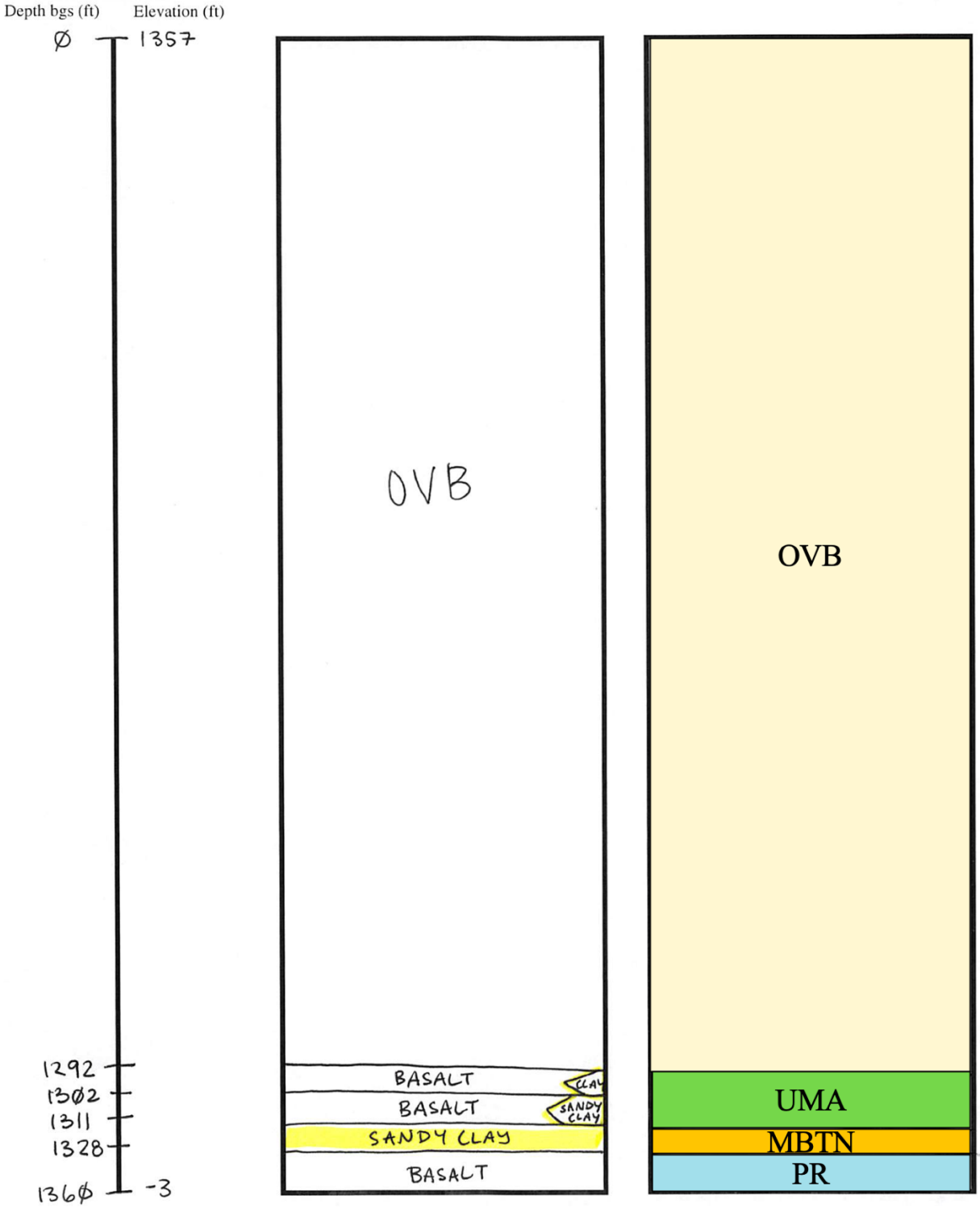
Static: 226

Casing: 16" + 1 to 1296'
12" 1322'

RECEIVED FEB 25 1981 DEPARTMENT OF ECOLOGY CENTRAL REGION

accept as well report
2.26.81 DK

Well ID: 3348	Well Name: Elephant Mountain	Cross Section: A-A' & C-C'
Surface Elevation: 1357ft	Well Depth: 1360ft	Aquifer: WNB



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

WATER WELL REPORT

3337

STATE OF WASHINGTON

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

(1) OWNER: Name MONA and CARL ALLWARDT Address R#1 Box 157 Moxee, WA 98936

(2) LOCATION OF WELL: County YAKIMA ¼ SW ¼ Sec 9 T 12 N., R 20 W.M. N

Bearing and distance from section or subdivision corner 1155 ft. FROM S. BOUND. 45 FT. FROM E. BOUND.

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

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

(5) DIMENSIONS: Diameter of well 10"-870 8"-965 inches. Drilled 972 ft. Depth of completed well 965 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 10" Diam. from -1 ft. to 870 ft.
Threaded ☐ 8" Diam. from 655 ft. to 720 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? 200 ft.
Material used in seal CEMENT + SAND GROUT
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 2 ft. below top of well Date NOV. 15, 1977
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? ECOLOGY'S
Yield: 760 gal./min. with 146 ft. drawdown after 4 hrs.
" 560 " 130 " 2 "
" 350 " 100 " 1 "
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
2 min.	Full				
	RECOVERY				

Date of test NOV. 15, 1977
Bailer test ... gal./min. with ... ft. drawdown after ... hrs.
Artesian flow ... g.p.m. Date .....
Temperature of water 60° Was a chemical analysis made? Yes ☐ No ☒

(10) WELL LOG:
Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
TOP SOIL	0	4
BROWN SAND, FINE	4	10
HARD PAN AND SAND STONE	10	18
SAND STONE	18	27
MULTI-COLORED GRAVEL (WATER)	27	40
BROWN CLAY	40	63
GREEN CLAY, STICKY	63	175
SAND	175	179
GREEN CLAY	179	225
BLACK SAND, FINE	225	229
CLAY	229	270
LIGHT GREEN CLAY + MULTI COL. GRAVEL	270	284
GREEN CLAY	284	292
SAND (WATER)	292	297
LIGHT GREEN CLAY, STICKY	297	350
GRAY CLAY W/ CEMENTED GRAVEL	350	410
GRAVEL + SAND (WATER)	410	420
BLUE GRAY CLAY + SAND	420	488
SAND	488	492
GREY CLAY, STICKY	492	550
GREEN CLAY	550	560
CLAY	560	590
CLAY + LAYERS OF SAND	590	648
LIGHT GREEN CLAY	648	665
SAND	665	676
CLAY	676	714
MULTI-COLORED GRAVEL (WATER)	714	719
SAND	719	726
BLUE GREEN CLAY, STICKY	726	740
GRAVEL W/ SAND (WATER)	740	750
CLAY, STICKY	750	765
SAND	765	770
CLAY	770	775
SAND	775	797
CLAY, STICKY	797	810
(CONT.)		

Work started May 16 19 77 Completed NOV. 10 19 77

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME LYNN A. TAYLOR (Person, firm, or corporation) (Type or print)
Address R#1, Box 207 T Moxee, WA 98936
[Signed] Lynn A. Taylor (Well Driller)
License No. 0655 Date Nov. 27, 19 77

ECY 050-1-20 (USE ADDITIONAL SHEETS IF NECESSARY) OR Continued

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

Page 2

WATER WELL REPORT

STATE OF WASHINGTON

Application No 94-24579
Permit No [redacted]

(1) OWNER Name MONA AND CARL ALLWARDT Address R#1 Box 157, Moxee, WA 98936

(2) LOCATION OF WELL County YAKIMA ¼ SW ¼ Sec 9 T 12N R 20WM

Bearing and distance from section or subdivision corner 1155 FT FROM S. BOUND 45 FT FROM E BOUND

(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 ... inches
Drilled ... ft Depth of completed well ... ft

(6) CONSTRUCTION DETAILS
Casing installed Diam from ... ft to ... ft
Threaded ☐ Diam from ... ft to ... ft
Welded ☐ Diam from ... ft to ... ft

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

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

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

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

(7) PUMP Manufacturer's Name
Type H P

(8) WATER LEVELS Land surface elevation above mean sea level ... ft
Static level ft below top of well Date
Artesian pressure lbs per square inch Date
Artesian water is controlled by (Cap valve etc)

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

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

Time	Water Level	Time	Water Level	Time	Water Level

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

(10) WELL LOG
Formation Describe by color character size of material and structure and show thickness of aquifers and the kind and nature of the material in each stratum penetrated with at least one entry for each change of formation

MATERIAL	FROM	TO
SAND (WATER)	810	810
BROWN CLAY, HARD	870	905
CEMENTED SAND + GRAVEL	905	908
SAND W/ LAYERS OF GRAVEL	908	920
BLACK BASALT, FRACTURED W/ CLAY	920	926
MULTI-COLORED BASALT	926	940
BLACK BASALT, HARD	940	958
BASALT, SOFT, FRACTURED	958	960
BLACK BASALT, SOFT W/ RED SAND + POURED CEMENT PLUG IN BOTTOM.	960	972

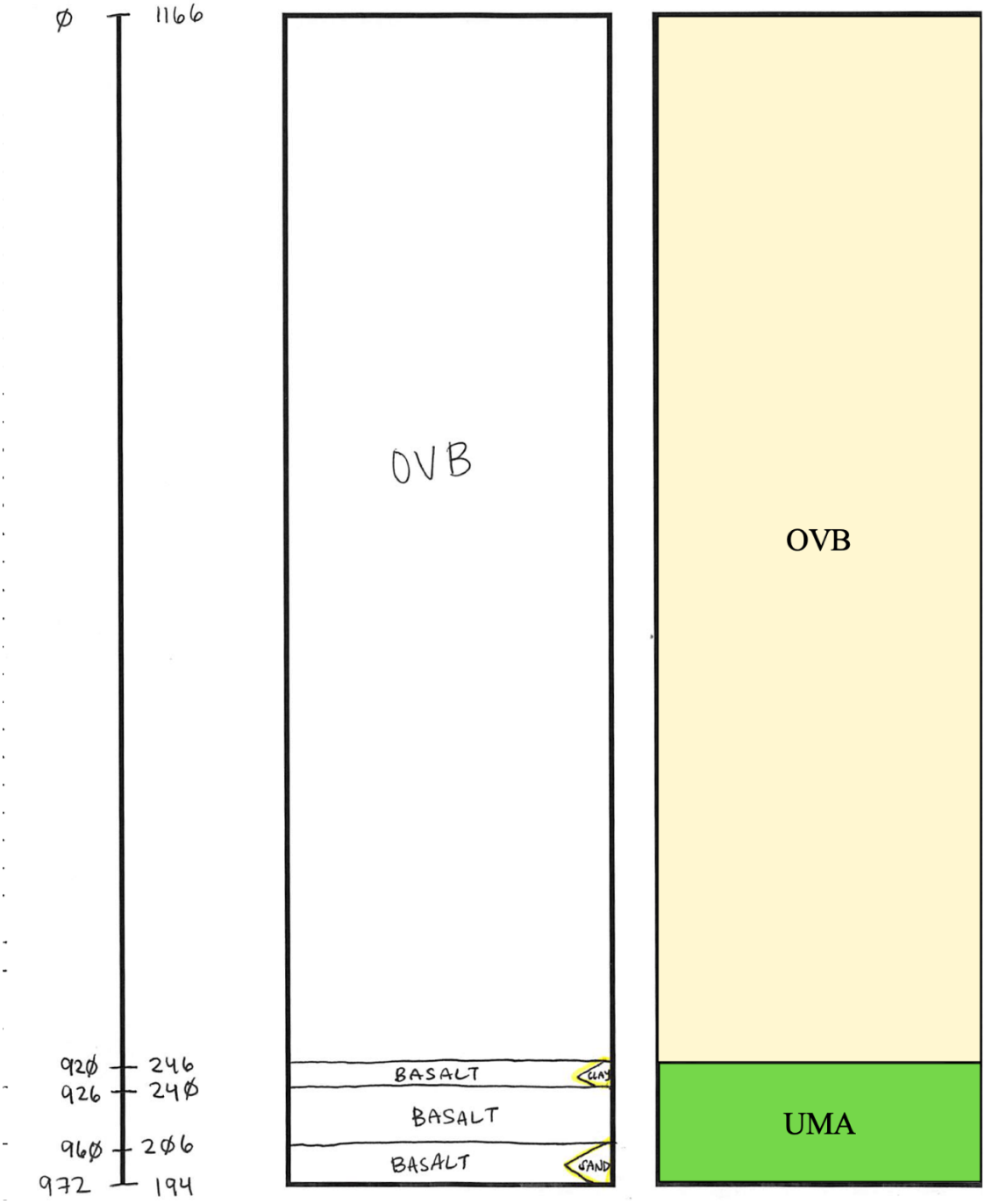
Work started MAY 16 1977 Completed NOV. 10 19 77

WELL DRILLER'S STATEMENT
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief

NAME LYNN A TAYLOR (Person firm or corporation) (Type or print)
Address R#1, Box 207 MOXEE, WA 98936
[Signed] Lynn A Taylor (Well Driller)
License No 0655 Date Nov. 27 19 77

S F No 7356—OS—(Rev 4 71) (USE ADDITIONAL SHEETS IF NECESSARY)

Well ID: 3337	Well Name:	Cross Section: C-C'
Surface Elevation: 1166ft	Well Depth: 972ft	Aquifer: LOWER SDMB



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

WATER WELL REPORT
STATE OF WASHINGTON

Application No
Permit No 94-25207P

(1) OWNER: Name L. S. Brulotte Address RT. 1, BX143 Moxee

(2) LOCATION OF WELL: County Yakima — NW¼ NE¼ Sec 18 T. 12 N., R. 20 WM
Bearing and distance from section or subdivision corner

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

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

(5) DIMENSIONS: Diameter of well 12 inches.
Drilled 1035 ft Depth of completed well 1035 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 12 " Diam from +1 ft. to 152 ft.
Threaded ☐ 10 " Diam. from ft. to 449 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? 140 ft.
Material used in seal clay
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? Depth of strata
Method of sealing strata off

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

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 56 ft below top of well Date 10-8-78
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☒ No ☐ If yes, by whom? Ackland
Yield: 800 gal/min with 194 ft drawdown after 8 hrs
" " " "
" Sp Cap "7.7 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
Bailer test gal/min with ft drawdown after hrs
Artesian flow g.p.m. Date
Temperature of water 69 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
soil	0	3
sand	3	72
clay (green)	73	107
clay (grey small rock)	108	120
Basalt (broken + little clay	121	192
Basalt (black honeycomb water)	193	196
Basalt (med. hard)	197	150
Basalt (hard)	151	167
Basalt (broken)	168	178
Basalt (hard)	173	181
Basalt (broken, red)	182	185
~~Basalt (grey) black hard~~) clay	186	342
~~Basalt~~ (green) clay	343	350
~~Basalt~~ (grey) clay	351	395
clay (grey) rocks)	396	441
Basalt (black broken med)	442	448
Basalt (" hard)	449	465
Basalt (med)	466	478
Basalt (hard)	479	570
Basalt (med)	571	720
Basalt (hard)	721	727
Basalt (" crevice)	728	732
clay (grey)	733	735
Basalt (hard, black)	736	910
Basalt (basalt shale)	911	914
Basalt (hard)	915	1005
Basalt (broken + clay)	1006	1012
Basalt (grey-med)	1013	1035
Well Construction OK JRD 10-11-78		

Work started Dec 19 77 Completed Oct 19 78

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Henry Beck Well Drilling (Person, firm, or corporation) (Type or print)
Address P.O. Box 1651 Yakima Wn. 98907
[Signed] Henry Beck (Well Driller)
License No. 00553 Date 10-10 , 1978

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

WATER WELL REPORT

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

3349

Construction/Decommission ("X" in circle) 452605
☒ 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 8" inches, drilled 7 7/8" ft.
Depth of completed well 1540 ft.

CONSTRUCTION DETAILS
Casing Installed: ☒ Welded 10 " Diam. from +1 ft. to 305 ft.
☐ Liner installed 8 " Diam. from +1 ft. to 469 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? 305 ft.
Material used in seal cement
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 362 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
Bailer Test gal./min. with ft. drawdown after hrs.
Airtest 250 gal./min. with stem set at 1540 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. W268415
Unique Ecology Well ID Tag No. AHP715
Water Right Permit No. G4-25207P
Property Owner Name Evans Fruit
Well Street Address ~~PO Box 70~~
City Cowiche County Yakima
Location NW 1/4-1/4 NE 1/4 Sec 18 Twn 12 R 20 EWM ☒ Check Or WWM ☐ One
(s, t, r Still REQUIRED)
Lat/Long Lat Deg Lat Min/Sec
Long Deg Long Min/Sec
Tax Parcel No. (Required) 201218-12001

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 black porous basalt	786	789
Very hard light gray basalt	789	847
Soft porous gray basalt trace of green clay	847	852
Hard gray basalt	852	862
Broken dark gray basalt	862	864
Hard gray basalt	864	867
Med soft porous black basalt 160 psi	867	883
Med hard brown basalt	883	886
Med hard gray porous basalt	886	893
Med soft gray fractured basalt 170 psi	893	906
Hard light gray basalt	906	935
Med hard gray basalt	935	953
Med soft porous dark gray basalt	953	955
Med hard dark gray basalt	955	969
Very hard light gray basalt	969	971
Med soft black porous basalt	971	986
Hard dark gray basalt	986	989
Green & black clay	989	995
Broken black porous basalt & some clay	995	999
Fractured black basalt 260 psi	999	1012
Hard gray basalt	1012	1036
Soft black & some reddish brown porous basalt	1036	1049
280 psi 73 deg		
Med hard black basalt	1049	1061
Soft porous black basalt 290 psi	1061	1069
Med hard black basalt	1069	1095
Very hard light gray basalt	1095	1100
Med hard gray basalt broken some green clay	1100	1103
Hard dark gray basalt	1103	1138
Med soft black basalt	1138	1158
Med hard black basalt	1158	1181

Start Date 4-19-12 Completed Date 5-22-12

DEPT OF ECOLOGY Received JUN 26 2012 CENTRAL REGION OFFICE

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) Larry McLanahan
Driller/Engineer/Trainee Signature Larry M
Driller or trainee License No. 0337
IF TRAINEE: Driller's License No:
Driller's Signature:

Drilling Company BJ Exploration & Drilling Co., INC
Address 404 N Conway St
City, State, Zip Kennewick , WA , 99336
Contractor's Registration No. BJEXPI132QK Date 6-22-12

ECY 050-1-20 (Rev 06/08) If you need this document in an alternate format, please call the Water Resources Program at 360-407-6600. Persons with hearing loss can call 711 for Washington Relay Service. Persons with a speech disability can call 877-833-6341.

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

WATER WELL REPORT

3349

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

Construction/Decommission ("X" in circle) 452605
- [X] Construction
- [ ] Decommission *ORIGINAL INSTALLATION Notice of Intent Number*

PROPOSED USE: [ ] Domestic [ ] Industrial [ ] Municipal [ ] DeWater [X] Irrigation [ ] Test Well [ ] Other

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

DIMENSIONS: Diameter of well 8" inches, drilled 7 7/8" ft. Depth of completed well 1540 ft.

CONSTRUCTION DETAILS

Casing [X] Welded 10 " Diam. from +1 ft. to 305 ft.
Installed: [ ] Liner installed 8 " Diam. from +1 ft. to 469 ft.
[ ] Threaded " Diam. From ft. to ft.

Perforations: [ ] Yes [X] No
Type of perforator used
SIZE of perfs in. by in. and no. of perfs from ft. to ft.

Screens: [ ] Yes [X] 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 [X] No Size of gravel/sand
Materials placed from ft. to ft.

Surface Seal: [X] Yes [ ] No To what depth? 305 ft.
Material used in seal cement
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 362 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
Bailer Test gal./min. with ft. drawdown after hrs
Airtest 250 gal./min. with stem set at 1540 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. W268415
Unique Ecology Well ID Tag No. AHP715
Water Right Permit No. G4-25207P
Property Owner Name Evans Fruit
Well Street Address PO Box 70
City Cowiche County Yakima
Location NW 1/4-1/4 NE 1/4 Sec 18 Twn 12 R 20 EWM [X] WWM [ ] Check One
(s, t, r Still REQUIRED)

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

Tax Parcel No. (Required) 201218-12001

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
Hard gray basalt	1181	1229
Med soft gray porous basalt trace of green clay	1229	1250
Med soft porous black basalt 74deg 310 psi	1250	1277
Med hard fractured black basalt	1277	1296
Med hard dark gray basalt	1296	1336
Med soft broken dark gray basalt with some green & gray clay	1336	1342
Hard gray basalt	1342	1401
Med hard dark gray basalt	1401	1414
Soft porous black basalt	1414	1436
Med hard gray basalt	1436	1500
Hard gray basalt	1500	1534
Med hard black basalt	1534	1540

8" casing to 469'
7 7/8" hole to 1,540'

DEPT OF ECOLOGY Received JUN 26 2012 CENTRAL REGION Office

Start Date 4-19-12 Completed Date 5-22-12

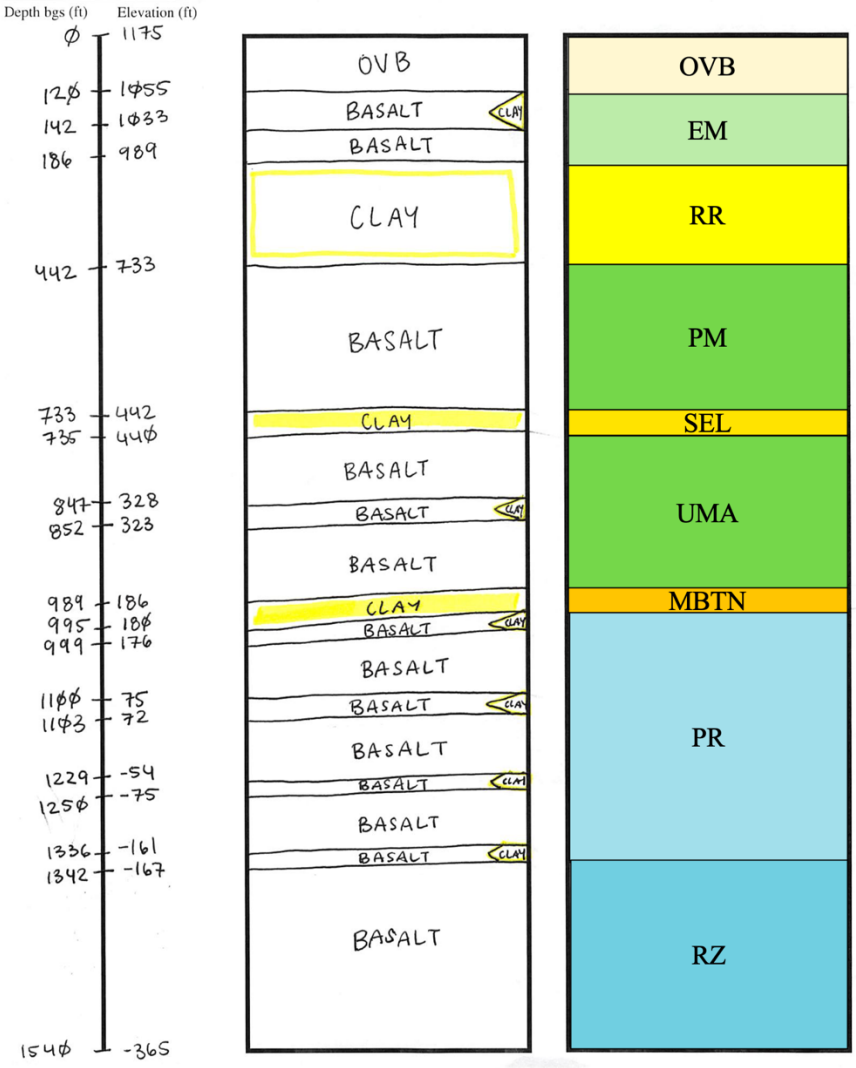
WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

[X] Driller [ ] Engineer [ ] Trainee Name (Print) Larry McLanahan
Driller/Engineer/Trainee Signature
Driller or trainee License No. 0337
IF TRAINEE: Driller's License No:
Driller's Signature

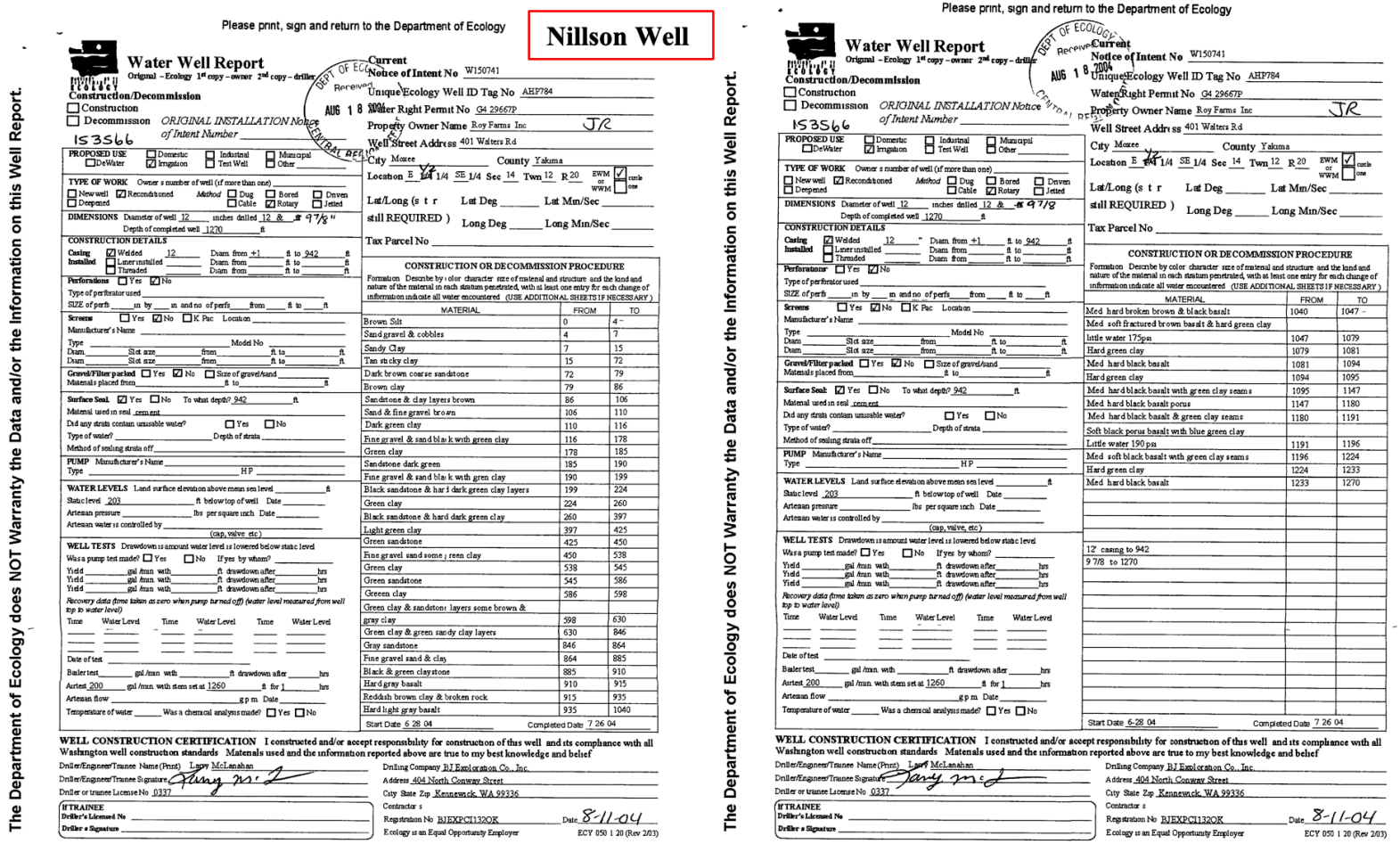
Drilling Company BJ Exploration & Drilling Co., INC
Address 404 N Conway St
City, State, Zip Kennewick , WA , 99336
Contractor's Registration No. BJEXPI132QK Date 6-22-12

ECY 050-1-20 (Rev 06/08) If you need this document in an alternate format, please call the Water Resources Program at 360-407-6600. Persons with hearing loss can call 711 for Washington Relay Service. Persons with a speech disability can call 877-833-6341.

Well ID: 3349 Well Name: Cross Section: C-C'
Surface Elevation: 1175 ft Well Depth: 1540 ft Aquifer: WNB



Figures A46-A47. Well reports and stratigraphic interpretations of aquifer testing wells. The abbreviations used to denote stratigraphic members are as follows: OVB = overburden, EM = Elephant Mountain, RR = Rattlesnake Ridge, PM = Pomona, SEL = Selah, UMA = Umatilla, MBTN = Mabton, PR = Priest Rapids, RZ = Roza, SQC = Squaw Creek, FS = Frenchman Springs, VTG = Vantage, and GRB = Grande Ronde.



Please print, sign and return to the Department of Ecology

Nillson Well

Water Well Report
Original – Ecology 1st copy – owner 2nd copy – driller

DEPT. OF ECOLOGY Received AUG 18 2004 CENTRAL REGION

Construction/Decommission
☐ Construction
☐ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* 153566

Current Notice of Intent No W150741
Unique Ecology Well ID Tag No AHP784
Water Right Permit No G4 29667P
Property Owner Name Roy Farms Inc JR
Well Street Address 401 Walters Rd
City Moxee County Yakima
Location E ½ ¼ SE 1/4 Sec 14 Twn 12 R 20 EWM ☑ or WWM ☐ circle one
Lat/Long (s t r still REQUIRED) Lat Deg ____ Lat Min/Sec ____ Long Deg ____ Long Min/Sec ____
Tax Parcel No ____

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

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

DIMENSIONS Diameter of well 12 inches drilled 12 & 9 7/8"
Depth of completed well 1270 ft

CONSTRUCTION DETAILS
Casing Installed: ☑ Welded 12 Diam from +1 ft to 942 ft; ☐ Liner installed Diam from ____ ft to ____ ft; ☐ Threaded Diam from ____ ft to ____ ft
Perforations ☐ Yes ☑ No
Type of perforator used ____
SIZE of perfs ____ in by ____ in and no of perfs ____ from ____ ft to ____ ft
Screens ☐ Yes ☑ No ☐ K Pac Location ____
Manufacturer's Name ____
Type ____ Model No ____
Diam ____ Slot size ____ from ____ ft to ____ ft
Diam ____ Slot size ____ from ____ ft to ____ ft
Gravel/Filter packed ☐ Yes ☑ No Size of gravel/sand ____
Materials placed from ____ ft to ____ ft
Surface Seal ☑ Yes ☐ No To what depth? 942 ft
Material used in seal cement
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 203 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 ____
Bailer test ____ gal /min with ____ ft drawdown after ____ hrs
Airtest 200 gal /min with stem set at 1260 ft for 1 hrs
Artesian flow ____ g p m Date ____
Temperature of water ____ Was a chemical analysis made? ☐ Yes ☐ No

CONSTRUCTION OR DECOMMISSION PROCEDURE
Formation Describe by color character size of material and structure and the land 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
Brown Silt	0	4
Sand gravel & cobbles	4	7
Sandy Clay	7	15
Tan sticky clay	15	72
Dark brown coarse sandstone	72	79
Brown clay	79	86
Sandstone & clay layers brown	86	106
Sand & fine gravel brown	106	110
Dark green clay	110	116
Fine gravel & sand black with green clay	116	178
Green clay	178	185
Sandstone dark green	185	190
Fine gravel & sand black with gren clay	190	199
Black sandstone & hard dark green clay layers	199	224
Green clay	224	260
Black sandstone & hard dark green clay	260	397
Light green clay	397	425
Green sandstone	425	450
Fine gravel sand some green clay	450	538
Green clay	538	545
Green sandstone	545	586
Greeen clay	586	598
Green clay & sandstone layers some brown & gray clay	598	630
Green clay & green sandy clay layers	630	846
Gray sandstone	846	864
Fine gravel sand & clay	864	885
Black & green claystone	885	910
Hard gray basalt	910	915
Reddish brown clay & broken rock	915	935
Hard light gray basalt	935	1040

Start Date 6-28-04 Completed Date 7-26-04

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

Driller/Engineer/Trainee Name (Print) Larry McLanahan
Driller/Engineer/Trainee Signature Larry McL
Driller or trainee License No 0337
Drilling Company BJ Exploration Co., Inc.
Address 404 North Conway Street
City State Zip Kennewick, WA 99336
IF TRAINEE Driller's Licensed No ____ Driller's Signature ____
Contractor's Registration No BJEXPCI132OK Date 8-11-04
Ecology is an Equal Opportunity Employer ECY 050 1 20 (Rev 2/03)

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

Please print, sign and return to the Department of Ecology

Water Well Report
Original – Ecology 1st copy – owner 2nd copy – driller

DEPT. OF ECOLOGY Received AUG 18 2004 CENTRAL REGION

Construction/Decommission
☐ Construction
☐ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* 153566

Current Notice of Intent No W150741
Unique Ecology Well ID Tag No AHP784
Water Right Permit No G4 29667P
Property Owner Name Roy Farms Inc JR
Well Street Address 401 Walters Rd
City Moxee County Yakima
Location E ½ ¼ SE 1/4 Sec 14 Twn 12 R 20 EWM ☑ or WWM ☐ circle one
Lat/Long (s t r still REQUIRED) Lat Deg ____ Lat Min/Sec ____ Long Deg ____ Long Min/Sec ____
Tax Parcel No ____

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

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

DIMENSIONS Diameter of well 12 inches drilled 12 & 9 7/8
Depth of completed well 1270 ft

CONSTRUCTION DETAILS
Casing Installed: ☑ Welded 12 Diam from +1 ft to 942 ft; ☐ Liner installed Diam from ____ ft to ____ ft; ☐ Threaded Diam from ____ ft to ____ ft
Perforations ☐ Yes ☑ No
Type of perforator used ____
SIZE of perfs ____ in by ____ in and no of perfs ____ from ____ ft to ____ ft
Screens ☐ Yes ☑ No ☐ K Pac Location ____
Manufacturer's Name ____
Type ____ Model No ____
Diam ____ Slot size ____ from ____ ft to ____ ft
Diam ____ Slot size ____ from ____ ft to ____ ft
Gravel/Filter packed ☐ Yes ☑ No ☐ Size of gravel/sand ____
Materials placed from ____ ft to ____ ft
Surface Seal ☑ Yes ☐ No To what depth? 942 ft
Material used in seal cement
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 203 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 ____
Bailer test ____ gal /min with ____ ft drawdown after ____ hrs
Airtest 200 gal /min with stem set at 1260 ft for 1 hrs
Artesian flow ____ g p m Date ____
Temperature of water ____ Was a chemical analysis made? ☐ Yes ☐ No

CONSTRUCTION OR DECOMMISSION PROCEDURE
Formation Describe by color character size of material and structure and the land 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
Med hard broken brown & black basalt	1040	1047 –
Med soft fractured brown basalt & hard green clay		
little water 175psn	1047	1079
Hard green clay	1079	1081
Med hard black basalt	1081	1094
Hard green clay	1094	1095
Med hard black basalt with green clay seams	1095	1147
Med hard black basalt porus	1147	1180
Med hard black basalt & green clay seams	1180	1191
Soft black porus basalt with blue green clay		
Little water 190 psn	1191	1196
Med soft black basalt with green clay seams	1196	1224
Hard green clay	1224	1233
Med hard black basalt	1233	1270
12" casing to 942		
9 7/8 to 1270		

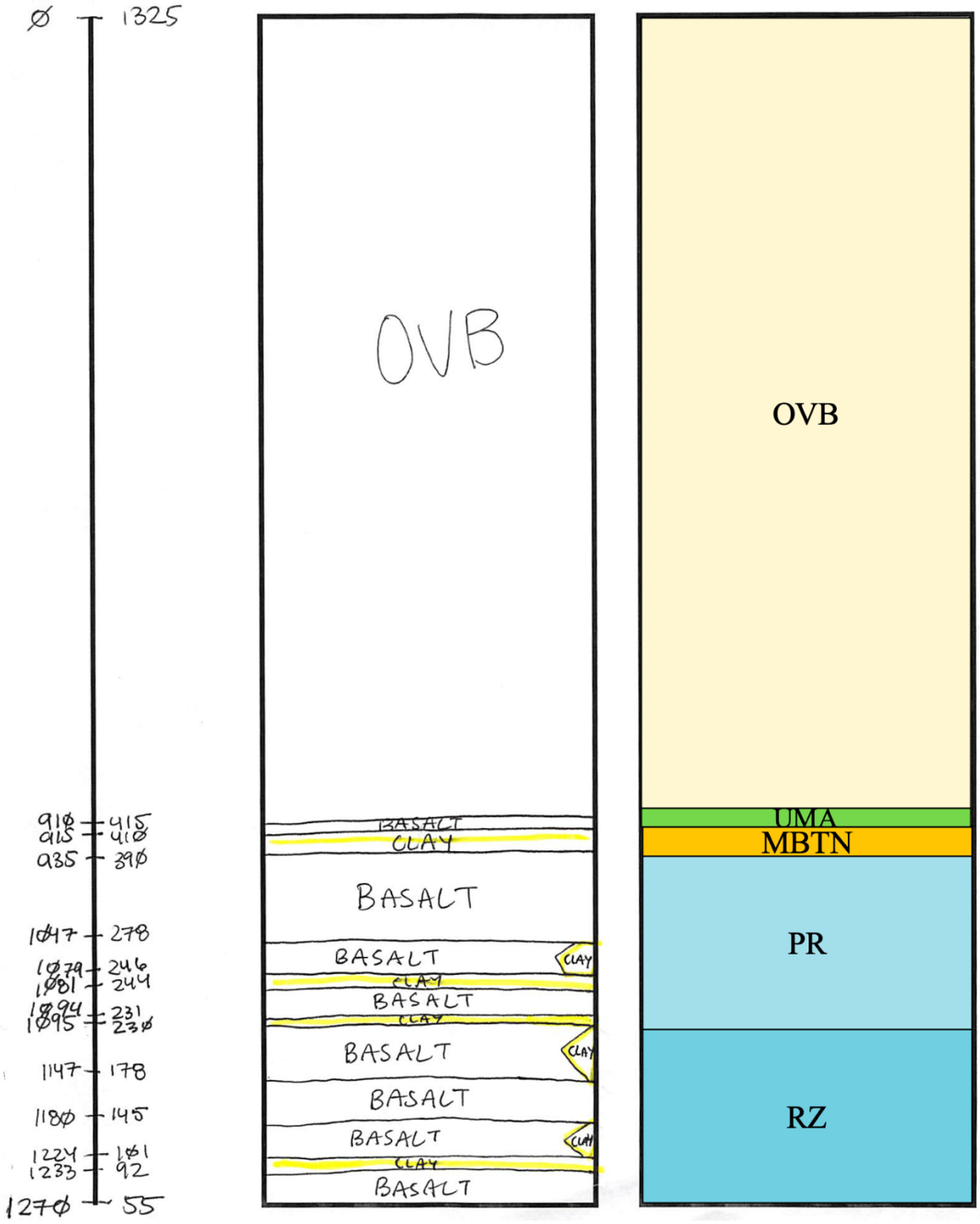
Start Date 6-28-04 Completed Date 7-26-04

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

Driller/Engineer/Trainee Name (Print) Larry McLanahan
Driller/Engineer/Trainee Signature Larry McL
Driller or trainee License No 0337
Drilling Company BJ Exploration Co., Inc.
Address 404 North Conway Street
City State Zip Kennewick, WA 99336
IF TRAINEE Driller's Licensed No ____ Driller's Signature ____
Contractor's Registration No BJEXPCI132OK Date 8-11-04
Ecology is an Equal Opportunity Employer ECY 050 1 20 (Rev 2/03)

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

Well ID:	Well Name: Nillson	Cross Section:
Surface Elevation: 1325ft	Well Depth: 1270ft	Aquifer: WNB



Charron Backup Well

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

CHARRON #2 — 8427 — Start Card No. 22412

Water Right Permit No. G4-31348

(1) OWNER: Name Bob Charron — Address 201 Desmarais Rd., Moxee, WA

(2) LOCATION OF WELL: County YAKIMA — NW ¼ N ¼ Sec 13 T 12 N., R 20 W.M.

(2a) STREET ADDDRESS 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 inches. Drilled feet Depth of completed well ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 20" Diam. from 0 ft. to 30 ft
Welded ☒ 16" Diam. from +2 ft. to 570 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
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? ft.
Material used in seal Cement grout
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name NOT INSTALLED
Type H P

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 220 ft. below top of well Date
Artesian pressure lbs per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

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

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test 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 ☐

ECY 050-1-20 (10/87) -1329-

(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	8	
caleche	8	40	EM?
tan & brwon clay w/gravel	40	170	
green & tan clay	170	200	PR?
sand, gravel, clay green	200	420	
clay w/ gravel & basalt	420	450	
brown clay w/ rock	450	508	
black tan basalt	508	550	
hard grey basalt, fract.	550	571	
cement - 16" casing	570		PM?
Drlg. 14 3/4" grey basalt	570	581	
black basalt water-med	581	583	
swl 220 grey basalt med	583		
lost cac. Drlg w/air	583		
black basalt w/ clay	583	588	
grey basalt hard	588	675	
fract. basalt	675	683	PM
grey basalt hard	683	694	
basalt w/ clay green	694	705	
basalt soft fract.	705	743	
clay soft	743	750	Set
basalt w/ clay soft	750	774	
basalt fract. black	774	820	
hard grey basalt fract.	820	834	
basalt soft black	834	845	
basalt black fract.	845	865	UM
basalt grey hard	865	875	
basalt grey very hard	875	1003	
basalt w/ clay soft black	1003	1020	
basalt med. black	1020	1043	HM
basalt grey med to hard	1043	1100	
sand top of mobton	1100	1105	MB

Work started 10-24-92, 19 Completed 1-26-93, 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 Aqua Drilling & Engineering (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address 3130 15th Ave. SE Albany, OR 97321
(Signed) Harold Rathmanner (WELL DRILLER) License No. 1532
Contractor's Registration No. 601-414-891 Date , 19

(USE ADDITIONAL SHEETS IF NECESSARY)

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

35218

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. W044888
UNIQUE WELL I.D.# AAM 730
Water Right Permit No. G4-31348E

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

(1) OWNER: Name Charron Farms — Address Moxee, WA 201 Demaraes Rd.

(2) LOCATION OF WELL: County Yakima — NE ¼ NW ¼ Sec 13 T 12 N.R 20 WM.

(2a) STREET ADDRESS OF WELL (or nearest address) NOV 23 1994

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

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

(5) DIMENSIONS: Diameter of well inches
Drilled feet Depth of completed well 2117 ft

(6) CONSTRUCTION DETAILS:
Casing installed: 14" Diam from 560 ft to 787 ft
Welded ☒ 10" Diam from 777 ft to 2117 ft
Liner installed ☐ Threaded ☐ " Diam from ft to ft

Perforations: Yes ☒ No ☐
Type of perforator used machined
SIZE of perforations 1/8 in by 6" 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? 40' ft
Material used in seal cement
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 220' 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? Layne Western
Yield 2000 gal /min with 120 ft drawdown after 1 hrs
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

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

ECL 050-1-20 (2/93) * * I

(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
Clay - green and tan	1105	1110
Hard gray basalt	1110	1141
Black basalt (med)	1141	1175
Gray basalt (hard)	1175	1202
Soft blk & brn basalt	1202	1215
Black basalt - med	1215	1302
Softer basalt black	1302	1318
Basalt med hard black	1318	1502
Soft black basalt	1502	1548
Med black basalt	1548	1586
Soft black	1586	1607
Harder gray basalt	1607	1618
Softer black w/gray and tan clay	1618	1672
Soft black basalt w/ gray clay	1672	1680
Hard gray basalt	1680	1709
Med black basalt	1709	1740
Hard gray basalt	1740	1796
Black basalt w/ gray clay	1796	1810
Soft green clay w/ basalt	1810	1827
Tan & brown clay - soft		
Soft black coal and rock	1827	1837
Gray basalt w/ shale	1837	1860
Softer black & brown basalt, porse	1860	1873
Basalt gray hard	1873	1883
Black vesacular basalt	1883	1900
Gray basalt med hard	1900	2015
Black med basalt	2015	2024
Hard gray basalt		
Softer black basalt	2024	2038
Soft black & brown basalt	2038	2071
Black basalt med	2071	2117
	T.D.	

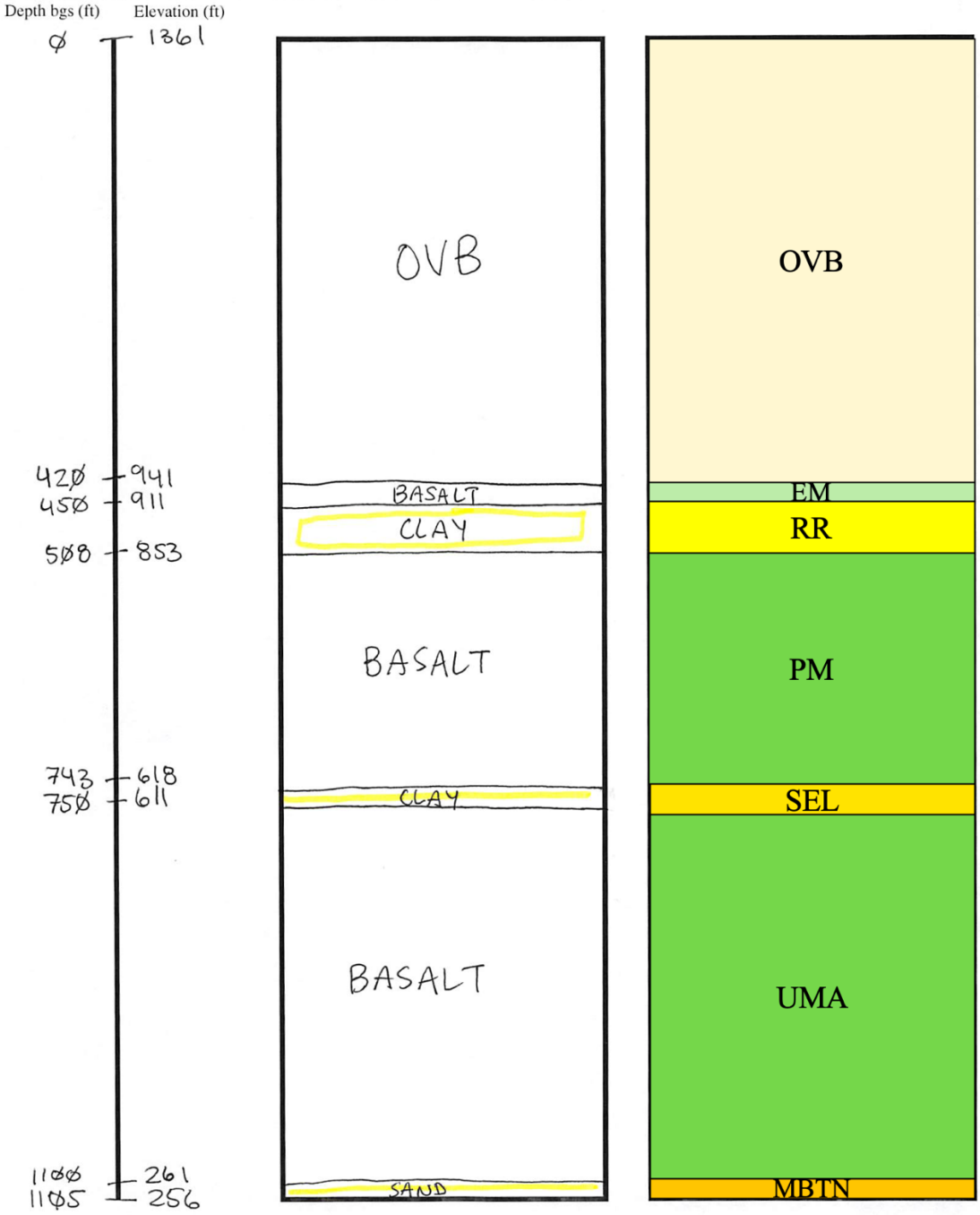
Work Started 6/10/94, 19 Completed 7-16, 1994

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 Aqua Drilling & Engeneering (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address 120 Crestview Dr., Colville, WA
(Signed) Harold Rathmanner (WELL DRILLER) License No 1532
Contractor's Registration No AQUADE095D3 Date NOV 23, 1994

(USE ADDITIONAL SHEETS IF NECESSARY)

Well ID: 3344	Well Name: Chamon Backup	Cross Section:
Surface Elevation: 1361ft	Well Depth: 1105ft	Aquifer: WNB



APPENDIX B

HISTORIC GROUNDWATER LEVELS

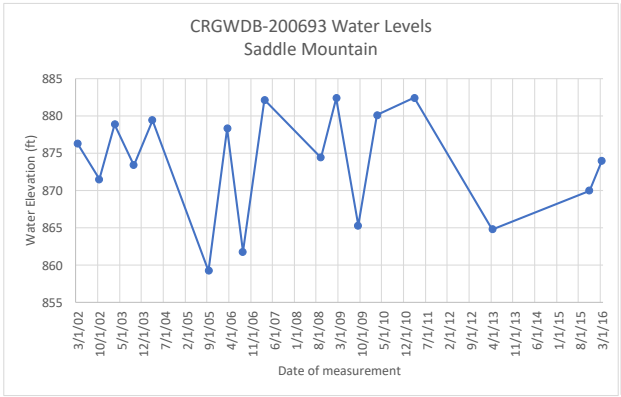
Table B1. Groundwater level trends in Saddle Mountain Basalt wells (1964-2019).

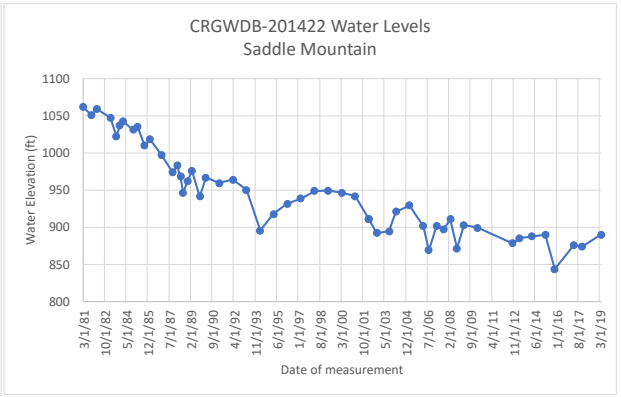
Saddle Mountain						
Well ID	Latitude	Longitude	Surface Elevation	Well Depth	Trend	Rate (ft/yr)
CRGWDB-201417	46.51393	-120.377	1299	400	Declining	-6.31
CRGWDB-201422	46.49345	-120.3638	1059.07	683	Declining	-4.64
CRGWDB-201439	46.4873	-120.3577	1143.54	1158	Declining	-7.34
CRGWDB-201449	46.47978	-120.3348	1002	560	Declining	-2.04
CRGWDB-201865	46.42373	-120.1895	1254	605	Declining	-5.37
CRGWDB-201885	46.40065	-120.1605	1052	810	Declining	-3.03
CRGWDB-201888	46.39488	-120.1312	985	720	Declining	-1.17
CRGWDB-201889	46.38622	-120.1687	930	775	Declining	-1.35
CRGWDB-203711	46.31228	-120.1196	756	420	Stable	-0.51
CRGWDB-210973	46.46945	-120.2699	1152	450	Declining	-1.02
CRGWDB-211014	46.51627	-120.3631	1288	512	Declining	-4.56
CRGWDB-211595	46.32277	-119.921	883	515	Declining	-2.74
CRGWDB-201549	46.50483	-120.353	1239	460	Declining	-8.07
CRGWDB-201847	46.43565	-120.2269	1137	535	Declining	-1.13
CRGWDB-201883	46.41347	-120.1574	1207	955	Declining	-0.99
CRGWDB-202824	46.4366	-120.2516	1017	1201	Declining	-2.01
CRGWDB-200693	46.39513	-120.0824	1129	1105	Increasing	3.50
CRGWDB-201558	46.46975	-120.33	1112	725	Declining	-4.23
CRGWDB-210985	46.4972	-120.4404	934	300	Stable	0.01
CRGWDB-201557	46.47545	-120.325	1155.25	440	Stable	-0.26
CRGWDB-201884	46.404	-120.1796	1015	773	Declining	-1.28
CRGWDB-201547	46.51627	-120.3631	1288	523	Stable	-0.18
CRGWDB-201446	46.48095	-120.3507	1117	552	Declining	-2.30
CRGWDB-203712	46.30872	-120.1099	734	400	Stable	0.80
CRGWDB-211885	46.39882	-120.0982	1106	990	Increasing	6.24
CRGWDB-210970	46.34735	-119.9014	1127	680	Stable	0.95
CRGWDB-211884	46.43132	-120.2466	1001	1193	Increasing	5.66
					Standard Deviation	3.405875
					Standard Error	0.655461

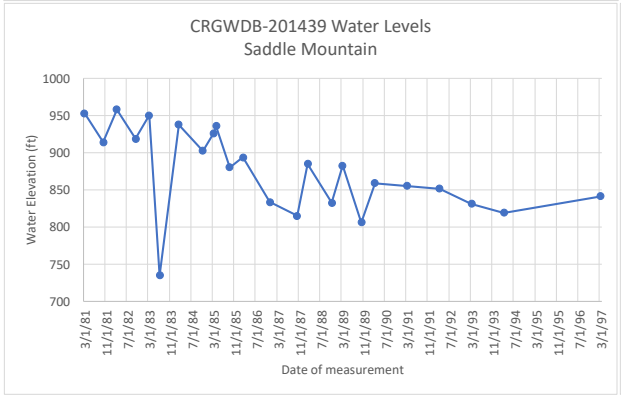
Table B2. Groundwater level trends in Wanapum Basalt wells (1974-2019).

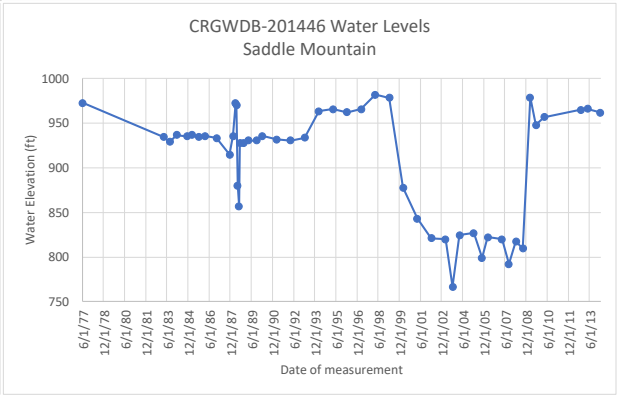
Wanapum						
Well ID	Latitude	Longitude	Surface Elevation	Well Depth	Trend	Rate (ft/yr)
CRGWDB-201475	46.46888	-120.2676	1199	1400	Declining	-8.69
CRGWDB-201712	46.3113	-119.8794	1158	923	Declining	-3.25
CRGWDB-201846	46.44667	-120.2261	1283	1945	Declining	-10.55
CRGWDB-202101	46.41843	-120.118	1228	2715	Declining	-5.37
CRGWDB-206455	46.51847	-120.4465	1103	518	Declining	-1.86
CRGWDB-211013	46.5189	-120.3761	1236	602	Declining	-4.09
CRGWDB-211878	46.3755	-119.9697	1079	1718	Declining	-2.70
CRGWDB-201191	46.43543	-120.2026	1288	1402	Declining	-5.99
CRGWDB-201420	46.50662	-120.3421	1336	1510	Declining	-7.30
CRGWDB-201836	46.45487	-120.2446	1151.6	1620	Declining	-3.21
CRGWDB-201867	46.42687	-120.1779	1265	1808	Declining	-4.49
CRGWDB-202116	46.40347	-120.0209	1264	1105	Declining	-2.85
CRGWDB-201839	46.47318	-120.2194	1457	1243	Stable	-0.69
CRGWDB-202108	46.40068	-120.0374	1160	1000	Stable	-0.84
CRGWDB-210969	46.30602	-119.9017	1045	817	Decreasing	-3.83
CRGWDB-201408	46.52213	-120.4577	1112.28	500	Increasing	1.28
CRGWDB-202103	46.40703	-120.1037	1129	1690	Stable	0.11
CRGWDB-201849	46.43662	-120.2186	1239	1605	Decreasing	-1.39
CRGWDB-202107	46.40768	-120.0216	1284	1538	Increasing	1.50
CRGWDB-202154	46.41533	-120.0631	1321	1165	Increasing	2.88
					Standard Deviation	3.42772856
					Standard Error	0.76646341

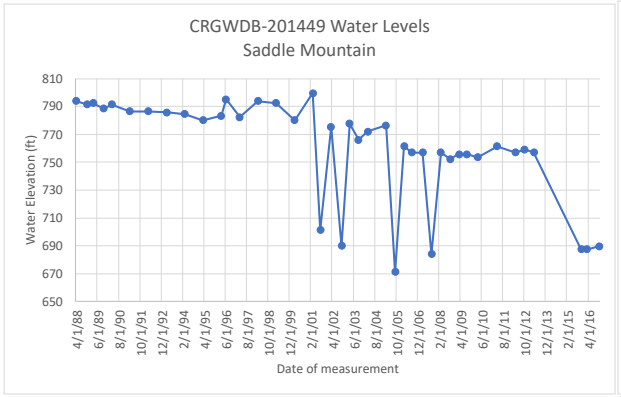
Figures B1-B27. Hydrographs of wells completed in the Saddle Mountain Basalt aquifer.

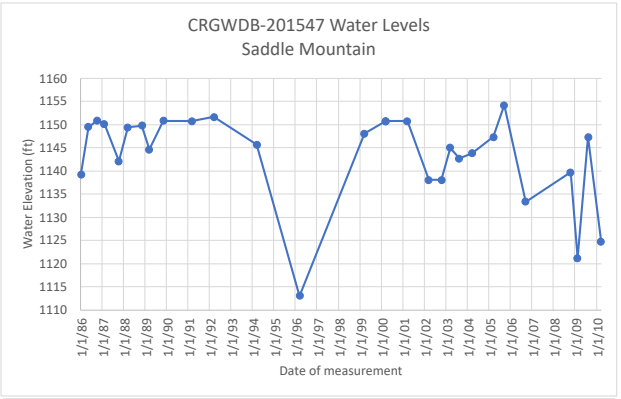


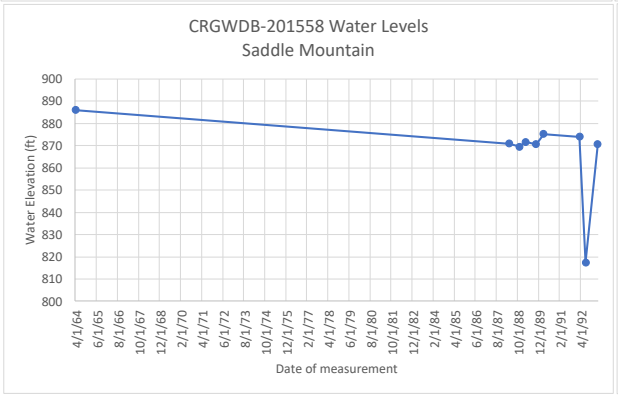


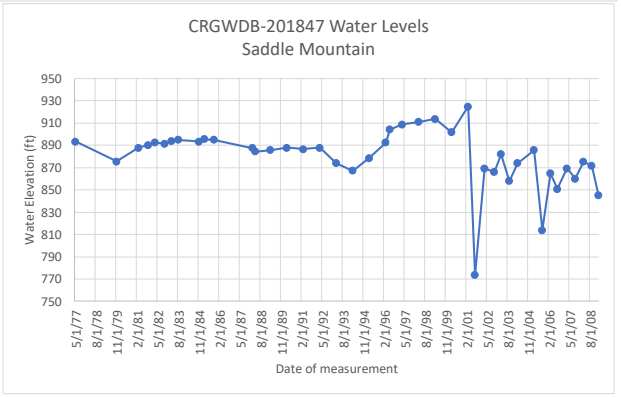


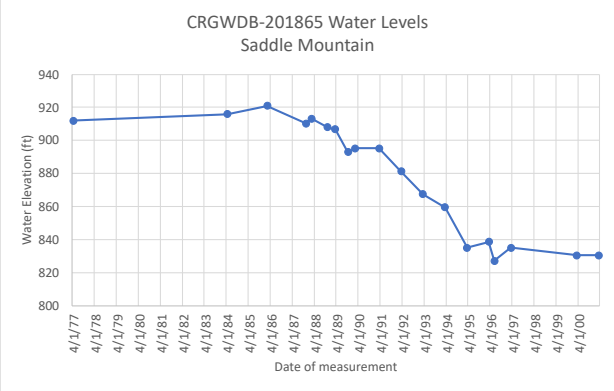


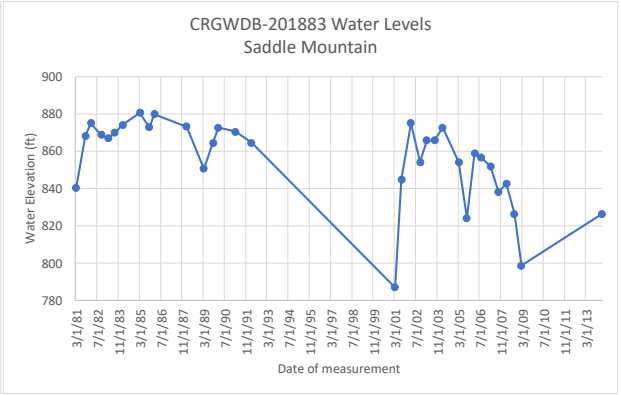


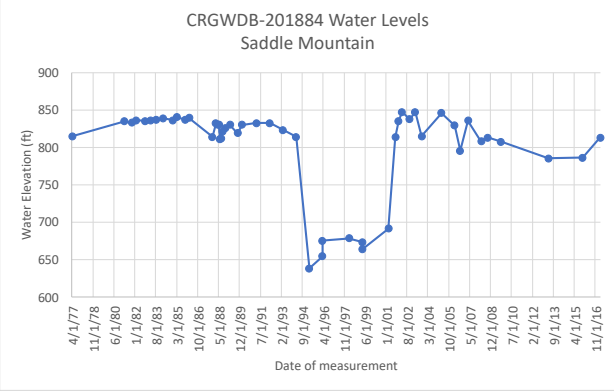


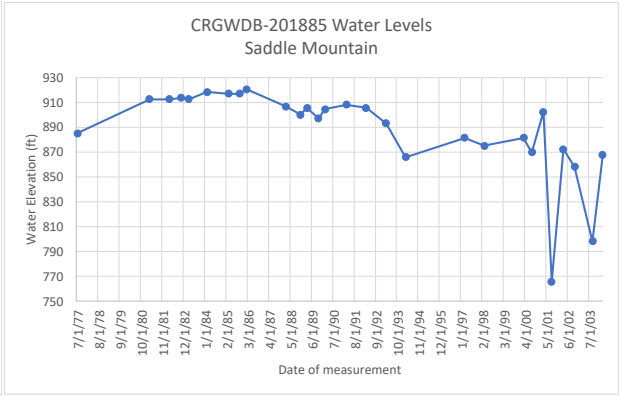


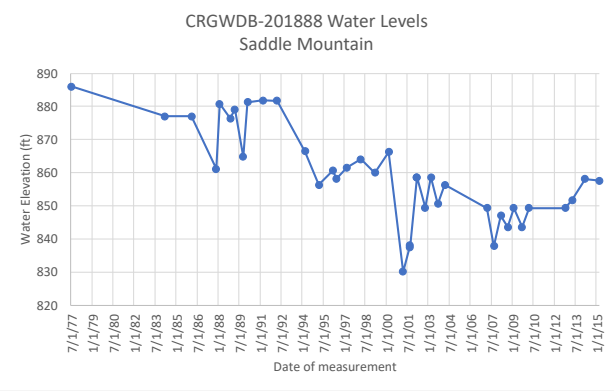


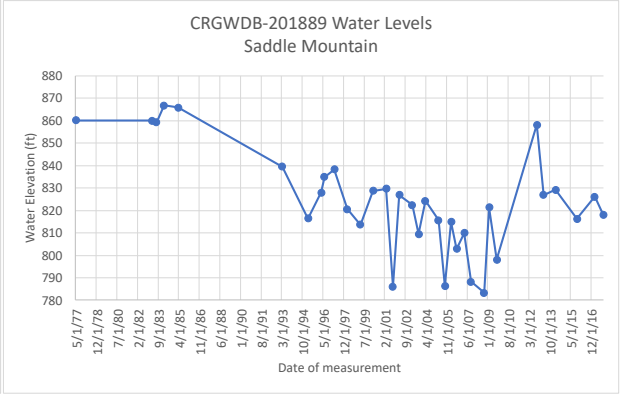

CRGWDB-201865 Water Levels
Saddle Mountain
Water Elevation (ft)
940
920
900
880
860
840
820
800
4/1/77
4/1/78
4/1/79
4/1/80
4/1/81
4/1/82
4/1/83
4/1/84
4/1/85
4/1/86
4/1/87
4/1/88
4/1/89
4/1/90
4/1/91
4/1/92
4/1/93
4/1/94
4/1/95
4/1/96
4/1/97
4/1/98
4/1/99
4/1/00
Date of measurement

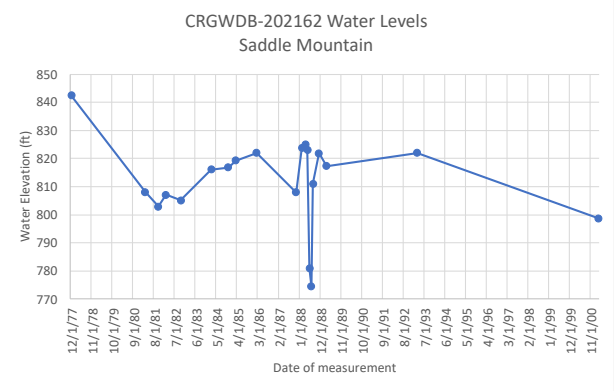

CRGWDB-201883 Water Levels
Saddle Mountain
Water Elevation (ft)
900
880
860
840
820
800
780
3/1/81
7/1/82
11/1/83
3/1/85
7/1/86
11/1/87
3/1/89
7/1/90
11/1/91
3/1/93
7/1/94
11/1/95
3/1/97
7/1/98
11/1/99
3/1/01
7/1/02
11/1/03
3/1/05
7/1/06
11/1/07
3/1/09
7/1/10
11/1/11
3/1/13
Date of measurement

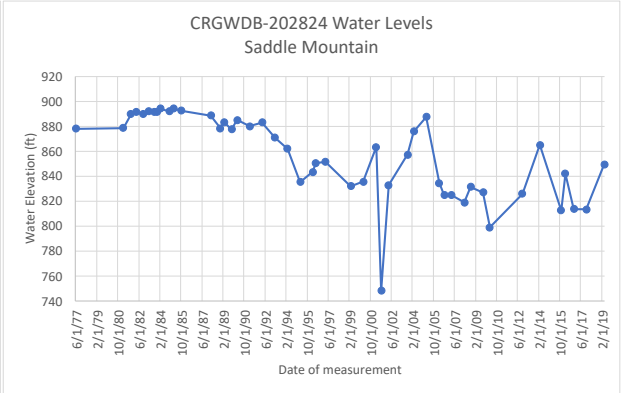

CRGWDB-201884 Water Levels
Saddle Mountain
Water Elevation (ft)
900
850
800
750
700
650
600
4/1/77
11/1/78
6/1/80
1/1/82
8/1/83
3/1/85
10/1/86
5/1/88
12/1/89
7/1/91
2/1/93
9/1/94
4/1/96
11/1/97
6/1/99
1/1/01
8/1/02
3/1/04
10/1/05
5/1/07
12/1/08
7/1/10
2/1/12
9/1/13
4/1/15
11/1/16
Date of measurement

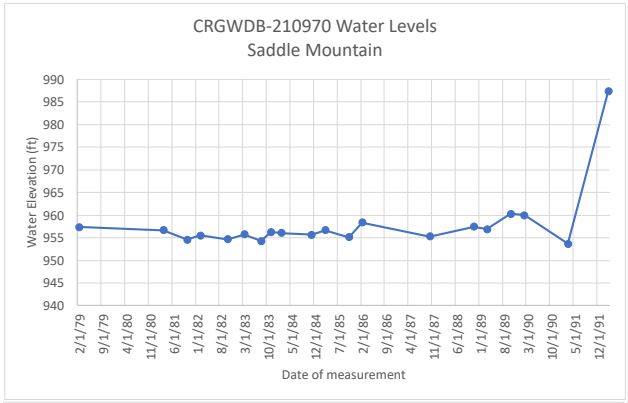

CRGWDB-201885 Water Levels
Saddle Mountain
Water Elevation (ft)
930
910
890
870
850
830
810
790
770
750
7/1/77
8/1/78
9/1/79
10/1/80
11/1/81
12/1/82
1/1/84
2/1/85
3/1/86
4/1/87
5/1/88
6/1/89
7/1/90
8/1/91
9/1/92
10/1/93
11/1/94
12/1/95
1/1/97
2/1/98
3/1/99
4/1/00
5/1/01
6/1/02
7/1/03
Date of measurement

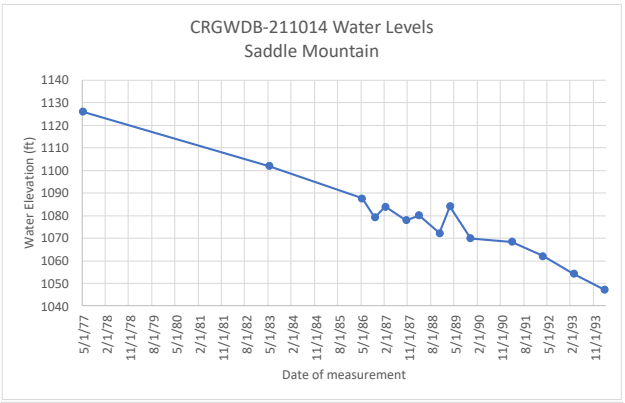

CRGWDB-201888 Water Levels
Saddle Mountain
Water Elevation (ft)
890
880
870
860
850
840
830
820
7/1/77
1/1/79
7/1/80
1/1/82
7/1/83
1/1/85
7/1/86
1/1/88
7/1/89
1/1/91
7/1/92
1/1/94
7/1/95
1/1/97
7/1/98
1/1/00
7/1/01
1/1/03
7/1/04
1/1/06
7/1/07
1/1/09
7/1/10
1/1/12
7/1/13
1/1/15
Date of measurement

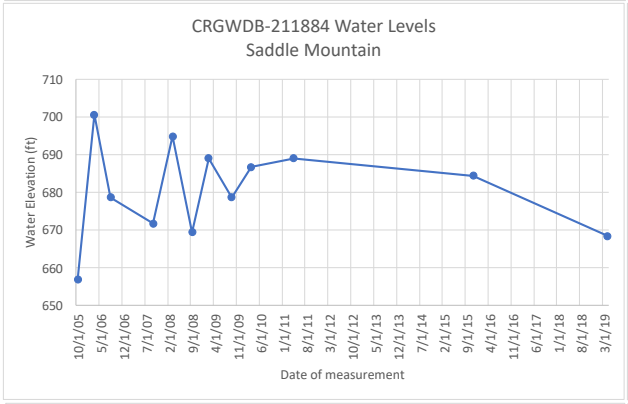

CRGWDB-201889 Water Levels
Saddle Mountain
Water Elevation (ft)
880
870
860
850
840
830
820
810
800
790
780
5/1/77
12/1/78
7/1/80
2/1/82
9/1/83
4/1/85
11/1/86
6/1/88
1/1/90
8/1/91
3/1/93
10/1/94
5/1/96
12/1/97
7/1/99
2/1/01
9/1/02
4/1/04
11/1/05
6/1/07
1/1/09
8/1/10
3/1/12
10/1/13
5/1/15
12/1/16
Date of measurement

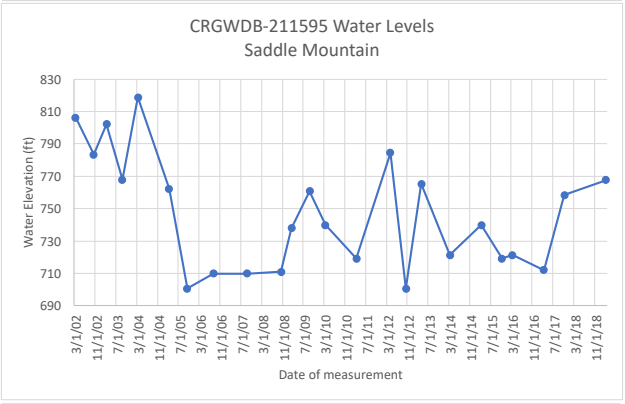

CRGWDB-202162 Water Levels
Saddle Mountain
Water Elevation (ft)
850
840
830
820
810
800
790
780
770
12/1/77
11/1/78
10/1/79
9/1/80
8/1/81
7/1/82
6/1/83
5/1/84
4/1/85
3/1/86
2/1/87
1/1/88
12/1/88
11/1/89
10/1/90
9/1/91
8/1/92
7/1/93
6/1/94
5/1/95
4/1/96
3/1/97
2/1/98
1/1/99
12/1/99
11/1/00
Date of measurement

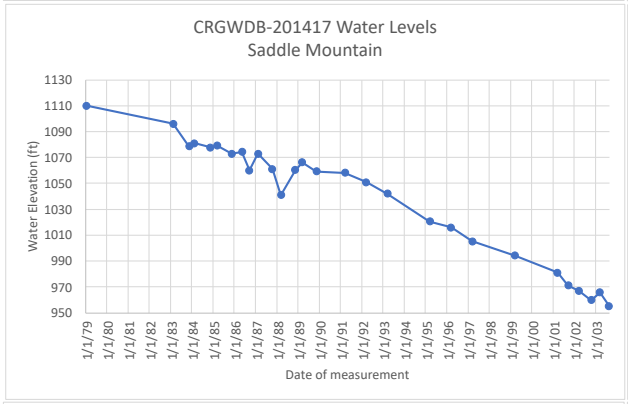

CRGWDB-202824 Water Levels
Saddle Mountain
Water Elevation (ft)
920
900
880
860
840
820
800
780
760
740
6/1/77
2/1/79
10/1/80
6/1/82
2/1/84
10/1/85
6/1/87
2/1/89
10/1/90
6/1/92
2/1/94
10/1/95
6/1/97
2/1/99
10/1/00
6/1/02
2/1/04
10/1/05
6/1/07
2/1/09
10/1/10
6/1/12
2/1/14
10/1/15
6/1/17
2/1/19
Date of measurement

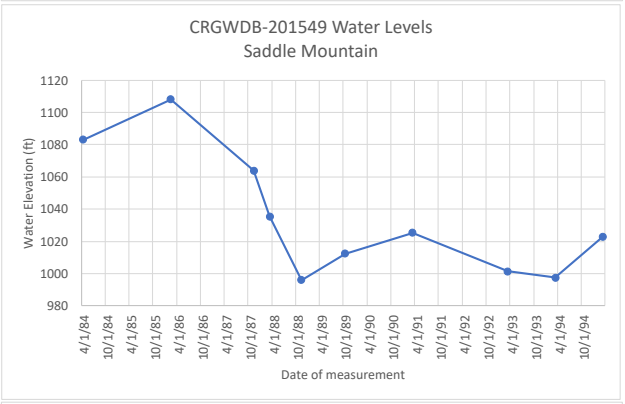

CRGWDB-210970 Water Levels
Saddle Mountain
Water Elevation (ft)
990
985
980
975
970
965
960
955
950
945
940
2/1/79
9/1/79
4/1/80
11/1/80
6/1/81
1/1/82
8/1/82
3/1/83
10/1/83
5/1/84
12/1/84
7/1/85
2/1/86
9/1/86
4/1/87
11/1/87
6/1/88
1/1/89
8/1/89
3/1/90
10/1/90
5/1/91
12/1/91
Date of measurement

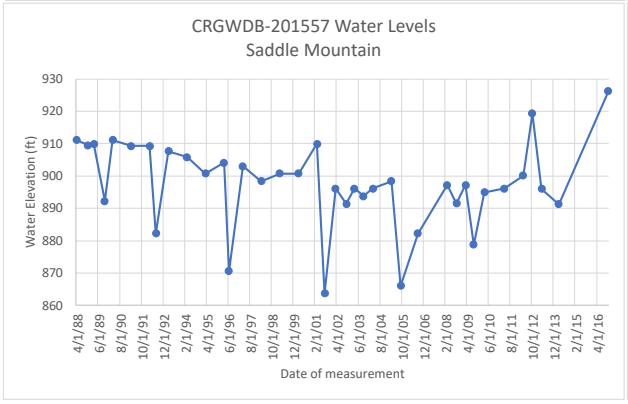

CRGWDB-211014 Water Levels
Saddle Mountain
Water Elevation (ft)
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
5/1/77
2/1/78
11/1/78
8/1/79
5/1/80
2/1/81
11/1/81
8/1/82
5/1/83
2/1/84
11/1/84
8/1/85
5/1/86
2/1/87
11/1/87
8/1/88
5/1/89
2/1/90
11/1/90
8/1/91
5/1/92
2/1/93
11/1/93
Date of measurement

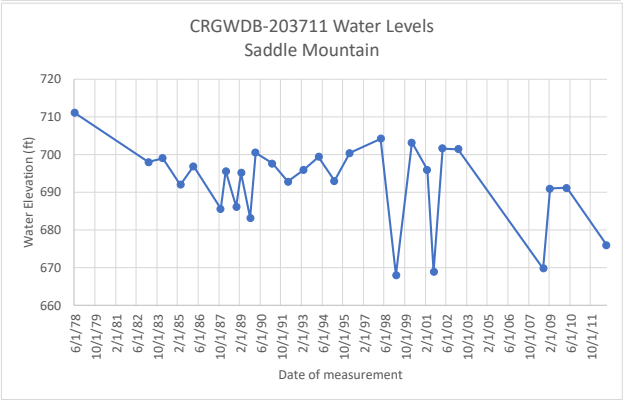

CRGWDB-211884 Water Levels
Saddle Mountain
Water Elevation (ft)
710
700
690
680
670
660
650
10/1/05
5/1/06
12/1/06
7/1/07
2/1/08
9/1/08
4/1/09
11/1/09
6/1/10
1/1/11
8/1/11
3/1/12
10/1/12
5/1/13
12/1/13
7/1/14
2/1/15
9/1/15
4/1/16
11/1/16
6/1/17
1/1/18
8/1/18
3/1/19
Date of measurement

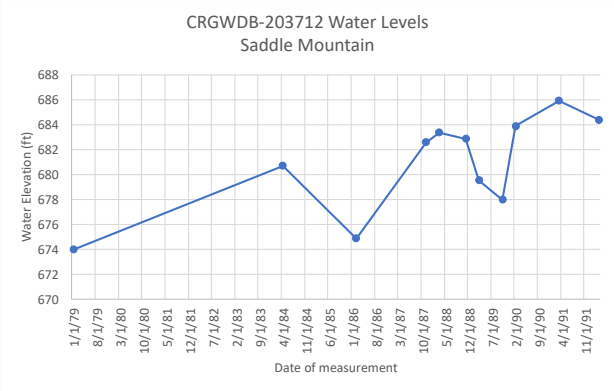

CRGWDB-211595 Water Levels
Saddle Mountain
Water Elevation (ft)
830
810
790
770
750
730
710
690
3/1/02
11/1/02
7/1/03
3/1/04
11/1/04
7/1/05
3/1/06
11/1/06
7/1/07
3/1/08
11/1/08
7/1/09
3/1/10
11/1/10
7/1/11
3/1/12
11/1/12
7/1/13
3/1/14
11/1/14
7/1/15
3/1/16
11/1/16
7/1/17
3/1/18
11/1/18
Date of measurement

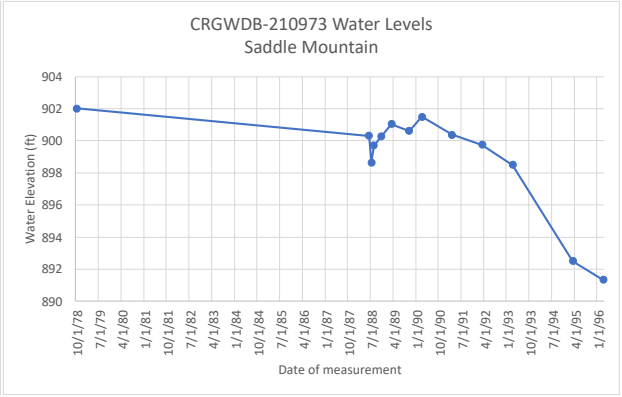

CRGWDB-201417 Water Levels
Saddle Mountain
Water Elevation (ft)
1130
1110
1090
1070
1050
1030
1010
990
970
950
1/1/79
1/1/80
1/1/81
1/1/82
1/1/83
1/1/84
1/1/85
1/1/86
1/1/87
1/1/88
1/1/89
1/1/90
1/1/91
1/1/92
1/1/93
1/1/94
1/1/95
1/1/96
1/1/97
1/1/98
1/1/99
1/1/00
1/1/01
1/1/02
1/1/03
Date of measurement

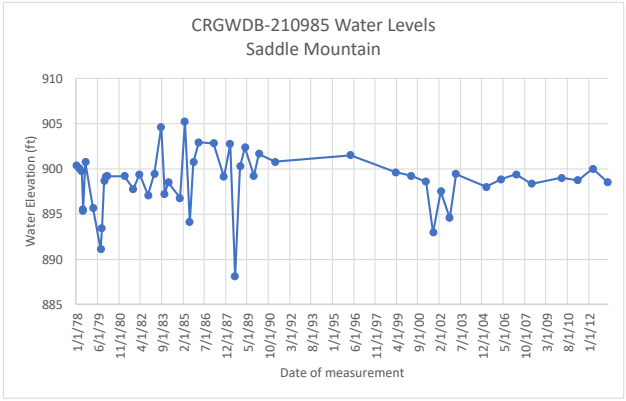

CRGWDB-201549 Water Levels
Saddle Mountain
Water Elevation (ft)
1120
1100
1080
1060
1040
1020
1000
980
4/1/84
10/1/84
4/1/85
10/1/85
4/1/86
10/1/86
4/1/87
10/1/87
4/1/88
10/1/88
4/1/89
10/1/89
4/1/90
10/1/90
4/1/91
10/1/91
4/1/92
10/1/92
4/1/93
10/1/93
4/1/94
10/1/94
Date of measurement


CRGWDB-201557 Water Levels
Saddle Mountain
Water Elevation (ft)
930
920
910
900
890
880
870
860
4/1/88
6/1/89
8/1/90
10/1/91
12/1/92
2/1/94
4/1/95
6/1/96
8/1/97
10/1/98
12/1/99
2/1/01
4/1/02
6/1/03
8/1/04
10/1/05
12/1/06
2/1/08
4/1/09
6/1/10
8/1/11
10/1/12
12/1/13
2/1/15
4/1/16
Date of measurement

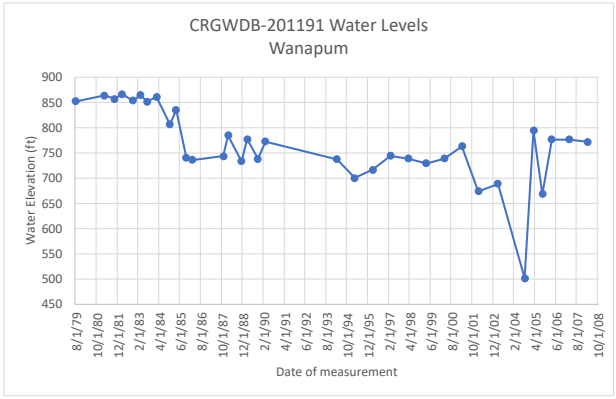

CRGWDB-203711 Water Levels
Saddle Mountain
Water Elevation (ft)
720
710
700
690
680
670
660
6/1/78
10/1/79
2/1/81
6/1/82
10/1/83
2/1/85
6/1/86
10/1/87
2/1/89
6/1/90
10/1/91
2/1/93
6/1/94
10/1/95
2/1/97
6/1/98
10/1/99
2/1/01
6/1/02
10/1/03
2/1/05
6/1/06
10/1/07
2/1/09
6/1/10
10/1/11
Date of measurement

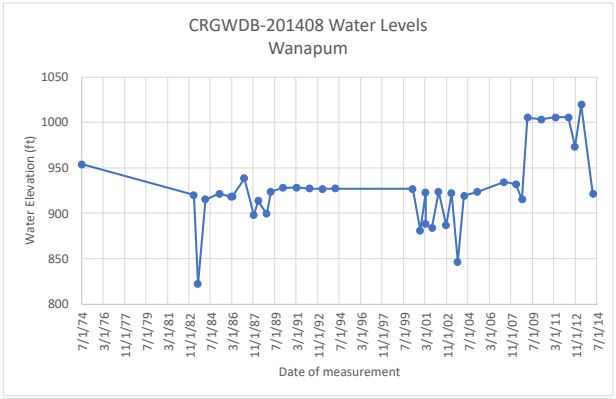

CRGWDB-203712 Water Levels
Saddle Mountain
Water Elevation (ft)
688
686
684
682
680
678
676
674
672
670
1/1/79
8/1/79
3/1/80
10/1/80
5/1/81
12/1/81
7/1/82
2/1/83
9/1/83
4/1/84
11/1/84
6/1/85
1/1/86
8/1/86
3/1/87
10/1/87
5/1/88
12/1/88
7/1/89
2/1/90
9/1/90
4/1/91
11/1/91
Date of measurement

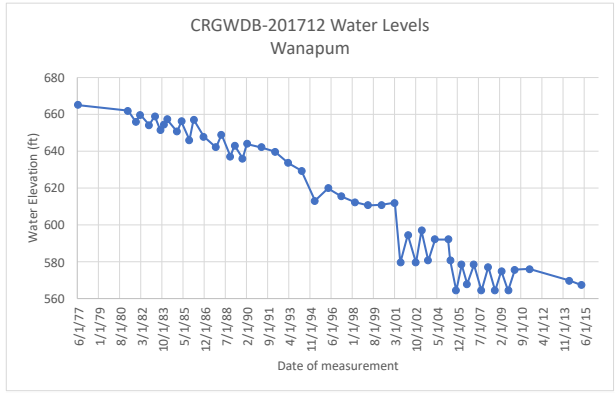

CRGWDB-210973 Water Levels
Saddle Mountain
Water Elevation (ft)
904
902
900
898
896
894
892
890
10/1/78
7/1/79
4/1/80
1/1/81
10/1/81
7/1/82
4/1/83
1/1/84
10/1/84
7/1/85
4/1/86
1/1/87
10/1/87
7/1/88
4/1/89
1/1/90
10/1/90
7/1/91
4/1/92
1/1/93
10/1/93
7/1/94
4/1/95
1/1/96
Date of measurement

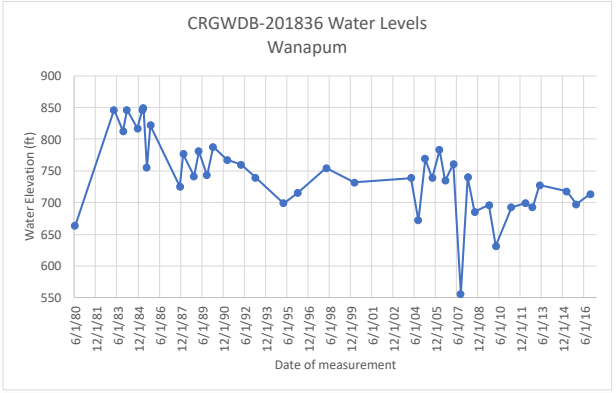

CRGWDB-210985 Water Levels
Saddle Mountain
Water Elevation (ft)
910
905
900
895
890
885
1/1/78
6/1/79
11/1/80
4/1/82
9/1/83
2/1/85
7/1/86
12/1/87
5/1/89
10/1/90
3/1/92
8/1/93
1/1/95
6/1/96
11/1/97
4/1/99
9/1/00
2/1/02
7/1/03
12/1/04
5/1/06
10/1/07
3/1/09
8/1/10
1/1/12
Date of measurement

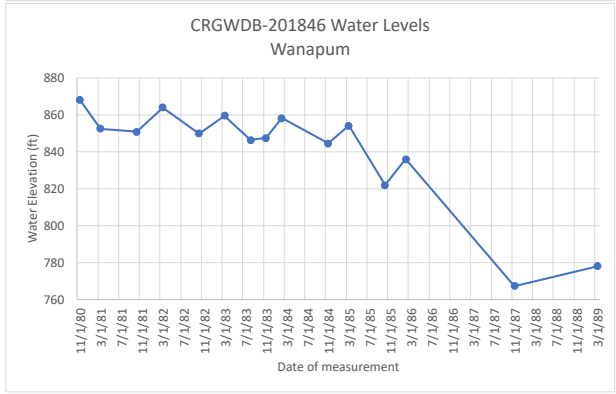
Figures B28-B47. Hydrographs of wells completed in the Wanapum Basalt aquifer.

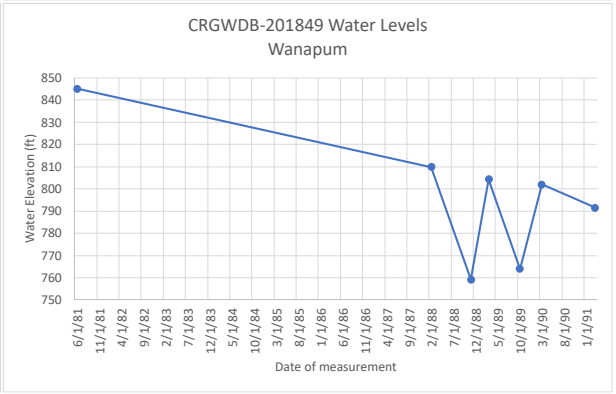


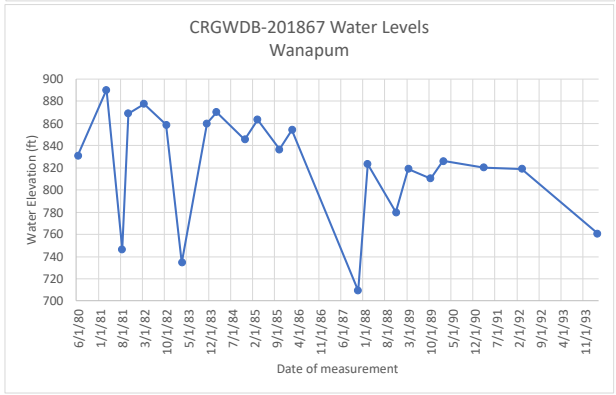


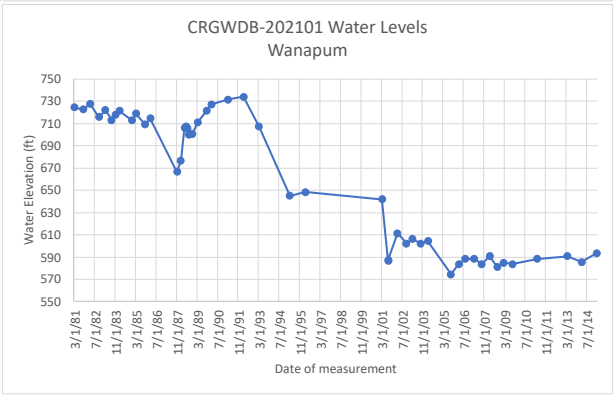


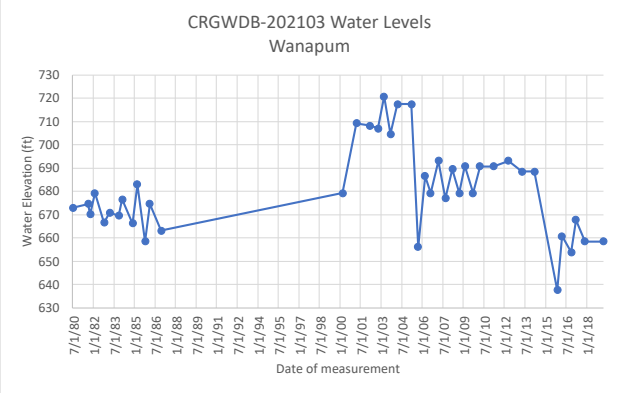


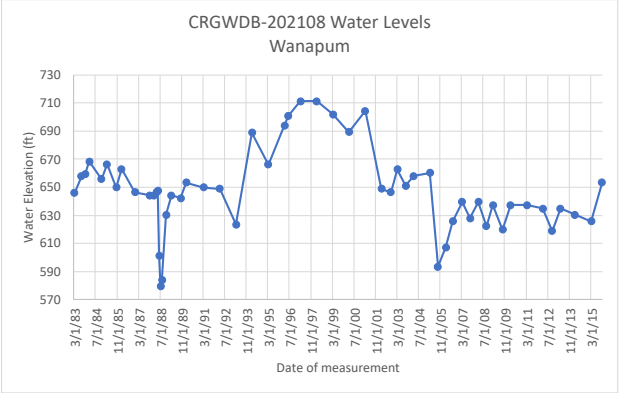


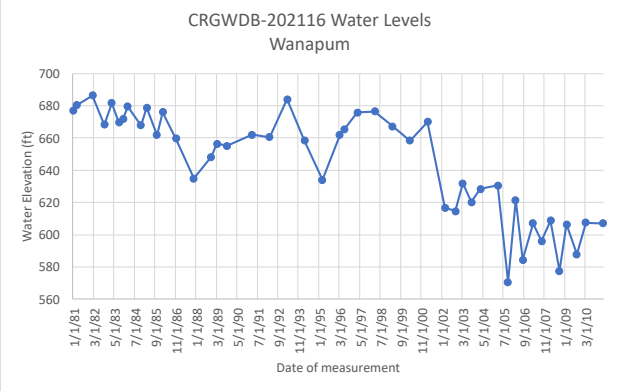


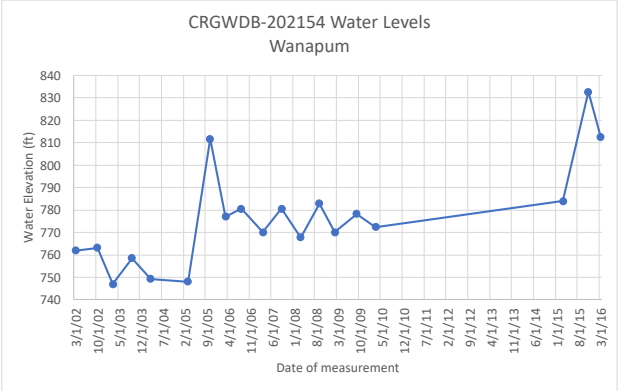


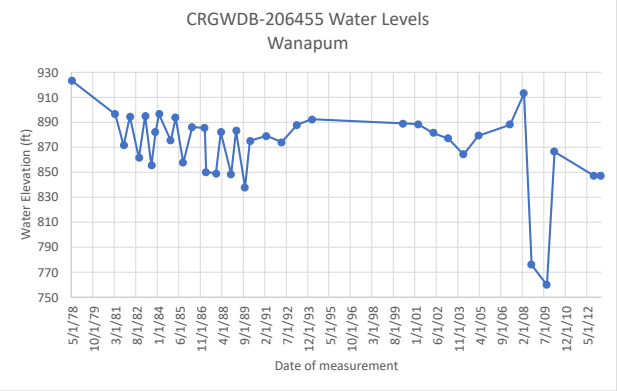


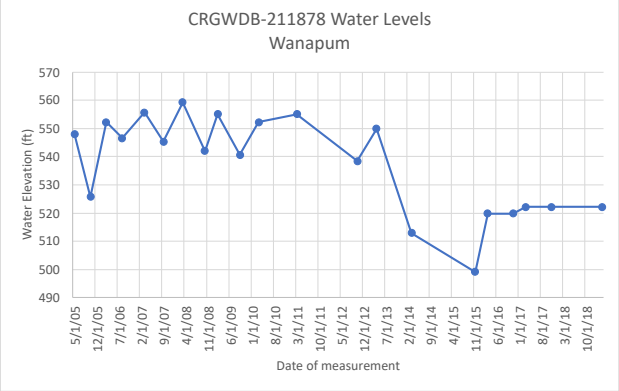

CRGWDB-202103 Water Levels
Wanapum
Water Elevation (ft)
730
720
710
700
690
680
670
660
650
640
630
7/1/80
1/1/82
7/1/83
1/1/85
7/1/86
1/1/88
7/1/89
1/1/91
7/1/92
1/1/94
7/1/95
1/1/97
7/1/98
1/1/00
7/1/01
1/1/03
7/1/04
1/1/06
7/1/07
1/1/09
7/1/10
1/1/12
7/1/13
1/1/15
7/1/16
1/1/18
Date of measurement

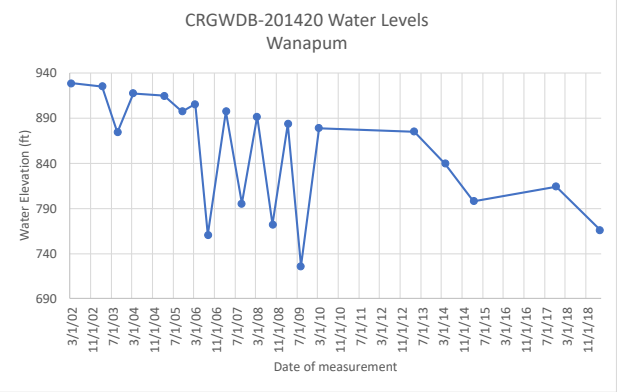

CRGWDB-202108 Water Levels
Wanapum
Water Elevation (ft)
730
710
690
670
650
630
610
590
570
3/1/83
7/1/84
11/1/85
3/1/87
7/1/88
11/1/89
3/1/91
7/1/92
11/1/93
3/1/95
7/1/96
11/1/97
3/1/99
7/1/00
11/1/01
3/1/03
7/1/04
11/1/05
3/1/07
7/1/08
11/1/09
3/1/11
7/1/12
11/1/13
3/1/15
Date of measurement

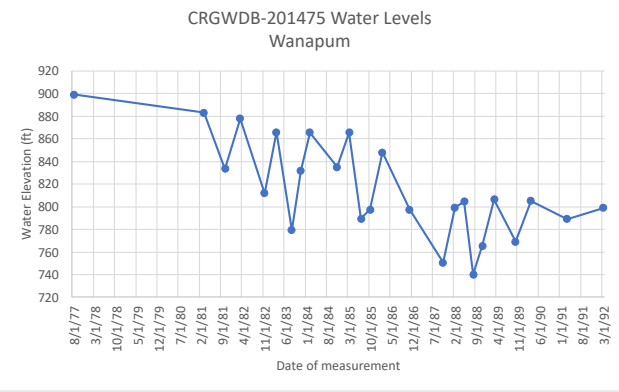

CRGWDB-202116 Water Levels
Wanapum
Water Elevation (ft)
700
680
660
640
620
600
580
560
1/1/81
3/1/82
5/1/83
7/1/84
9/1/85
11/1/86
1/1/88
3/1/89
5/1/90
7/1/91
9/1/92
11/1/93
1/1/95
3/1/96
5/1/97
7/1/98
9/1/99
11/1/00
1/1/02
3/1/03
5/1/04
7/1/05
9/1/06
11/1/07
1/1/09
3/1/10
Date of measurement

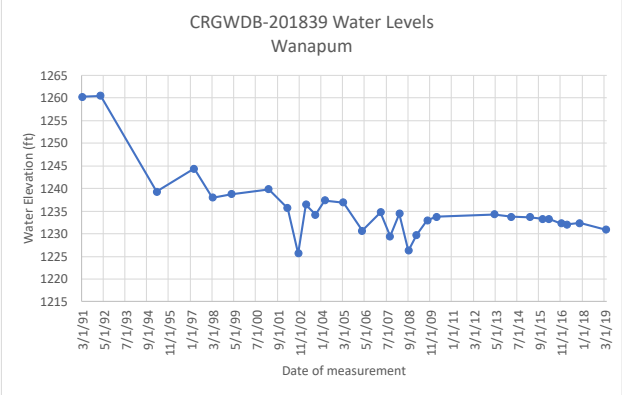

CRGWDB-202154 Water Levels
Wanapum
Water Elevation (ft)
840
830
820
810
800
790
780
770
760
750
740
3/1/02
10/1/02
5/1/03
12/1/03
7/1/04
2/1/05
9/1/05
4/1/06
11/1/06
6/1/07
1/1/08
8/1/08
3/1/09
10/1/09
5/1/10
12/1/10
7/1/11
2/1/12
9/1/12
4/1/13
11/1/13
6/1/14
1/1/15
8/1/15
3/1/16
Date of measurement

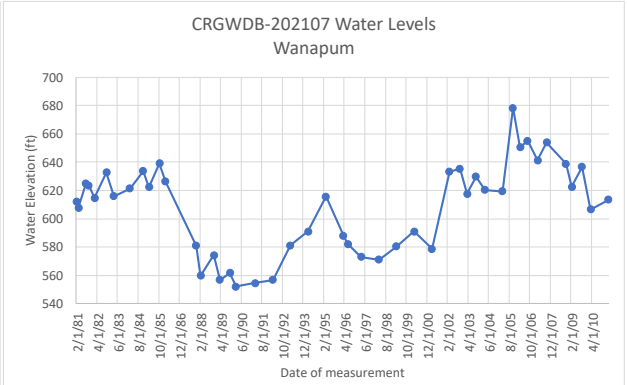

CRGWDB-206455 Water Levels
Wanapum
Water Elevation (ft)
930
910
890
870
850
830
810
790
770
750
5/1/78
10/1/79
3/1/81
8/1/82
1/1/84
6/1/85
11/1/86
4/1/88
9/1/89
2/1/91
7/1/92
12/1/93
5/1/95
10/1/96
3/1/98
8/1/99
1/1/01
6/1/02
11/1/03
4/1/05
9/1/06
2/1/08
7/1/09
12/1/10
5/1/12
Date of measurement

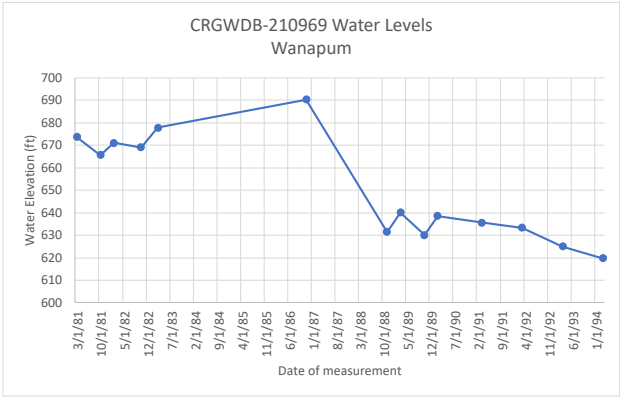

CRGWDB-211878 Water Levels
Wanapum
Water Elevation (ft)
570
560
550
540
530
520
510
500
490
5/1/05
12/1/05
7/1/06
2/1/07
9/1/07
4/1/08
11/1/08
6/1/09
1/1/10
8/1/10
3/1/11
10/1/11
5/1/12
12/1/12
7/1/13
2/1/14
9/1/14
4/1/15
11/1/15
6/1/16
1/1/17
8/1/17
3/1/18
10/1/18
Date of measurement

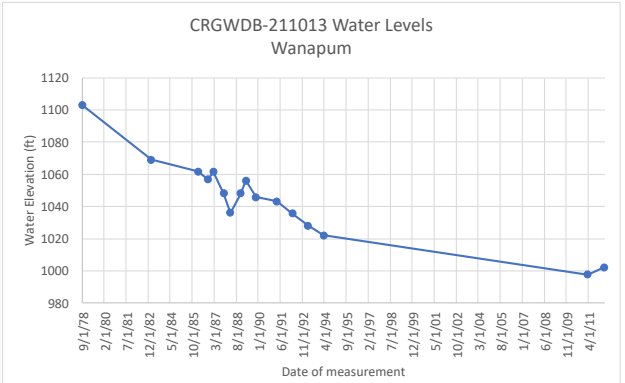

CRGWDB-201420 Water Levels
Wanapum
Water Elevation (ft)
940
890
840
790
740
690
3/1/02
11/1/02
7/1/03
3/1/04
11/1/04
7/1/05
3/1/06
11/1/06
7/1/07
3/1/08
11/1/08
7/1/09
3/1/10
11/1/10
7/1/11
3/1/12
11/1/12
7/1/13
3/1/14
11/1/14
7/1/15
3/1/16
11/1/16
7/1/17
3/1/18
11/1/18
Date of measurement


CRGWDB-201475 Water Levels
Wanapum
Water Elevation (ft)
920
900
880
860
840
820
800
780
760
740
720
8/1/77
3/1/78
10/1/78
5/1/79
12/1/79
7/1/80
2/1/81
9/1/81
4/1/82
11/1/82
6/1/83
1/1/84
8/1/84
3/1/85
10/1/85
5/1/86
12/1/86
7/1/87
2/1/88
9/1/88
4/1/89
11/1/89
6/1/90
1/1/91
8/1/91
3/1/92
Date of measurement


CRGWDB-201839 Water Levels
Wanapum
Water Elevation (ft)
1265
1260
1255
1250
1245
1240
1235
1230
1225
1220
1215
3/1/91
5/1/92
7/1/93
9/1/94
11/1/95
1/1/97
3/1/98
5/1/99
7/1/00
9/1/01
11/1/02
1/1/04
3/1/05
5/1/06
7/1/07
9/1/08
11/1/09
1/1/11
3/1/12
5/1/13
7/1/14
9/1/15
11/1/16
1/1/18
3/1/19
Date of measurement


CRGWDB-202107 Water Levels
Wanapum
Water Elevation (ft)
700
680
660
640
620
600
580
560
540
2/1/81
4/1/82
6/1/83
8/1/84
10/1/85
12/1/86
2/1/88
4/1/89
6/1/90
8/1/91
10/1/92
12/1/93
2/1/95
4/1/96
6/1/97
8/1/98
10/1/99
12/1/00
2/1/02
4/1/03
6/1/04
8/1/05
10/1/06
12/1/07
2/1/09
4/1/10
Date of measurement


CRGWDB-210969 Water Levels
Wanapum
Water Elevation (ft)
700
690
680
670
660
650
640
630
620
610
600
3/1/81
10/1/81
5/1/82
12/1/82
7/1/83
2/1/84
9/1/84
4/1/85
11/1/85
6/1/86
1/1/87
8/1/87
3/1/88
10/1/88
5/1/89
12/1/89
7/1/90
2/1/91
9/1/91
4/1/92
11/1/92
6/1/93
1/1/94
Date of measurement


CRGWDB-211013 Water Levels
Wanapum
Water Elevation (ft)
1120
1100
1080
1060
1040
1020
1000
980
9/1/78
2/1/80
7/1/81
12/1/82
5/1/84
10/1/85
3/1/87
8/1/88
1/1/90
6/1/91
11/1/92
4/1/94
9/1/95
2/1/97
7/1/98
12/1/99
5/1/01
10/1/02
3/1/04
8/1/05
1/1/07
6/1/08
11/1/09
4/1/11
Date of measurement

APPENDIX C

CROSS-SECTION DATA

Table C1. Wells used to illustrate the A-A' cross-section. Aquifers and completion units are color-coded to the stratigraphy.

A-A Cross-Section Wells								
Well ID	2763	3375	3365	3348	3322	3967	3963	3961
Well Name				Elephant Mountain				
Distance from line (ft)	111520.3	117592.3	120232	132904	141669	146844	147900	151543
Surface Elevation (ft)	985	1096	1203	1357	1366	1501	1522	1676
Depth (ft, bgs)	315	460	1550	1360	1388	525	520	687
Depth Elevation (ft)	670	636	-347	-3	-22	976	632	989
Aquifer	Upper SDMB	Upper SDMB	WNB	WNB	WNB	WNB	WNB	WNB
Completion Unit	EM	RR	FS	PR	FS	PR	PR	FS

Table C2. Member thickness (ft) and top boundaries (ft bgs) of the wells in the A-A’ cross-section.

A-A' Cross-Section	Member Thicknesses (ft)				Depth to Top of Member (ft, bgs)		
	Average	Minimum	Maximum	Standard Error	Average	Minimum	Maximum
Overburden	366	109	1292	136.56	0	0	0
Elephant Mountain	26	2	53	9.09	294	155	371
Rattlesnake Ridge	108	39	177	34.50	319	208	375
Pomona	138	99	195	17.78	329	191	550
Selah	57	11	80	13.98	468	290	745
Umatilla	152	83	228	21.91	523	109	1292
Mabton	21	6	37	4.46	653	258	1311
Priest Rapids	217	207	227	3.54	674	295	1328
Roza	121	107	145	7.38	860	522	1275
Squaw Creek	19	8	37	5.64	981	629	1420
Frenchman Springs					999	640	1428

Table C3. Wells used to illustrate the B-B’ cross-section. Aquifers and completion units are color-coded to the stratigraphy.

B-B' Cross-Section Wells																		
Well ID	3384	2743	2773	2792	2801	2798	2799	2827	2862	2865	2880	2394	2391	2439	2455	2451	2470	1812
Distance from line (ft)	19700	31152	36300	38600	43600	49632	51100	57552	73392	77088	94512	99792	100320	114048	126086	132898	137069	174979
Surface Elevation (ft)	1185	1179	1139	1159	1259	1326	1284	1273	1223	1161	1160	1074	1078	1083	1004	1208	1141	1274
Depth (ft, bgs)	1410	1500	2004	1620	1945	1189	2540	1808	2715	901	1000	880	950	1718	985	700	848	985
Depth Elevation (ft)	-225	-321	-865	-461	-686	137	-1256	-535	-1492	260	160	194	128	-635	19	508	293	289
Aquifer	WNB	WNB	WNB	WNB	WNB	WNB	GRB	WNB	GRB	Lower SDMB	Lower SDMB	Lower SDMB	Lower SDMB	WNB	Lower SDMB	Lower SDMB	Lower SDMB	WNB
Completion Unit	PR	PR	FS	RZ	FS	PR	GRB	FS	GRB	UMA	UMA	UMA	UMA	RZ	UMA	UMA	UMA	RZ

Table C4. Member thickness (ft) and top boundaries (ft bgs) of the wells in the B-B’ cross-section.

B-B' Cross-Section	Number of wells	Member Thicknesses (ft)				Depth to Top of Member (ft, bgs)		
		Average	Minimum	Maximum	Standard Error	Average	Minimum	Maximum
Overburden	18	211	1	397	32.913	0	0	0
Elephant Mountain	17	58	27	111	5.510	249	1	1074
Rattlesnake Ridge	17	207	15	353	27.552	304	67	1074
Pomona	18	284	174	447	20.144	461	122	742
Selah	18	67	18	252	11.865	746	308	975
Umatilla	11	254	22	493	25.793	813	338	1046
Mabton	11	38	2	180	12.990	1119	528	1312
Priest Rapids	8	230	122	376	22.881	1157	628	1322
Roza	5	245	134	368	24.426	1372	750	1585
Squaw Creek	5	38	18	91	7.183	1705	1540	1953
Frenchman Springs	2	390	175	604	71.500	1740	1594	1971
Vantage	2	103.5	31	176	24.167	1783	1273	2198
Grande Ronde	2					2142	2055	2229

Table C5. Wells used to illustrate the C-C’ cross-section. Aquifers and completion units are color-coded to the stratigraphy.

C-C' Cross -Section Wells																			
Well ID	3349	3337	3348	3347	3345	3395	3397	3394	3392	3404	3402	3411	3400	3406	3421	3420	3427	3424	3426
Well Name			Elephant Mountain		Charron Main														
Distance from line (ft)	5386	14626	16896	23496	31363	38702	39758	42187	44563	45250	46200	46570	47520	48787	52378	52800	55440	61776	64416
Surface Elevation (ft)	1175	1166	1357	1403	1338	1415	1443	1509	1550	1512	1581	1489	1684	1538	1567	1578	1562	1639	1629
Depth (ft, bgs)	1540	972	1360	2802	2213	1709	862	1551	704	732	580	782	624	655	662	255	287	606	429
Depth Elevation (ft)	-365	194	-3	-1399	-875	-294	581	-42	846	780	1001	707	1060	885	905	1323	1275	1033	1200
Aquifer	WNB	Lower SDMB	WNB	GRB	GRB	WNB	Lower SDMB	WNB	Lower SDMB	Lower SDMB	Lower SDMB	WNB	Lower SDMB	Lower SDMB	Lower SDMB	Lower SDMB	Lower SDMB	Lower SDMB	Lower SDMB
Completion Unit	RZ	UMA	PR	GRB	GRB	PR	UMA	PR	PM	PM	PM	MBTN	SEL	UMA	UMA	PM	SEL	UMA	UMA

Table C6. Member thickness (ft) and top boundaries (ft bgs) of the wells in the C-C’ cross-section.

C-C' Cross-Section	Number of Wells	Member Thicknesses (ft)				Depth to Top of Member (ft, bgs)		
		Average	Minimum	Maximum	Standard Error	Average	Minimum	Maximum
Overburden	19	394	18	1292	82.969	0	0	0
Elephant Mountain	10	73	10	160	10.450	782	18	1629
Rattlesnake Ridge	10	106	9	256	17.928	820	78	1629
Pomona	10	141	23	291	23.828	615	108	1629
Selah	8	110	2	247	21.707	824	256	1629
Umatilla	7	290	19	670	54.924	879	325	1684
Mabton	6	56	6	195	16.999	1148	727	1447
Priest Rapids	3	186	84	367	36.058	1274	1138	1531
Roza	2	575	540	609	11.193	1280	1222	1280
Squaw Creek	2	14	1	27	4.218	1813	1762	1864
Frenchman Springs	2	544	336	751	67.322	1827	1789	1865
Vantage	2	58	41	75	5.516	2371	2125	2616
Grande Ronde	2					2429	2200	2657

Table C7. Average aquifer thicknesses (ft) of the Upper and Lower Saddle Mountain Basalt and Wanapum Basalt aquifers.

Average Aquifer Thickness (ft)						
Aquifer	Lower Yakima Valley	Number of wells	Standard Error	Moxee Valley	Number of Wells	Standard Error
Upper Saddle Mountain	196	17	15.945	143	10	23.447
Lower Saddle Mountain	567	11	38.557	789	3	130.095
Wanapum	788	3	112.623	1228	2	240.500

APPENDIX D

STATISTICAL ANALYSES

The following analyses are Welch two sample t-tests of member thickness by location (Lower Yakima Valley and Moxee Valley).

Overburden

```
data:  OVB by Location
t = -2.0479, df = 23.495, p-value = 0.05191
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -367.222507    1.637712
sample estimates:
mean in group Lower Yakima Valley        mean in group Moxee Valley
                         210.9444                          393.7368
```

Elephant Mountain Basalt

```
data:  EM by Location
t = -0.91925, df = 11.845, p-value = 0.3763
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -48.00502  19.54619
sample estimates:
mean in group Lower Yakima Valley        mean in group Moxee Valley
                         58.47059                          72.70000
```

Rattlesnake Ridge Interbed

```
data:  RR by Location
t = 2.6899, df = 24.454, p-value = 0.01268
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
  23.61879 178.71062
sample estimates:
mean in group Lower Yakima Valley        mean in group Moxee Valley
                         206.7647                          105.6000
```

Pomona Basalt

```
data:  PM by Location
t = 3.7134, df = 15.857, p-value = 0.001914
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
  61.33752 224.81803
sample estimates:
mean in group Lower Yakima Valley        mean in group Moxee Valley
                         284.2778                          141.2000
```

Selah Interbed

```
data:  SEL by Location
t = -1.2001, df = 8.8147, p-value = 0.2614
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -123.15001   37.95557
sample estimates:
mean in group Lower Yakima Valley        mean in group Moxee Valley
                         67.27778                         109.87500
```

Umatilla Basalt

```
data:  UMA by Location
t = -0.37862, df = 7.6206, p-value = 0.7153
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -260.5123  187.5772
sample estimates:
mean in group Lower Yakima Valley        mean in group Moxee Valley
                         253.8182                         290.2857
```

Mabton Interbed

```
data:  MBTN by Location
t = -0.5145, df = 8.1036, p-value = 0.6206
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -97.17059  61.65544
sample estimates:
mean in group Lower Yakima Valley        mean in group Moxee Valley
                         37.90909                         55.66667
```

Priest Rapids Basalt

```
data:  PR by Location
t = 0.45224, df = 2.5979, p-value = 0.6861
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -293.7486  381.4986
sample estimates:
mean in group Lower Yakima Valley        mean in group Moxee Valley
                          229.875                          186.000
```

Roza Basalt

```
data:  RZ by Location
t = -5.7064, df = 4.3358, p-value = 0.003638
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -485.3317 -174.0683
sample estimates:
mean in group Lower Yakima Valley        mean in group Moxee Valley
                            244.8                            574.5
```

Squaw Creek Interbed

```
data:  SQC by Location
t = 1.2849, df = 3.3841, p-value = 0.2797
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -32.0691  80.4691
sample estimates:
mean in group Lower Yakima Valley        mean in group Moxee Valley
                             38.2                              14.0
```

Frenchman Springs Basalt

```
data:  FS by Location
t = -0.51602, df = 1.9978, p-value = 0.6573
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -1439.439  1131.439
sample estimates:
mean in group Lower Yakima Valley        mean in group Moxee Valley
                            389.5                             543.5
```

Vantage Interbed

```
data:  VTG by Location
t = 0.61101, df = 1.1096, p-value = 0.6425
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -706.004  797.004
sample estimates:
mean in group Lower Yakima Valley        mean in group Moxee Valley
                            103.5                              58.0
```

The following analysis is a Welch two sample t-test of groundwater elevation change by aquifer (Saddle Mountain and Wanapum Basalts).

```
data:  Groundwater Elevation Change Rate by Aquifer
t = 1.4476, df = 40.943, p-value = 0.1553
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.576995  3.497402
sample estimates:
mean in group Saddle Mountain         mean in group Wanapum
                    -1.606296                     -3.066500
```

APPENDIX E

NILLSON WELL STEP TEST

At the time of writing this thesis, one aquifer test was attempted in the Wanapum aquifer in Moxee Valley. Three wells in Moxee Valley were selected for aquifer testing based on their proximity to one another and access agreements with participating well owners (Table D1 and Figure D1). To measure the change in groundwater levels during pumping, a Van Essen 100 m Micro-Diver was deployed with a 1,000 ft Van Essen communication cable in the Nillson and Charron Backup Wells. Issues with the access port at the Greenhouse Well meant that the well was not suitable for a transducer, and thus omitted from the testing design. Additionally, interpretations of the driller notes of the Greenhouse Well report suggest that the well is completed in the Grande Ronde, rather than the Wanapum aquifer. This interpretation is supported by the observation of a higher hydraulic head in the Greenhouse Well compared to the Wanapum wells in the test design. A transducer remains in the Charron Backup Well for long-term observations over the 2023 irrigation season and barometric compensation is completed on the transducer data by using barometric pressure measurements recorded by a Van Essen Baro-Diver stationed in Ellensburg, Washington.

Table E1. Aquifer testing design in the Wanapum aquifer in Moxee Valley.

Aquifer Testing Design (Moxee Valley)			
Well Name	**Nillson**	**Charron Backup**	**Greenhouse**
Role in Aquifer Testing	Pumping	Observation	Observation
Surface elevation (ft amsl)	1,390	1,360	1,220
Total depth (ft)	1,270	1,105	2,100
Completion Aquifer	Wanapum	Wanapum	Grande Ronde

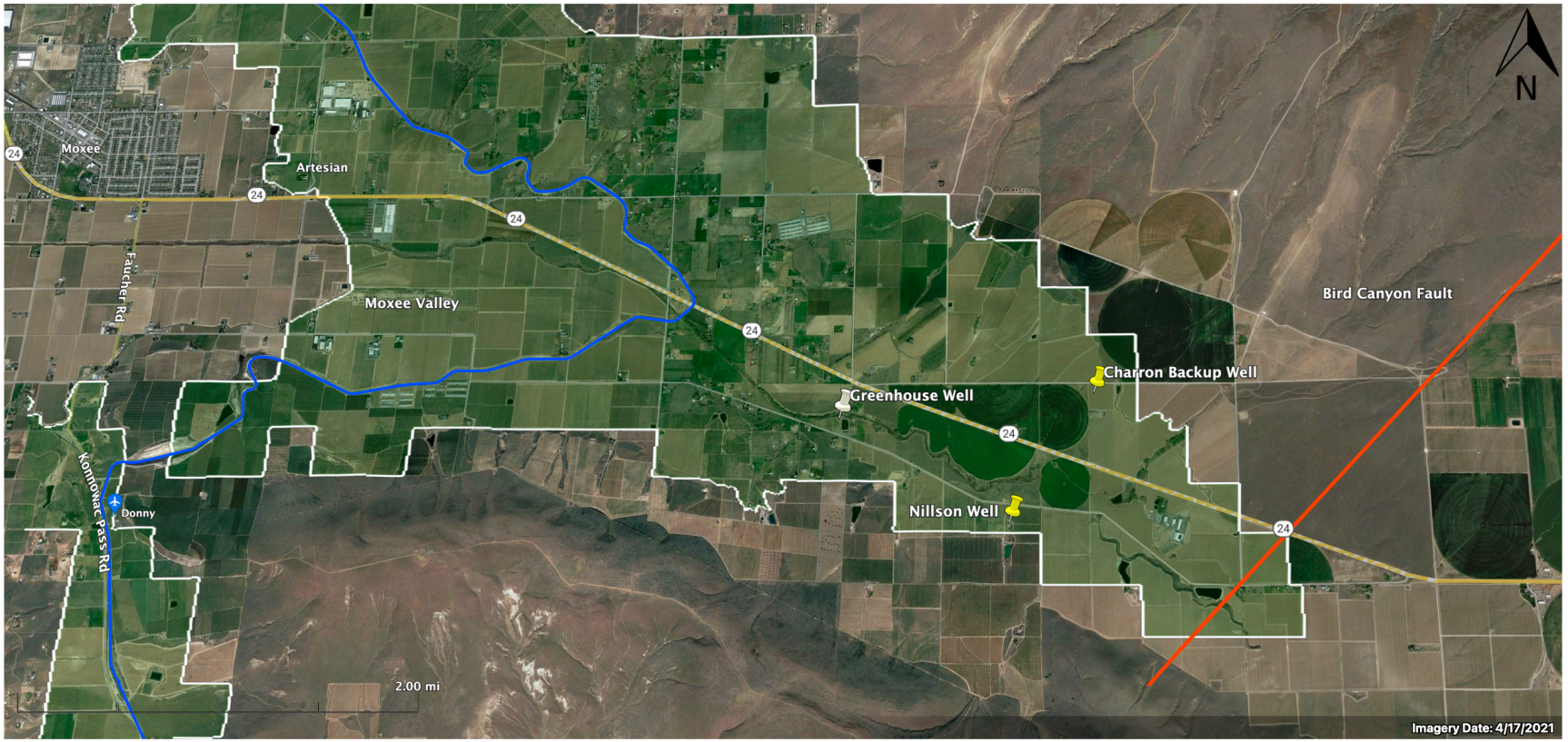


Figure E1. Map of aquifer testing wells in Moxee Valley. Pumping occurs at the Nillson Well and is observed in the Charon Backup Well. The Roza Irrigation District is outlined in white, and the Roza canal is in blue. Imagery from Google Earth.

A 3.5-hour step test was completed at the Nillson Well on March 17, 2023, before the irrigation season, however many problems arose when designing and attempting the Nillson Well Step Test. During the test, pumping was inconsistent due to malfunctions in the pump engine and other well parts, manual water level measurements were not possible during the test, and the

transducer installed in the well was not retrievable after the test. Therefore, there is no drawdown data available during the Nillson Well Step Test. Despite these complications, other measurements were recorded. During the step test, regular instantaneous flow and total volume readings were taken from the flow meter. The flow data can be grouped into four main steps (Tables D2 and D3, and Figure D2). The average flow rate during the step test was 306 gpm.

Table E2. Summary table of the flow during the Nillson Well Step Test including the time frame (min), duration (min), and average flow rate (gpm) during the four steps. The pump was turned off briefly during the second step due to complications with the flow meter.

Nillson Well Step Test Results			
Step	Time Frame (min)	Time Elapsed (min)	Average Flow Rate (gpm)
1	0 to 69	69	342
2	69 to 106	37	81
3	106 to 171	65	142
4	171 to 210	39	528

Table E3. Total volume and flow rate of each step during the Nillson Well Step Test.

Clock Time	Minutes elapsed	Totalizer Readings (gal / 100)	Total (gal)	Flow Meter Readings (gpm)	Average flow rate (gpm) per step
12:05 PM	5	199573	0	300	342
12:21 PM	21	199636	6300	400	342
12:35 PM	35	199693	12000	360	342
12:39 PM	39	199713	14000	370	342
12:48 PM	48	199746	17300	380	342
12:56 PM	56	199776	20300	375	342
1:09 PM	69	199820	24700	250	342
1:14 PM	74	199822	24900	0	81
1:24 PM	84	199821	24800	0	81
1:34 PM	94	199828	25500	150	81
1:46 PM	106	199830	25700	175	81
1:48 PM	108	199834	26100	175	142
1:50 PM	110	199837	26400	150	142

1:52 PM	112	199840	26700	125	142
1:58 PM	118	199847	27400	100	142
2:03 PM	123	199852	27900	125	142
2:06 PM	126	199856	28300	100	142
2:19 PM	139	199870	29700	100	142
2:22 PM	142	199873	30000	100	142
2:24 PM	144	199875	30200	100	142
2:25 PM	145	199877	30400	225	142
2:26 PM	146	199878	30500	200	142
2:28 PM	148	199883	31000	175	142
2:31 PM	151	199889	31600	150	142
2:35 PM	155	199893	32000	150	142
2:43 PM	163	199905	33200	150	142
2:45 PM	165	199908	33500	125	142
2:49 PM	169	199914	34100	150	142
2:51 PM	171	199918	34500	150	142
2:53 PM	173	199920	34700	400	528
2:55 PM	175	199930	35700	550	528
2:57 PM	177	199940	36700	550	528
2:59 PM	179	199954	38100	500	528
3:02 PM	182	199965	39200	550	528
3:04 PM	184	199977	40400	550	528
3:06 PM	186	199989	41600	550	528
3:09 PM	189	200004	43100	550	528
3:11 PM	191	200017	44400	500	528
3:15 PM	195	200036	46300	525	528
3:17 PM	197	200047	47400	550	528
3:20 PM	200	200063	49000	550	528
3:23 PM	203	200082	50900	525	528
3:25 PM	205	200092	51900	500	528
3:27 PM	207	200102	52900	550	528
3:29 PM	209	200111	53800	550	528
3:30 PM	210	200116	54300	0	0

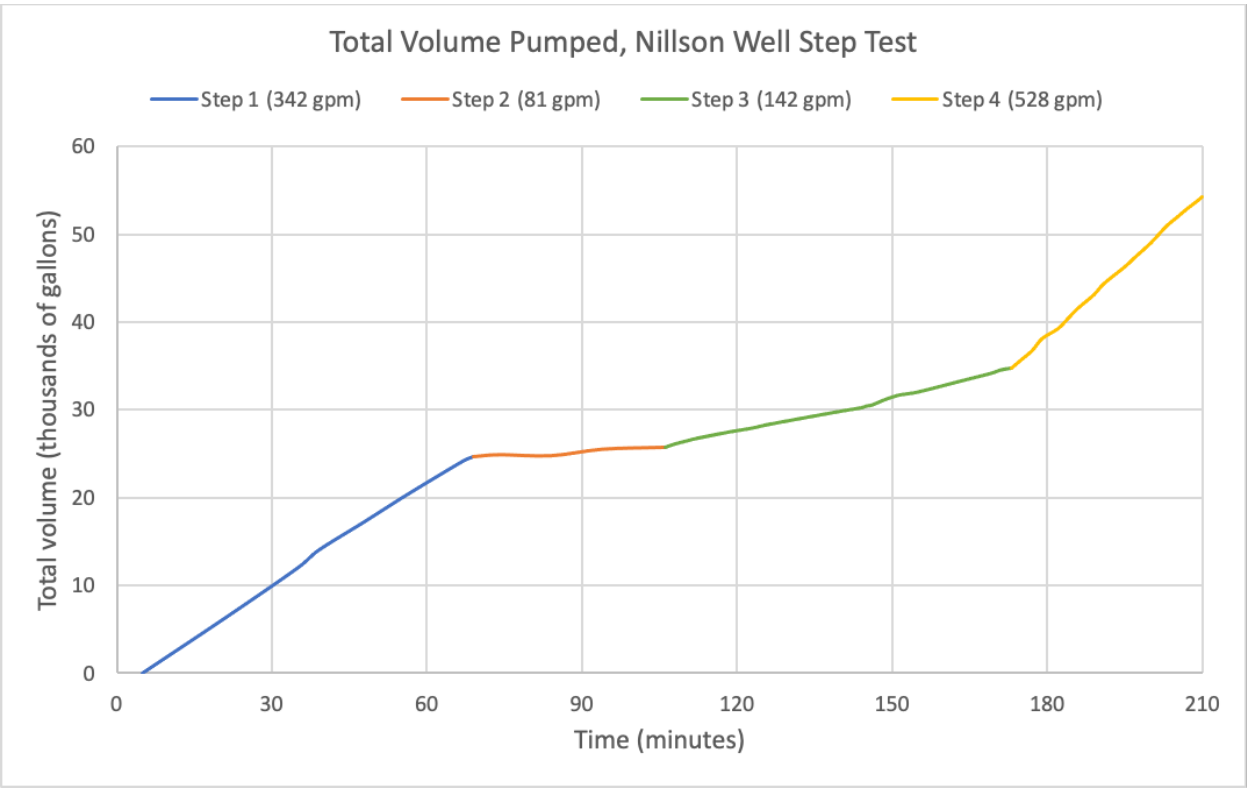


Figure E2. Total volume discharged (gal) over time (min) for each step during the Nillson Well Step Test. The pump was turned off briefly during the second step due to complications with the flow meter.

After the step test, the recovering water levels were measured. It took 40 minutes for the water levels to return to the static water level of 231.4 ft (Table D4 and Figure D3). The transducer data from the Charron Backup Well did not record a response to pumping at the Nillson Well during the step test (Figure D4). This data was imported into AQTESOLV, a software used to analyze aquifer testing data, as a slug test to estimate the hydraulic conductivity of the WNB aquifer and the maximum displacement that had occurred during the step test. This was accomplished by applying the confined aquifer Bouwer and Rice (1976) solution (Equation D1) to the data (Figure D5). The analysis suggests there was about 310 ft of drawdown by the end of the 3.5-hour test and provides a hydraulic conductivity estimate of 1.56 ft/day for the

WNB aquifer (Table D5). With the hydraulic conductivity and saturated thickness of the aquifer, a transmissivity of about 1,920 ft^2/day was calculated using Equation D2 for the WNB aquifer in Moxee Valley.

Table E4. Manual water level measurements at the Nillson Well before and after the Nillson Well Step Test.

Clock Time	Seconds Elapsed	Minutes Elapsed	Water Level (ft)	Displacement (ft)	Notes
10:00:00 AM			231.40		pre-testing
11:58:00 AM			231.32		pre-testing
3:37:40 PM	460	7.7	353.80	122.40	recovery
3:38:00 PM	480	8.0	343.40	112.00	recovery
3:38:20 PM	500	8.3	337.40	106.00	recovery
3:38:40 PM	520	8.7	333.05	101.65	recovery
3:38:54 PM	534	8.9	329.10	97.70	recovery
3:39:12 PM	552	9.2	323.60	92.20	recovery
3:39:37 PM	577	9.6	319.00	87.60	recovery
3:40:27 PM	627	10.5	311.00	79.60	recovery
3:41:07 PM	667	11.1	305.00	73.60	recovery
3:41:41 PM	701	11.7	300.00	68.60	recovery
3:42:27 PM	747	12.5	294.00	62.60	recovery
3:43:08 PM	788	13.1	289.00	57.60	recovery
3:44:01 PM	841	14.0	283.00	51.60	recovery
3:45:32 PM	932	15.5	274.00	42.60	recovery
3:46:42 PM	1002	16.7	268.00	36.60	recovery
3:48:34 PM	1114	18.6	260.00	28.60	recovery
3:51:44 PM	1304	21.7	250.00	18.60	recovery
3:56:57 PM	1617	27.0	240.00	8.60	recovery
4:06:06 PM	2166	36.1	232.84	1.44	recovery
4:07:57 PM	2277	38.0	232.00	0.60	recovery
4:09:15 PM	2355	39.3	231.66	0.26	recovery
4:09:55 PM	2395	39.9	231.40	0.00	recovery

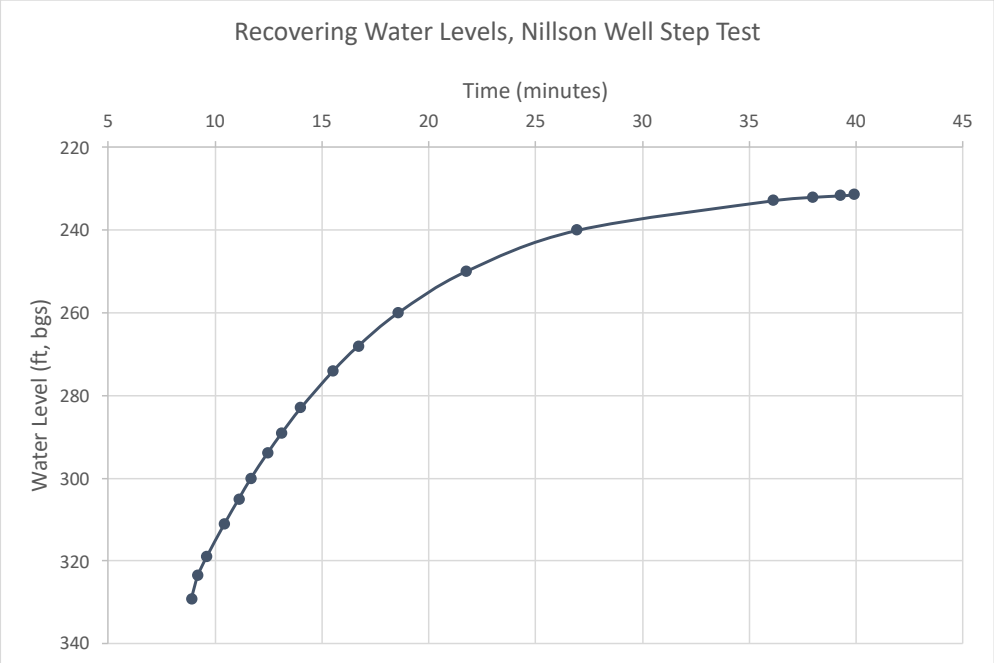


Figure E3. Water level measurements during recovery of the Nillson Well after the 3.5-hour step test. It took about 40 minutes for water levels to return to the static water level of 231.4 ft.

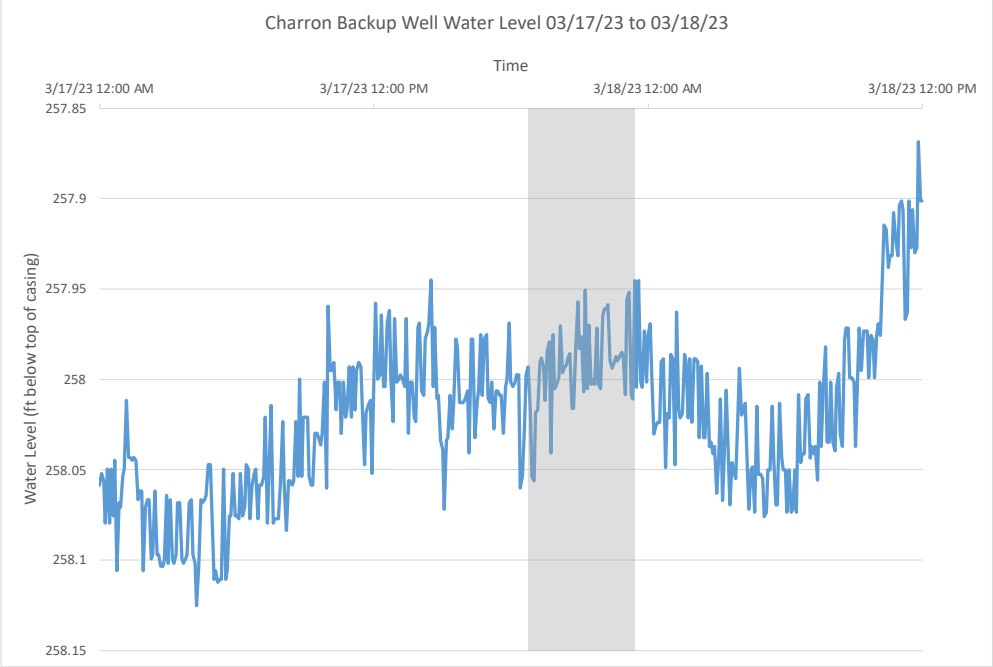


Figure E4. Water level (ft below top of casing) at the Charron Backup Well from 03/17/23 to 03/18/23. The gray box represents the timeframe of the 3.5-hour Nillson Well Step Test. Note the vertically exaggerated scale of the y-axis. The water levels have been compensated with barometric pressure data.

$$K = \frac{r_c^2 \ln \frac{R_e}{R}}{2L_e} \frac{1}{t} \ln \frac{h_0}{h_t}$$

Equation E1. The Bouwer and Rice (1976) equation for hydraulic conductivity (K) in ft/day as a function of the radius of the well casing (r_c) in ft, ratio of the effective radial distance of dissipated head (R_e) to radius of the gravel envelope (R) in ft, length of the screen (L_e) in ft, and the drawdown in ft at the beginning of the test (h_0) and at the end of the test (h) using time (t) in days.

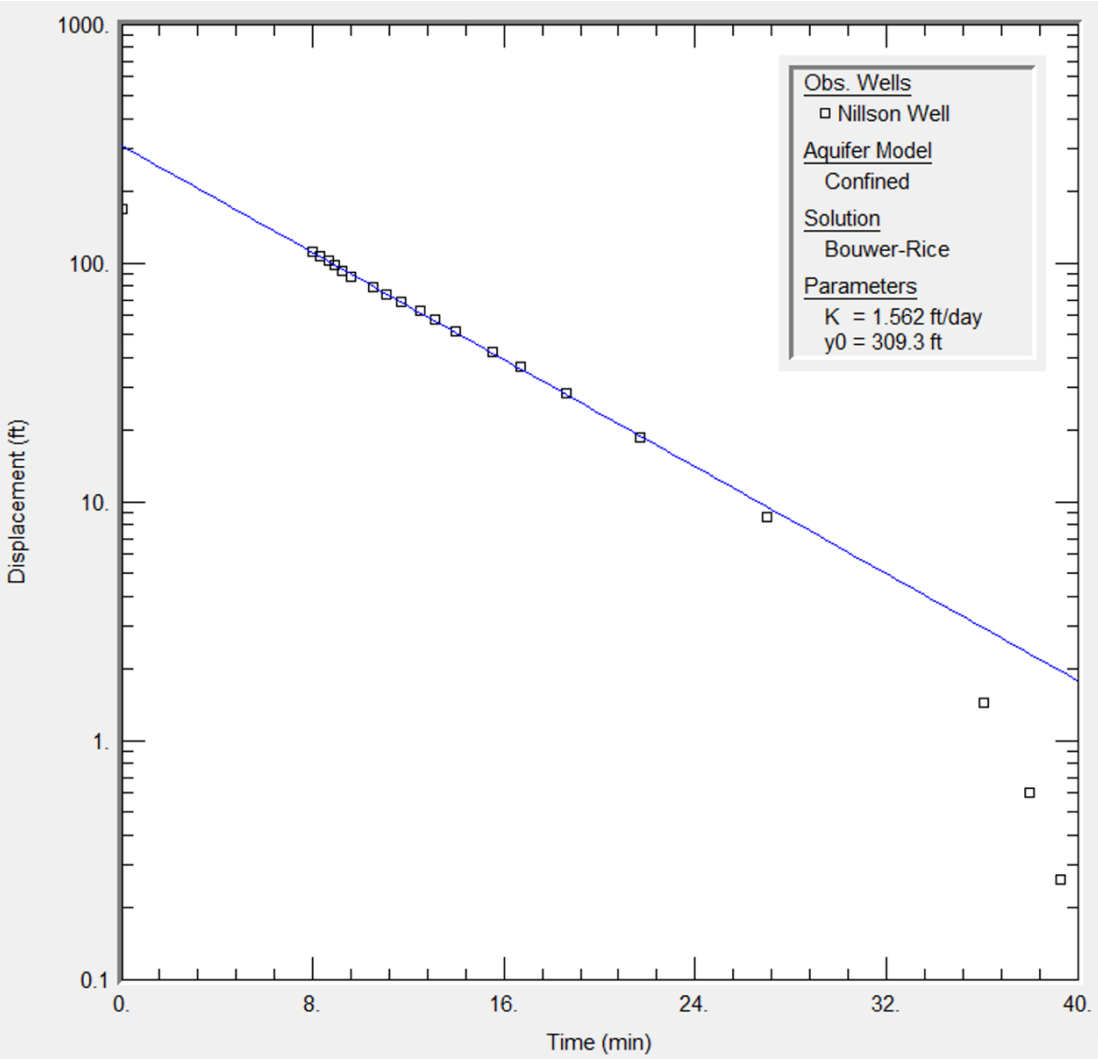


Figure E5. AQTESOLV confined aquifer Bouwer-Rice solution (blue line) on water level displacement measurements during recovery after the Nillson Well Step Test. This analysis produced a hydraulic conductivity value for the Wanapum aquifer (1.562 ft/day) and a maximum drawdown (y0) estimation for the end of the step test (309.3 ft).

Table E5. Analysis of recovering water levels after the Nillson Well Step Test including results from the [a]Bouwer and Rice (1976) solution on recovery data.

Nillson Well Step Test Recovery Analysis						
Recovery Time (min)	Static Water Level (ft, bgs)	Hydraulic Conductivity (ft/day)	Aquifer Thickness (ft)	Transmissivity (ft^2/day)	Maximum Drawdown (ft)	Maximum Drawdown Water Level (ft, bgs)
40	230	1.56[a]	1,230	1,920	310[a]	540

$$T = Kb$$

Equation E2. Transmissivity (T) of an aquifer in ft^2/day given the hydraulic conductivity (K) in ft/day and saturation thickness (b) in ft.

If a pumping test was simulated at the Nillson Well using the Theis (1935) Method (Equations D3 and D4) with a constant pumping rate of 306 gpm (the average pumping rate during the Nillson Well Step Test) and transmissivity values of 11,270 ft^2/day (Germiat and Flynn, 2005) and 1,918 ft^2/day (calculated from the Bouwer and Rice (1976) solution), only 6.6 ft and 34.6 ft of drawdown is expected after 3.5 hours, respectively (Figure D6).

$$s = \frac{Q}{4\pi \mathrm{T}} W(u)$$

Equation E3. Theis (1935) equation for aquifer drawdown (s) as a function of pumping rate (Q) in gpm, transmissivity (T) in ft^2/day, and well function (W(u)).

$$u = \frac{r^2 S}{4Tt}$$

Equation E4. Well function equation given the distance from the pumping well (r) in ft, the storage coefficient (S) and transmissivity (T) in ft2/day of the aquifer, and time (t) in days after the beginning of a pumping test.

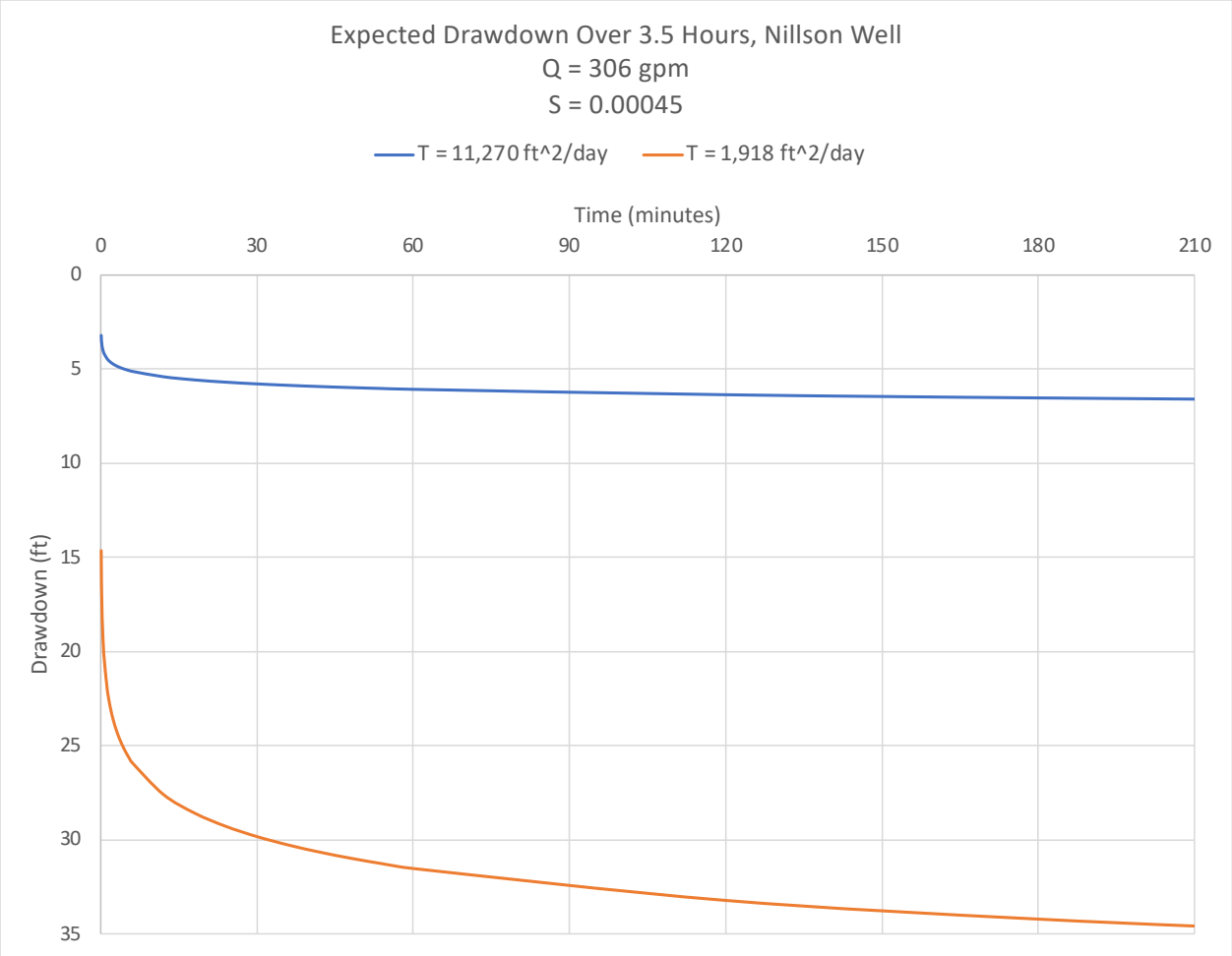


Figure E6. Expected drawdown over 3.5 hours of pumping at 306 gpm at the Nillson Well, based on the average pumping rate during the Nillson Well Step Test for a transmissivity of 11,270 ft^2/day (Germiat and Flynn, 2005) and 1,918 ft^2/day from the Bouwer and Rice (1976) solution. Drawdown is expected to be about 6.6 ft for the higher transmissivity and about 34.6 for the lower transmissivity after 3.5 hours. Expected drawdown was calculated using the Theis (1935) equation embedded in a spreadsheet provided by the U.S. Geological Survey for predicting drawdown in a confined aquifer (Halford and Kuniansky, 2002).

These expected values greatly underestimate the actual drawdown that occurs at this well. However, well efficiency, the well's ability to transmit water through its screens and borehole, is not included in this calculation. The large difference between expected and actual drawdown at the Nillson Well suggests that this well has an extremely low efficiency. This information is useful for stakeholders who may decide that new wells be drilled for ASR. In this case, the

Nillson Well would not be an ideal injection well for effective groundwater recharge because the well may not be able to transmit recharge waters at sufficient rates.

Based on the analysis of recovery after the Nillson Step Test, transmissivity was calculated using the hydraulic conductivity from the Bouwer and Rice (1976) solution (Equation D1). Transmissivity can also be calculated based on the specific capacity of a well (Equation D5) in the Theis (1963) and Razack and Huntley (1991) formulas (Equations D6 and D7). Table D6 compares the results of these calculations to previous estimates of transmissivity in the WNB aquifer.

$$SC = \left(\frac{Q}{h_0 - h}\right)$$

Equation E5. Specific capacity (SC) of a well in ft^2/day as a function of the pumping rate (Q) in ft^3/day and drawdown ($h_0 - h$) in ft of a pumping well.

$$T = \frac{Q}{(h_0 - h)} \frac{2.3}{4\pi} \log \frac{2.25 T_e t}{r^2 S}$$

Equation E6. Theis (1963) equation for estimating transmissivity (T) in ft^2/day based on the specific capacity $\left(\frac{Q}{h_0 - h}\right)$ in ft^2/day and radius (r) of a pumping well, and the aquifer's expected transmissivity (T_e) in ft^2/day and storativity (S) over a time (t) of pumping in days for a confined aquifer.

$$T = 33.6 \left(\frac{Q}{h_0 - h}\right)^{0.67}$$

Equation E7. Razack and Huntley (1991) equation for estimating transmissivity (T) in ft^2/day from the specific capacity $\left(\frac{Q}{h_0 - h}\right)$ in ft^2/day.

Table E6. Transmissivity (ft^2/day) comparisons of previous estimates to calculations based on the Nillson Well Step Test recovery of the Wanapum aquifer.

Transmissivity Comparisons					
	Previous estimates		Calculated from Nillson Step Test Recovery		
	Germiat and Flynn (2005)	Repasky (1993)	Bouwer and Rice (1976)	Theis (1935)	Razack and Huntley (1991)
Transmissivity (ft^2/day)	11,270	10,000	1,920	2,380	1,130

There are a few explanations for why previous estimates of the transmissivity in the WNB aquifer are about 5 times greater than the calculations of transmissivity from the Nillson Well Step Test. First, the low efficiency of the Nillson Well could be underestimating the transmissivity of the WNB aquifer. An observation well closer to the Nillson Well would have been helpful to identify the influence of the well's performance on the calculations. Additionally, the Nillson Well Step Test was a short test. Longer aquifer tests, like a 24-hour or 72-hour pumping test, would be required to observe the aquifer stabilize over time, yielding a more accurate estimate of the hydrogeologic properties. The results of this test probably only represent the hydraulic conductivity right around the well. The longer test could also potentially detect the presence of nearby barriers to flow.