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

A Thesis

Presented to

The Graduate Faculty

Central Washington University

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

Geological Sciences

by

Bethany Kharrazi

May 2023

CENTRAL WASHINGTON UNIVERSITY

Graduate Studies

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ABSTRACT

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

by

Bethany Kharrazi

May 2023

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.

V

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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 mi² subbasin in south-central Washington.¹ The watershed is located within the greater Columbia River Basin which spans 258,000 mi² 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).

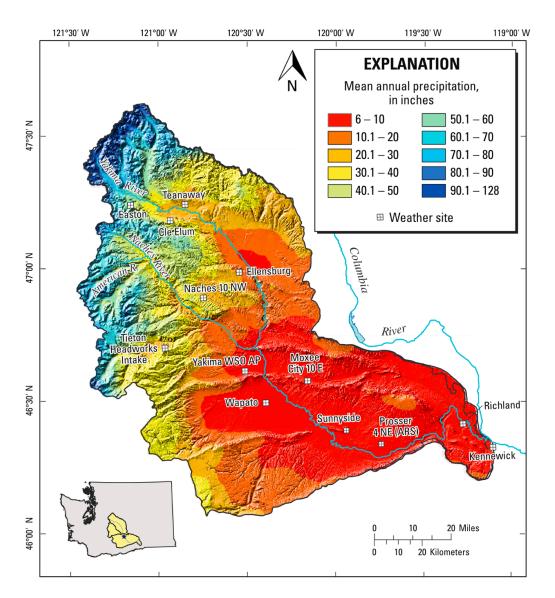


Figure 1. Mean annual precipitation (in) in the Yakima River Basin. Figure from Vaccaro and Olsen (2007).

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-comefirst-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).

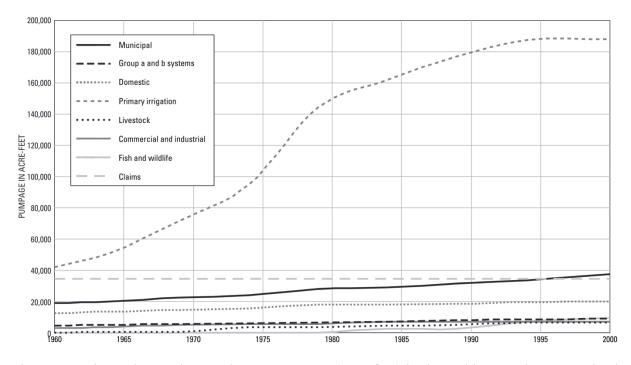


Figure 2. Estimated annual groundwater pumpage (acre-feet) in the Yakima Basin, categorized by water use from 1960 to 2000. Figure from Vaccaro and Sumioka (2006).

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.

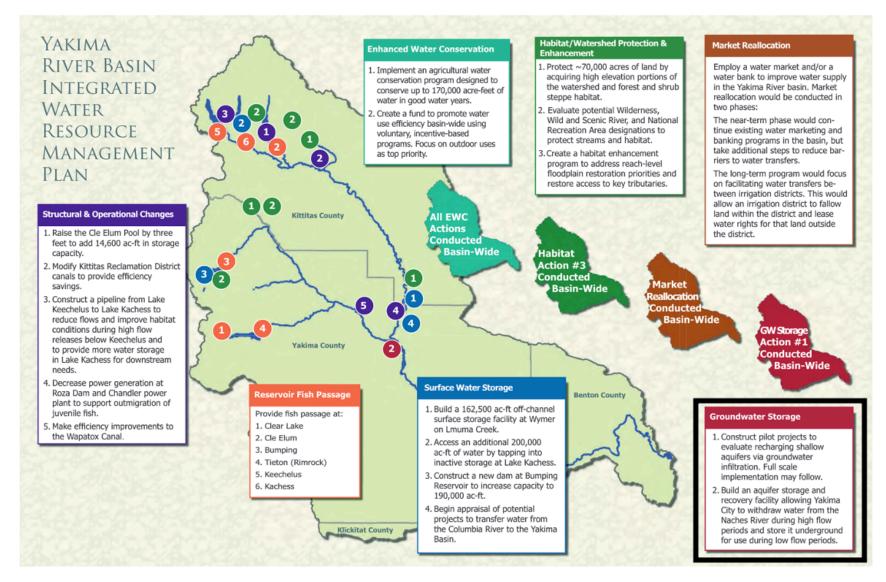


Figure 3. The seven elements of the Yakima Basin Integrated Plan. This study is a part of the groundwater storage element, boxed in black. Figure modified from McKinley and Sandison (2012).

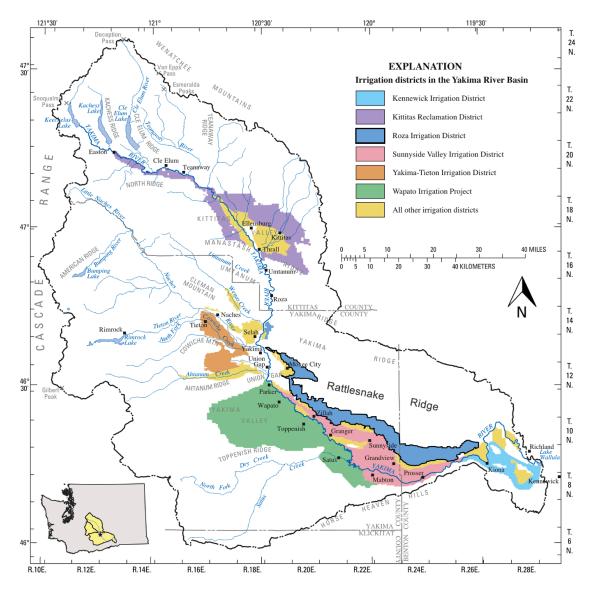


Figure 4. Map of irrigation districts in the Yakima River Basin. The Roza Irrigation District is highlighted in dark blue and outlined in black. Rattlesnake Ridge is labeled. Figure modified from Vaccaro et al. (2009).

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 8.1x10⁵ to 8.1x10⁶ 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 2.4x10⁶ 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 8.1x10³ 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.

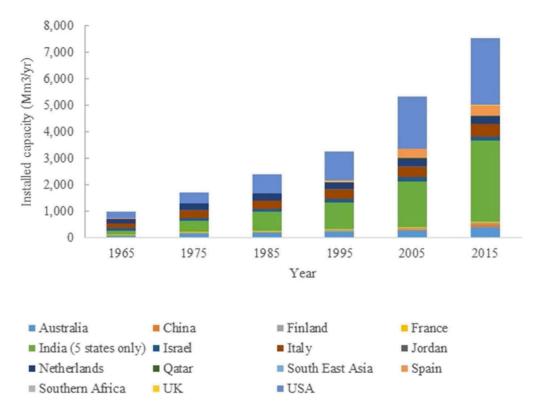


Figure 5. Global managed aquifer recharge capacity categorized by country from 1965 to 2015. Figure from Dillon et al. (2019).

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.

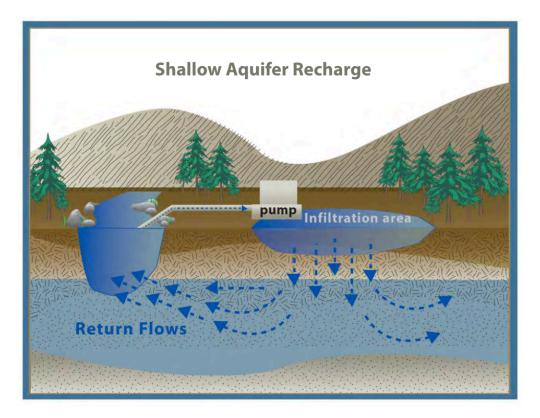


Figure 6. Shallow aquifer recharge with passive recovery through an infiltration pond. Figure from McKinley and Sandison (2012).

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).

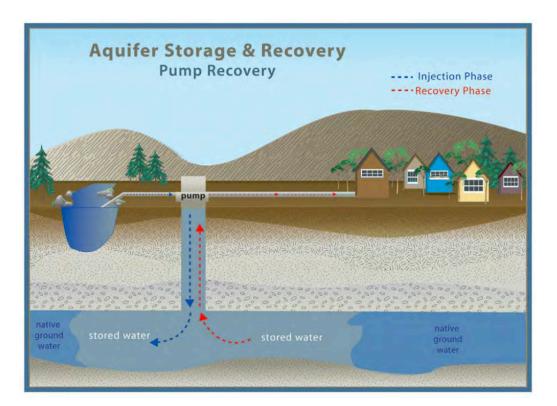


Figure 7. Aquifer storage and recovery through an injection well. Figure from McKinley and Sandison (2012).

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 mi² 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														
	Quaternary	Holocene Pleistocene Pliocene	0-5.6	Overb	burden	Landslide, flood, loess deposits														
	Neogene	Miocene		Upper Saddle Mountain	Elephant Mountain	Basalt flow														
			5.6 - 15.8	Lower Ellensburg	Rattlesnake Ridge	Sedimentary interbed														
				Lower Saddle Mountain	Pomona	Basalt flow														
						Lower Ellensburg	Selah	Sedimentary interbed												
Cenozoic				Lower Saddle Mountain	Umatilla	Basalt flow														
							Lower Ellensburg	Mabton	Sedimentary interbed											
			15.8 – 16.1													Wanapum	Priest Rapids	Basalt flow		
					Roza	Basalt flow														
				15.8 – 16.1	Lower Ellensburg	Squaw Creek	Sedimentary interbed													
								l	1									Wanapum	Frenchman Springs	Basalt flow
					Lower Ellensburg	Vantage	Sedimentary interbed													
			16.1 - 16.5	Grande	Ronde	Basalt flow														
<i>Note:</i> 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 mi² (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).

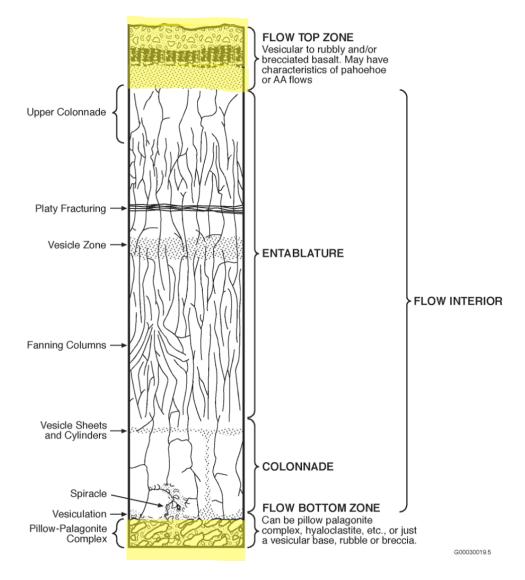


Figure 9. The simplified structure of a typical Columbia River Basalt Group flood basalt flow. The interflow zone is highlighted in yellow. Figure modified from Reidel et al. (2003).

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).

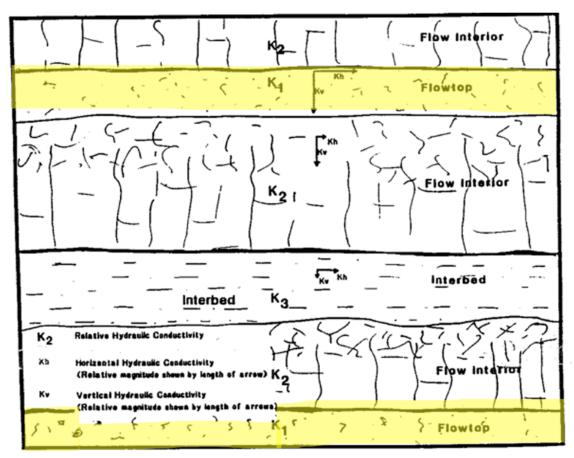


Figure 10. Relative hydraulic conductivity of basalt flows and interbeds of the Columbia River Basalt Group. Interflow zones are highlighted in yellow. Figure modified from Kirk and Mackie (1993).

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 finegrained 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 mi² 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.

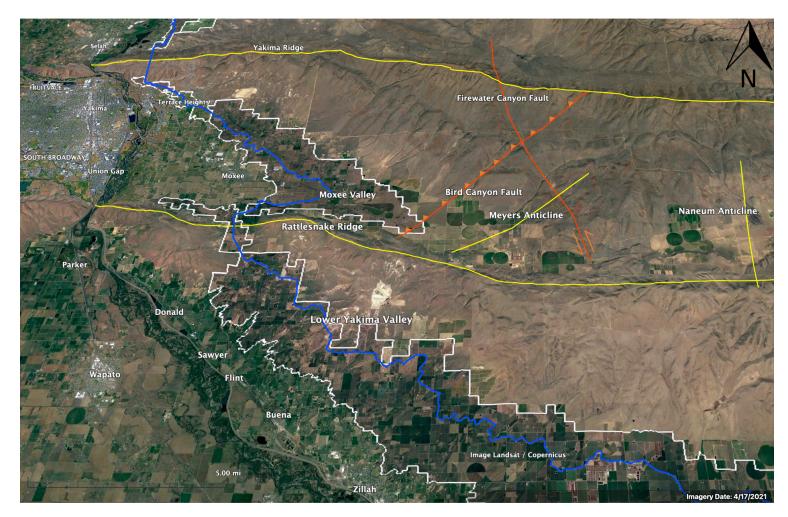


Figure 11. Map of notable faults and folds of the study area. Faults are marked in orange and folds are marked in yellow. The Roza Irrigation District is outlined in white, and the Roza Canal is in blue. Imagery from Google Earth.

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	Well ID: 3349	Well Name:	Cross Section: C-C'
$\begin{array}{c c} soll & 0 \\ sold & 4 \\ 72 \end{array}$		Well Depth: 1540FF	
$\begin{array}{c} clay (green) & 73 & 107 \\ clay (green) & 73 & 107 \\ clay (green) & 108 & 120 \\ Bassalt (broken+little clay & 114 \\ Bassalt (block haversonh wither) & 142 \\ Bassalt (block haversonh wither) & 143 \\ Bassalt (basken) & 143 \\ Bassalt (broken) & 164 \\ 173 & 164 \\ Bassalt (broken) & 164 \\ 173 & 181 \\ Bassalt (broken, rid) & 162 \\ 185 & 167 \\ Bassalt (broken, rid) & 162 \\ 185 & 167 \\ Bassalt (broken, rid) & 162 \\ 185 & 167 \\ Bassalt (broken, rid) & 162 \\ 185 & 167 \\ 185 & 185 \\ 185 & 167 \\ 185$	Surface Elevation: 1175 ft	well Depth: 139944	Aquifer: WNB
Basalt (broken+little clay 11/142	Depth bgs (ft) Elevation (ft) 0 - 1175		
Basalt (black heneycent worker) 198 196 Basalt (med. hard) 197 150.	φ T ¹¹⁷⁵	and R	
Bessit (hard) 151 167 Basalt (broken) 168 173		ÓVB	OVB
Basalt (hard) 173 181	120 - 1455	BASALT CLAY	
Basalt (Groken, red) 182 185 Basalt (Group) Block hard) chy 186 312	142 - 1033	BASALT (LA)	EM
Breat (green) c/ay 343 350 Breat (grey) c/ay 351 395	186 - 989	BASALT	LIVI
clay (grey) yock = 396 441	104		
Basalt (bard) 442 448 Basalt (bard) 449 445	x	CL OV	DD
Basalt (" havd) 449 465 Basalt (med) 446 478 Basalt (havd) 479 570	1 1 1	CLAY	RR
Bessell (med) 571 720 Bessell (bard) 721 720	722		
Basalt (Bard) 721 727 Basalt (" «CYGYICe) 728 732	442 - 733		
Clay (grey) 133 135- Bosalt (bard, Gloch) 136 910 Bosalt (bard, Gloch) 136 910 Bosalt (basalt shale) 911 914	I I I		
Baselt (baself shale) 914 Baselt (baself shale) 911 914 Baselt (bard) 915 1005		BASALT	PM
Baselt (bard) 915 1005 Baselt (brekens clay) 1006 1018 Baselt (grey-med) 1018 1035		BASACI	
MATERIAL FROM TO Broken black porous basalt 786 789	733 - 442	C . 014	
Very hard light gray basalt 789 847 Soft porous gray basalt trace of green clay 847 852	735 - 440	CLAY	SEL
Hard gray basalt 852 862		BASALT	
Hard gray basalt . 864 867	242	BASHET	
Med soft porous black basalt 160 psi 867 883 Med hard brown basalt 883 886	847-328	BASALT	UMA
Med hard gray porous basalt 170 psi 55 55 893 906	852 - 323		
Med soft gray fractured basalt 170 psi 893 906 Hard light gray basalt 0F ECOT 906 935 Med hard gray basalt Received 935 953		BASALT	
Med soft porous dark gray basalt/ 953 955		1	MBTN
Med hard dark gray basalt JUN 2 6 2012 955 969 Very hard light gray basalt 969 971	989-186	CLAY DADAUT CAAY	
Med soft black porous basalt 986 Hard dark gray basalt 986 989 Green & black clay 989 993	995 - 186 999 - 176	BASALT CLAY	
Green & black clay 989 995 Broken black porous basalt & some clay 995 999		BASALT	
Fractured black basalt 260 psi 999 1012	1100 - 75	RASALT CLAY	
Soft black & some reddish brown porous basalt 1036 1049	1143 - 72	BASALT CUA	DE
280 psi 73 deg Med hard black basalt 1049 1061		BASALT	PR
Soft porous black basalt 290 psi [106] 1069 Med hard black basalt 1069 1095	122954		
Very hard light.gray basalt 1095 1100 Med hard gray basalt broken some green clay 1100 1103	1250 75	BASALT	
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Med soft black basalt 1138 1158 Med hard black basalt 1158 1181	1336161	BASALT CUM	
MATERIAL FROM TO Hard gray basalt 1181 1229	1342167		
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 1295		BASALT	
Med hard dark gray basalt 1296 1336 Med soft broken dark gray basalt with some green 1336 1342	· ·	BUCALI	RZ
& gray clay 1342 Hard gray basalt 1342	8°, 3		Tub
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	1540 I -365		
	L		alfares.

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.

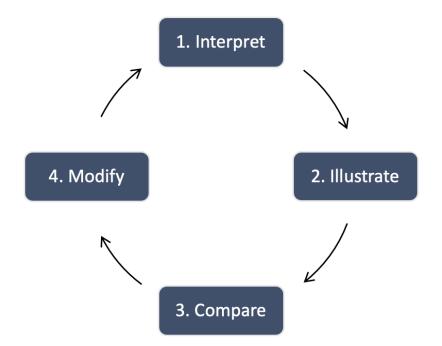


Figure 13. Simplified methodology for cross-section development: (1) interpret driller notes, (2) illustrate cross-sections based on interpretations, (3) compare stratigraphic interpretations to one another and available geologic maps, and (4) modify to make geologic sense of the stratigraphy. This process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

Cross-section Trend	Trend	Location	Location Number of wells	Length of cross- section (mi)	Well distance from cross- section line (ft)	
				section (IIII)	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

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

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.

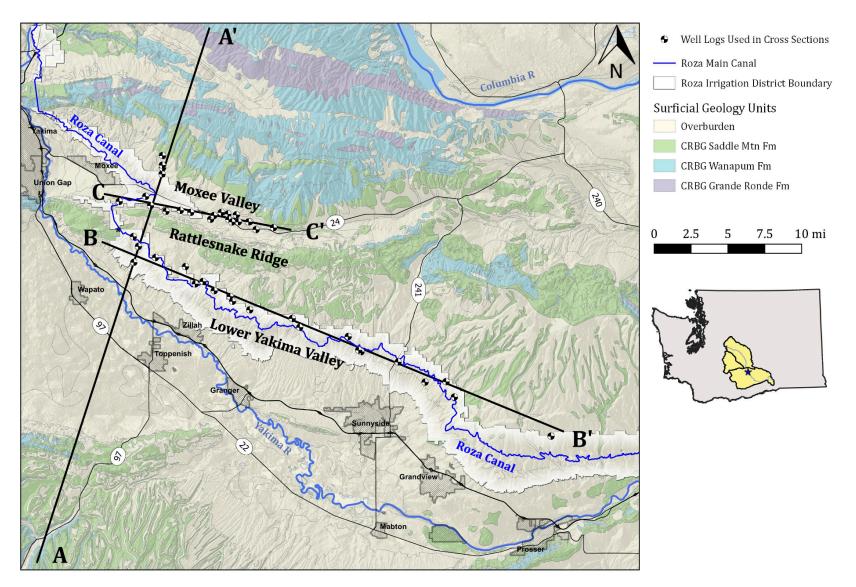


Figure 14. Surface geology map of the study area with three cross-section lines (A-A', B-B', and C-C'). The Roza Canal (blue) is within the Roza Irrigation District (shaded in white). Rattlesnake Ridge, Moxee Valley, and the Lower Yakima Valley are labeled. Map by Sherry Wilhelm (Coho Water Resources,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

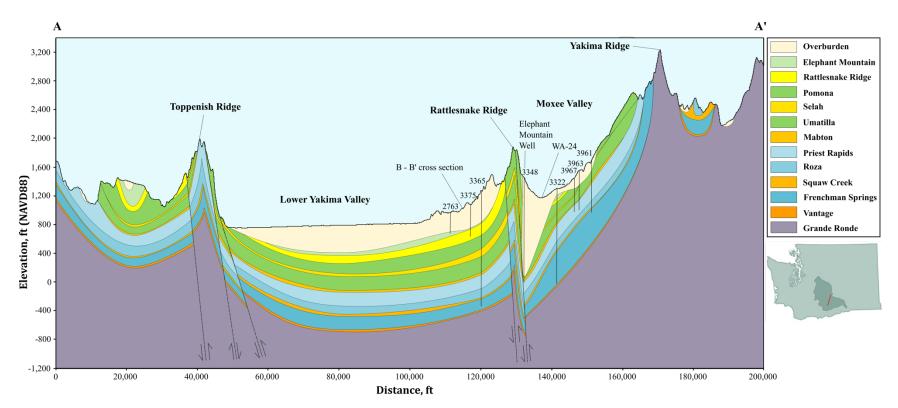


Figure 15. A-A' cross-section trending north-south featuring Yakima, Rattlesnake, and Toppenish Ridges and the Lower Yakima and Moxee Valleys. Stratigraphic legend is provided with color-coded units. The inset map includes a red line representing the location of the cross-section line within the Yakima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

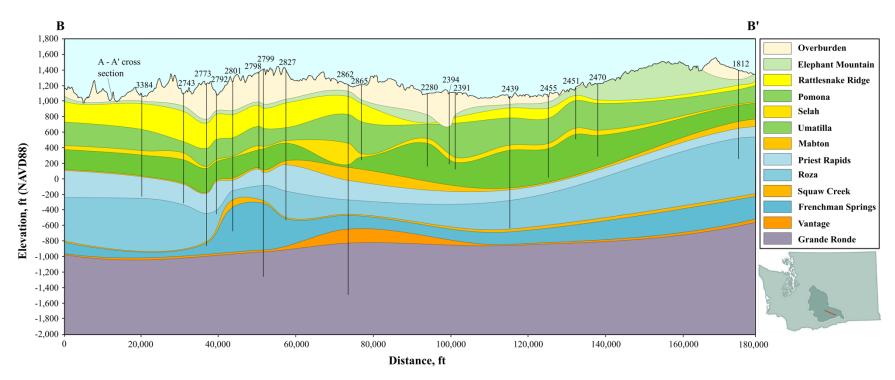


Figure 16. B-B' cross-section trending east-west in the Lower Yakima Valley. Stratigraphic legend is provided with color-coded units. The inset map includes a red line representing the location of the cross-section line within the Yakima Basin and Washington State.

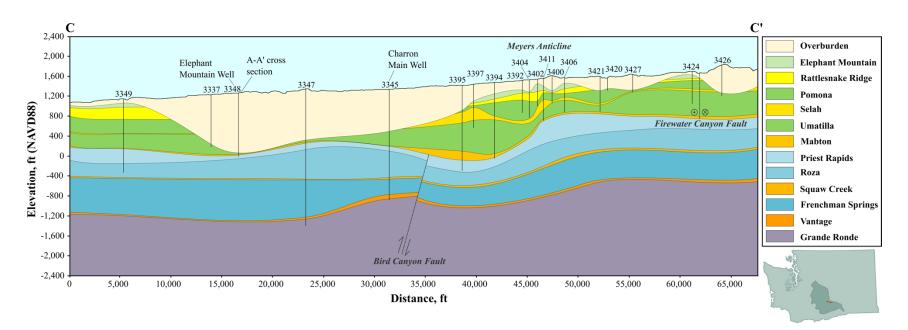


Figure 17. C-C' cross-section trending east-west in Moxee Valley including the reverse Bird Canyon Fault, strike-slip Firewater Canyon Fault, and Meyers Anticline. Stratigraphic legend is provided with color-coded units. The inset map includes a red line representing the location of the cross-section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

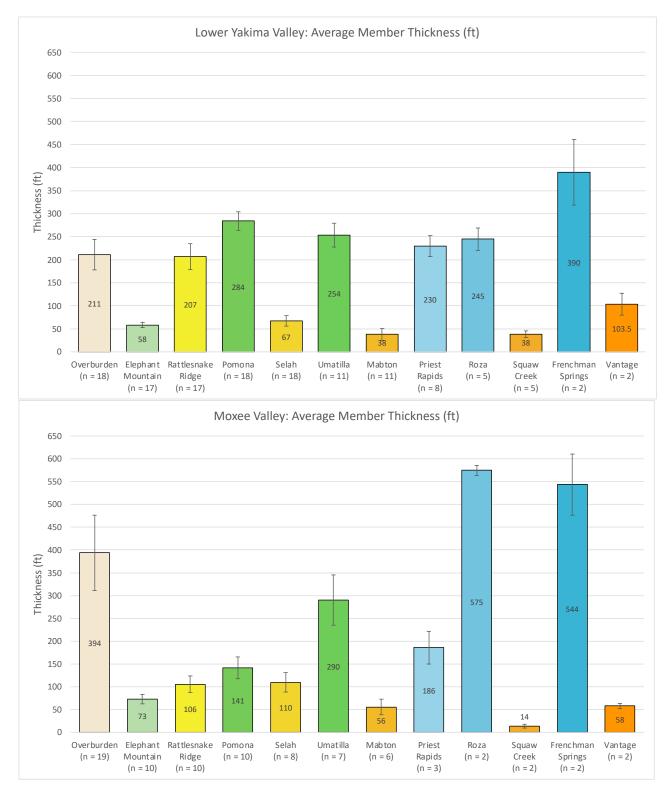


Figure 18. Average member thicknesses (ft) of the wells in the Lower Yakima Valley (B-B' cross-section) and Moxee Valley (C-C' cross-section) with standard error bars, color-coded with the stratigraphy. The number of wells used to calculate the average thickness (n) is labeled under each member.

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 (≥ 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.

			Number of Wells				Rate (ft/year)	
Aquifer	Date Range	Date Range Total		Declining	g Stable Increasir		Pango Ave	Avorago
		TOLAI	(≤ -1 ft/yr)	$(-1 \le 1 \text{ ft/yr})$	(≥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	

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

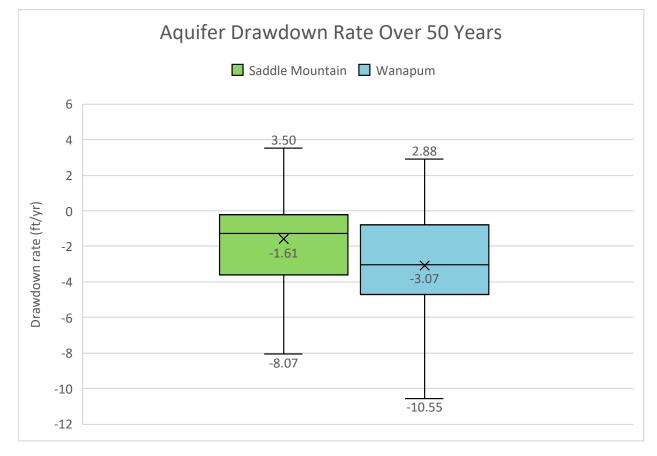


Figure 19. Box and whisker plot of annual groundwater drawdown rate (ft/yr) in the Saddle Mountain (n = 27) and Wanapum (n = 20) aquifers. The graph is color-coded with the stratigraphy.

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.

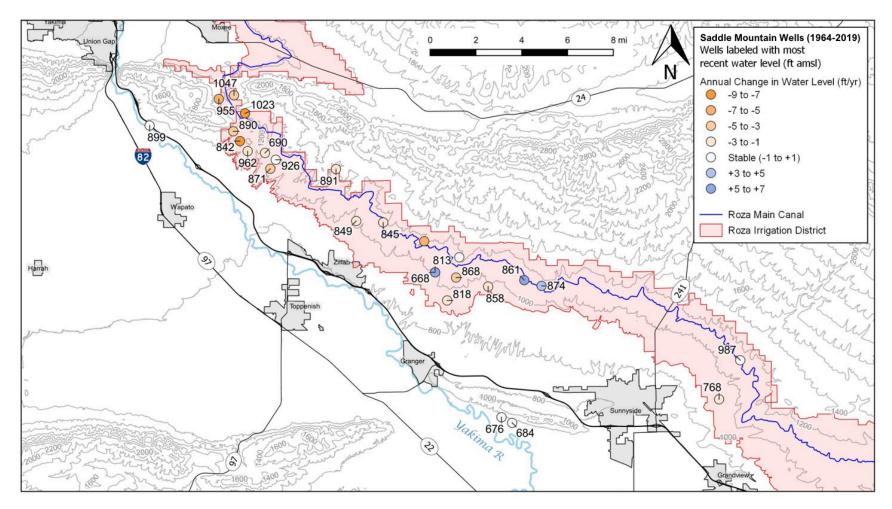


Figure 20. Map of groundwater level trends in the Saddle Mountain Basalt aquifer. The Roza Canal (blue) is within the Roza Irrigation District (shaded in red). The annual change in water level is represented by blue (increasing), white (stable), and orange (decreasing) circles. The recent water level 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.

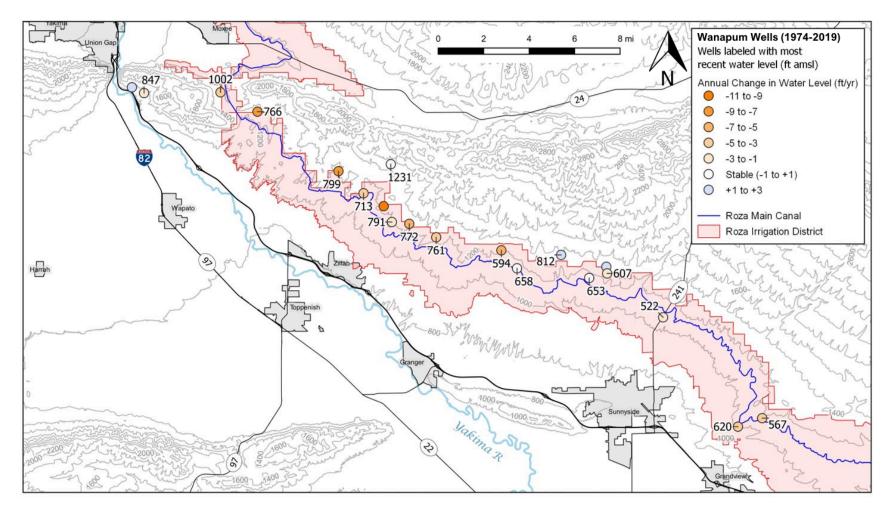


Figure 21. Map of groundwater level trends in the Wanapum Basalt aquifer. The Roza Canal (blue) is within the Roza Irrigation District (shaded in red). The annual change in water level is represented by blue (increasing), white (stable), and orange (decreasing) circles. The recent water level measurement 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

_	_	Stratigraphic interpretations of			Previous		
Formation	Member	driller notes			estimations		
		Mean	Min	Max	Mean	Max	
Overburden	Upper Ellensburg Formation and Quaternary sediments	305	1	1,292		2,000 [*] 1,200 [†]	
	Elephant Mountain	64	10	160	98 [§]	_,	
	Pomona	233	23	447			
	Umatilla	268	19	670			
Saddle Mountain	Total	655	52	1,277	550 ^{††}	400 [#] 990 ^{**}	
						1,110 ^{††}	
	Priest Rapids	218	84	276	98-164 [§]	220 [#]	
	Priest Rapius	210	04	376	200 ^{§§}	220	
Wanapum	Roza	339	134	609		200 [#]	
wanapam	Frenchman Springs	467	175	751		375 [#]	
	Total	1,023	393	1,736	600 ⁺⁺	1,200 ^{**} 1,180 ^{††}	
	Rattlesnake Ridge	169	9	353			
	Selah	80	2	252			
	Mabton	44	2	195	50 [*]	200*	
					40-80 ^{§§}	520 ^{**}	
Lower Ellensburg					70 ⁺⁺	250 ⁺⁺	
	Squaw Creek	31	1	91		17 [#]	
			31	176	30 ^{††}	35 [#]	
	Vantage	81				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)							
	2005)						
§§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.

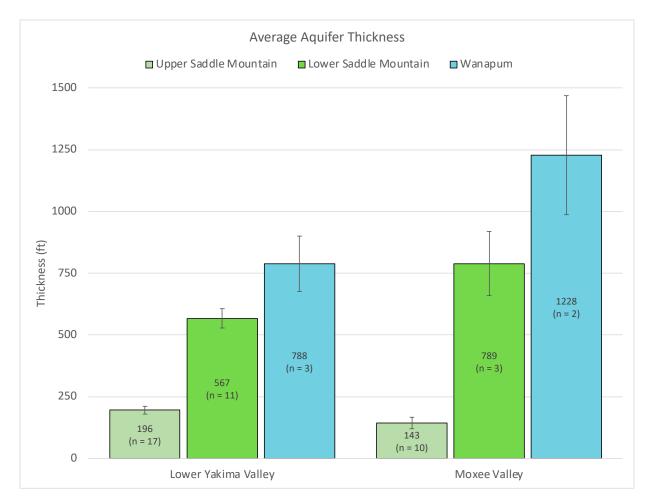


Figure 22. Average aquifer thickness (ft) of the basalt aquifers in the Lower Yakima and Moxee Valleys with standard error bars and the number of wells (n). Aquifers are color-coded with stratigraphy.

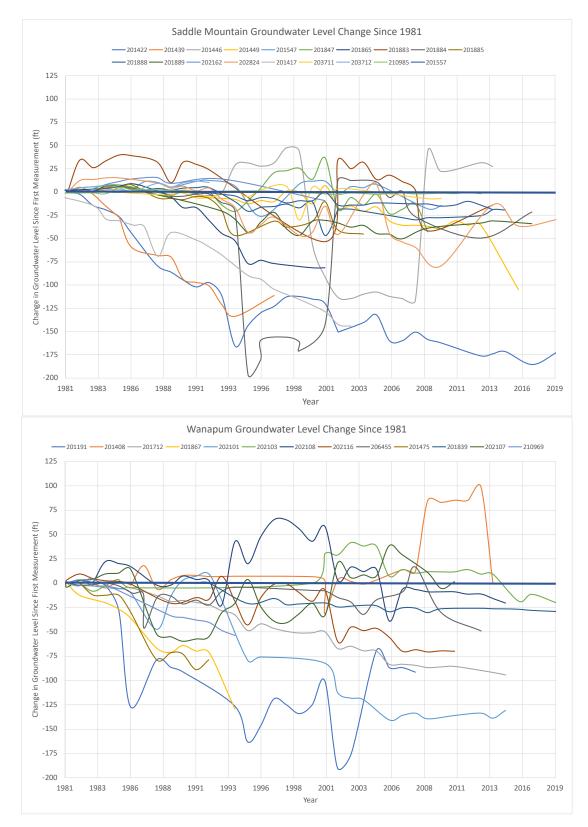


Figure 23. Groundwater level change since 1981 of the Saddle Mountain (n = 19) and Wanapum (n = 13) aquifers. Data normalized to zero ft. for the initial measurement, with the blue line representing zero ft over time.

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 ft², 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.

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					
Lo	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					

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

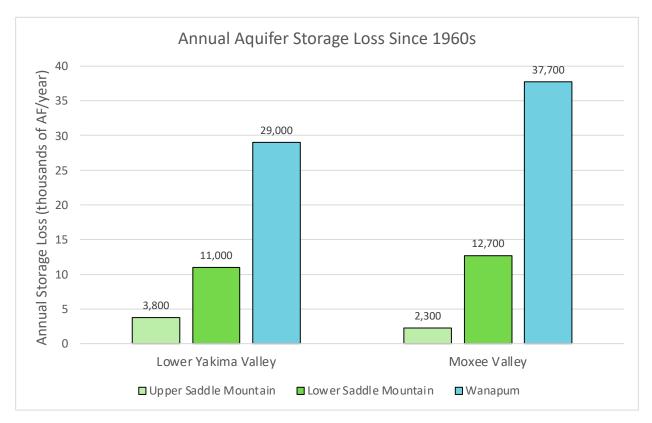


Figure 24. Annual storage loss (acre-feet/year) since the 1960s in the Lower Yakima Valley and Moxee Valley for the Upper Saddle Mountain, Lower Saddle Mountain, and Wanapum aquifers.

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.

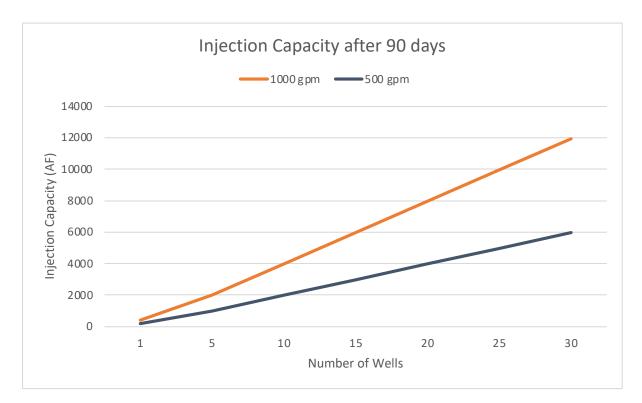


Figure 25. Injection capacity (acre-feet) for an ASR program with varying numbers of wells and injection rates (gpm).

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 (ft²/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.

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

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

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).

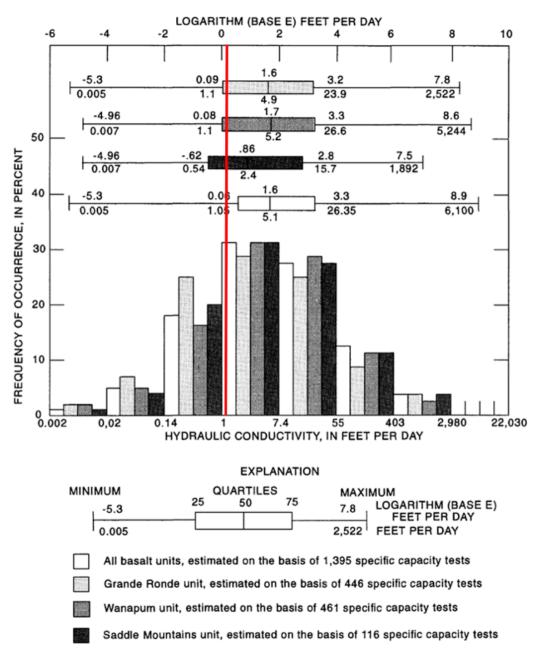


Figure 26. Distribution of hydraulic conductivity (ft/day) values for Columbia River Basalt Group formations with the Bouwer and Rice (1976) hydraulic conductivity solution of 1.562 ft/day from the Nillson Well Step Test (Appendix E) marked in red. Figure modified from Hansen et al. (1994).

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.

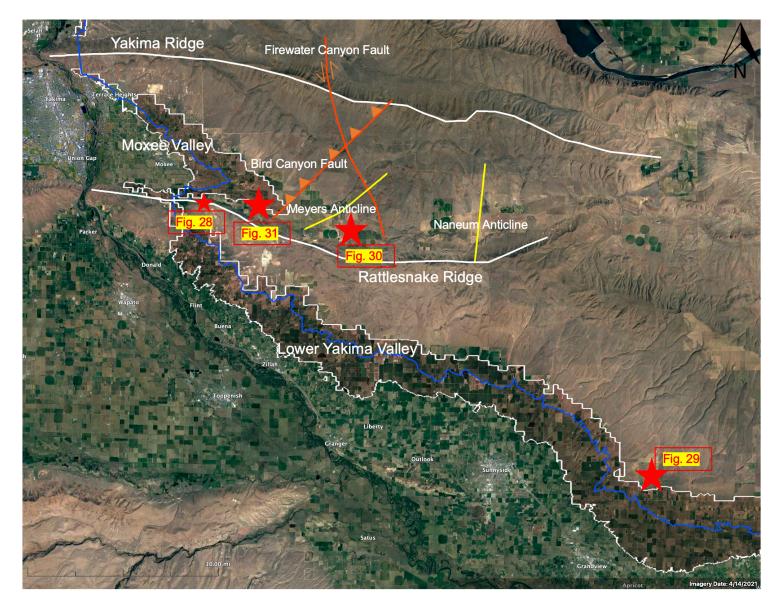


Figure 27. Map of potential recharge locations with locations of Figures 28 through 32. The Roza Canal (blue) is within the Roza Irrigation District (outlined in white). Notable regions of the study area and faults and folds are labeled. Imagery from Google Earth.

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.

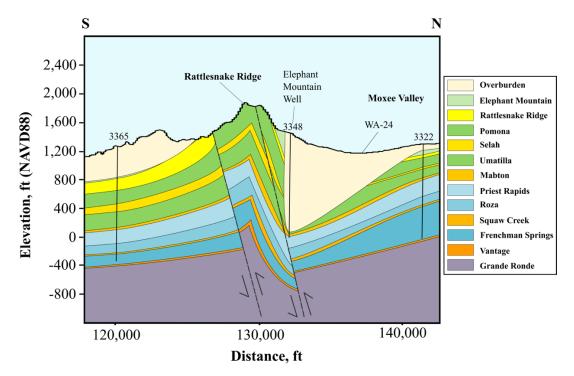


Figure 28. The Rattlesnake Ridge and Moxee Valley region of the A-A' cross-section, horizontally exaggerated with color-coded stratigraphic legend. See Figure 27 for the specific location of this feature.

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.

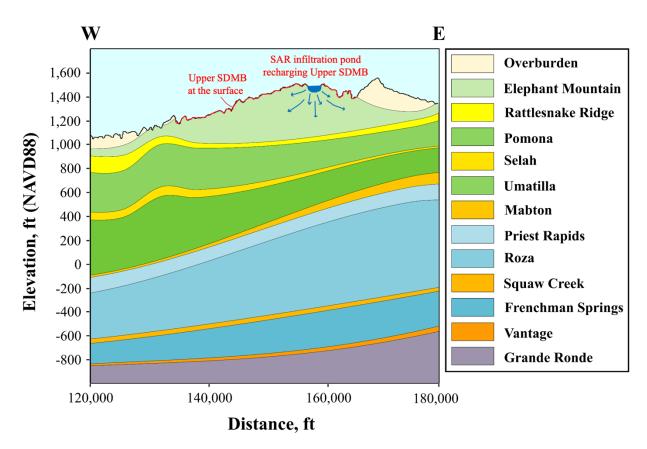


Figure 29. Potential SAR location targeting the Upper SDMB aquifer in the Lower Yakima Valley, a part of the B-B' cross-section, with color-coded stratigraphic legend. This location is slightly upslope on Rattlesnake Ridge (Figure 27) and 2 to 3 miles north of the Roza Canal.

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.

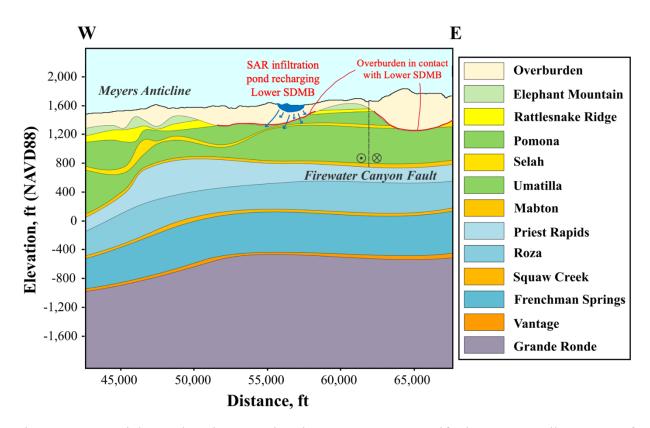


Figure 30. Potential SAR location targeting the Lower SDMB aquifer in Moxee Valley, a part of the C-C' cross-section, with color-coded stratigraphic legend. The Firewater Canyon fault is a strike-slip fault. This location is around 6 to 8 miles east of the Roza Canal. See Figure 27 for the specific location.

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.

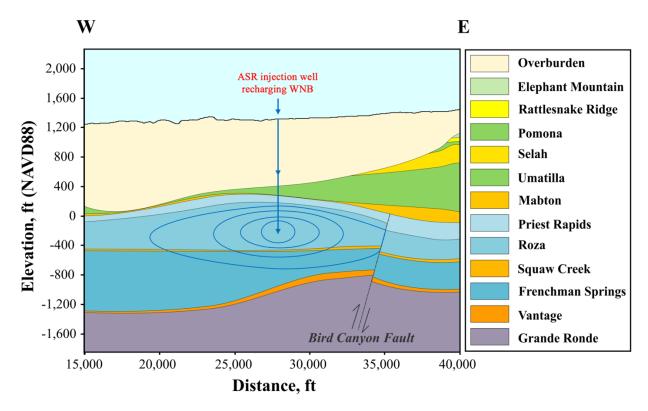


Figure 31. Potential ASR location targetting the WNB aquifer in Moxee Valley, a part of the C-C' cross-section, with color-coded stratigraphic legend. The blue concentric circles illustrate the propogation of recharge water into the aquifer over the duration of injection. This location is 4 miles east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

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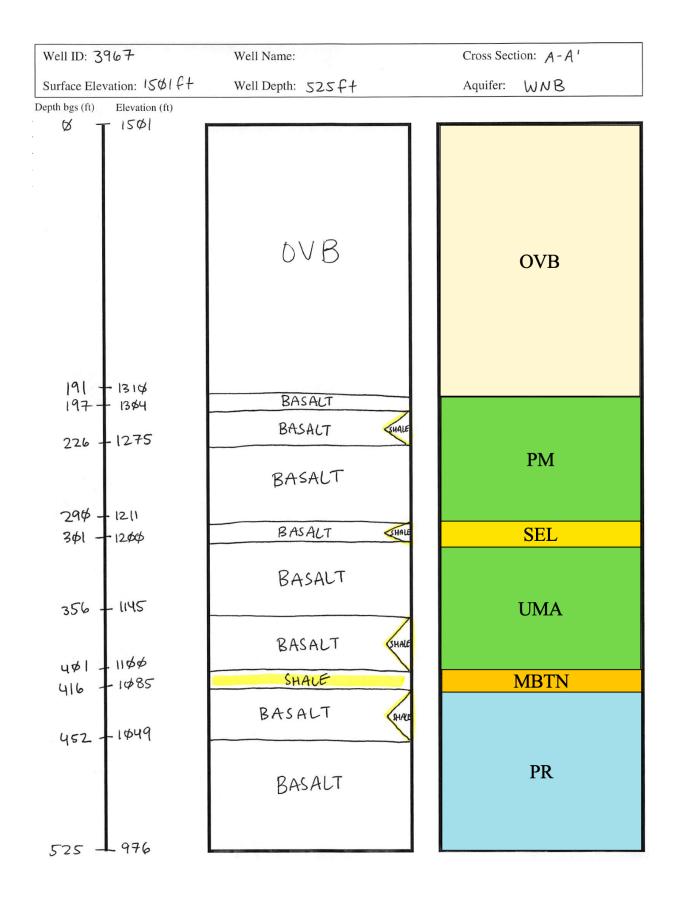
APPENDICES

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.

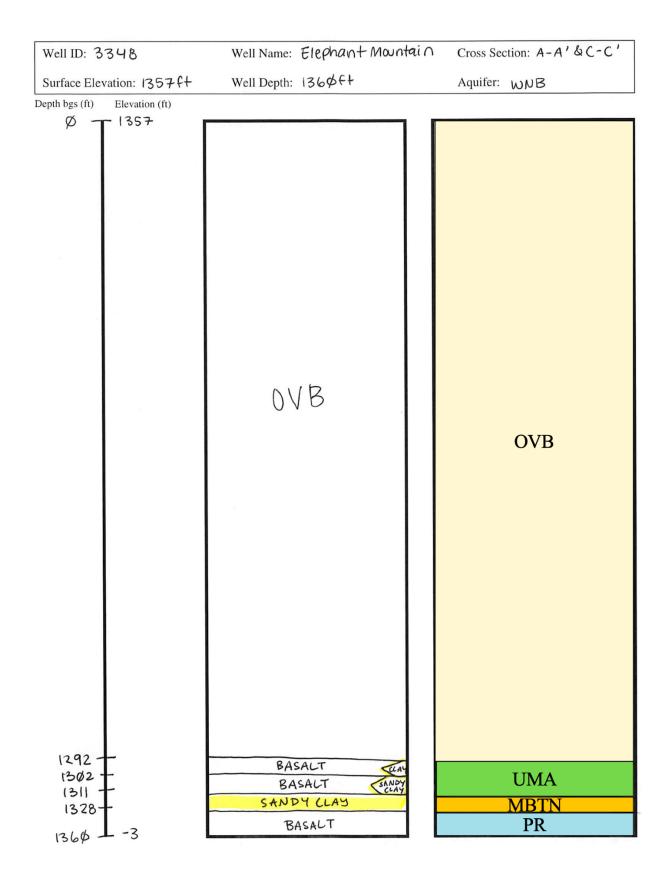
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		Basalt, fractured, honeycomb	a	Gravel packed: Yes No Size of gravel	AUG 1 7/1902		
	Gravel placed fromft_toft_	green shale in seams,	E	Gravel placed from ft_toft_	///902		
	Surface seal: Yes No To what depth? 231 ft	H20, 40 to 50 gpm 356 376 Basalt, blk, seamed, brown,	- K	Surface seal: Yes No To what depth?ft	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		
	Material used in seal Enviro-Plug, bentonite	green 376 401	-	Surface seal: Yes No. To what deputy	The way of the		
	And any strata contain unusable water? Yes No 🔀	Shale, green 401 416	NOT	Did any strata contain unusable water? Yes No	Crew a		
	Type of water?Depth of strata	Basalt, blk. green seams 416 452		Type of water? Depth of strate	/		-
	Method of sealing strata off	Basalt, med. blk. honeycomb	ŝ	Method of sealing strate off			
(7)	PUMP: Manufacturer's Name Sta-Rite	brown & green, H20, 100+ 4521 462	oes) PUMP: Manufacturer's Name			
	туре Sub. нр 20	Basalt, med. blk. firmer 462 471					+
(8)	WATER LEVELS: Land-surface elevation above mean sea level	Basalt, fractured, red &	cology **	1300			
	Static levelft below top of well Date8/12/92	blk. H20 471 480	6 (8	acove mean sea level II		+	+
	Artesian pressure Ibs per square inch Date	Basalt, Med. gray, firm 480 490	<u>o</u>	Static level ft below top of well Date		<u>+</u>	+
	Artesian water is controlled by(Can when alc 1)	Cont.	ы	Adama unio a seconda bu		+	+
(0)	Coop, third, and J	Work started 7/29/92 19 Completed 8/13/92 19	<u>_</u> و	(Cap, valve, etc.))	Work started 7/29/92	102	
(9)	WELL TESTS: Drawdows is amount water level is lowered below static level Vas a pump test made? Yes No Hyes, by whom?			WELL TESTS: Drawdown is amount water level is lowered below static level	work stated 19 Completed	176-	
	field gal /min with ft drawdown after hrs	WELL CONSTRUCTOR CERTIFICATION:	rtment	Ves a pump test made? Yes No If yes, by whom?	WELL CONSTRUCTOR CERTIFICATION:		
		I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards	Ĕ	Yield gal /min with It drawdown after hrs	I constructed and/or accept responsibility for con-	struction c	of this w
		Materials used and the information reported above are true to my best knowledge and belief	- E -	n n n n	and its compliance with all Washington well com Materials used and the information reported above	struction	standar to my be
	Recovery data (time taken as zero when pump turned off) (water level measured rom wall top to water level)	nomeage and bener	- a	Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)	knowledge and belief		
	Time Water Level Time Water Level Time Water Level	NAME Cassel Drilling & Pump	e	from well top to water level) Time WaterLovel Time WaterLovel Time WaterLovel	Coggol Dwilling & Dunn		
		(PERSON FIRM, OR CORPORATION) (TYPE OR PRINT)	Δ		NAME Cassel Drilling & Pump PERSON, FRAM, OR CORPORATION	(TYPE (OR PRINT)
		Address 1308 Voelker, Yakima, Wa.	e _				
	Date of test		È –		Address		
m		(Signed)License No 73	æ	Date of test	(Signed)		
	Balertest gal /min with ft drawdown after hrs	Contractor's	,	Bailer test gal /mn with ft drawdown after hrs	(Signed)License Contractor's	NO	
	Aurtest gal /min with stem set at ft for hrs	Registration NoCassewd 317 cp Date 8/13 192		Airtest gal /min with stem set at It for hrs	Registration		
	Artesian flow g p m Date remperature of water Was a chemical analysis made? Yes No	NOVELEDGENG JAL OF Date OF L		Artesian flow g p m Date	No Date		
	emperature of water Was a chemical analysis made? Yes No	(USE ADDITIONAL SHEETS IF NECESSARY)		Temperature of water Was a chemical analysis made? Yes No		SSARY)	



3963 Application No Application No Application No Application No Application No OWNER: Name Ralph Lamb Addree 314 Nth. 5th, Selah, Wa. 98942 LOCATION OF WELL: County County Addree 314 Nth. 5th, Selah, Wa. 98942 LOCATION OF WELL: County Addree 314 Nth. 5th, Selah, Wa. 98942 LocAtion OF WELL: County Tark of Wathing corner LocAtion OF WELL: County County Addree 314 Nth. 5th, Selah, Wa. 98942 LOCATION OF WELL: County Tark of Wathing corner (10) WELL County Tark of Wathing conner Marking New well & Municipal Tormation: Describe by color, character, and drame prestricted, with at iteat one entry for ecol change of formation. New well & Municipal New well & Method: Dug & Bored Soil, Brrn, Cravel, Small 35 Spred o	Surface Elevation: $1522f+$ Depth bgs (ft) Elevation (ft) \emptyset \uparrow 1522	Well Depth: 52\$ff	Aquifer: WNB
IDCATION OF WELL: county Yakima NEx, SE, Sec. 34 T, I3.N. B. 20 Ke.M. ing and distance from section or subdivision corner LoT / PROPOSED USE: Demeetic II industrial III Industrial IIII Industrial IIII IIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	Ø - 1522	ONB	
Irrigation Test Well Other Prometion: Deerofe by color, other there and structure, and		OVB	
CONSTRUCTION DETAILS: Gravel. Cemented. Clay. Hrd. 81 87 Casing installed: 6 Diam. from 0 n. to 197 nt. Threaded D "Diam. from 0. to 197 nt. Brn. Med. 87 95 Sandstone. Lt. Brn. Soft 95 147 147 147 147			OVB
Weided (3 Diam. from ft. to ft. Perforations: Yes [] No [] Type of perforations from in. by StZE of perforations from it. to perforations from it. to months from it. to perforations from it. to screens: Yes [] No [] Manutcurrer's Name Model No. Diam. Side size from ft. to plan. Side size	165 -1357 -	BASALT	UMA
Gravel packed: yes No 25 Size of gravel: Gravel placed from t. to to to what depth? Surface seal: yes 25 No 2 To what depth? Material used in seal. bentonite clay Did any strata contain unuable water? Yes No 7X Type of water? Method of sealing strata off.	292 - 1230	BASALT SHALE	
DEPARTMENT OF ECULOGY Type: HP CENTRAL REGIONAL OFFICE	369 - 1159	SHALE	MBTN
WATER LEVELS: Land-surface elevation ici tevel 340 .ft. below top of weil Date6-23-77. erian pressure bis. per square inch. Date Artesian water is controlled by. (Cap, valve, etc.)	μι - μιι	BASALT	
WELL TESTS: Downdown is smooth specia lawed a pump test made? No IX If yes, by whom? d: gal/min.with ft. drawdown atter m. """"""""""""""""""""""""""""""""""""	417-1105	SHALE	PR
were water (three takes as zero when pump turned off) (water level mee water Level Time Time Time Water Level Time Time Time Time <td></td> <td>BASALT</td> <td>ΓK</td>		BASALT	ΓK

	Well ID: 39	Well Name:	Cross Section: $A - A'$
Bie Oristinal and First Copy with Been drawy Control to Copy Third Copy — Derlines Copy Third Copy — Derlines Copy STATE OF WARHINGTON	Surface Elevation	ion: 1676ft Well Depth: 68	7ft Aquifer: WNB
(1) OWNER: Name Happy Bilerstatte Addres Vanima syster GA-30	419 br Ø T	Elevation (ft)	
(2) LOCATION OF WELL: county yah+mq -Alf whk wsec34. ₹3 Jet and distance from section or subdivision corner (3) PROPOSED USE: Domestic _ Industrial _ Municipal _ (10). WELL LOG:			
	and structure, and	OVB	OVB
(4) TYPE OF WORK: Owner's number of well (if more than one).	FROM TO 109	567	
Beconditioned B Rotary & Jetted B AND STUNE, TAN	$ \begin{array}{c} 0 & q \\ \frac{q}{21} \\ \frac{21}{21} \\ \frac{1}{9} \end{array} $		
5 DIMENSIONS: Diameter of well of inches. DASALT, Fractured Gray MH. Drilled 4022 ft. Depth of completed well 687 ft.	109 127 127 179		
(6) CONSTRUCTION DETAILS: Casing installed: 570 " plan. from +1 n. to 334 n. BASALT, GLACK, Boxas M. H. BASALT, GLACK, Boxas M. H.	179 217	BASAL	UMA
Q Threaded D Diam. from the to the BHSALT, Gray Hard	<u>295 378</u> 378 397		
U Perforations: Yes No X Type of perforation used BAGMAT, Gray Hard BAGMAT, Olack Reveus W.B.	397 462 462 472 259	1418	
perforations from the to the BASALT, BLOCK PORCUS 4/,	4/2 342	BASALT	THALE MBTN
g Screens: Yes No A	<u>536 554</u> 248	1381	
rg Screens: ver □ No Å G Manutacturer's Name Diam. Slot size from fr. to fr. Diam. Slot size from from fr. Diam. Slot size from from from from from from from from	554 561 561 600 600 629		
	629 633		
Surface seal: yes No I To what deputs 134 H SALE, Ora y SOFT NO	633 634 634 640 640 698	BASAL	τ
H Type of water? Depth of strata BARSALT, POYOUS, Brown M.H N.O	648 657	Driving	PR
Z Method of sealing strate off. (7) PTIMP. (7) PTIMP	666 673		
	679 687		
0 (8) WATEB LEVELS: above mean seas iever side of Artesian presure Artesian water is controlled by. (Cap, valve, etc.) 1000000000000000000000000000000000000			
(9) WELL TESTS: Drawdown is amount water level is	522 - 522 - 536 - 1	BASHT	SHALE
Was a pump test made? Yes No X If yes, by whom? Yield: gal/min. with tt. drawdown after hrs. WELL DRILLER'S STATEMENT:	554	II32. BASALT	
This well was drilled under my jurisdiction a true to the best of my knowledge and belief.		BASALT	ZEHALE RZ
O Time Water Level Time Water Level Time Water Level NABLE (Person, firm, or corporation) (T	129	BASALT	
a Address / SOF P Dell A P ave	<i>Junney</i> (33)	643 642 BAJALT	SQC
A of set both real 200 f gal/min. with OFP Cottood water 2 hr. Artedan flow gp. Date flow for the set of the		406	
USE ADDITIONAL SHEETS IF NECESSARY)		BASALT	FS
ECY 050-1-20	 ● 687 ⊥ 	989	

		23/8 Flon	hant Mount	ain Wall			
File Original and First Copy with Department of Ecology Second Copy – Owner's Copy Third Copy – Differ's Copy STATE OF W				aiii VV CII			
(1) OWNER: Name Dept of NAT. Rosourae	Shddress	e b	. C.		LL DRILLING		
2) LOCATION OF WELL: County Allman	Story North Sec. 16. T. 12. N. R. 20 W		CASSEL	1308 SOUTH V	nd Irrigation DELKER AVENUE HINGTON 98902	PHONE 453	-2560
3) PROPOSED USE: Domestic Industrial Municipal Irrigation + Test Well Other	(10) WELL LOG: Elegodant MT # 1 Formation: Describe by color, character, size of material and structure a show thickness of aquifers and the kind and nature of the material in the stratum penetrated, with all least one entry for each change of formatis						11
4) TYPE OF WORK: Owner's number of well #/ (if more man one)	ATTAL MATERIAL WITH at least one entry for each change of formative material with at least one entry for each change of formative material for a second seco	5 Dept. o	of Natural Resours at Mt. <u>Well # 1</u>	ses	Permit #	¥ G4-25817₽	Γ
Reconditioned Rotary Jetted 5) DIMENSIONS: Diameter of well //G	REMARNS!	- up Locatio	on SWA NEA SEA NI	2			
6) CONSTRUCTION DETAILS:	Cemented TUP a Bottom of		1 ТО	THICKNESS	FORMATIC	N	
Casing installed: <u>/6</u> Diam. from <u>+</u> 1 tt. to <u>1294</u> . Threaded □ <u>12</u> Diam. from <u>/26</u> 2tt. to <u>/322</u> tt. Welded □ <u>12</u> Diam. from <u>tt. to</u> <u>13</u> .	Conunted hole TO 1335	b b c c c c c c c c c c	3 12 282	3 9 270	Top Soil Boulder,sand,clay Clay,sandy w/sm gr	cavel,brown	
Perforations: Yes No 2 Type of perforator used		12 270 292 292 292	362 392 426 462	92 30 32 36	Clay,brown w/large Clay,gray, w/large Clay,brown, w/sm g Clay,brown, very s	gravel	
perforations from		426 462 492 492	462 492 595 602	30 103 7	Clay, brown, very s Clay, brown, sandy Shale,green Clay,gray,w/sm gra	y,w/sm gravel	
Screens: Yes No # Manufacturer's Name Model No			617 634 683	10 17 51	Clay,brown,sticky Clay,green w/grave Clay,brown w/sm gr	el	
Diam. Slot size from ft. to ft. Gravel packed: Yes D No ff. Size of gravel: ft. Gravel placed from ft. to ft. to ft.			782 906 923	99 124 17	Shale,green Shale,green w/gray Shale,green,sand	vel Lenses	
Surface seal: Yes No To what depth? 30 n. Material used in seal Cemin 47		LON 923 923 928 943	928 943 1020	5 15 77	Shale,green,very s Shale,green w/smal Shale,green w/sand	ll gravel	
Type of water?			1073 1106 1138	77 53 33 32	Clay, green, sticky Clay, gray, sand lo Clay, green, very s	ticky	
7) PUMP: Manufacturer's Name		A 1106 A 1138 A 1159 A 1185 A 11	1159 1185 1218	21 26 33	Clay,green,very s Clay,green,sandy Clay,green,very s	• • •	:1
8) WATER LEVELS: Land-surface elevation above mean sea level		b 1292	1292 1302 1311	74 10 9	Clay,green,sandy Decomposed,basalt Basalt,broken w/c	w/dark clay har lay,black	
(Cap, valve, etc.) 9) WELL TESTS: Deswdown is amount water level is been below static level	Work started	tu 1311 1328	1328 1360	17 32	Compacted sand, san Basalt, redish to 1		
Was a pump test made? Yes \mathscr{C} No \Box if yes, by whom?. Tield: gai/min. with ft. drawdown after hrs. " $390 \pm " 2^{1/2} 2^{1/1} " 3 "$	WELL DRILLER'S STATEMENT: This well was drilled under my jurisdiction and this report	ba	226				
	true to the best of my knowledge and belief. NAME (A.S.S.e.) (1) Del 11/14-9 (Perpen firm or perpendion) (Type & print)	e Casing	g: 16" + 1 to 12	96 1	NEC	EIVEN	
	(Person, firm, or corporation) (Type of print)/ Address 13.08 U.O.114 of VGAIM 9	······	12 1)		FEB	2 5 1981	
le of test	[Signed] Well Driller) Well Driller) License No. 00 9 3 Date 5-13 19.0			accept	as well report	Edion over	
	uerts if necessary) DK 7.15.81 @	•••		/	2.26.81 DK		



3375 CURRENT CURRENT Notice of Intent No. MULTER WELL REPORT Notice of Intent No. MULTER WELL REPORT CORRENT Construction/Construction/Second © Decommission (%" in circle) 88295 @ Intent Number(TION Notice) JM 11 000 PROPOSED USE: Domestic Industrial @ Doversh number of well (f more than one) County: Autors Dorderse Well Reconder County: County: @ New Well Reconder Driven County: County: @ New Well Reconder Broord Driven County: County: @ New Well Reconder Broord Driven County: County: County: @ New Well Reconder Broord Driven County: County: County: Driven Gradie Broord Driven Lat/Long: Lat Min/Sec Driven Driven Long Min/Sec Kestill Long Min/Sec <th>2 100-0</th> <th>Well Depth: 460 ft</th> <th>Aquifer: JPPER SDMB</th>	2 100-0	Well Depth: 460 ft	Aquifer: JPPER SDMB
PROPOSED USE: Domestic Industrial Municipal Municipal </th <th>Depth bgs (ft) Elevation (ft) Ø 1¢96</th> <th></th> <th></th>	Depth bgs (ft) Elevation (ft) Ø 1¢96		
Tax Parcel No. Tax Parcel No. Tax Parcel No. CONSTRUCTION OR DECOMMISSION PROCEDU Struction of the material ad struct of the ma	re, and the states of the stat	ONB	OVB
Date of test		BASALT	EM
Airtesian flow	375 - 721		
WELL CONSTRUCTION CERTIFICATION: 1 constructed and/or accept responsibility for construction of this well, and its compliance with Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief. Örnitter Engineer [] Trainee Name (Prin). Materials used and the information reported above are true to my best knowledge and belief. Driller/Engineer [] Trainee Name (Prin). Materials used and the information reported above are true to my best knowledge and belief. Driller/Engineer [] Trainee Name (Prin). Materials used and the information reported above are true to my best knowledge and belief. Driller/Engineer [] Trainee Signature. Materials used materials used and the information reported above are true to my best knowledge and belief. Driller/Engineer [] Trainee Signature. Materials used materials used and the information reported above are true to my best knowledge and belief. Driller/Engineer/Trainee Signature. Materials used to my best knowledge and belief. Driller or Trainee License No. 2.2	all Liber 1992-6 8/2005	SAND & CLAY	RR

WATER WELL REPORT Application No. Other Market Coord (1) OWNER: Market Coord Direct Coord OWNER:	A State of the second		Department of Ecology Second Copy — Owner's Copy Third Copy — Dwner's Copy
WATES WELL REPORT North B WATES WELL REPORT North B WATES WELL REPORT North B (1) OWNER North Corr North B (2) OWNER North Corr North B (3) PROPOSED USE north Corr North B (4) TYPE OF WORL Corr & Corr & Corr North B (4) TYPE OF WORL Corr & Corr & Corr North B (4) TYPE OF WORL Corr & Corr & Corr North B (5) DEMERSIONS Down B (6) DEMERSIONS Down B (7) OWNER North B North B (8) DEMERSIONS Down B (9) DEMERSIONS Down B (10) DEMERSIONS Down B			Second Copy - Owner's Copy Third Copy - Driller's Copy
(1) OWNER: manufaptic licel favore, tak and the second	Whe Original and First Copy with	7	i n internet
(1) OWNER: mem./1aple Lock Farm, Tak Adverted Image and the second and the secon	Become Copy - Owner's Copy	LL REPORT Application No.	= (1) OWNER: Name MAPLE
(1) OWNER: mar./Ap.Lat.	Third Copy Driller's Copy STATE OF W	ABBINGTON Permit No	. S . LOCATION OF WELL
10 LOCATION OF WELL Comp. / A & T rel 2 Substance in a status or excitation and the origination of the intervent of	(1) OWNER: Non Maple Least Faxing The		
(1) PROFORD USE. Senset:))) (1) (1) (1) (1)))) (1) <		- JW & NEW 29 - 12 N = 20,	
2/10 PEOPOSED USE: Deserte	Bering and distance from section or subdivision corner		
Intention B, Nort Weil Concerning by concernent and rest of the set	(3) PROPOSED USE: Domestic Industrial Municipal	(10) WELL LOG:	(4) TYPE OF WORK: Owner
(4) TTPE OF WORK: Crew's make of well The form is maked and form is			
Table [] Table [] <th< td=""><td></td><td>show thickness of squifers and the kind and nature of the material in</td><td>Deepened</td></th<>		show thickness of squifers and the kind and nature of the material in	Deepened
Tabled Table The sector that for the sector that is a sector tha	(4) TYPE OF WORK: Owners number of well (If more than one)		
Tabled Table The sector that for the sector that is a sector tha			(5) DIMENSIONS.
Table [] Table [] <th< td=""><td>Bernerd C. Brierr P. Januar D</td><td></td><td>Drilled 2 80 it Depth</td></th<>	Bernerd C. Brierr P. Januar D		Drilled 2 80 it Depth
Type of performance Type of performance<			
Type	Diputeret of weth		
(d) CONSTRUCTION DETAILS: Caling industry 'promotion of the start of the sta	Drilledft. Depth of completed wellft.	Sold S. K. C. Ek u uma in	Casing installed: 10 " D
Type	(6) CONSTRUCTION DETAILS:	Sand Keck-Centrated avers Ha-5060 182 50	
Type of performance Type of performance<		Comented Sand (Water) 195 20	
Total The set of the first set of the set	Threaded II (0" " Diam from 270" a to 500 ft.	Sand Rock Vellow Less Water 20531	7 R Perforations: Yes No D
Performition: Ywo D No D Three of performitions from the total total total state of the t	Welded [] Diam. from ft. to ft		Type of perforator used
Type of performance the intermediate transmission in the intermediate transmission intermediate transmissi treamedintereamediate transmission intermediate transmi		Sandree & Velle V Comented Sand Low 15 2 1 10 3	SIZE of perforations
Size of principles from in by in bit and principles from		CLZY Vallow Little Seed No Water 1235 26	R
		Saxdy CLOY Vallow No Water 268 29	a perforations fr
Dam Bot size from ft to ft ft <td></td> <td>Chary blue No Water 289 50</td> <td></td>		Chary blue No Water 289 50	
Dam Bot size from ft to ft ft <td></td> <td>Chay Eluc Groy No Water 305 33</td> <td></td>		Chay Eluc Groy No Water 305 33	
Dam Bot size from ft to ft ft <td>perforations from ft. to ft.</td> <td>Sand Pock Grey Blac Water 71-16614 322 37</td> <td></td>	perforations from ft. to ft.	Sand Pock Grey Blac Water 71-16614 322 37	
Dam Bot size from ft to ft ft <td>Screens: Yes D No D</td> <td></td> <td>Diam. Slot size</td>	Screens: Yes D No D		Diam. Slot size
Dum. Biot size	Manufacturer's Name		Slot size
Dum But viss from ft. to ft. ft. to ft. to ft. to ft. to ft. to ft.		Sound (H-O) +06 1 524 (Liquid (H-O) +06 1 +2	Gravel nacked: yes G
Gravel packed: Ywc No Bits of gravel: R. to R. to <td></td> <td></td> <td></td>			
Offered placed form No Bit of strate Material used form ft. bo ft. bo<			# 2
(i) PURI: Manufacture's Name (ii) WATER LEVELS: More many first and more store stored in the point of the board [22] 277 Artesian present in the point of the board [22] 277 Artesian present in the point of the board [22] 277 Artesian present in the point of the board [22] 277 Artesian present is controlled by (Gap, valve, store) (ii) WELL TESTS: Devertous is smaller than the point [22] 277 (iii) WELL TESTS: Devertous is smaller than a sero (iiii) (iv) (Gap, valve, store) (iv) WELL TESTS: Devertous is smaller than a sero (iiii) (iv) (Gap, valve, store) (iv) WELL TESTS: Devertous is smaller than a sero (iv) (iv) (iv) (iv) (iv) (iv) (iv) (iv)	Gravel packed: Yes No Bize of gravel:		
(i) PUBLY: Manufacture's Name. (i) WATER LEVELS: Manufacture's Name. (ii) WATER LEVELS: Manufacture's Name. (iii) WATER LEVELS: Manufacture's Name. Advantage presenter is controlled by or Vetel Date. (iii) WELL: TESTS: Developed balance static level (iii) WELL TESTS: Developed balance static level Wet a pramp test made's Ves [] Note: a pramp test made's Ves [] New Water Level This well of the best of my knowledger and Clevel. New Water Level Time Water Level New Water Level Time Water Level New Water Level Time Water Level Name. Time Water Level Date of test gal/min. with. Addresse:	Gravel placed from ft. to ft.		Did any strata contain us
(i) PUBLY: Manufacture's Name. (i) WATER LEVELS: Manufacture's Name. (ii) WATER LEVELS: Manufacture's Name. (iii) WATER LEVELS: Manufacture's Name. Advantage presenter is controlled by or Vetel Date. (iii) WELL: TESTS: Developed balance static level (iii) WELL TESTS: Developed balance static level Wet a pramp test made's Ves [] Note: a pramp test made's Ves [] New Water Level This well of the best of my knowledger and Clevel. New Water Level Time Water Level New Water Level Time Water Level New Water Level Time Water Level Name. Time Water Level Date of test gal/min. with. Addresse:	Surface seal: Yes & No T To what depth?		Type of water?
(i) PUBLY: Manufacture's Name. (i) WATER LEVELS: Manufacture's Name. (ii) WATER LEVELS: Manufacture's Name. (iii) WATER LEVELS: Manufacture's Name. Advantage presenter is controlled by or Vetel Date. (iii) WELL: TESTS: Developed balance static level (iii) WELL TESTS: Developed balance static level Wet a pramp test made's Ves [] Note: a pramp test made's Ves [] New Water Level This well of the best of my knowledger and Clevel. New Water Level Time Water Level New Water Level Time Water Level New Water Level Time Water Level Name. Time Water Level Date of test gal/min. with. Addresse:	Material used in scal		Method of sealing strata of
(i) PURI: Manufacture's Name (ii) WATER LEVELS: More many first and more store stored in the point of the board [22] 277 Artesian present in the point of the board [22] 277 Artesian present in the point of the board [22] 277 Artesian present in the point of the board [22] 277 Artesian present is controlled by (Gap, valve, store) (ii) WELL TESTS: Devertous is smaller than the point [22] 277 (iii) WELL TESTS: Devertous is smaller than a sero (iiii) (iv) (Gap, valve, store) (iv) WELL TESTS: Devertous is smaller than a sero (iiii) (iv) (Gap, valve, store) (iv) WELL TESTS: Devertous is smaller than a sero (iv) (iv) (iv) (iv) (iv) (iv) (iv) (iv)		Sandstone Hard	
(i) PUBLY: Manufacture's Name. (i) WATER LEVELS: Manufacture's Name. (ii) WATER LEVELS: Manufacture's Name. (iii) WATER LEVELS: Manufacture's Name. Advantage presenter is controlled by or Vetel Date. (iii) WELL: TESTS: Developed balance static level (iii) WELL TESTS: Developed balance static level Wet a pump test made? Ves [] No [] (iii) WELL TESTS: Developed balance static level Wet List part is a pump test made? Ves [] No [] (iii) Wet List part by monor. New Water Level This we drilled under the part by monor. This we drilled under the part by monor. Iiii) Water Level New Water Level Time Water Level New Water Level Time Water Level New Water Level Time Water Level Date of test gal/min. with Addresse Jal/min. with Addresse Jal/min. with Addresse Jal/min. with Addresse Jal/	Method of sealing strata off	Sandstore Soft Water 336121	
Image: construction of the second			аз II ——————————————————————————————————
(8) WATEE LEVELS: Land-eurface eleveliation Image: Control of the image			(o) WAIER DEVELS. abov
Was a pump test mader Yes [] No [] Yes (window start It Dompiles Thid: gal/min. with It. diversions start It Dompiles It Will LING It. diversions start It Dompiles It It Becovery data (time taken as zero to water constrained starts and take report in me water Loost It			
Was a pump test maker Ves No	(8) WATER LEVELS: Land-surface elevation		Artesian pressure
Was a pump test mader Yee No	Matter level A below top of well Date 1 27. 77		Ě – – – – – – – – – – – – – – – – – – –
Was a pump test maker Ves No			(9) WELL TESTS: Draw
(9) WELL TESTS: Deveroive to an acceler water lavel is been as also been water lavel is been as also been water lavel is been as all real water lavel is been	(Cap, valve, sto.)		Was a pump test made? Yes 🗌 No 🕼
Was a pump test mader Yee No			Wield: 450. gal/min. with 2.4
Tid: gal/min. with ft. drawdown after hm. Tid: gal/min. with ft. drawdown after hm. Tid: gal/min. with ft. drawdown after hm. WELL DRILLER'S STATEMENT: This well was drilled under my furicidities and him septors is Recovery data (time taken as arrow when pump turned of) (wrise lawing) Time was drilled under my furicidities and ball. The well was drilled under my furicidities and ball. Time was drilled under my furicidities and ball. The well was drilled under my furicidities and ball. Time was drilled under my furicidities and ball. The well was drilled under my furicidities and ball. Time was drilled under my furicidities and ball. The wear Level Time water Level Date of test gal/min. with Adverse Jan. Baller under gal/min. with Test of test gal/min. with Baller under gal/min. with Test of test gal/min. with Baller under gal/min. with Test of test ft. Was a comment of the main formal was the main formal was a comment of the main formal was a comment of the main formal was a comment of the main formal was a commain of the main formale was a comment of the main formale was a c	Not a summ test madel Van D No Fo below static level	Work started	
Imagine of the wider Level Time T		WELL DRILLER'S STATEMENT	e
Imaging from with the distribution with the distribution of the distr			Recovery data (time taken as zero w measured from well top to water)
Assessed from well top to with larged The Weier Level Time Weier Level Time Weier Level Time Weier Level Time Weier Level Date of test		true to the best of my knowledge and baller.	Time Water Level Time W
Time Weier Level Time Weier Level Time Weier Level NAME 1/2/2/2/2/2/2/2/2/2/2/2/2/2/2/2/2/2/2/2	Recovery data (time taken as sero when pump turned off) (water level		
Date of set	Time Water Level Time Water Level Time Water Level	NAME - HD QUEC ANCE DE VALME W	
Address Date of set	Weter Lebet	(Person, firm, er enryerstien) / (Type er affen)	
Data of test		ALL TO BO OLD ROOM AND AND	
Date of test		A HAVE TON'S A DAVIE	
Beiler seet gal/min. with ft. drawdown after hrs.			
	Data of just	and the second	

WATER WELL REPORT Application No. STATE OF WASHINGTON Permit No. ROE EAF FARMS TAK Address yAkiMA - JW 14 NE 14 Sec 29 T 12 N. R26 WM vision corner G (10) WELL LOG: Jndustrial [] Municipal [] Test Well D Other 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 charge of formation. FROM TO MATERIAL Soft Brown BASAlt 550 570 14 B 15 ter of well 10 inches. completed well 8.3.0 ft. hard Gray BASAlt 570 575 Soft Blue Basalt 575 580 hard Gray Basatt 570 590 from 0 st. to 541 st. from ft. to ft. Soft Black Basalt 590 620 from ft. to ft. hard Blug BASAH 620 680 in, by in. MEdium Black BASALT 680 700 ft. to ft ... ft. to . ft hard Gray Basalt 700 745 ft. to ft Soft Black with Blue 745 825 Shale Mixed water bearing Medium hard Basa Ht / 825 830 from ft. to ft. from ft. to ft. Size of gravel: To what depth? ft. $c A \int c A y$ ble water? Yes No Depth of strata..... NEOCOVEN <u>H.P</u> face elevation ean sea level... SB 2 9 BB n... op of well Date..... quare inch Date CENTRAL REGION OF (Cap, valve, etc.) is amount water level is slow static level 19 Completed 3 - 2 8 , 19 86 Work started..... yes, by whom?.... WELL DRILLER'S STATEMENT: drawdown after hrs. _____ This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief. pump turned off) (water level NAME BACK Drilling Co. (Person, firm, or corporation) Level | Time Water Level (Type or print) Address Rt. 5, Box 1010, ELLENSburg, WA. [Signed] Wile Back (Well Driller) ft. drawdown after..hrs Date.... Date 4-4 , 1986 cal analysis made? Yes 🗌 No 🔐 License No. 2.2. (USE ADDITIONAL SHEETS IF NECESSARY) - 🖘 i

3365	W 28	Well ID:	3365	Well Name:	Cross Section: A - A '
		155			
Second Copy-Owner's Copy 10936 STATE OF	WASHINGTON	Surface E	evation: 12¢3f+	Well Depth: 155\$ Ft	Aquifer: WNB
· · · · · · · · · · · · · · · · · · ·	Water Right Permit No.	Depth bgs (ft)	Elevation (ft)		
1) OWNER: NameMaple Leaf	Address P.O. Box 1588 Yakima, W	<u>A 96907</u> Ø	- 1203		
(2) LOCATION OF WELL: County_Yakima	<u>. SW % NE % sec 29 t.12 N</u>			<i>x</i> - <i>x</i>	
(2a) STREET ADDDRESS OF WELL (or nearest address)		20 6	1 1		
(3) PROPOSED USE: Domestic Industrial Municipal	(10) WELL LOG or ABANDONMENT PROCEDURE DE				
DeWater Test Well Other	Formation: Describe by color, character, size of material and struc thickness of aquifers and the kind and nature of the material in each stra	cture, and show atum penetrated,		OVB	
(4) TYPE OF WORK: Owner's number of well (if more than one)	with at least one entry for each change of information. MATERIAL FROM	и то .		000	OVB
Abandoned Deepened Method: Dug Bored Deepened Cable Driven Reconditioned Rotary & Jetted D		6 1050			
		0 1053			
(5) DIMENSIONS: Diameter of well 10 inches.		3 1068 8 1 1 27			
Drilled_714teet. Depth of completed well1550ft.	Brown clay 112	7 111.00	022		
(b) CONSTRUCTION DETAILS: Casing installed: <u>n/a</u> ' Diam. fromft. toft.			+ 832 830	BASALT	EM
Valded Diam. from the top the term term term term term term term ter		0 1270 0 1339 - 433	= 770	SANDSTONE	
Threaded Diam. fromft. toft.	Med grey 133	9 11408		SANDSTONE	RR
Perforations: Yes No X	Broken basalt 140		- 711 700	BASALT	, in the second s
Type of perforator used in. by in.	Med grey1414 Cemented sand little water	0 <u>1420</u> 595 550	-653	SANDSTONE	
perforations fromft. toft.		0 1428	0.00		
perforations from ft. to ft.		8 1550			
			12 C	BASALT	PM
Manufacturer's Name					1 111
Type Model No					
DlamSlot sizefromft. toft. DiamSlot sizefromft. toft.	Deepened with 7 7/8" bit.	745	- 458		
Gravel packed: Yes No Size of gravel	<u> </u>		T 430		
Gravel placed from ft. to ft.		Not and the state		BASALT SHALF	SEL
		8 1994 825	- 378		
Surface seal: Yes No To what depth?ft. Material used in seal Previously_doneft.		8 1994			
Did any strata contain unusable water? Yes No		*4			
Type of water?Depth of strata Method of sealing strata off	1 . ·	<u> </u>		BASALT	UMA
(7) PUMP: Manufacturer's Name				DUSALI	
Туро:Н.Р					
(8) WATER LEVELS: Land surface elevation above mean sea level ft.		1953	- 15¢		MBTN
Static level ft. below top of well Date		1068	- 135		MBIN
Artesian pressure Ibs. per square inch Date Artesian water is controlled by(Cap. valve, etc.))		1129 1129	+ 74 74	BASALT	
	Work started 12/9/93	93			PR
Was a pump test made? Yes No Hyes, by whom?	WELL CONSTRUCTOR CERTIFICATION:				PK
Yield: gal./min.with ft. drawdown after hrs.	I constructed and/or accept responsibility for construction	n of this well,			
H H H H	and its compliance with all Washington well construction Materials used and the information reported above are true	ue to my best 1275	72	RASALT	
Recovery data (time taken as zero when pump turned off) (water level measured from wall top to water level)	knowledge and belief.			0,12,120,1	
Time WaterLevel Timo WaterLevel Time WaterLevel	NAME BJ ExplorationCo., Inc.	PE OR PRINT)			RZ
· · · · · · · · · · · · · · · · · · ·		00227			
		<u>99537</u> 1420 0337 1420			
Date of test	(Signed) any Mathematicense No.	0337 1428	225	SAND&CLAY	SQC
Bailer test gal./min. with ft. drawdown after hrs. Airtest250 gal./min. with stem set at1500 ft. for hrs.	Contractor's				
Artesian flow gal./min. with stem set at ft. for hrs.	Registration No	, 19		DACALT	FS
Temperature of water Was a chemical analysis made? Yes No	USE ADDITIONAL SHEETS IF NECESSARY	2		BASALT	15
1 050-1-20 (10/87) -1329- 4 3	, (SOL ADDITIONAL GALLIO & NEOLOGAN		L -347		

File Original and First Copy with 31357 WATER WE	3365 P1 32 Start Card No. W02 4300		Start Card No. 4024300
		Second Copy — Owner's Copy Third Copy — Driller's Copy Company	WASHINGTON Water Right Permit No.
Second Copy — Owner's Copy Third Copy — Driller's Copy GAM Ache	VASHINGTON Water Right Permit No. <u>G4-31364E</u>		Tress
	310 Benudry Rd. Moxee, WA		
<u>; </u>		(2) LOCATION OF WELL: County NOV 2 3 1994	W/2 NA NE 144 Sec 3 T. 12 N. R. 20
(2) LOCATION OF WELL: County Yakima NOV 2 3 1994	W1/2 NEIA 14500 3 T. D. N. A 200 WM.	(2a) STREET ADDRESS OF WELL (or nearest address)	
(2a) STREET ADDRESS OF WELL (or nearest address)	B		(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION
(3) PROPOSED USE: Domestic Industrial Municipal :	(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION	□ Irrigation	Formation: Describe by color, character, size of material and structure, and show thickness of a
DeWater Test Well C Other	Formation: Describe by color, character, size of material and structure, and show thickness of acuiters		and the kind and nature of the material in each stratum penetrated, with at least one entry for change of information.
(4) TYPE OF WORK: Owner's number of well	and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.	(4) TYPE OF WORK: Owner's number of well (If more than one)	MATERIAL
(If more than one)	MATERIAL FROM TO	E Abandoned New well Method: Dug Bored D	Soft black basalt shale s. 893 920
Abandoned D New woll D Method: Dug D Bored D Cable D Driven D	Soil m. 0 5	C Despened Cable Driven	Basalt black clay shale m. 928 930
Reconditioned Rotary Jetted	Brown clay cobels and boulders h. 5 20	(5) DIMENSIONS: Diameter of well inches.	Gray basalt fine h. 930 96
(5) DIMENSIONS: Diameter of well inches.	Tan clay m. 27 34	Drilled feet. Depth of completed well ff.	Black, brown, green basalt s. 965 974
Drilledfeet. Depth of completed well feet ft.		š <u> </u>	Basalt black mh. 974 990
6) CONSTRUCTION DETAILS:		(6) CONSTRUCTION DETAILS:	Gray hard basalt h. 990 10
Casing installed: Diam. from ft. to ft.	Sand stone brown m. 84 112	Control for the lines. Casing installed: * Diam. fromft. toft.	Black & red & green basalt s. 1075 10
Casing installed: Diam. from ft. to ft. toft. to ft. toft. to	Clay s/m/p green m. 112 132	Welded Diam. from ft. to ft. Uner installed Diam. from ft. to ft.	Med hard black basalt mh. 1082 11
Weided ZZ Diam. fromh. to	Clay shale dark green h. 132 140		Black basalt h. 1100 11
Perforations: Yes No		Perforations: Yes - No -	Black oesicular basalt s. 1163 11
Type of perforator used		Type of perforator used in. by in.	Black basalat new bit s. 1183 11 Med soft black basalt m. 1193 12
SIZE of perforations in. by in.	Basalt_and_shale h. 189 208 Gray_green_sandy_clay ms. 208 247	U perforations from ft. to ft.	ned sore brack basare me
perforations from ft. toft.	Porous basalt red & black mh. 247 270	perforations from t, to tt.	Hara Bray babaro
perforations from ft. to ft.	Gray basalt h. 270 294	> perforations from ft. to ft.	Soft black, gray fracture 1350 13 Gray basalt mh. 1360 13
perforations fromft. toft.	Black basalt vh. 294 332		Gray basalt Int. 1900 19
Screens: Yes No D	Burnt basalt mh. 332 342	Manufacturer's Name	KB. TD
Manufacturer's Name	Porous_basaltmh, 342 368	Type Model No.	
Type Model No	Blue green clay m. 368 447	Diam. Slot sizefromft. toft.	
DiamSlot sizefromft. toft. Diam. Slot sizefromft. to ft.	Fractured basaltager claymh. 447 457	Diam Slot size fromft. to ft.	
		Gravel packed: Yes No Size of gravel	
Gravel packed: Yes No Size of gravel Gravel placed from ft. to ft.	Gray_basalth. 470 485	Gravel placed fromft. toft.	· · · · · · · · · · · · · · · · · · ·
	Basalt_w/ clay shalemh. 485 503	Surface seal: Yes No To what depth?	·
Surface seal: Yes No To what depth? 108 ft.	Fractured basaltm. 503 556 Blue green sand and clay s. 556 530	O Material used in seal	
Did any strata contain unusable water? Yes No	Gray fractured basalt vh. 530 600	Did any strata contain unusable water? Yes No	
Type of water? Depth of strate	Crow bacalt b 600	Type of water? Depth of strata	
Method of sealing strata of	Hard gray fractured h. 600 718	Method of sealing strata off	
	Basalt grayh. 718 782	(7) PUMP: Manufacturer's Name	······
(7) PUMP: Manufacturer's Name UNKown			
Туре: Н.Р	Basalt gray h. 786 796	(8) WATER LEVELS: Land surface elevation	
(8) WATER LEVELS: Land-surface elevation 22 200 h.	Soft black basalt w/ wood796809Black basalt med hard809849	(6) WATER LEVELS: above mean sea level ft. Static level ft. below top of well Dato ft.	
Static level ft. below top of well Date Artesian pressure to s. per square inch Date	Baslat gray h. 849 893	Artesian pressure bs. per square inch Date	
Artesian pressure tos. per square inch Artesian water is controlled by (Cap, value, etc.)	<u>nastat gray</u> <u></u>	Artesian water is controlled by(Cap, valve, etc.)	A. I.I.
	Work Started 8/1.6/94		Work Started 8/1/0/99 19. Completed1
(9) WELL TESTS: Drawdown is amount water level is lowered below static level	WELL CONSTRUCTOR CERTIFICATION:	(9) WELL TESTS: Drawdown is amount water level is lowered below static level Was a pump test made? Yes No I if yes, by whom?	WELL CONSTRUCTOR CERTIFICATION:
Was a pump test made? Yes No If yes, by whom?		Yield:gal/min. withft. drawdown afterhrs.	I constructed and/or accept responsibility for construction of this well, and
	I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and	g	compliance with all Washington well construction standards. Materials used
	the information reported above are true to my best knowledge and belief.		the information reported above are true to my best knowledge and belief.
Recovery data (time taken as zero when pump turned off) (water level measured from well	NAME Aqua Drilling & Engeneering	Recovery data (time taken as zero when pump turned off) (water level measured from well	NAME Aqua Drilling & Engeneering
top to water level) Time Water Level Time Water Level Time Water Level	(PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)	top to water level) Time Water Level Time Water Level Time Water Level	(PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
	Addres 120 Crestview Dr., Colville, WA		Address 120 Crestview Dr., Colville, WA
	(Signed) Douge On Upplan License No. 2175	···	(Signed)
	(Signed) LOW HERE HAVER HAVER HAVER 1532		(Signed) License No
Date of test	Contractor's	Date of test	Contractor's
Bailer testQúl./min. withft. drawdown afterhrs. AirlestQal./min. with stern set atft. forhrs.	Registration AQUADEL 08503 11/23 1994	Bailer testgal./min. withh. drawdown afterhrs. Airtest gal./min. with stem set ath. forhrs.	Registration No. Date
Artesian flow g.p.m. Date		Artesian flow	
Temperature of water Was a chemical analysis made? Yes D No D	(USE ADDITIONAL SHEETS IF NECESSARY)	Temperature of water Was a chemical analysis made? Yes D No D	(USE ADDITIONAL SHEETS IF NECESSARY)

Well ID: 3322	Well Name:	Cross Section: A-A'
Surface Elevation: 1366 ft	Well Depth: (388ft	Aquifer: WNB
Depth bgs (ft) Elevation (ft)		
Ø T 1366	OVB	OVB
155 - 1211 189 - 1177	BASALT CHALE	EM
268 - 1158	SANDY CLAY	RR
247 - 1119 368 - 998	BASALT	РМ
	CLAY	SEL
447 - 919 457 - 909 470 - 896 485 - 881 503 - 863 530 - 836 556 - 800	BASALT BASALT BASALT BASALT BASALT SHAGE	UMA
530 + 830 556 + 800	BASALT SAND & CLAY	MBTN
	BASALT	PR
782 = 584 766 = 580 893 = 473	BASALT CUAYT BASALT	RZ
930 - 436	BASALT SHALE	SQC
1388	BASALT	FS

File Driginal and First Copy with Department of Ecology Scored OcpDurlier's Copy Third CopyDriller's Copy	ASHINGTON AVAL 64- SILES WATC	Well ID: 2763 Surface Elevation: 985 f+	Well Name: Well Depth: 315ff	Cross Section: A-A' Aquifer: UPPER SDMB
1) OWNER: Name ULARASS FAUCHER 2a) STREET ADDRESS OF WELL (: county ULARASIMA 2a) STREET ADDRESS OF WELL (: county ULARASIMA 2a) STREET ADDRESS OF WELL (: county ULARASIMA 33) PROPOSED USE: Domgsic 10: DRAWNE Deving the county Municipal 11: OPE OF WORK: Deving the county Municipal 12: Abandoned New well Method: Dug Bored 13: DIMENSIONS: Dimeter of well Method: Dug Bored 14: OPE OF WORK: Devine of well Method: Dug Bored 15: DIMENSIONS: Dimeter of well Method: Dug Bored Diven 16: OCONSTRUCTION DETAILS: Casing installed: * Olen, from ft. to ft. 17. Por of perforations ad in. by in. by in. ft. 17. por of perforations ad in. by ft. to ft. 18. Distize from ft. to ft. 19. perforations from ft. to ft. ft. 19. perforations add ft. to ft. ft. 19. perforations from ft. to	Address III KI SQUAS KD: WINHETE NULL NE' Sic III K, RZOWA (10) WELL LOG OF ABANDONMENT PROCEDURE DESCRIPTION Formation: Describe by coin: character, kis of material and attricts, and those with all deal one with or activation of the material in each stratum presented; with all deal one with or activation of the material in each stratum presented; with all deal one with or activation of the material in each stratum presented; with all deal one with or activation of the material in each stratum presented; with all deal one with or activation of the material in each stratum presented; with all deal one with or activation of the material in each stratum presented; with all deal one with or activation of the material in each stratum presented; with all deal one with or activation of the with all deal one with or activation of the material in each stratum presented; with all deal one with or activation of the with all deal one with or activation of the material in each stratum presented; with all deal one with or activation of the material in each stratum presented; with all deal one with all deal one with or activation of the material in each stratum presented; with all deal one with one complexity with all deal one with one deal one with all deal one with all deal one with all deal one with all deal one with one complexity with all deal one with all deal deal one with all deal deal one with all	295 - 69ø	OVB	OVB
Bailer test gal./min. with fl_dgawdown after hrs. Airtost Y2_ gal./min. with stom set at 1200_ ft. for hrs. Artosian flow g.p.m. Date Date NO	(Signad Little With Contents No 200 , Signad Little Note Contractor No 200 , Signad Note Contractor No 200 , Signad No. 200 ,		BASALT	EM

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.

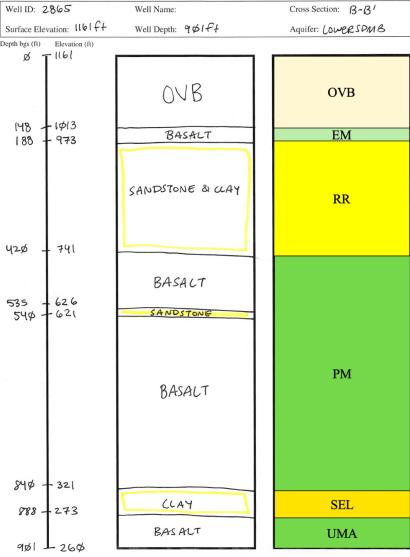
п

WATER WALL DEFORT Dama Description Description <thdescription< th=""> Description</thdescription<>				ah oh	3384	unnai and First Copy with ment of Freidry Copy — Owner's Copy Copy — Owner's Copy	WATER WE		Application No. G4-240 Permit No. G4-24077
Difference Description Description <thdescription< th=""> <thdescription< th=""></thdescription<></thdescription<>	Pile of statial and First Copy with Department of Ecology Second Copy — Owner's Copy								and the second
(1) OWERE w	Third Copy - Driller's Copy	STATE OF	WASHINGTON PO	ermit No G4-2407	_		44 A. J. J.		34 12 20E
(1) DATA THAN MARKET AND ALL DOL. (1) WILL DOL. (1) WILL LOC. (1) WILL LOC. (1)	(1) OWNER: Name Marvin Estes	3	Address Route 2, Box 2104	, Wapato, Wa.					4 Sec - 1 N.N. N
Control contro control control control control control control control control	(2) LOCATION OF WELL: County	Yakima	W 1- SW 1 SW 1 ser	34 T 12N R 20B				(10) WELL LOG:	
	ng and distance from section or subdivision of	corner						Formation: Describe by color, charact	er, nze of material and structure.
				·	<u> </u>				
(1) (1)	frigation 🕱 Test	t Well [] Other []	Formation Describe by color, character, size show thickness of aquifers and the kind and	of material and structure.			Method: Dug 🖸 Bored 🖸		
Number and general band, block of meet 2 Description Description <thdescription< th=""> Description</thdescription<>	(4) TYPE OF WORK: Wher's number of	f well First	stratum penetrated, with at least one entry		ion O			SWL 178	372 00
Noncomparing Noncomparin Noncomparing Noncomparing </td <td>New well Method</td> <td>Dug D Bored</td> <td>Ban Call</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>	New well Method	Dug D Bored	Ban Call						
moment 1910 nume at magneting was light of numeric states and states in the state					õ – E (5)				
moment 1910 nume at magneting was light of numeric states and states in the state	(5) DIMENSIONS:	18	_Cemeted Gravel		<u> </u>				
(a) CONSTRUCTION DETAILS: 0 n ± 167 3 and 2002 12 10 0 constructions that 100 m ± 102 172 0 constructions that 100 m ± 1	Drilled 1410 (t Depth of complete	ed well 1410 ft.							ne Sand Br.
Constrain inside: 20					ă- £				
10 10 <td< td=""><td>Coving installed: 20</td><td>0 187</td><td>Sand</td><td></td><td>9 b</td><td></td><td></td><td></td><td></td></td<>	Coving installed: 20	0 187	Sand		9 b				
winds y = y = y = y = y = y = y = y = y = y =	Threaded Ci 10 " Diam from 1	.67 n to 528 m			6 þ	Perforations: Yes C No C		Gravel & Sand	856 8
Predefitions variable 216 219 219 100 Predefitions	Welded X 8 "Diam from ?	20 n to 869 n	Black Bagalt Hand	oh men 200 21	2 a	Type of perforator used			35
1700 The second state of the second state state of t	Perforations: YesXX No []		Broken Basalt	216 21	ata 🦉		ft. to		862 8
700 performance runn 720 performance runn									ing) 866 8
Green Sand stone 130 133 130 133 Streff Streen Sand 130 1333 1333 1333 1333 <td>700 perforations from 720</td> <td>n 10 869 n</td> <td></td> <td></td> <td></td> <td></td> <td>11 10 11</td> <td></td> <td>868 8</td>	700 perforations from 720	n 10 869 n					11 10 11		868 8
Green Sand 331 332 Yes Main	We perforations from \$17					Screens: Yes No D			
Data Maiser from file from file for file					7 1				
Dam Max up Tem Rand Careen Shall				357 38	o E				
Dam Max up Tem Rand Careen Shall	Туре М				Vai			Gray Basalt Hard	957 9
Crear Dank Strate and the control of the strate strat									
Glasse filter flo flo flo flo flo floo	· · · · · · · · · · · · · · · · · · ·			460 48	5 0	-			
Water and works			Green Sandy Shale	485 49	0 Z		To what depth? ft.	Gray Shale	1090 10
District used in pair distribution consistence of the pair distribution of the pair distributio distribution of the pair distribution of the	· · · · · · · · · · · · · · · · · · ·				õ sõ	Did any strata contain unusa			
Dd any strata contan unexable water? Yes No. No. Duttings 555 557 Type of water? Depth of strata Type of water? No. Duttings 555 557 Trype of water? No. Duttings 557 552 557 Type No. Duttings Type Type No. Duttings Type Type No. Duttings Type Type <td>Material used in seal Cement</td> <td>depth? 20 ft</td> <td></td> <td></td> <td></td> <td></td> <td>Depth of strata</td> <td></td> <td></td>	Material used in seal Cement	depth? 20 ft					Depth of strata		
Swell of direction with its controlled by Swell of the book is of well base Type: NP Swell of the book is of well base Type: NP Crack Baselt Broken SSSE diftigs Type: NP (B) WATER LEVELS: Land safets direction mode of well base SME direction mode of well base SSSE direction mode of well base SSSE direction mode of well base SSSE direction mode of well base SSSE direction mode of well base SSSE direction mode of well base SSSE direction mode of well base SSSE direction mode of well base SSSE direction mode of well base SSSE direction mode of well base SSSE direction mode of well base SSSE direction mode of well base SSSE direction mode of well base SSSE directio	Did any strata contain unusable wate	r? Yes 🗍 No 🛣	No Cuttings	555 55	<u> </u>	PI'MP.		SWL raised 11'	from 164-155
17) PUMP: Manufacturers Name Non-Cultings 502 503 18) WATER LEVELS: Land Larder drauting move mean set level 1144 the low of of will Date 1165 116 1165 116 19) WATER LEVELS: Land Larder drauting freman pressure 1144 the low of of will Date 3/9/78 Arterian Water is controlled by (Cap, valve etc) Cap, valve etc)		of strata					Я.Р.	Gray Clay	1148 11
Type HP (8) WATER LEVELS: Land Mitter deviation and the sequence of well on a serve when pump turned off; (water keel) (9) WELL TESTS: Land with well is controlled by (Cap, value, etc) (9) WELL TESTS: Date analyse mader is controlled by (Cap, value, etc) (9) WELL TESTS: Date down after well is controlled by (Cap, value, etc) (9) WELL TESTS: Date down after well is controlled by (Cap, value, etc) (9) WELL TESTS: Date down after well is controlled by (Cap, value, etc) (9) WELL TESTS: Date down after well is controlled by (Cap, value, etc) (9) WELL TESTS: Date down after well is controlled by (Cap, value, etc) (9) WELL TESTS: Date down after well is controlled by (Cap, value, etc) (9) WELL TESTS: Date down after well is controlled by (Cap, value, etc) (9) WELL TESTS: Date down after well is controlled by (Cap, value, etc) (9) WELL TESTS: Date down after well is controlled by (Cap, value, etc) (9) WELL TESTS: Date down after well is controlled by (Cap, value, etc) (9) WELL TESTS: Date down after well is controlled by (Cap, value, etc) (9) WELL TESTS: Date down after well is controlled by (Cap, value, etc) (9) WELL TESTS: Date down after well is controlled by (Cap, value, etc)				557 562	20 <u></u>	WATER LEVELS Land-aut	rface elevation		
(8) WATER LEVELS: Long strice stready SWL 200		НР				ic level ft. below	top of well Date		
144 the level 144 the low log of will Date 3/9/78	(8) WATER LEVELS Land surface elev	vation			- 0 AT				1195 12
If the task pressure Desperson pressure Despers		ell Date 3/9/78			<u>e</u>		(Cap, valve, etc.)	Gray Basalt (losin	g cuttings1225 12
(9) WELL TESTS: Drawdown is amount water level is make the rest in the line of	rtesian pressure lbs per square inc	ch Date .			2 <u>E</u> (9)	WELL TESTS: Drawdown	n is amount water level is elow static level		Cont. Pa
(9) WELL TESTS: Drawdown is amount water level is make the rest in the line of	Artesian water is controlled by (i	Cap, valve etc)	Gray Basalt Firm	585 59	2 2 43	a pump test made? Yes 🗋 No 🗖 If	yes, hy whom?-		
Was a pump text made? by any non- Att/or / A	(9) WELL TESTS: Drawdown is amou	int water level is				d; gal/min with f	t. drawdown atter nrs		
Vieting Color from with method on a terr with full conder my jurisdiction and this report is inserted for with the best of my knowledge and belief Well L Dikiller's STATEMENT: Precovery data (time taken as zero when pump turned off) (water level inserted for with point water level inserted for with point with fit drawdown after for with point inserted for water level inserted for water level inserted for water level inserted for with point inserted for with point with fit drawdown after for with point with fit drawdown after for water level inserted for water level insert	Was a pump test made? Ye by No E If yes, by y	whom? HK/Nr. J IKK.						true to the best of my knowled	ge and belief.
The Water Level Time Wa	iela gul/min with ft drawdo	wn after hrs			Ľ Rec	measured from well top to water level	1)	Moriarty Dr	illing
Percent plan (under all more a	· · · · ·		This well was drilled under my juris true to the best of my knowledge and	sdiction and this report belief	is õ T	me Water Level Time Water	Level Time Water Level	(Person. firm, or c	orporation) (Type or print)
Time Water Level Time Water Street Time Water Time Water Time Water Time Water Time Time Water Time Time Time Time Time Time Time Time	Fecovery data (time taken as zero when pump tu	arned off) (water level			De			Address Route 9, Bo	x 269, Yakima, Ka
Arcerian flow ster 81 Was a chemical analysis mader Ten No. [USE ADDITIONAL BEDETS IF NECESSARY]		Time Water Level		n) (Type == ===::	ē		· · · · · · · · · · · · · · · · · · ·	111	,.
Arcerian flow ster 81 Was a chemical analysis mader Ten No. [USE ADDITIONAL BEDETS IF NECESSARY]	• • • • • • •	· ···· · · · ·	pt 0 Box 260 Yel)te of test	tt drawdown after be	[Signed] Kank ///	(Well Driller)
bate of test Bailer test Reterantice of water B1 Was a chemical analysis made? Tes No (USE ADDITIONAL EXERTS IF TRECESSARY) (USE ADDITIONAL EXERTS IF TRECESSARY)	. ئى ئ		Autres	· · · · · · ·		min flow	n. Date	0355	3/0
Arrenan now FEM Date FEM Date (USE ADDITIONAL BEBETS IF NECESSARY)	Date of test		(Signed) Cak 77/2015	CL.	ſen	operature of water. Was a chemi	ical analysis made? Tes 🗋 Ne 🗋	License No.	Date. 1
Temperature of water 81 Was a chemical analysis mader 7 or 0 No.6 [License No 0300] Date 3/9 , 19 78 (Cr 996-170	Artesian flow gpm Date	in all all all all all all all all all al		ller				HITS IF NECHSAARY)	
(USK ADDITIONAL BERETS IF TRCEBSARY,		sis made? Tes 🗋 No 🖧	License No 0355 Date	3/9 , 19 7	8	950-1-20			4
(USK ADDITIONAL BEARTS IF TRICESSARY)		1							
	EC'Y 050 1 20	USE ADDITIONAL DE	HETS IF NECESSARY)						

He G. shall and First Copy with 3384 WATER WELL REPORT	Well ID: 3384	Well Name:	Cross Section: B-B'
	Surface Elevation: 1185 F+	Well Depth: 1416ft	Aquifer: WNB
1) OWNER: Name Marvin Estes Address Route 2, Box 2104, Wapato, Wa.	Depth bgs (ft) Elevation (ft)		-
t) LOCATION OF WELL: County Yakima W2 SW 14 Sec 34 T 12 N. R. 20 K.M.	Ø - 1185		
/ PROPOSED USE: Domestic [] Industrial [] Municipal [] (10) WELL LOG:	'		
Irrigation Test Well Other Formation: Describe by color, character, nas of moternal and structure, and show thickness of quarter and drik kind and nature of the maternal in each show thickness of quarter and drik kind and nature of the maternal in each show thickness of quarter and drik kind and nature of the maternal in each show thickness of quarter and drik kind and nature of the maternal in each show thickness of quarter and drik kind and nature of the maternal in each show thickness of quarter and the kind and nature of the maternal in each show the			
		NB	OVB
New well MATERIAL MATERIAL MATERIAL TROM TO Decomed Cable Driven Gray Basalt Extra Hard 1235 1295		0	
Reconditioned Botary Jetted G Grav Basalt Hard 1295 1406	186 - 999		
b) DIMENSIONS: Diameter of well inches. (Losing Cuttings)	219 966	BASALT	EM
Drilled (t Depth of completed wellt.	219 - 966		
ONSTRUCTION DETAILS:			
Casing installed: Diam from ft. to tt.			
		SAND & CLAY	RR
Perforations: Yes No C 0- 21920*			
Type of perforation used. SIZE of perforations in. by in. 607-64014"			
perforations from	550 - 635		
perforations from // to	55Ø - 635		
Screens: Yes No D	~		
Type Model No Model No Model No			
Diam Slot size from ft to , ft, Diam Slot size from ft, to , ft,		BASALT	PM
Jravel packed: yes No Size of gravel		Gristie	
Gravel placed from ft. to ft.			
Surface seal: Yes 🗇 No 🗇 To what depth?			
Material used in seal	820 - 365 825 - 360	BASALT CEAND	
Type of water? Depth of strata	aud - 345	SANDSTONE SANDSTONE BASALT	SEL
N Brito.	856 - 22-1	GRAVEL & SANDSTONE	
Type HP	876 - 309		
3) WATER LEVELS: Land-surface elevation above mean sea level			
atic level		BASALT	
Artesian water is controlled by (Cap, valve, etc.)			UMA
	1090 - 95 1093 - 92		
as a pump test marke? Yes 🗍 No. 🗌 If yes, by whom?	1893 - 92	SHALE	
eld: gal/min with ft drawdown after hrs WELL DRILLER'S STATEMENT:	1145 - 40	BASALT	
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and beliet.	1151 - 34	SHALE	MBTN
covery 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			
(Person, firm, or corporation) (Type or print)			
Address Route 9, Box 169, Yakima, Wa. 9890		DACAL	
je of test have test gal min with ft. drawdown atter		BASALT	PR
testan flow g. g.p.m. Date g.p.m. Date 3/13 78 mperature of water Was a chemical analysis made? Tes No [License No. 0355 Date 3/13 19			
USE ADDITIONAL SERVERS IF RECOSSARY			
250.170	141¢ -225		

E DOU - 2880	64 27805	Well ID: 288¢	Well Name:	Cross Section: B-B'
Construction of Ecology With Department of Ecology WATER WE	Application No. 64-29349 WASHINGTON Permit No. 7-009454	Surface Elevation: $(160f4)$	Well Depth: 100004	Aquifer: Lower SDMB
(1) OWNER Name Bill Evans	Address Evans Rattlesnake Ranch	Depth bgs (ft) Elevation (ft)		
(1) OWNER Name Bill Evans	X_ NW 1, NW 1, Sec-22 T11 N R35 WM	6 - 1160 E		
	35 11 22			
PROPOSED USE Domestic Industrial Municipal	(10) WELL LOG			
G Irrigation 🗵 Test Well 🗋 Other	Formation Describe by color character size of material and structure and			
6 (4) TYPE OF WORK Owners number of well 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 penctrated with at least one entry for each change of formation			
	MATERIAL FROM TO		2,10	
New well Method Dug Bored Deepened Cable Driven Reconditioned Ratury ØJ Jetted (5). DIMENSIONS 16" to 740", 9 7/8" to 1000"	Gravel and boulders 0 37 Brown clay soft 37 68		OVB	
Reconditioned Rotary Jetted	_Tao_clay68_153		0.0	
E (3) DIMENSIONS Diameter of well inches	Gravel 153 216			OVB
Drilled 1000 ft Depth of completed well 1000 ft	Sandstone brown 216 226			
(6) CONSTRUCTION DETAILS	Brown sandy clay 226 290 Gravel multi-color 290 300			
Casing installed 18 Diam from +1 ft to 40 ft	Ian slicky clay			
Threaded 16 Diam from +1 ft to 740 ft Welded 28 Diam from ft to ft	Soft brn rock, hard yellow clay 311 344			
	_Medium gray/black basalt 344 410			
Perforations Yes □ No ⊠ Type of perforator used	Basalt hard gray fractured 410 445			
SIZE of perforations in by in	Blk & brn basalt, med soft clay 445 449 Blk & brn basalt, tr of orn clay 449 460	344 - 826		
perforations from ft to ft perforations from ft to ft	Basalt hard gray 460 637			
perforations from ft to ft	Clay hard gray 637 640		BASALT	EM
operformations from it to it performations from it to it performations from it to it Screens yes No B Manufacturer Name Model No Type Model No Diam Slot size Gravel packed Yes No B Cirvel packed from ft to Gravel packed from ft to Sufface Seal Yes B No B Diam Surface from Diam To what depth 7	Gray and brown clay 640 648		Distant	
Manufacturer s Name	Green and gray clay 648 708 Basalt soft black 708 714	445 - 715		
Type Model No Diam Slot size from ft to ft	Basalt med gray black 714 718	460 - 700	BASALT CLAY	RR
Diam Slot size from ft to ft Diam Slot size from ft to ft	Basalt med gray black 718 729	90¢ T /P/		
Gravel packed Yes D No D Size of gravel	Basalt med hard gray 729 790			
Gravel packed Yes No Size of gravel Gravel placed from ft to ft	Basalt medium black 790 793		Disting	
S Suntan and	Basalt broken black 793 798 Basalt hard gray 798 805	.	BASALT	PM
Surface seal Yes No To what depth? 40 ft Material used in seal Cement	Basalt pray fractured 805 808			1 1/1
	Basalt hard gray 808 814			
Type of water? Depth of strata Method of sealing strata off	Basalt_medium_black814_818_			
0	Basalt medium soft gray w/clay 818 825 Basalt bard gray 825 876	637 - 523		
O (7) PUMP Manufacturers Name	Basalt hard gray 825 876 Basalt medium black fractured 876 907	⁶³¹ + 523		
	Basalt medium black - 907 929	-	CLAY	SEL
(8) WATER LEVELS Land surface elevation above mean sea bevel ft below top of well Date 3/16/81	Basalt porous black 929 958		CLAI	
Static level S88 ft below top of well Date 3/16/81 Artesian pressure lbs per square inch Date	Basalt hard black 958 971	708 - 452		
Artesian water is controlled by (Cap value etc.)	Basalt soft black fractured 971 976 Basalt soft blk, bro, grav 976 980	I I		
Static level Joo ft below top of well Date Job 01 Artesian pressure Ibs per square inch Date Artesian water is controlled by (Cap valve etc) (9) WELL TESTS Drawdown is amount water level is	Basalt_medium_black 980 1000		BASALT	
Was a pump test made? Yes 🗵 No 🗆 If yes by whom? Akland	Work started 2/16 19 81 Completed 3/13 1981		Direite	
Yield 2400 gal/min with 181 ft drawdown after 24 hrs	WELL DRILLER'S STATEMENT	818 - 342	1.0 s	
Ч Т не	This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief	810 - 592	BASALT CUAY	
Recovery data (time taken as zero when numn turned off) (water level	and belief	845 - 355		
Recovery dala (time taken as zero when pump turned off) (water level Time Water Level Time Water Level Time Water Level	NAME MOORE DRILLING, INC	1 1		
C Water Level Time Water Level	(Person firm or corporation) ""(Type or print)	1 1	I	UMA
Lhe C	Address P D Drawer P, Moses Lake, Wa 98837	1 1		
Pate of test	() MARCH	1 1	BASALT	
r test gal/min with ft drawdown after hrs	[Signed] Druce WC Kins-	1 1	Q	
Artesian flow g p m Date Temperature of water Was a chemical analysis made? Yes I No I		1 1		
•	Date 19			
(USE ADDITIONAL SH	LEETS IF NECESSARY) OK GP 9-16-8	1 1		
ECY 050-1 20		1000 - 160		
		- 17/7		

Second Copy—Owner's Copy Third Copy—Driller's Copy 127194 STATE OF W	VASHINGTON Draught Porting No	502 Surfa
(1) OWNER Name MARIO MARTINEZ		HIMA WA Depth b
(2) LOCATION OF WELL County YAHIMA		N R HOWM
(2) LOCATION OF WELL County (2) STREET ADDDRESS OF WELL (or nearest address)	NE / Sec_ JO PAP	Riaal'
(3) PROPOSED USE Domestic Industrial Municipal	(10) WELL LOG or ABANDONMENT PROCEDURE	DESCRIPTION
DeWater Test Well U Other U	Formation Describe by color character size of material and si thickness of aquifers and the kind and nature of the material in each	
(4) TYPE OF WORK Over s number of well 11 20	with at least one entry for each change of information	
Abandoned 🗆 New well 🖉 Method Dug 🗆 Bored 🗆		ком то Э 4/
Deepened F Cable Driven Cable Driven Reconditioned, j Rotary 🗗 Jetted D		41 53
(5) DIMENSIONS Diameter of well 10"+ 12" inches	clay	53 97
Drilled <u>901</u> feet Depth of completed well <u>901</u> ft		11 170
(6) CONSTRUCTION DETAILS		48 188 88 214
Casing installed 12 Diam from 12 ft to 440 ft	tan clear 2	14 265
Welded Diam from +2ft to \$24_ft		65 283
Threaded Diam fromft toft Perforations Yes No		83 292
Perforations Yes No2		72 298 98 316
SIZE of perforations in by in		16 386
perforations fromft toft		86 397
perforations fromft toft		97 420
		20 468
Manufacturer s Name		68 535 421 35 540
Type _S rain Less Model No		40 545
Diam 10"Tele Slot size 1020 from 824 ft to 895 ft		45 820
DiamSlot sizefromft toft Gravel packed YesNo Gravel		20 840
Gravel placed fromft toft	Band Long bearing 8	40 848 48 888
		88 901 53
Surface seal Yes - No - To what depth? <u>440</u> tt Material used in seal <u>PTD</u> <u>Com</u>		5
Did any strata contain unusable water? Yes No P		
Type of water?Depth of strata	<u>z lo_l² ll_₩ la_</u>	
Method of sealing strata off		
(7) PUMP Manufacturer s Name	SEP 2 3 1994	
Type HP	<u>As with</u>	
(8) WATER LEVELS Land surface elevation /200 ft sistic level 339 thelow top of well Date 8-16-94		
Artesian pressure Ibs 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	Work started 19 Completed X-18	-94 19
Was a pump test made? Yes Vo Mo If yes by whom? Yield gal /min with ft drawdown after hrs	WELL CONSTRUCTOR CERTIFICATION	
rield gal /min with It drawdown after hrs	I constructed and/or accept responsibility for construct and its compliance with all Washington well construct	ion of this well
	Materials used and the information reported above are knowledge and belief	true to my best
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		
Water Level	NAME Jary Burd Well Drills	NE OR BRINT
	Address 5543 54 Douglas R	
Date of test	0	8
Bailer test gal /min with ft drawdown after hrs	(Signed) Jam Bur License No	0062
	Contractor s (WELL DRILLER)	
		• • • •
	Registration No LIRRY B 4 1320 Bate 8-23	19 <u>9</u> 4



File Original and First Copy with Department of Zeology Second Copy Owner's Copy Third Copy Driller's Copy	ATER WELL REPORT STATE OF WASHINGTON	Permit No.	G <u>4-246</u>	Re (19	/ File Original and First Cop Department of Ecology Second Copy - Owner's Co Third Copy - Driller's Cop	y with py y	WATE Sta
(1) OWNER: Name Charles de La Chapel	le Address 3206 H	ome Drive, Yakima, WA	64-26 98902		(1) OWNEB: Name.	Charles de La	Chapelle
LOCATION OF WELL: County Yakima	7 C's Orchard	- SE 16 NW 16 Sec 30 T]	INB	2 WM 3	LOCATION OF	WELL: County	akima
and distance from section or subdivision corner 7				o o	ing and distance from	n section or subdivision	corner 750
(3) PROPOSED USE: Domestic D Industrial	Municipal (10) WELL L	0G:		בי איי איי איי איי איי איי איי איי איי א	(3) PROPOSED US	SE: Domestic D In	dustrial 🗍 Mu
Irrigation (2) Test Well			al and strue	ture, and O	.,	Irrigation 🗌 Te	
	show thickness of a stratum penetrated	e by color, character, size of materi quifers and the kind and nature of , with at least one entry for each	the materia change of f			K. Owner's number	of well
(4) TYPE OF WORK: Owner's number of well New well Method: Dug	D Bored D	MATERIAL	FROM	ti or	(4) TYPE OF WOL	wwell D Metho	od: Dug 🔲
Deepened Cable	Driven D Congiomerate	-sandstone, caliche,		u	De	epened D	Cable
Reconditioned [] Rotary		sarge_rocks	12	12 12 54 74		conditioned	Rotary
(5) DIMENSIONS: Diameter of well [6"]	9-/ menes [Small grave]	arge_rocks	54	<u>54</u>	(5) DIMENSIONS:		
Drilled 2715 Depth of completed well	Joundi Ock		74	85 a		ft. Depth of comple	ted well
(6) CONSTRUCTION DETAILS:		lay, small gravel	85	<u>91</u> 5	(6) CONSTRUCTIO		
Casing installed: 16." Diam. fromf ThreadedUam. from 1041. fr	to 1115 # Sandy clay	k fractured brown, green sticky	91	162 367 O	Casing installed	l:" Diam. from	ft. to
Threaded 10_" Diam. from 1041 f	to 2049 n. Sandy Clay,	oapstone, siltstone,	102	<u>367</u> 380 bug 380 bug	Threaded	" Diam. from	ft. to
Welded 🖉	clay		367				
Perforations: Yes 🗋 No 💢		oapstone, siltstone	380	394	Perforations: y	es C No C	
Type of perforator used		iltstone, streaks of	204	<u>394</u> page	SIZE of perfor	rations	
perforations from		·	394 408			rforations from	
perforations from	II.	k fractured	420	. 541		rforations from	
·····	Black basalt	, streaks of clay	541	550			~*
Screens: Yes No (X) Manufacturer's Name		stone clay-sandy brown		<u>569</u>	Screens: Yes D Manufacturer's	No 🗌	
Type Model No		tstone th streaks of blue	569	<u>781</u>	Туре		
Diam. Slot size from from from from from from from from	. to		781	550 569 781 781 795	Diam.	Slot size from Slot size from	
	Blue green s	andy clay	795	853 LO	Caral and the		
Gravel placed from		andy clay with streaks		9	Gravel packed:	Yes No Size	a of gravel: ft. to
		e	853 879	879 Z			
Surface seal: Yes (X No D To what depth? Material used in seal	-1+1-1-0 m. [D] -1 -11	sand	952	952 So 968 O 1019 D	Material used	ts[] No[] To what in seal	at depth?
Did any strata contain unusable water? Y	Soft siltsto		968	1019	Did any strat	a contain unusable wa	
Type of water? Depth of strats		th black silty sand	1019	_1033 6	Type of water	? Dept	h of strata
Method of sealing strata of		th redish rock brown	1022				
(7) PUMP: Manufacturer's Name		ter bearing hale fragments, clav	1033	_1055 8	(7) PUMP: Manufact	turer's Name	
		icles, basalt hard	1055				
(8) WATER LEVELS: Land-surface elevation above mean sea level	Siltstone, s	hale_particles, clay-		`		LS: Land-surface e above mean se	a level
Static level		d particles, water br.	1122	1153 ta	Static level		
Artesian water is controlled by (Cap. val	Jana Les green	in siltstone_rock	1153	1235	Artesian water	r is controlled by	(Cap. valve, c
			1	1235 Uta	(9) WELL TESTS:	Drawdown is an lowered below s	
(9) WELL TESTS: Drawdown is amount wate lowered below static level Was a pump test made? Yes 1 No' If yes, by whom?	Work started9-	12	4		(9) WELL TESTS:	lowered below s	tatic level
Yield: gal/min. with ft. drawdown after		ER'S STATEMENT:				with Aft. drav	vdown after
······································	This well wa	s drilled under my jurisdiction	and this	report is			
No Conclusive Information		of my knowledge and belief.		Ē		<u>A</u>	
Recovery data (time taken as zero when pump turned o measured from well top to water level) Time Water Level Time Water Level Time	I) (water level Water Level NAME Layne-	Western Company, Inc. Person, firm, or corporation)	(Type or p	int)	Recovery data (time taky measured from well t Time Water Level	en at zero when pump op to water level) Time Water Level	
	Address P.O.	Box 336, Moses Lake, W	IA 988	37			-
		L N/B/			·		
Date of test	[Signed]	K (Well Driller)			Date of test		
Bailer test		67			Bailer testgal./n Arterian flow		
Artesian flow							alysis made? Yes

Application N Application N vasBington Permit No. J _ Address 3206 Home Drive, Yakima, WA _ SE ¼ NW ¼ sec 30. T. est and 600 feet north from center of (10) WELL LOG: Pormation: Describe by color, character, size of material	98902	48P
Address 3206 Home Drive, Yakima, WA - SE 4 NW 4 sec 30 T est and 600 feet north from center of (10) WELL LOG:	98902	
Address 3206 Home Drive, Yakima, WA - SE & NM % sec 30 r. est and 600 feet north from center ((10) WELL LOG:	98902	
- SE 34 NW 34 Sec 30 T. est and 600 feet north from center of (10) WELL LOG:		
est and 600 feet north from center ((10) WELL LOG:		22 жм
(10) WELL LOG:	ofSec.	
		30
Formation: Describe by color, character, size of materia		*
	and stru	cture, and
Formation: Describe by color, character, size of materia show thickness of aquifers and the kind and nature of t stratum penetrated, with at least one entry for each ch		
(CONTINUED) MATERIAL	FROM	TO
Soft black basalt with green shale	1005	1050
		1252 1317
		1333
		1501
	1501	1537
Soft red black basalt (wood chunks	1537	1569
Medium hard black_basalt	1569	1660
	1660	1665
		1665 1686
		1704
		1727
	1727	1835
Silty - clay black dark stones	1835	1841
Harder basalt, gray/black	1841	1852
	-	
	1852	1879
	1070	1883
		1003
		1906
woody grained material	1906	1950
Sandy clayish mica mixed greenish		
		2030
		2055
	2055	2062
	2062	2073
gray basalt	2073	2221
Medium hard basalt, some shales		
_present, some_water		2230
	2230	2240
	4	19.8]
		, 19.0.1.
This well was drilled under my jurisdiction a	and this	report is
and to the best of my knowledge and bench.		
NAME Layne-Western Company, Inc.		
(Person, firm, or corporation) (?	Type or p	rint)
Address P. 0. Box 336, Moses Lake, W	A 988	37
() h h		
[Signed]		
// .		
License No. 1167 Date Febru	uary 2	5, ₁₉ 81
	Medium hard black basalt, rough Siltstone Soft red black basalt (wood chunks Medium hard black basalt Soft black basalt wood chunks water bearing Medium hard black basalt Soft brown shales (woody particles Black basalt medium hard Medium gray basalt Silty - clay black dark stones Harder basalt, gray/black Medium hard black basalt (fraces of mica)chuncks black silty sand Soft clayish sand(chunks of wood) mica quartz particles(Blk. & Gry Rough drilling, fractured material basalts and sandy.clays Black silty clayish material. woody grained material Sandy clayish mica mixed greenish sand, black and silty particles Clayish black & brown, large chunks Basalt, rough drilling, gray Soft basalt black, red rock, vol- canic pourous, some water bear. Fractured, rough drilling, hard gray basalt. Medium hard basalt, some shales present, some water Harder black basalt, smoothe drlg. (CONTINUED) Wet stored 9=12. 10.80 Completed 22 WELL DRILLER'S STATEMENT: This well was drild under my pirisdiction true to the best of my knowledge and belief. NAME Layne-Western Company. Inc. (Address P. 0.80 336, Moses Lake, M (Signed)	Medium hard basalt, rough 1252. Soft black basalt, traces of water 1317 Sittstone 1501. Soft red black basalt, rough 1333. Sittstone 1501. Soft red black basalt (wood chunks) Soft black basalt (wood chunks) Medium hard black basalt 1569 Soft black basalt with wood chunks 1567. Medium hard black basalt 1665. Soft brown shales (woody particles) 1686. Soft brown shales (woody particles) 1688. Black basalt medium hard 1704. Medium ard black dark stones 1835. Harder basalt gray/black 1841. Medium hard black basalt (traces of mica)chuncks black silty sand 1852. Soft clayish sand(chunks of wood) mica quartz particles(Blk. & Gry)1879. Rough drilling, fractured material. moody crained material. Moody crained material. Moody clayish mica mixed greenish sand, black abcown, large chunk2030. Basalt, rough drilling, particles 1950. Clayish black & brown, large chunk2030. Basalt, rough drilling, hard gray basalt. present, some water bear. Medium hard basalt, some shales 1221. Harder black basalt, some shales 2221. Harder black basalt, some shales 2220. (CONTINUED) Werk startet 9-12. 19.80 completed 2-4. WELL DRILLER'S STATEMENT: This well was drilled under my jurisdiction and this tree to the best of my knowledge and belef. NAME layne-Western. Company, Inc. (Person firm, creiprovision) (Type or p Address P. O. BON 336. Moses Lake, MA 988 [Signed] Medium And Salt, back order bear. [Signed] Medium basalt, back base shales 18. Signed] Medium basalt, black Marke Basalt, Some shales 18. Signed] Medium basalt, basalt, base shales 18. Medium basalt, basalt, base shales 18. NAME layne-Western. Company, Inc. (Person firm, creiprovision) (Type or p Address P. O. BON 336. Moses Lake, MA 988 [Signed] Medium basalt, base shales 18. Medium basalt, base shales 18. Medium basalt, basalt, base basalt, some balef. NAME layne basalt, basalt, base base basalt. Medium basa

Second Copy — Owner's Copy	R WELL REPORT	Application No64-24648	Surface
	E OF WASHINGTON	Permit No. 64-24648P	Depth bgs
	Address 3206 Home Drive.		Ø
LOCATION OF WELL: County Yakima			9
ing and distance from section or subdivision corner 750 fe		rom center of Sec.30	(6
(3) PROPOSED USE: Domestic [] Industrial [] Mun			
Irrigation [] Test Well [] Othe	Formation: Describe by color, chara show thickness of aquifers and the	acter, size of material and structure, and kind and nature of the material in each one entry for each change of formation.	20
(4) TYPE OF WORK: Owter's number of well (if more than one)	MATERIAL	FROM TO	39
	riven		42
	Hard black basalt, fra		
	inches. Medium Hard black basa		54
Drilled	Soft_basalts, black (s	ome water)	
(6) CONSTRUCTION DETAILS:	vestcular	2267 2348	
Casing installed:	ft. Soft_basalts_black & b water)_vesicular	2348 2361	78
Threaded []	Hard black basalt	2361 2417	
	Black vesicular basalt		•
Perforations: Yes No D Type of perforstor used	bearing_fair Medium_hard_black_basa	2417 2436 11t 2436 2456	
SIZE of perforations in. by			105
perforations from ft. to	nblack_basalt_soft	2456 2483	105
perforations from ft. to			
Screens: Yes No D	Rough black hard basal Rough black hard basal		123
Manufacturer's Name	basalt	26472671	125
Diam Slot size from ft. to		rd2671 2715	
Diam. Slot size from ft. to	ft		
Gravel packed: Yes No Size of gravel:			
			15
Surface seal: Yes No To what depth?	TOEQE		15.
Did any strata contain unusable water? Yes 🗌	No []	7 1001	150
Type of water?	FEB 2	7 1981	160
(7) PUMP: Manufacturer's Name			16
Type:HP	DECARTMENT CENTRAL HE		(7)
(8) WATER LEVELS: Land-surface elevation above mean sea level	tt.		
Static levelft. below top of well Date			10
Artesian pressure			18
(Cap, valve, etc.			. ເຽ
(9) WELL TESTS: Drawdown is amount water level lowered below static level	Work started 9-12	0. Completed 2-4	
Was a pump test made? Yes 🗍 No 📋 If yes, by whom? Yield: gal./min. with ft, drawdown after	hrs. WELL DRILLER'S STAT	EMENT:	2φ
и и и и ¹ и и	This well was drilled under	r my jurisdiction and this report is	:
		euge and benet.	22
Recovery data (time taken as zero when pump turned off) (wat measured from well top to water level) Time Water Level Time Water Level Time Water	Level NAMELayne-WesternC	ompany, Inc.	. 22
	(Person, firm, or	(Type or print)	-
	Address	1	
Date of test	[Signed]	1 mm	
Bailer test	hrs. [Longhou]	(Well Driller)	•
Artedian flow	No D License No1167	Date February 25, 19.81	
	I		

Vell ID: 2862	Well Name:	Cross Section: $\beta - \beta'$
urface Elevation: 1223 FL	Well Depth: 2715ff	Aquifer: 🛲 GrRB
pth bgs (ft) Elevation (ft)		
Ø T 1223		
91 - 1132	OVB	OVB
162 - 1061	BASALT	EM
2011 . 020	SAND & CLAY	RR
394 - \$29 408 - \$15 428 - 803	SILTSTONE (SASALT SILTSTONE	
420 - 803		
	BASALT	
541 - 682 781 - 442	BASALT CASULT	РМ
1422 100	CLAY & SILTSTONE	SEL
1055 - 168	SILTSTONE (BASALT	UMA
1235 12	SILTSTONE & SHALE	MBTN
12.52 29	BASALT (SHALE)	
1561278 1537314	BASALT	PR
1537314 1569346 1680377 1685442 1686463 1484481	SILTSTONE BASALT (WOOD BASALT BASALT BASALT BASALT SHALE (WOOD	RZ
1.01		SQC
935612 841618 852629 879656	BASALT CLAY & SHLT BASALT BASALT CSAND	FS
,	SAND, SILT, CLAY	VTC
2055	SHIND, SICT, CLAY	VTG
2 221998 2 230 1007	BASALT CSHALE	
	BASALT	GRB
2715 1-1492		

File Original and First Copy with Department of Boology Stord Copy — Owner's Copy In Third Copy — Durlier's Copy	LL REPORT Application No. CHIEFT	Well ID: 2827	Well Name:	Cross Section: $B-B'$
Ž	ASHINGTON Permit No G4-24469P	Surface Elevation: 1273f4	Well Depth: 18\$8 ft	Aquifer: WNB
	Address Route 2, Box 69 Zillah, WA 98953	Depth bgs (ft) Elevation (ft)		
		Ø T 1273		
() and distance from section or subdivision corner				
(3) rROPOSED USE: Domestic D Industrial Municipal D	(10) WELL LOG:	1 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 pensitrated, with at least one entry for each change of formalion.	1 1	AV B	OVB
C (4) TYPE OF WORK: Owner's number of well 2 (if myre than one)	MATERIAL FROM TO			
Deepened Cable Driven	Sand & topsoil 0 5	254 - 1423		
C New well KK Method: Dug D Bored D Despend Reconditioned Rotary XK Jetted D (5) DIMENSIONS: 16" to 1128 4 11" to 1808 inches. Drilled 1808 ft. Depth of completed well 1808ft.	Sand & gravel 5 30 Gravel with streams of clay 30 81	250 - 1023 297 - 976	BASALT	EM
5) DIMENSIONS: ^{16"} to <u>1128</u> to <u>1808</u> inches. Drilled <u>1808</u> rt. Depth of completed well <u>1808</u> rt.	Clay, brown, soft 81 83	297 - 9116		
	Clay, streaks of gravel83130	I I		
(6) CONSTRUCTION DETAILS:	Clay, brown & green - sticky 130 250 Basalt, black, weathered 250 253			
	Basalt, black, hard 253 297	1 1	CLAY, SAND & GRAVEL	RR
O Threaded []	Clay, sand, streaks of gravel 297 607		1 /	
Threaded "Diam. from ft. to ft. Welded "Diam. from ft. to ft. Perforations: Yes No XX	Basalt, black, hard 607 780 Basalt, brown with streaks of clay 780 782			
Type of perforator med	Clay, grey with some black sand 782 807	607-666		
Type of perforator used SIZE of perforations	Basalt, black, fractured 807 821			
U perforations from	Basalt, black, hard 821 1037 Clay, green with sand 1037 1088		BASALT	PM
U perforations fromft. toft. U perforations fromft. toft. U ft.	Clay, green with sand 1037 1088 Basalt, red & brown, soft 1088 1112	780 - 493	0.11	1 111
Screens: Yes D NoXX	Basalt, grey, medium hard 1112 1177	782 - 491	BASALT CCAY	~~~
C Manufacturer's Name	Basalt, grey, med. hard, frac.w.b.1177 1180 Basalt, grey, med. hard 1180 1192	807-466	CLAY	SEL
Diam	Basalt, black, soft, w.b. 1192 1215			
	Basalt, black, hard 1215 1359			
Gravel placed from ft. to ft.	Basalt, black, soft, w.b. 1359 1377 Basalt, black, hard 1377 1473		BASALT	UMA
2	Basalt, black, soft, w.b. 1473 1506			Olvin I
Surface seal: Yes/X No D To what depth; <u>1128</u> rt. Material used in seal Cement top & bot. Bepzonit Did any strata contain unuable water; Yes D Mid 1988	Basalt, black, medium hard 1506 1529	1037 - 236		
O Did any strata contain unusable water? Yes I III ON SX Type of water? NZA Depth of strats N/A	Basalt, black, hard 1519 1717 Basalt, black, frac. 1717 1747	1088 - 185	CLAY	MDTN
	Basalt, black, frac. 1717 1747 Basalt, black, med. to soft, w.w. 1747 1760	1000	CLAT	MBTN
Nethod of sealing strate of N/A (7) PUMP: Manufacturer's Name N/A Type: N/A	Basalt, black, hard 1760 1772			
S Type: N/A H.P. N/A	Basalt, black & red, soft with some wood, w.b. 1772 1798			
	Basalt, black, hard 1798 1808			PR
O Static level 434				ГК
to the sector is controlled by				
Cap, valve, etc.)				
(9) WELL TESTS: Drawdown is amount water lavel is lowered below static level 0 Was a pump test mader Yes [] No KH it yes, by whom: by others. 0 Yield: gal/min. with ft. drawdown after hrs.	Work started March 13_, 19.80. Completed June 5, 19.80	1430157	BASALT	
Was a pump test made? Yes No XX 12 yes, by whom?byOthers. Vield: gal/min. with tt. drawdown after hrs.	WELL DRILLER'S STATEMENT:		DAJAUT	
	This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.			
Becovery data (time taken as zero when pump turned off) (water level	William A Gustavson			
Recovery data (tima taken as zero when pump turned off) (water level measured from well top to water level) U Time Water Level Time Water Level U Time Water Level	NAME Layne-Western Company, Inc. (Person, firm, or corporation) (Type or print)			RZ
	D. O. Ben 226, Massa Laka MA 00027			145
e				
F N/A sal Art U to dry rodown after hrs.	[Signed] (Well Briller)			
Artesian flow	License No. 0733 Date June 30, 19.80	1772 499		
Temperature of water OV		17.48	BASALT (WOOD	SQC
(USE ADDITIONAL &	EXETS IF NECESSARY)	5 25	BASALT	FS
ECY 050-1-20	••• :	1808 1-535	UNSKUI	

			1
(Lloyd Garretson Co.)	P.O. P.O. Yakima, WA		
OWNER: Name William Campric			3 =
V LOCATION OF WELL: County Yakima	- Gree 17 - 17	1 N. R2	IE ww
g and distance from section or subdivision corner	NW NW		
) PROPOSED USE: Domestic 🖸 Industrial 🗆 Municipal		L	<u> </u>
Irrigation 🖉 Test Well 🗋 Other	Formation: Describe by color, character, size of materia show thickness of aguifers and the kind and nature of stratum penetrated, with at least one entry for each of	l and struc the materia	cture, and al in each
) TYPE OF WORK: Owner's number of well	stratum penetrated, with at least one entry for each t	TROM	TO
i) TYPE OF WORK: Owner's number of well (if more than one)		0	20
Deepened Cable Driven Reconditioned Rotary 2 Jetted		20	45
	Gravel with clay seams	45	
b) DIMENSIONS: Diameter of well 16" x 12% then Drilled 1945 tt. Depth of completed well 1945	Sands with gravel & clay seams	85	. 195
Drilled 1343	Sand & small gravel	195	220
) CONSTRUCTION DETAILS:	Clay, sandy, brown	220	328
Casing installed: 16	Clay, brown, hard Basalt, black, hard, fractured	328	<u>380</u> 430 €
Welded 0	The Class blue with sand	430	460
	Clay, brown, sticky	460	503
Perforations: Yes 🗋 No 💢	Clay, brown, sandy	503	518
Type of perforator used in. by	Clay, blue	518	574
perforations from	n. Samustone with tray	574 658	658
perforations fromft. to		661	731
	Basalt, black, rough	731	913
Screens: Yes D No ()	Basalt, black, Med. hard, fracture		919
Manufacturer's Name Model No	Basalt, black, hard	919	944
Diam	n. Basalt, grave with clay seams	944	963
Diam		963 974	974
Gravel packed: Yes D No XX Size of gravel:	Glay, blue w/ gray basalt, rough Basalt, med, hard	1006	1253
Gravel placed from	" Clay, blue with sand martha	1253	1272
Surface scal: Yes X No D To what depth?	" Basalt, gray, med. hard	1272	1306
Material used in seal Neat_cement_grout	Basalt, gray, med. hard	1306	1362
Did any strata contain unusable water? Yes No Type of water? N/A Depth of strata N/A	D Basalt, black, med. hard	1362 1452	1452 1500
Method of sealing strata off. N/A	Basalt, med. hard, fractures Basalt, black, fractured, W.B.	1922	
7) PUMP: Manufacturer's Name N/A	(820 F)	1500	1526
Туре:	Basalt, black, soft, W.B. 64		1540
B) WATER LEVELS: Land-surface elevation # 1500	- Siltstone	1540	1631
atic level 415 the below top of well Date 11-6-80	# Basalt, Black, soft, W.B.	1631	1658
N/A more than more			
Artesian water is controlled by			
	-		
WELL TESTS: Drawdown is amount water level is lowwred below static level as a pump test made? Yes N No I if yes, by whom? <u>Layne</u>	Work started June 13	ember	6., 19.80
eld: 680 gal/min. with 94 ft. drewdown after 10 Mint	WELL DRILLER'S STATEMENT:		
	This well was drilled under my jurisdiction	and this	report is
<u> </u>	- true to the best of my knowledge and belief.		
scovery data (time taken as zero when pump turned off) (water is measured from well top to water isvel)	vel		
Time Water Level Time Water Level Time Water Lev	I NAME Layne-Western Company, Inc.	Type or p	rint)
1 Min. 531 30 Min. 510 60 Min. 501 0 Min. 517 40 Min. 505			
Min. 515 50 Min. 501	(D)		
Jate of test November 6, 1980	Isigned] J.R. Baker (Well Driller)		
nier test N/Asal/min. withft. drawdown afterft.	J. R. Baker (Well Driller)		

2001				1.1
2801		SID 20	1846	
- /		00	18 -14	
				1.19
original and First Copy with artment & Ecology crond Copy — Owner's Copy hird Copy — Driller's Copy	WATER WE	LL REPO	ta	1 1 1
	STATE OF W	VASHINGTON (CONT.) Permit No .	G426387	1 1 19
(1) OWNER: Name	- arretson Co.;	Address P. O. Box 1552, Yakima, WA .9	9007	1
(2) LUCATION OF WELL:				
(2) LOCATION OF WELL: Bearing and distance from section or		— N ³ , X NW 14 Sec. 17 т 1	1 N., RZIE.W.M.	1 .
				1.1.1
	estic [] Industrial [] Municipal [] ation [] 1est Well [] Other []	(10) WELL LOG:		r'
Irrig	ation [] 1est Well [] Other []	Formation Describe by color, character, size of materia show thickness of aquifers and the kind and nature of 1 stratum pencirated, with at least one entry for each c	he material in each	
(i) ALLO OL HOME. (If m	er's number of well ore (han ont)	MATERIAL	FROM TO	
	Cable Driven	(CONTINUED)		
Deepened Reconditioned				1 1,
		Basalt, black, fractured	1658 1680	
	hameter of will . inches the of completed well ft	Basalt, black, med. hard	_16801881_	1 .
		Basalt, black, vesicular, W.B.	1881 1899	· ·
(6) CONSTRUCTION DETA		Basalt, black, hard	1899 1905	1
	Diam from ft to . , ft Diam from ft to . ft	Basalt, red, soft vesicular,		1 1
	Diam. from ft to ft		1905 1914	
		Basalt, black, Med. hard (T.D.)	1914 1945	
Type of perforator used	u	Pirla Line Flore		- 1
SIZE of perforations	in by in			
perforations f		Need 350 00	ut	
perforations f				
Screens: Yes D No D		1 Otamole france	de .	·
Manufacturer's Name			~	
Type	. Model No from ft to ft			
Diam . Slot size Diam Slot size	from ft to ft from ft to ft			
				11
Gravel placed from	ft to ft			
				il -
Surface seal: Yes D No (Material used in seal	To what depth? ft.			:1
Did any strata contain u				1.
Type of water?				1
The second se				
 PUMP: Manufacturer's Name Type:	н. нр	1	/	
				1
	nd-surface elevation ve mean sea level . ft clow top of well Date .			1
	per square inch Date			11
Artesian water is controlle				
	red below static level	Work started June 13 . 19 80 Completed NON	ember 6 19.80.	1
/as a pump test made? Yus [] No ield gal/min_rit:-	ft drawdown after his	WELL DRILLER'S STATEMENT:		1
		This well was drilled under my jurisdiction .	and this report is	
		true to the best of my knowledge and belief.	-	
	when pump turned off) (water level level)	NAME ISI ne-Western Company Inc		
Time Water Level Time	Vater Level Time Water Level	NAME Lay ne-Western Company Inc	Type or print)	1
		Address P.O. Box 336, Moses Lake, M	IA 98837	
		CARI .		
Date of test		[Signed] A 2/12		
Sailer test gal/ndn with.	ft. drawdown after hrs g p m. Date	J. X. Baker (Well Driller)		
	chemical analysis made? Yes 🗌 No 📋	Licen. No. 1167 Date Novell	1ber.12,10 80	1 5
		•		1
CCY 050 1-20	USE ADDITIONAL SH	HEETS IF NECESSARY)	- (B) '	1

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

(USE ADDITIONAL SHEETS IF NECESSARY)

Well ID: 2801	Well Name:	Cross Section: B~B'
Surface Elevation: 1269ft	Well Depth: 1945ft	Aquifer: WNB
Depth bgs (ft) Elevation (ft)		
	OVB	OVB
38\$ 879 43\$ 829	BASALT	EM
	CLAY & SANDSTONE	RR
731 - 528 944 - 315 963 - 296 974 - 285	BASALT	РМ
	BASALT CLAY CLAY CLAY	SEL
1006-253 1253-6	BASALT	UMA
127213	CLAY WITH SAND	MBTN
1466147	BASALT	PR
		RZ
154\$281 1631372	SILTSTONE	SQC
	BASALT	FS
1965 -646	BASALT (WOOD) BASALT	
1945686	UPSHUI	

Ŵ	ATER	WE	LLI	REPO	ORT
Origina	1& 1° copy	Ecology,	2 nd copy	- owner,	3 rd copy -

ECOLOGY Original & t ^a copy - Ecology, 2 nd copy - owner, 3 nd copy - driller	CURREN
Construction/Decommission ("x" in circle). 368039	Notice of
X Construction	Unique Eo
Decommission ORIGINAL INSTALLATION	Water Rig
Notice of Intent Number	Property O
PROPOSED USE: Domestic Industrial Municipal	
DeWater Irrigation Test Well Other	Well Street
TYPE OF WORK: Owner's number of well (if more than one)	City Selah
New Well Reconditioned Method: Dug Bored Driven	Location S
DIMENSIONS: Diameter of well 16 inches drilled 20:16:12: a x 97/o	
New well Reconditioned Method: Dug Bored Driven Depend V Gable New Well B Conditioned Method: Dug Bored Driven Discontinued of Well 10 Indensions: Diameter of well 10 Discontinued of Well 2,540 Total 20216/12; a £ 97/8	(s, t,
CONSTRUCTION DETAILS	Lat/Long
$\begin{array}{c} \textbf{Casing} \qquad \textbf{M} \text{Welded} \qquad \frac{16''}{12''} \text{``Diam. from } \frac{\pm 1}{11} \text{ft. to} \frac{1206}{441} \text{ft.} \\ \textbf{h. tot } \frac{441}{11} \text{ft. tot } \frac{44}{11} \text{ft. tot } \frac{44}{11}$	
Installed: Liner installed 12" Diam. from +1 ft. to 441 ft.	
Diam. From fl. to fl.	Tax Parce
Perforations: E Yes No Type of perforator used Torch Cut	
-SIZE of performed and the second sec	Formation: nature of th
	of informat
Screens: Yes KNo K-Pac Location	
Manufacturer's Name	Sand, grav
Diam Slot size from 0 to 0	Sandy clay
Diam. Slot size from ft. to ft. Diam. Slot size from ft. to ft.	Cemented
Gravel/Filter packed: Yes X No Size of gravel/sand	Sandstone
Materials placed from ft. to ft.	Gray Clay
Surface Seal: X Yes No To what depth? 1205 ft.	Sticky bro
Material used in seal Cement	Sandstone
"Did any strate contain unusable water?: Vec No.	Broken bas
Type of water? Death of straits	Med.soft b
Method of sealing strate off	Hard gray
Method of realing strain of the strain of th	Brown Cla Green:clay
	Gray silty
WATED ISVELS: Land surface elevation above more ser lavel	Gray silty
WATER LEVELS: Land-surface elevation above mean sea level ft. Static-level 710ft. below top of well Date	Gray sand
Artesian pressure Ibs. per square inch Date	Clay to sar
Artesian pressure los, per square inch Date Artesian water is controlled by (cap, valve, etc.)	Green clay
	Broken-bla
WELL TESTS: Drawdown is amount water level is lowered below static level	Black & b
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. Yield: gal/min: with ft drawdown after hrs.	Very hard
Yield:gal/min. with ft. drawdown after hrs.	Gray clay
Yield: gal/min, with ft, drawdown after hrs.	Green clay
 Recovery data (time taken as zero when pump turned off) (water level measured from well 	Broken ba
top to water level Time Water Level Time Water Level	Broken bla
	Med hard Hard fract
	Hard fract Hard gray
	Broken da
Date of teat	Hard dark
Bailer Test gal./min. withft drawdown after hrs.	Med hard
Airtest 800 gal/min. with stem set at 2200 ft. for hrs.	Green clay
Artesian flow gp.m. Date	- Count only
Temperature of water Was a chemical analysis made? Yes No	Start Da
indo a catalitar analysis made:	

mt. 0."

	799	
NT Intent No. W242794		
cology Well ID Tag No. AHP736		
ht Permit No. G4-24192		
Owner Name Department of Natural R	esources	
t Address PO Box 190		
County	Yakima	
county		
E 1/4-1/4 <u>SW</u> 1/4 Sec <u>16</u> Twn <u>11</u> , r Still REQUIRED)		ewm ∎ Ch or wwmit⊡ Or
Lat Deg Lat N	fin/Sec _	
Long Deg Long	Min/Sec	
el No. (Required) 21111611900		
CONSTRUCTION OR DECOMMISSION PROC	EDURE	
Describe by color, character, size of material ar the material in each stratum penetrated, with at le	ast one entry fo	
tion. (USE ADDITIONAL SHEETS IF NECESS	ARY.)	
MATERIAL	EROM	TO
vel & cobbles	0	39
y brown & gravel	60	60
e brown	70	86
e blown	86	114
own clay	114	129
e & Clay layers	129	315
asalt & brown clay	315	321
black to brown basalt	321	334 .
basalt	. 33,4	. 371
ay a	371	435
y	435	468
clay	468	486
clay & sandstone layers	486	-503
clay trace of black sand	503	513
industone layers	585	633
y lack basalt w/ black & green clay	633	678
brown basalt trace of green clay	678	682
i gray basalt	682	875
	875	883
ay .	883	.893
asalt & green clay	893	918
lack basalt	918	924
black porous basalt trace of green clay	924	938
tured gray & brown basalt	938	955
	1043	1043
ark gray basalt k gray basalt	1043	1152
I black basalt	1152	1175
vy & gray sandstone	1175	1188
vate 8-20-09 Completed Da)

		· ·				
	I constructed and/or accept responsibility					
	the information reported above are tru					

Driller Engineer Trainee Name (Print) Larry Mc Lanahan	Drilling Company BJ Exploration & Drilling Co., INC
Driller/Engineer/Trainee Signature	- Address 404 N Conway St
Driller or trainée License No. 0337	City State Zin, Kennewick WA 1, 99336
IF TRAINEE: Driller's License No:	Contractor
Driller's Signature:	Registration No. BJEXPCI132QK Date
· · · · · · · · · · · · · · · · · · ·	.IAN 222010

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and the second second

(magine
WATER WELL REPORT
Criginal & 1 th copy - Ecology, 2 rd copy - owner, 3 rd copy - driller
Construction/Decommission ([#] x" in circle) 3Ъ&039 ⊠ Construction
Decommission ORIGINAL INSTALLATION
Notice of Intent Number
PROPOSED.USE: Domestic Industrial Municipal DeWater Inrigation Test Well Other
TYPE OF WORK: Owner's number of well (if more than one)
New well Reconditioned Method: Dug Bored Depend Cable Retain Letted
Dimensions: Diameter of well 16 inches, drilled 20,16,12 ⁴ a. 9 %
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: 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
Screens: Yes No K-Pac Location
Manufacturer's Name
.Type Model No
Diam. Slot size from ft to ft.
Graves/Finter packed: 1cs 🔺 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
Туре: Н.Р.
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

Artesian flow ______ g.p.m. Date ____ Temperature of water

top to water level) Time Water Le

Date of test Bailer Test

WELL TESTS: Drawdown is amount water level is lowered below static level
 WELL INSTE UTWOOM IN AMOUNT Wale revel is lowered before static level

 Wes a pump term mode?
 I Ves [No II Yes, Ny whon?]

 Vield:
 gal /min. with
 ft. drawdown after

 Pried.
 gal /min. with
 ft. drawdown after

 No II Yes, Ny Wood
 ft. drawdown after
 hts.

 Recovery data (lime taken as zero when pump tumed off) (water keet messure
 hts.
 hts.

Water Level Time Water Level Time

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

Was a chem

gal/min. with

VELL REPORT			
ology, 2 ^{ed} copy - owner, 3 rd copy - driller	CURRENT		
x" in circle) 368039	Notice of Intent No. W242794		
x in circle)	Unique Ecology Well ID Tag No. AHP736		
INSTALLATION	Water Right Permit No. G4-24192		
of Intent Number	Property Owner Name. Department of Natural Re	esources	
Industrial Municipal Test Well Other	Well Street Address PO Box 190		
if more than one)		Valsima	
hod: Dug Bored Driven	City Selah County		
inches, drilled 20,16,12, a 97,8"	Location <u>SE_1/4-1/4 SW_1/4</u> Sec <u>16</u> Twn <u>11</u> (s, t, r Still REQUIRED)		ewm ■ Chec or wwm □ One
	Lat/Long Lat Deg Lat M	lin/Sec	
Diam. from ± 1 ft. to $\frac{1206}{441}$ ft. Diam. from ± 1 ft. to $\frac{141}{441}$ ft.			
Diam. From ft. to ft.	Tax Parcel No. (Required) 21111611900		
	CONSTRUCTION OR DECOMMISSION PROC	COULOF.	
	CONSTRUCTION OR DECOMMISSION PROC Formation: Describe by color, character, size of material an		nd the kind and
of perfs 25 from 1381 ft to 1386 ft.	. nature of the material in each-stratum penetrated, with at lea	ist one entry f	
Location	of information. (USE ADDITIONAL SHEETS IF NECESS		
Locaton	MATERIAL	FROM	TO
Model No.	Hard black basalt	1188	1278
omfl. tofl.	Soft porous black trace of basalt trace of water	1278	1298
mft. toft.	Med hard porous black	1298	1312
Size of gravel/sand	Hard fractured black basalt	1312	1322
ft. toft.	Hard black	1322	1335
nat depth? 1205 ft.	Soft porous black basalt 170 psi little water	1335	1352
	Med hard black basalt Hard black basalt	1352	1405
Yes No	Hard gray basalt	1364	1403
Depth of strata	Soft porous black basalt little water 180 psi	1403	1439
	Med'hard black basalt	1439	1559
	Soft porous black basalt	1559	1563
H.P.	Hard black basalt	1563	1575
ove mean sea level ft.	Soft gray siltstone & trace of green clay some black	1575	
top of well Date	basalt		1590
Y	Wood & some clay	1590	1599
inch Date	Med soft broken black & some brown basalt	1599	1610
(cap, valve, etc.)	Med hard black basalt	1610	1702
vel is lowered below static level	Hard gray basalt	1702	1762
If yes, by whom?hrs.	Med hard gray basalt fractured	1762	1772
drawdown after hrs.	Med soft gray basalt fractured	1772	1778
. drawdown after hrs.	Hard broken gray basalt	1778	1783
o turned off) (water level measured from well	Hard gray basalt	1783	1845
ter Level Time Water Level	Med soft fractured black basalt	1845	1860
ter Level 1 me Water Level	Med hard porous gray basalt	1860	1874
	Hard gray basalt Broken porous black basalt 330 psi 100deg	1874	1887
		1887	1905
	Hard gray basalt Med hard porous dark gray basalt	1905	1919
ft. drawdown after hrs.	Soft black porous basalt	1919	1937
2200 fl. för hrs.	Med hard black basalt	1953	,1961
		1700	
emical analysis made? Yes No	Start Date 8-20-09 Completed Da	te <u>12-22-0</u>	9

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

construction standards, materials used and the information reported above are true to	my best knowledge and benet.
Driller Engineer Trainee Name (Print Larry Mc Lanahan	Drilling Company BJ Exploration & Drilling Co., INC
Driller/Engineer/Trainee Signature Joury In	Address 404 N Conway St
Driller or trainee License No. 0337	City, State, Zip Kennewick WA. 99336
IF TRAINEE: Driller's License No:	Contractor's RECEIVED
Driller's'Signature:	Registration No. BJEXPCI132QK Date
	.IAN 222010

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7g2

Pg.1.

Location SE_14-1/4 SW 1/4 Sec 16_T (s, t, r Still REQUIRED) Lat/Long Lat Deg Long Deg Tax Parcel No. (Required) 2111161190 Formation: Describe by color, character, size of ma- ngarer of the mainting in each strange mortringt. w of information: Describe by color, character, size of ma- ngarer of the mainting in each strange mortringt. w of Marchanda Matteria II and II	ural Resources bunty Yakima ivn 11 R 21 Lat Min/Sec Long Min/Sec 10 NPROCEDURE terial and structure, at at that alead one at	or www.m One	Well ID: 2 Surface Ele Depth bgs (ft) Ø - 321 321 371 633 -	vation: [2 Elevation 1284 - 969 - 963 - 913
Notice of Intent No. W242794 Unique Ecology Well ID Tag No. AHP730 Water Right Permit No. 64-24192 Property Owner Name Department of Nath Well Street Address PO Box 190 City Selah Co Location SE. 1/4-1/4 SW 1/4 Sec 16 T (9, 4, r Still REQUIRED) Lat/Long Lat Deg Lang Deg Tax Parcel No. (Required) 2111161190 CONTINUED SHORMSSIG Formation: Describe by colex, chanater, size of ma ngarer of the maintel in each strange merinde, wi of information. USE-ADDRESS SHORMSSIG	5 ural Resources punty Yakima wn 11 _ R 21 Lat Min/Sec Long Min/Sec 0 NPROCEDURE terial and structure, are entry fi	or www.m One	Depth bgs (ft) Ø - 315 - 321 - 371 -	Elevation (284 - 969 - 963 - 913 - 913
Notice of Intent No. W242794 Unique Ecology Well ID Tag No. AHP730 Water Right Permit No. 64-24192 Property Owner Name Department of Nath Well Street Address PO Box 190 City Selah Co Location SE. 1/4-1/4 SW 1/4 Sec 16 T (9, 4, r Still REQUIRED) Lat/Long Lat Deg Lang Deg Tax Parcel No. (Required) 2111161190 CONTINUED SHORMSSIG Formation: Describe by colex, chanater, size of ma ngarer of the maintel in each strange merinde, wi of information. USE-ADDRESS SHORMSSIG	ural Resources bunty Yakima ivn 11 R 21 Lat Min/Sec Long Min/Sec 10 NPROCEDURE terial and structure, at at that alead one at	or www.m One	8 - 315 - 321 - 371 -	- 969 - 969 - 913 - 913
Unique Ecology Well ID Tag No. AHP736 Water Right Permit No. G4-24192 Property Owner Name Department of Nat Well Street Address PO Box 190 City Selah Coation SE. 1/4-1/4 SW 1/4 Sec 16 T (9, 1, r Still REQUIRED) Lat/Long Lat Deg Long Deg Tax Parcel No. (Required) 2111161190 Communic. Describe by colex, chanator, size of ma ngarer of the maint in each strange mererisde, wi of information. Describe by colex, chanator, size of ma of the mainton. Still RESULTION ASHEETS IN TO MATERIAL	ural Resources bunty Yakima ivn 11 R 21 Lat Min/Sec Long Min/Sec 10 NPROCEDURE terial and structure, at at that alead one at	or www.m One	8 - 315 - 321 - 371 -	- 969 - 969 - 913 - 913
Water Right Permit No. G4-24192 Property Owner Name Department of Nati Well Street Address PO Box 190 City Selah Co. Location SE_ 1/4-1/4 SW_1/4 Sec 16_ T (s, t, 7 Still REQUIRED) Lat/Long Lat Deg Long Deg Tax Párcel No. (Required) 2111161190 CONSTRUCTION GO BECOMUSSIO CONSTRUCTION CON DECOMUSSIO CONSTRUCTION CON DECOMUSSIO Formation: Describe by color, chanacter, size of man parter of the mainfail nech artangu perrentid, wi of information. Excite by Color, chanacter, size of main MATERIAL FI	ural Resources bunty Yakima ivn 11 R 21 Lat Min/Sec Long Min/Sec 10 NPROCEDURE terial and structure, at at that alead one at	or www.m One	315 321 - 371 -	- 969 963 - 913 - 913
Property Owner Name Department of Nati Well Street Address PO Box 190 City Selah Co Location SE_ 1/4-1/4 <u>SW</u> 1/4 Sec 16_T (s, t, r Still REQUIRED) Lat/Long Lat Deg Tax Parcel No. (Required) 2111161190 CONSTRUCTION OF DECOMMISSIO CONSTRUCTION OF DECOMMISSIO CONSTRUCTION OF DECOMMISSIO CONSTRUCTION OF DECOMMISSIO CONSTRUCTION AD INTERIAL IF	wn11 R 21 wn11 R 21 Lat Min/Sec Long Min/Sec 0 NPROCEDURE terial and structure, and that lead one entry for	or www.m One	321 - 371 - 633 -	- 651
Well Street Address PO Box 190 City Selah Cool City Selah Cool City Selah Cool City Selah Cool City Selation Cool City Cool City Cool City Cool City City City City City City City City	wn11 R 21 wn11 R 21 Lat Min/Sec Long Min/Sec 0 NPROCEDURE terial and structure, and that lead one entry for	or www.m One	321 - 371 - 633 -	- 651
City Selah Co Location SE_ 1/4-1/4 SW 1/4 Sec 16_ T (9, 1, r Still REQUIRED) Lat/Long Lat Deg Construction of Deg Tax Parcel No. (Required) 2111161190 CONSTRUCTION of DeGOMMESSIO Communic, USE ADDITIONAL SHEETS IN MATERIAL	Ung Min/Sec Long Min/Sec NPROCEDURE Intal-and structure, and that-least one entry for	or www.m One	321 - 371 - 633 -	- 651
Location SE_14-1/4 SW 1/4 Sec 16_T (s, t, r Still REQUIRED) Lat/Long Lat Deg Long Deg Tax Parcel No. (Required) 2111161190 Formation: Describe by color, character, size of ma- ngarer of the mainting in each strange mortringt. w of information: Describe by color, character, size of ma- ngarer of the mainting in each strange mortringt. w of Marchanda Matteria II and II	Ung Min/Sec Long Min/Sec NPROCEDURE Intal-and structure, and that-least one entry for	or www.m One	321 - 371 - 633 -	- 651
Location SE_14-1/4 SW 1/4 Sec 16_T (s, t, r Still REQUIRED) Lat/Long Lat Deg Long Deg Tax Parcel No. (Required) 2111161190 Formation: Describe by color, character, size of ma- ngarer of the mainting in each strange mortringt. w of information: Describe by color, character, size of ma- ngarer of the mainting in each strange mortringt. w of Marchanda Matteria II and II	Ung Min/Sec Long Min/Sec NPROCEDURE Intal-and structure, and that-least one entry for	or www.m One	321 - 371 - 633 -	- 651
(s, t, r Still REQUIRED) Lat/Long Lat Deg Long Deg Tax Parcel No. (Required) 2111161190 Comstruction Kon Becomusisio Formation: Describe by cick, character, size of ma- gamer of the maintain used stratum generatide, wi of information. (USE ADDITIONAL SHEETS IF N MATERIAL	Lat Min/Sec Long Min/Sec 0 NPROCEDURE terial and structure, an ith at least one entry of	or www.m One	371 - 633 -	- 651
Long Deg Tax Parcel No. (Required) 2111161190 CONSTRUCTION OR DECOMMISSIO Formation: Describe by color, character, size of nan- gature of the material in each stratum penetried, wi of information. (USE ADDITIONAL SHEETS IF N MATERIAL	Long Min/Sec 0 N PROCEDURE terial and structure, and ith at least one entry fi	d the kind and		- 651
Tax Parcel No. (Required) 2111161190 CONSTRUCTION OB DECOMMISSION Formation: Describe by color, character, size of mar- ngature of the material in each stratum penetrated, wi of information. (USE ADDITIONAL SHEETS IF N MATERIAL	N PROCEDURE terial and structure, an ith at least one entry f	d the kind and		
CONSTRUCTION OR DECOMMISSIO Formation: Describe by color, character, size of main nature of the material in each stratum penetraied, wi of information. (USE ADDITIONAL SHEETS IF N MATERIAL	N PROCEDURE terial and structure, an ith at least one entry f	d the kind and or each change		
Formation: Describe by color, character, size of mat nature of the material in each stratum penetrated, wi of information. (USE ADDITIONAL SHEETS IF N MATERIAL	terial and structure, an ith at least one entry f	d the kind and or each change		
nature of the material in each stratum penetrated, wi of information. (USE ADDITIONAL SHEETS IF N MATERIAL	ith at least one entry f	or each change		
MATERIAL	ECESSARY.)		682 -	
	FROM	TO	602 -	- 642
Soft black porous basalt	1961	1977	875 -	- 409
Med hard black porous basalt	1977	2015	893 -	- 391
Soft broken porous black & some brown basalt		2024	918 -	-366
		2198	938 -	-346
and green clay	2198	2229		
Hard dark-gray basalt	2229	2310		
Hard dark gray basalt	2310	2347		
			1175	- 1069
Med hard dark gray basalt	2412	2465	1180 -	76
Med soft black basalt	2465	2472		
		2540		
230 psi 100 deg.	2540		1386-	96
		+		
			1575	-291
		+	15914 -	3466
16* casing 1,206		1	1594	-314
12" casing liner from 1,182" to 1,622		· · · · · · ·		
	~ .	-+		
Hole plugged with cement from 2,231 to 2,540	,			~
		+		
		+	2198 -	914
			2229	945
Start Date 8-20-09 Complete	ed Date 12-22-0	9		
to my best knowledge and belief.		well		-1ø63 -1ø69
				1
	WAR	386/1212		1
Contractor		iveu		1
Registration No. BJEXPCI132QK	JAN 2	2 2010		
	Hard dark gray basalt 216-2170 broken. Med soft Black provue basalt trace of quartz. and green clay. Hard dark gray basalt. Hard dark gray basalt. Broken dlark, gray basalt. Broken dark, gray basalt. Broken dark, gray basalt. Broken dark, gray basalt. Soft porous dark gray basalt. Soft porous dark gray basalt. Hard dark gray basalt. Broken dark, gray basalt. Hard gray basalt. 230 psi 100 deg. 16° cansing 1.00° 11.22° to 2.231° Hole plugged with cement from 2.231° to 2.540 Start Date 8-20-09 Complet Start Date 8-20-09 Complet Drilling Company BE Exploration & Dr Drilling Company BE Exploration & Dr Address 404 N Convay St.	Hard dark gray basalt 216-62170 broken 2024 Med soft black provus basalt trace of quartz 2198 Indi green clay 2239 Hard dark gray basalt 2239 Hard dark gray basalt 2239 Hard dark gray basalt 2210 Broken dark gray basalt 2310 Broken dark gray basalt 2313 Soft provis dark gray basalt 2447 Hard dark gray basalt 2412 Med and dark gray basalt 2442 Hard dark gray basalt 2442 Hard dark gray basalt 2442 Hard gray basalt 2442 Hard gray basalt 2442 Hold part dark gray basalt 2442 Hard gray basalt 2442 Hard gray basalt 2442 12° casing liner from 1,182° to 1,522° 12° casing liner from 1,622° to 2,231° Hole plugged with cement from 2,231° to 2,540 12° casing liner from 1,622° to 2,231° Start Date 8-20-09 Completed Date 12-22-00 s construction of this well, and its compliance with all Washington to no y bet knowledge and belict. Drilling Conpany BI Exploration & Drilling Co., INC	Hard dark gray heash? 16:6-2170 broken 2024 2198 Med soft black promus basalt trace of quartz 2198 2229 Hard dark gray basalt 2229 2310 Hard dark gray basalt 2229 2310 Hard dark gray basalt 2229 2310 Hard dark gray basalt 2233 2337 Broken dark gray basalt trace of green clay 2417 2333 Soft porous dark gray basalt 2465 2412 Med hard dark gray basalt 2465 2412 Med and Tark gray basalt 2472 2386 1and gray basalt 2472 2465 Med soft black basalt 2465 2472 230 psi 100 deg 2540 2472 12' casing liner from 1,182' to 1,622' 270 270 7/78' hole from 1,622' to 2,231' 100 100 12' casing liner from 1,22' to 2,231' to 2,540' 100 100 12' casing liner from 1,22' to 2,231' to 2,540' 100 100 12' casing liner from 1,22' to 2,231' to 2,540' 100 100 12' casing liner from 1,22	Hard dark gray basalt trace of quartz 2198 92.9 and green clay 2229 2310 Hard dark gray basalt 2229 2310 Hard dark gray basalt 2231 2353 Broken dark gray basalt 2310 2347 Broken dark gray basalt 2310 2347 Broken dark gray basalt 2427 2353 Soft porous dark gray basalt 2427 2465 Med and dark gray basalt 2462 2472 Hard dark gray basalt 2462 2472 Hard gark gray basalt 2472 2540 230 psi 100 deg. 2540 1880 12' casing liner from 1,182' to 1,622' 19 9 7/8' hole from 1,622' to 2,231' 15 Hole pulgged with cement from 2,231' to 2,540' 15 Start Date 8-20-09 Completed Date 12-22.09 or construction of this well, and its compliance with all Washington well to my bet knowledge and belicf. 23474 Drilling Company BL Exploration & Drilling Co., INC 23473 Address 404 N Convay St. WEECEBWED Commator's BEXPCH1120K

Well ID: 2799	Well Name:	Cross Section: B-B'
Surface Elevation: $1284f$ Well Depth: 2 Depth bgs (fr) Elevation (fr) Ø 1284 Ø $0Vf$ 315 961 Batant BASA $0Vf$ Batant 321 961 Batant $0Vf$ Batant 321 961 Batant $0Vf$ $0Vf$ 321 961 $0Vf$ $0Vf$ $0Vf$ 321 961 $0Vf$ $0Vf$ $0Vf$ 321 961 $0Vf$ $0Vf$ $0Vf$ 921 $00f$ $00f$ $00f$ $00f$ 921 $00f$ $00f$ $00f$ $00f$ $100f$ $00f$ $00f$ $00f$ $00f$ $00f$ $100f$ $00f$ $00f$ $00f$ <td>Well Depth: 254\$Ff</td> <td>Aquifer: GRB</td>	Well Depth: 254\$Ff	Aquifer: GRB
	OVB	OVB
321 7963	BASALT COLAY T	EM
	CLAY & SAND	RR
	BASALT (UAY	PM
875 = 409	BASALT	SEL
924 <u>-</u> 366 924 <u>-</u> 369 938 - 346	BASALT (UNY BASAGALT CUNY BASALT CUNY BASALT	UMA
1180 - 76	CLAY & SANDSTONE	MBTN
(38496	BASALT	PR
1575 -291		RZ
1590366	SILTSTONE BASALT	SQC
2100 014	BASALT	FS
2229 - 945	BASALT CUAY	VTG
	BASALT BASALT BASALT	GRB
2540 1-1256		

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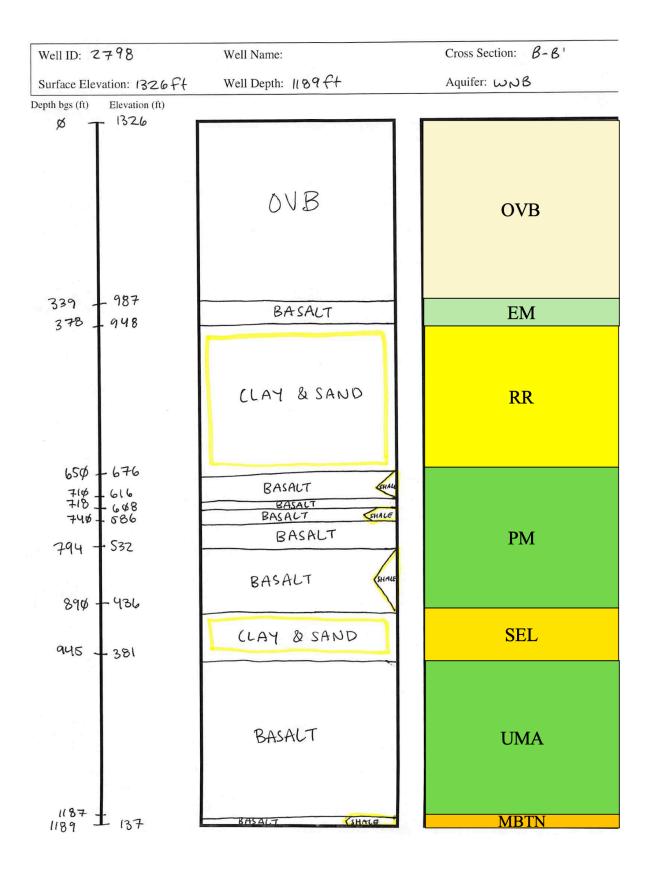
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Pg 3

(I) OWNER: Name Pat Clude		<u>7.41-25216</u>
(1) LOCATION OR WHEN	. Address	-Y'
ting and distance from section or subdivision corner	No 13 at 12 13 5 22 16 Sec Flo T.	(N., R
	140 100	
	(10) WELL LOG:	
	Formation: Describe by color, character, size of materi show thickness of aquifers and the kind and nature of stratum penetrated, with at least one entry for each	al and structure, and the material in each
(4) TYPE OF WORK: Owner's number of well (if more than one)	MATERIAL	FROM TO
Deepened Cable Driven	Coment Gravel	0. 40
Reconditioned Rotary Jetted	Land & Class awww	40 120
(5) DIMENSIONS: Diameter of well inches.	fund stone.	120 240
Drilled 744 tt. Depth of completed well 744 tt.	Sand stoney Plan	240 300
6) CONSTRUCTION DETAILS:	Basalt Brahen	339 378
Casing installed: Diam. from ft. to	Clay How	378 414 .
Threaded []	11 11 of sand	414 424
		424 440
Type of perforator used	Clay Blue	478 510
SIZE of perforations in. by in.	Real Part 2.	510 580
perforations from	Clear Blue + rand	540 588
perforations from	Sand fighe collored	620 633
Screens: Yes D No D	Clay Blue + aund	633 640
Manufacturer's Name	Baralt, the later of Rhy shill	640 670
Diam	Basalt Ing. Solut	710 718
Diam	Basalty Holefy winte Villow stall day	718 740
Gravel packed: Yes D No De Size of gravel;	Barate solut dans	740 794
Gravel placed from ft. to ft.		
Surface seal: Yes I No D To what depint 25 R. Material used in seal Bert-It		
Did any strata contain unusable water? Yes No D		
Type of water? Depth of strate		
7) PUMP: Manufacturer's Name		
WATEB LEVELS: Land-surface elevation atic level 47.5 ft. below top of well Date		
rtesian preasure		
Artesian water is controlled by		
WELL TESTS: Drawdown is amount water level is lowered below static level		
as a pump test made? Yes 🗆 No 🗆 If yes, by whom? And		pal Ju 79
eld: 35 gal/min. with ft. drawdown after hrs.	WELL DRILLER'S STATEMENT:	,
	This well was drilled under my jurisdiction a true to the best of my knowledge and belief.	nd this report is
measured from well top to water level)	NA DIA 1	
Time Water Level Time Water Level Time Water Level	(Person, firm, or corporation) (T	YDE or print)
	Address Rt 3 Bot 3356	(pa or print)
	Martin 1-1 2 0 41 3 336	
Sets of test	(Signed) That Tout.	
first testgal/min, withft, drawdown afterhrs.	(Well Driller)	

OWNER: Name PAUL PORTTEUS LOCATION OF WELL: County YAKIMA ag and distance from section or subdivision corner PROPOSED USE: Domestic industrial industrial InfrastantAX rest Well industrial INFrew will infrastantAX rest Well industrial INFree infrastantAX rest InfrastantAX rest INFree infrast INFree infrastantAX rest INFree infrast INFree infrast INFree infrast INFree	
LOCATION OF WELL: County YAKIMA	
working and distance from section or subdivision corner	Sec TIL_N, RAL_WM.
	unicipal (10) WELL LOG:
(4) TYPE OF WORK: Owner's number of well	show inschness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.
New well Dethod: Dug	Bored
Deepened A Cable [] Beconditioned []	Driven DBLACK_BASALT_BLUE_SHALE_H_7001775_
	BUIE CLAY SHALE
	inches. FINE BLUE GREEN SAND S 905 920
	CONGLOMERANT_STREAKS OF SAND_ 9201 940
Threaded Diam, from	FRAC. BLACK BASALT VVVH 948 1028
Welded	T GREY BASALT VVVH 1028 1153
Perforations: Yes F No	
Type of perforator used TORCH	BRUSER DESERT BLUE SHALE WATER 1187.11
SIZE of perforations 1.48 in. by 6	in
perforations from ft. to	
	<u></u>
Screens: Yes D No	
Manufacturer's Name	
Diam Slot size from ft. to	
/	
Gravel packed: Yes D No Size of gravel;	
Material used in seal. BENTONITE	n
Did any strata contain unusable water? Yes	
Static level 498 ft below top of well Date 3/	
Artesian water is controlled by (Cap, valve, o	E)
	the second se
WATER WELL REPORT STATE OF WAREDOTON 11 OWNER: Name PAUL PORTTEUS Address P.O. BOX 12 OWNER: Name PAUL PORTTEUS Address P.O. BOX 12 OWNER: Name PAUL COUNTY VAKIMA	
WATER WELL REPORT Address 10 OWNER: Non PAUL FORTEEUS Address 21 OWNER: Non PAUL FORTEEUS Address 22 OWNER: Non PAUL FORTEEUS Address 23 PROPOSED USE: Domestic fouristical owner Municipal 33 PROPOSED USE: Domestic fouristical owner Municipal 41 TYPE OF WORK: Create autobase of wall Municipal 35 DIMENSIONS: Diameter of wall SA C. table Detection 36 ONSTRUCTION DETAILS: Enter table SA C. table 37 Proforming: Yang D No Municipal 38 ONSTRUCTION DETAILS: Casing installed: ('Due to complete wall 18.9 39 ONSTRUCTION DETAILS: Casing installed: ('Due to completed wall 18.9 39 ONSTRUCTION DETAILS: Casing installed: ('Due to complete wall 18.9 30 ONSTRUCTION DETAILS: Casing installed: ('Due to complete wall 18.9 30 ONSTRUCTION DETAILS: Casing installed: ('Due to complete wall 18.9 30 ONSTRUCTION DETAILS: Casing installed: ('Due to complete wall 18.9 30 OGPM by AIR State of profession from f to f	
Recovery data (time taken as zero when pump turned off) (" measured from well top to water level) Time Water Level Time Water Level Time Wa	NAME RIEBE WELL DRILLING INC.
	(Person. firm, or corporation) (Type or print)
	Address P. 0. 10866 Yakima, 98909-1866
test	COLORIDA DE DETERMON
sating test	
Artesian flowg.p.m. Date Temperature of water	and the second sec
	/1

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	Well ID: 2792	Well Name:	Cross Section: $B-B'$
File Original and First Copy with Department of Ecology Second Copy - Owner's Copy Third Copy - Differer Copy Brate of Manual State of Manual	Surface Elevation: 1159F4	Well Depth: 1620Ff	Aquifer: WNB
	Depth bgs (ft) Elevation (ft)	11 3 10 10 2 1	
(1) OWNEE: Name Roza Investment Co. Address Yakima, Washington	Ø T ¹¹⁵⁹		
(2) LOCATION OF WELL: County Yakima 5E 4 UU is See 27 7 28 N R 7 28 WM	,		
	,		
	5 A.	DVB	OVB
(4) TYPE OF WORK. Owner's number of well 1		UNE	UvB
New well M Method: Dug D Bored D	~~R		
Reconditioned Batary R Jetted D Gravel sand 9 21			
(5) DIMENSIONS: 12" to 690"; 10" to 1220" Sandy clay yellow 21 140 (5) DIMENSIONS: Dumeter of well 8" to 1620 the standard stress of the standard stress o	282 - 877		EM
Drilled 1520 ft. Depth of completed well 1520 ft. Clay tan, shale 4 171 282	325 - 834	BASALT	EM
(6) CONSTRUCTION DETAILS: Casing instelled: 12	· · · · ·		
Casing instanted: The plan from 59 ft to 122 ft Sand white 340 348			
Welded (x 8 Diam. from 1512_ft to 1595_ft Shale tan 348 357 Clay sticky white 357 368		CLAY	DD
Perforations: Yes IV No C			RR
Size of perforationa 3/16 in by 2 in Liay sticky white 383 385	1		
perforations from 1313 ft to 1335 ft. perforations from ft to 1335 ft.			
perforations from	655 - 504	Pacala	
Screens: Yes O No Dr Basalt hard gray Pomora 655 685	685 - 474 695 - 464	BASALT	
Type			
Diam. Slot size from ft. to ft. Basalt hard gray 705 864	· .	BASALT	PM
Gravel packed: Yes D No (2) Size of gravel: Gravel large green black gray 902 937		Brisne .	
Grave placed from f. to Basalt medium black (Louis 937 1182	864 - 295	BASALT (LAY	
Surface seal: Yes D No To what depth? 702 at Clay hard gray & black & brkn has 1182 1189 Material weed in seal Comment. Yes D No No Resalt medium black P 1189 Did any strata contain unushic water Yes D No No Resalt medium Contact P 1189	902-257 937-222	GRAVEL	SEL
Search and Shart we s	-157		
Type of water? Depth of strate Basalt medium black 1317 1350 Method of sealing strate off Basalt hard gray 1350 1440		in the second	
(7) PUMP: Manufacturer's Name Beaalt med hard gray & bro frac. 1440 1538		BASALT	UMA
Type:		01.0(101	UNIA
(8) WATER LEVELS: Land-surface elevation bove mean es level			
Artesian pressure has per square inch Date Besalt hard gray 1598 1620	1182 - 23 118930	BASALT CUAY	
(Cap, valve, etc.)		STRACT CON	MBTN
(9) WELL TESTS: Drawdown is amount yater level is lowered below static level Was a pump test made? Yes [Z] No [] Hyes, by whonn: Akland			
Yield: 420 gal/min. with 40 ft. drawdown after 4 hrs. WELL DRILLER'S STATEMENT;	and the second sec	,	
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.	1	0.1.5.0.1.77	
Recovery data (time taken as zero when pump turned off) (water level		BASALT	PR
Time Water Level Time Water Level Time Water Level NAME milling inc. (Type or print)			IR
Address P. D. Drawer P, Moses Lake, Wa. 98837			
		·,	
String 5. 10 f. drywdown after bra [Signed] Steven Moor	1565	i sa kamilia ana s	
Artestan file ()	1770	LLAY	
DEPART VE		BASALT	RZ
(USE ADDITIONAL SHEETS IF NECESSARY)	1620 -461	BUSUCI	

Water Well Report	Current Notice of Intent No W150735		OF ECOLOGY		Water Well Report	Current		0
Original - Ecology 1st copy - owner 2nd copy - driller			St Received	\backslash	VV ALEF VV EII REPORT	Notice of Intent No W150735		AS BO
Construction/Decommission	Unique Ecology Well ID Tag No AHP790		2004	1	In the set	Unique Ecology Well ID Tag No AHP790		VO: HP
	Water Right Permit No G4-2362	20 2	JUL 2 7 2004	نے ب	Construction/Decommission	Water Right Permit No G4G	200	JUL
Decommission ORIGINAL INSTALLATION Notice	Property Owner Name Valley Fruit Orchard LLC		6	Report.	Construction			300
			The of	<u>d</u>	Decommission ORIGINAL INSTALLATION Notice	Property Owner Name Valley Fruit Orchard LLC	2	6
152182	Well Street Address 12 Hoffer Rd.		PAL PEGINAI	ď.	IS2782 of Intent Number	Well Street Address 12 Hoffer Rd.		X PAL
PROPOSED USE Domestu: Industrial Municipal DeWater Zimgation Test Well Other	City Wapato County Yakama			=	PROPOSED USE Domestic Industrial Municipal DeWater Zimgation Test Well Other	City Wapato County Yakuma		
	Location NE1/4 1/4 SE 1/4 Sec 12 Twn 11	R 20 EW1	M Gurche	Well	DeWater 💟 Imgalion 🗋 Test Well 🗖 Other	Location NE1/4 1/4 SE 1/4 Sec 12 Twn]]		MT.
TYPE OF WORK Owner s number of well (if more than one)		***		5	TYPE OF WORK Owner's number of well (if more than one)	Location 101/4 1/4 00 D4 See 11 1WH		<u>м П</u>
Depend □ Depend Method □ Dug □ Bored □ Daven □ Depend □ Cable □ Rotary □ Jetted	Lat/Long (s t, r Lat Deg Lat	Min/Sec_		this	New well Reconditioned Method Dug Bored Daven	Lat/Long (st, r Lat Deg Lat	Min/Sec	··· ـــ
DIMENSIONS. Diameter of well 12 inches dailed 2004 ft.	still REQUIRED) Long Deg Lon			i.	Cable V Rotary Jetted			
Depth of completed well 2004 ft.	Long Deg Loo	ig Min/Se	ec	Ē	DIMENSIONS. Drameter of well 12 inches dailed 2004 ft.	still REQUIRED) Long Deg Lor	ig Min/Se	c
CONSTRUCTION DETAILS	Tax Parcel No			5	Depth of completed well 2004 ft.	Tax Parcel No	-	
Carper Welded Diam from £ 10 £					CONSTRUCTION DETAILS			
Installed Linerinstalled Diam from f. to f.	CONSTRUCTION OR DECOMMISSION	NPROCED	DURE	Information	Casing Weided 12 Diam from +1 ft. to 1060 ft Installed Liner installed Diam from ft. to ft	CONSTRUCTION OR DECOMMISSIO	NPROCED	URF
Threaded Diam. fromft. toft. Perforations: Yes ZNo	Formation. Describe by color character size of material and s	structure and	the kind and	at	Threaded Diam. Fom R. to R	Formation Describe by color, character, size of material and	structure and t	the kind and
Type of pertorator used	nature of the material in each stratum penetrated, with at least of in ~ m_on_due_al' water er-o_stared, (USE ADD) TIONA	one entry for a	each change of	Ë	Perforations: Yes No	nature of the material in each stratum penetrated, with at least	one entry for e	ach change
SIZE of perfs in by m and no of perfs from 1 to 1.	MATERIAL	FROM	TO	E E	Type of perforator used	.nformation in.acate all we er encountered. (JSE .DD TION)		
Screens Yes WNo KPac Location		0	4	¥	Screens Yes MNo K Pac Location	MATERIAL	FROM 936	975
Manufacturer's Name	Grav Sandstone sit	4	25		Manufacture's Name		936	999
Type Model No		25	33	the	Time Model No	Clay gray	999	1046
DamR toR toR toR toR toR		33	38	÷	Durn Slot aze from ft to ft	Hard green clay some broken basalt	1046	1046
Gravel/Filter packed Yes Z No Size of gravel/sand		38	69		DiamStot azefromft toft	Med hard broken basalt	1046	1030
Matenals placed fromf. tof.	Brown siltstone & sandstone layers	69	83	and/or	Gravel/Filter packed Yes No Size of gravel/sand	Hard fractured gray basalt	1050	1085
Surface Sealt 2 Yes No To what depth? 1050 ft		83	110	P		Very broken gray basalt water 180 ps 100gpm	1083	1085
Materal used in seal <u>cement</u>		110	145	ar	Surface Seal: 27 Yes No To what depth? 1060 ft	Hard fractured gray bas alt		
Did any strata contain unusable water?		145	172		Material used in seal CEMENT	Med hard basalt	1196	1118
Type of water? Depth of strata		172	179	Data	Did any strata contain unusable water?	Hard fractured basalt	1118	1140
Method of sealing strata off		179	206	õ	Type of water? Depth of strata Method of sealing strata off	Med hard basalt	1140	1312
PIMP: Manufacturer's Name		206	248	e U	PUMP Manufacturer's Name	Hard black day	1312	1315
Туре:НР		248	270	the	Type HP	Green Clay Med. soft black basalt	1315	1322
WATER LEVELS Land surface devation above mean sea level f.		270	315		WATER LEVELS Land surface devation above mean sea level 1	Hard dark gray basalt	1322	1396
Static level 543 ft below top of well Date		325	335	ŧ.	Saucievel 543 fibelow top of well Date			1404
Artesan pressure los per square inch Date		335	376	Warranty	Arteaan pressure lbs per square inch Date	Soft black porus basalt Little water 200psi 74 degrees		1404
Artenan water is controlled by		376	382	5	Arteaan water is conrolled by	Med hard dark gray basalt	1404	
(cap, valve, etc.)		382	423	La la	(cap, valve, etc.)	Hard fractured basalt Very hard gray basalt	1448	1456
WELL TESTS Drawdown is amount water level is lowered below static level		423	428		WELL TESTS Drawdown is amount water level is lowered below static level	Hard gray basalt some fracture	14:05	1505
Wasa pump test made? Yes No if yes by whom?		428	476	NOT	Wasa pump test made? Yes No If yes by whom?	Hard gray basalt some tracture Med soft black porus basalt Trace of hard green clay	1505	1575
Yield gal Immo with ft. drawdown after hrs.		476	534	2	Yield. gal /mn. with ft. drawdown after hrs. Yield. gal /mn. with ft. drawdown after hrs.	Soft black porus basait Trace of mard green clay	(1)	1100
Yieldgal Anna. withft. drawdown afterhrs.		534	543		Yield gal /min. with ft drawdown after hrs.	225 ps	1585	1604
Recovery data (time taken as zero when pump turned off) (water level measured from well the to water level)		543	579	oes	Pecovery data (time taken as zero when pump turned off) (water level measured from well		1585	1675
Time Water Level Time Water Level Time Water Level		579	590	<u> </u>	top to water level)	Hard light gray basalt some fracture	1604	16/5
		590	663	ō	Time Water Level Time Water Level Time Water Level	Soft black basalt water 250psi	1685	1712
	Hard green clay	663	685	ΥĒ			1712	1733
Date of test		685	705	Ecology	Cate of test	Soft black porus basalt Trace of green & gray clay		1
aler test gal /mn. with ft_drawdown after hrs	Green & Gray clay layers	705	742	0	Bailer test gal/man. with ft. drawdown after hrs		1733	1752
Aurtest 600 gal/man with stem set at 1995 ft for 1 hrs	Broken Black basalt & green clay	742	752	.0	Austest 600 gal /mm with stem set at 1995 ft for 1 hrs		1752	1825
stean flowgpm_Date		752	785		Artesan flow gpm Date	Hard gray basalt	1825	1941
emperature of water Was a chemical analysis made? Tyes No	Very hard gray basalt	785	936	٥f	Temperature of water Was a chemical analysis made? Yes No	Med hard fractured gray basalt	1941	1953
	Start Date 12 11-03 Completed	d Date 2 5-0	04	ŧ			d Date 2 5-0	
ELL CONSTRUCTION CERTIFICATION I constructed and/or acc				er				
ashington well construction standards Matenals used and the informatio	on reported above are true to my hest knowledge an	d belief	ance with all	Ē	WELL CONSTRUCTION CERTIFICATION I constructed and/or a	ccept responsibility for construction of this well and	its complia	ance with
Iler/Engineer/Trainee Name (Pnnt) Larty McLanahan	Driling Company BJ Exploration Co., Inc.	- Jener		5	Washington well construction standards Matenals used and the informat		d belief	
Der/Engineer Trainee Signature Sarry Ma	Address 404 North Conway Street			a	DnBer/Engineer/Trainee Name (Print) Laser McLanahan DnBer/Engineer/Trainee Signature) 1999 M	Dulling Company BJ EXPLORATION CO., INC.		
Der or tramee License No. 0337	City Sate Zip Kennewick WA 99336				Dniler/Engineer/Trainee Signiture) Pring Pring Dniler or trainee License No 0337	Address 404 North Conway Street		
	Contractor's					City State Zip Kennewick, WA 99336		
					(# TRAINEE	Contractor i		
TRAINEE	Registration No BJEXPCI132OK	Dale <u>3/4</u>	1/14	he	Driler' Largend Ne	Registration No BJEXPCI132OK	Date 3 -	4-11

		Well ID: 2773	Well Name:	Cross Section: B-B'
		Surface Elevation: 1139ft	Well Depth: 2004ft	Aquifer: WNB
Please print sign and return	n to the Department of Ecology Current Notice of Intent No W150735	Depth bgs (ft) Elevation (ft) \emptyset T 1/39		
Construction/Decommission Construction/Decommission Construction Decommission IS2782 of Intent Number	Unique Ecology Well ID Tag No <u>AHP790</u> Water Right Permit No <u>54 - Z36 20 PJUL 27 2004</u> Property Owner Name Valley Fruit Orchard ILC Well Street Address ¹² Hoffer Rd		OVB	OVB
PROPOSED USE Domestic Industrial Municipal DeWater Zimgation Test Well Other	City Wapato County Yaluma Location <u>NE1/4 1/4 SE 1/4 Sec 12</u> Twn II R20 (EWM) Core	376 - 763	BASALT	EM
Image: Construction Addred Dage Barred Dawm Depynend Cohie Z Rolary Jaized DIMENSION Damates of well 12 undre failed 200M A Depth of completed well 200M # CONSTRUCTION DETAILS Carrage ZJ Weided 12 Damatrom +1 \$ to 1060 #	Lat/Long (s t r Lat Deg Lat Mm/Sec still REQUIRED) Long Deg Long Mm/Sec Tax Parcel No	423 - 716		
Carsong ZWedded 12 Dama from +1 1 10000 8 Installed Uncerturalide Dama from A to A Intransded Uncerturalide Dama from A to A Intransded Uncerturalide Dama from A to A Verifications Vers ZNo Type of partinuary used SZZ of parts us by m ading of parts A Size of parts us by CK for the Location A A	CONSTRUCTION OR DE COMMISSION PROCEDURE Formition, Describe by order character size of mixtual and structure and the fands and mixer of the material scale astitus prostruction, while all science entry for each charge of method number of the science of the science of the science of the science of the method number of the science of the science of the science of the method number of the science of the science of the science of the method number of the science of the science of the science of the method number of the science of	742 - 297	BLAY & SANDSTONE	RR
Strees Urso K Fac Model No Type	Soft Water 350ps 85 degrees 1 Bitck porus bask 1Trace of green clay & quartz 1953 1971 Wood to black clay 1968 1971 Med hard black basali 1971 1976	742 - 397 752 - 307	RASALT CUAY	PM
Cravel/Filter packed Yes No Size of gravel/sandf. Muenals placed fromf. tof.	Med soft porus black basalt Trace of quartz 1976 1982 Hard dark gray basalt 1982 1988	975 - 164	CLAY	
Surface Seak Yes No To what depth? 1060 ft Muncal used in real CELMENT Dd any strain contains unusable wulle? Yes No Type of wulle? Depth of strata Depth of strata	Soft red basalt & red clay 1988 1990 Soft black porus basalt 360 ps 1990 1996 Hard dark gray basalt 1996 2004	999 - 140 1046 - 93	CLAY GASALT	SEL
Method of valung strata off			BASALT	UMA
Saucievei <u>543</u> ft belowiop of well Date Arceaan pressure Tos per square unch Date Arceaan water is controlled by (map, valve, etc.)		1312 173 1322 183	(LAY	MBTN
WELL TESTS Drawdown i narouzi water level i lowerzh bedow state level Weis parou tearnen de level en level de level de level Yiel gal tans with A structure alter print Yiel gal tans with A structure alter print Yiel gal tans with print artworkson after ben manuel effon will	12" Casing to 1060' 12" Rock hole to 1660' 9 1/8 hole from	· · · · · · · · · · · · · · · · · · ·	BASALT	PR
top to water level) Time Water Leve Time Water evel	1640 - 2004	1575436 1585446	BASALT (CLAY	
Dae of less gal /mm, whb ft, drawdown â.fsr hri Baller test gal /mm, whb acm set al 1995 ft, for hri Arcean for w gp m. Date Temperature of water Was a chemical analysis made? for Date		1733 - 594 1752 - 613	BASALT CUAY	RZ
·	Start Date 12 11-03 Compress Date 2 5-04 scept responsibility for construction of this well and its compliance with all on reported above are true to my best knowledge and belief Driling Company ID EXPLORATION CO. INC Address 4004 North Conwary Street	1752-615	BASALT	KZ.
Driller of trainee Licensie No (333) If TRAINEE Driker Licensie No Driker Signure	City Sale 2/P, Kanzwick WA99336 Cotinada's Regaration No <u>BIEKPCT132OK</u> Date <u>3-4-()</u> 4 Ecology an Equil Openaturaty Employer ECY 098 130 (Rev 200)	(953814 -829 -929 -929 -937 -937 -937 -937		SQC
		2004 -865	BASALT	FS

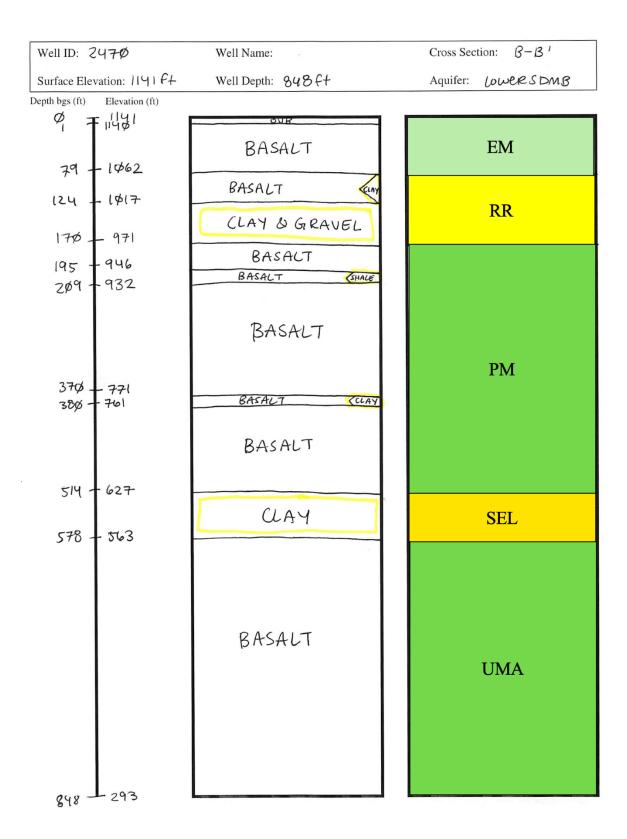
	2742	· ·			Well ID: 2743
Department of Ecology Econy – Owner's Copy	2743				Surface Elevation: 1179 f
	Condent to functions on the second construction of the second construction of t				
			_ N W 34	SW 14 Sec. 1 T.11 N. R. 20 W.M.	
			(10) WELL LOG:	M	
			Formation: Describe by color show thickness of aquifers an stratum penetrated, with at 1	character, size of material and structure, and d the kind and nature of the material in each east one entry for each change of formation.	
(4) TYPE OF WORK: New well	(if more than one) (if more than one)	ug D Bored D			
Deepened	D O	Cable 🗌 Driven 🗌			220-957
					262 - 917
Drilled 1500 (t	Diameter of well Depth of completed	well 1400 rt			
					210
		<u> </u>			319 - 800
Threaded D 16	" Diam. from +1				
Welded 2 10-	3/4 Diam. from 80	43 WATER WELL REPORT Application Ne. Surface Clevaling Johnson Astern Rt. 61, Box 247 Zillah, Washington 9993 Surface Elevation Johnson Astern Rt. 61, Box 247 Zillah, Washington 9993 Dophoson 9993 Industrial Omerican Astern Rt. 61, Box 247 Zillah, Washington 9993 Dophoson 9993 Industrial Omerican (10) WELL LOG: Dop 5011 Dop 5011 Industrial Omerican (10) WELL LOG: Dop 5011 Dop 5011 Industrial Omerican (10) WELL LOG: Dop 5011 Dop 5011 Industrial Omerican (10) WELL LOG: Dop 5011 Dop 5011 Industrial Omerican (10) WELL LOG: Dop 5011 Dop 5011 Industrial Omerican (11) Top 5011 Dop 5011 Dop 5011 Industrial John Constructure Stratt 220 262 243 38 Inter of well J1-1(2) Sand. 6.1ay Sand. 6.1ay Sand. 12, Jana 14,			
Perforations: Yes @	No 🖸 🚽	a .			
Type of perforator u	1/8 In h	$\frac{y \ Cut}{2 - 1/2}$ in			
M111 perforati	ons from 800	n w 1400 n			
			Clay & sand; thin s	treeks of basalt 841 934	
		1 10 - 17 1 - 19 - 1 10 - 19 - 19 - 19 - 19 - 19			
					705 - 474
Gravel packed: yes	No 24 Size of a	travel:			714 - 462
Gravel placed from	ft. to				
Surface seal: Yes X	No [] To what de	pth?41n	Grey clayish sand.	basalt 1120 1163	211 228
		was a was b			841 - 550
Type of water? N/	A Denth of	strata N/A			
Method of sealing str	ata off		Black, brown, whit	e, Grey basalt 1200 1220	934 - 245
7) PUMP: Manufacturer's					
					1030-149
				1268 1341	1050-129
atic level					
	trolled by				1120-59
(9) WELL TESTS:	Drawdown is amount lowered below static	water level is level	Green clay, string	ers blk & brn bst 1438 1468 salt, very hard 1468 1500	1183 4
Was a pump test made? Yes 🙆	No If yes, by wh	om? Lubdorff			1220 - 41
			1		12.48 .61
			true to the best of my k	nowledge and belief.	1268 59
Time Water Level Time	m 300 6	ime Water Level O min 300	(Person, fir	m, or corporation) (Type or print)	
min 350 10 m	in 300		Address P.O. Box 38	6) Hoses Lake, Wash. 98837	
<u>300</u> 30 m	in		Bhy P.	Grad All :.	
	bft. drawdor	wn afterhrs.	[Signed]	(Well Driller)	
Artesian flow			License No. 0762	Contenter 10 77	
FCY 050-1-20		USE ADDITIONAL S	HEFTS IF NECESSARY)	— (3)	1500 -321
					1049

	Well Name:	Cross Section: B-B'
179ft	Well Depth: 1500 ft	Aquifer: WNB
on (ft)	-	
۹ ا		
L	OVB	OVB
	BASALT SAND	
	BASALT	EM
	BASALT QUAY	
	CLAY & SAND	RR
	BASALT (CIAY	
	BASALT (UAY	PM
	BASALT	F IVI
	CLAY SSAND	SEL
	BASALT	
	BASALT (UAY	
	BASALT	UMA
	BASALT	
	BASALT	
	BASALT TAND.	MBTN
	CAND & SHALE	
	BASALT	
1	SHALE & SAND	
4	BASALT	PR
	BASALT (URY	
٩	LLAY (BASALT	
ι	BASALT	

Second Copy-Owner's Copy	Start Card No 08		:
Ihird Copy—Driller a Copy	Water Right Permit No	r	
1) OWNER Name Waren E Hazen	Address PO Box 302, Sunnyside,	WA 98944	
		0 <u>n r 23 wm</u>	
2) LOCATION OF WELL County Yakıma		<u> </u>	
2a) STREET ADDDRESS OF WELL (or nearest address)			2
3) PROPOSED USE Domestic Industrial Municipal	(10) WELL LOG or ABANDONMENT PROCEDU		
DeWater Test Well U Other U	Formation Describe by color character size of material an thickness of aquifers and the kind and nature of the material in e	nd structure and show ach stratum penetrated	š
(if more than one)	with at least one entry for each change of information	FROM TO	
Abandoned 🗌 New well 🔯 Method Dug 🗌 Bored 🗌	Top soil	0 1	-
Deepened Cable Driven Reconditioned Retaining States	Light brown rotten basalt	1 12	-
(5) DIMENSIONS Diameter of well 18x16x12x10 inches	Hard gray basalt	12 30	_
Drilled 848feet Depth of completed well 848ft	Brown rotten basalt	30 39	-
(6) CONSTRUCTION DETAILS	Black basalt	39 45	-
Casing installed <u>12"</u> Diam from +2 ft to 223 ft	Rotten basalt Layers of solid & rotten basalt	45 <u>55</u> 55 79	
	Layers of clay & rotten basalt	79 124	-
Wolded X 10" Diam from +2 tt to 618 ft Liner installed X Diam from +2 tt to 618 ft Threaded Image: Constraint of the second	Layers of brown clay & gravel	124 170	
Perforations Yes No	Rotten brown basalt	170 185	-
Type of perforator used	Black basalt	185 195 	-
SIZE of perforations in by in in ft to ft	Yellow shale brown & black basalt Brown & gray basalt fractured	209 214	-
perforations fromft toft	Hard black basalt	214 232	-
perforations from ft to ft	Fractured black basalt	232 309	_
	Gray basalt	309 317	-
Manufacturer s Name	Red/brown pouris basalt water Fractured brown black basalt	317 331 331 340	-
Type Model No Diam Slot sizefromft toft	Rotten brown basalt	340 362	
Diam Slot sizetromtt tott	Fractured black basalt	362 370	-
Gravel packed Yes No X Size of gravel	Yellow clay brown & black basalt	370 380	_
Gravel placed fromft toft	Layers of black/red/brown basalt	380 470	-
Surface seal Yes No To what depth? 618 ft	Fractured gray basalt Blue conglomerate	<u>470 514</u> 514 525	
Material used in seal Cement	Brown shale	525 530	-
Did any strata contain unusable water? YesNo ⊠	Soupy brown sand w/mica	530 550	_
Type of water?	Brown sandy clay & shale	550 5.66	- "
(7) PUMP Manufacturer s Name	Blue clay	566 570	-
Туре Н Р	Layers of blue & brown clay Blue clay and shale	570 574 574 578	-
(8) WATER LEVELS Land surface elevation above mean sea level ft	Hard black basalt	578 618	
Static level <u>535</u> It below top of well Date $4/29/93$	Hard gray basalt	618 635	_
Artesian pressure lbs per square inch Date	Medium black basalt	635 650	-
Artesian water is controlled by (Cap valve etc))	Work started 4/12/93 19 Completed	4/29 19 9	. 3
(9) WELL TESTS Drawdown is amount water level is lowered below static level Was a pump test made? Yes No If yes by whom?			5
Yield gal /min with ft drawdown after hrs	WELL CONSTRUCTOR CERTIFICATION		
Estimated air lift 500+ GPM	I constructed and/or accept responsibility for cons and its compliance with all Washington well con	nstruction standards	
Recovery data (time taken as zero when pump turned off) (water level measured	Materials used and the information reported above knowledge and belief	are true to my best	1
from well top to water level) Time Water Level Time Water Level Time Water Level	Dondonoso Drallang (Double	mmant Tr -	
	NAME Ponderosa Drilling & Develo (PERSON FIRM OR CORPORATION)	(TYPE OR PRINT)	
	Address E 6010 Broadway Spokane,	WA 99212	
Date of test	RKB. T		
Bailer test gal /min with ft drawdown after hrs	(Signed) Der Miller License	No 0043	
Airtest gal /min with stem set at ft for hrs	Contractor s (WELL DRILLER) (Bob Britton		
Artesian flow g p m Date	Registration No PO-ND-EI*248JE Date 4/30	19.93	-
Temperature of water Was a chemical analysis made? Yes 💭 No 💭	(USE ADDITIONAL SHEETS IF NECES		

File	Original and First Copy with WATER WE			
Sec	ond Copy—Owner a Copy STATE OF V	WASHINGTON Water Right Permit No 64-2960	5P	
_				
<u></u>		Address		
Ø	LOCATION OF WELL County Yakıma	<u>SE_v_NW_v_sec_24_</u> r_ <u>1</u>	<u>0_</u> n r.	<u>23</u> w
(2a)	STREET ADDDRESS OF WELL (or nearest address)			
(3)	PROPOSED USE Domestic Industrial Municipal	(10) WELL LOG or ABANDONMENT PROCEDUR	RE DESC	CRIPTI
	DeWater Test Well Dother	Formation Describe by color character size of material an	d structure	e and si
(4)	TYPE OF WORK Owner a number of well (if more than one)	thickness of aquifers and the kind and nature of the material in et with at least one entry for each change of information MATERIAL	FROM	то
	Abandoned New well Method Dug Bored	Hard gray basalt	650	750
	Deepened Cable Driven Reconditioned Rotary Jetted	Pouris black basalt w/water	750	760
(5)	DIMENSIONS Diameter of wellinches	Hard black basalt	760	767
(-)	Drilledfeet Depth of completed wellft	Soft black basalt	767	777
(8)	CONSTRUCTION DETAILS	Hard black basalt	777	805
(0)		Hard gray basalt	805	837
	Welded	Pouris black basalt black glass Hard black basalt	837 846	846
	Uner installed Diam fromft toft Threaded Diam fromft toft	naru biack basait	040	048
	Perforations Yes No	Note water at 750' has a lot of		
	Type of perforator used	gas in it		
	SIZE of perforations in by in			
	ft_toft_ttofttttoft_tttoft_ttoftttttofttttto _			
	ft_toft_ttoft_ttoft_ttoft_ttoft_ttoft_ttoft_ttt			
_	perforations from ft to ft		L	<u> </u>
	Screens Yes No			
	Manufacturer s Name			
`	Type			
~	Diam Slot sizefromft toft	E BOCHWS,		+
	Gravel packed Yes No Size of gravel	In 519		
	Gravel placed fromft toft	111		
_		MAY - 6 1993 124		
	Surface seal Yes No To what depth?ft	113-1		
	Did any strata contain unusable water? Yes No	· · · · · · · · · · · · · · · · · · ·		-
	Type of water?Depth of strata	IDPan DEar Did in a b		
	Method of sealing strata off			1-
(7)	PUMP Manufacturer s Name			
	Туро Н Р			+
(8)	WATER LEVELS Land surface elevation above mean sea level ft			
,	Static levelft below top of well Date			
	Artesian pressure Ibs per square inch Date			
	Artesian water is controlled by(Cap valve etc.))	4 /12 /02		1
(9)	WELL TESTS Drawdown is amount water level is lowered below static level Was a pumptest made? No X If yes by whom?	Work started 4/12/93 19 Completed 4/29	2	19_
		WELL CONSTRUCTOR CERTIFICATION		
	Yield gal /min with ft drawdown after hrs Estimated air lift 500+ GPM	I constructed and/or accept responsibility for const	truction o	f this w
_	Estimated an IIIt 500+ GFM	and its compliance with all Washington well com Materials used and the information reported above	are true	to my b
	Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)	knowledge and behef		
	Time Water Level Time Water Level Time Water Level	NAME Ponderosa Drilling & Develop	asn+ ⊺	Inc
		(PERSON FIRM OR CORPORATION)	(TYPE C	DR PRINT)
		Address E 6010 Broadway Spokane,	WA 99	9212
	Date of test	R.K. R. O.H.		
	Bailer test gal /min with ft drawdown after hrs	(Signed) Boy Dillon License	No004	13
	Airtest gal / min with stem set at ft for hrs	(Signed) UPUP UPUPUPUPUPUPUPUPUPUPUPUPUPUPUPUPU)	
	Artesian flow g p m Date flow	Registration No PO-ND-EI*248JE Date 4/30		_ 19_
	Temperature of water Was a chemical analysis made? Yes No			

108



<u>^</u>	2455		Well ID: 2455	Well Name:	Cross Section: \mathcal{B} - \mathcal{B}'
	ELL REPORT	tion No.9 .4,25,0 52	Surface Elevation: $/\phi\phi 4 f_{+}$	Well Depth: 985ff	Aquifer: Lower SDMB
(1) OWNER: Name William Visser	Support La Hasht		Depth bgs (ft) Elevation (ft)		
LOCATION OF WELL: County	N.E. 15	T. 28. N., R. 10. WM H	Ø11 7 993	ONB	OVB
ring and distance from section or subdivision corne: (3) PROPOSED USE: Domestic Industrial Municipal Irritation & Test Well Other	(10) WELL LOG:	0 x 3			
		cterial and structure, and e of the material in each ich change of formation.		BASALT	EM
(4) TYPE OF WORK: Owner's number of well New well S Method: Dug Bored	MATERIAL	FROM TO	101 - 903		
Signature and a state and a st	Soll (Overburden)	0 11	121 - 883	SAND, CLAY & GRAVEL BASALT	
5) DIMENSIONS: Diameter of well 18-14-16 inches	Porous Black Hard Basalt	59 75 520	130 - 874	BASACI	RR
Drilled 202 ft Depth of completed well 202 (t	Black Hard Basalt Sand Clay and Gravel	75 101 ATN (101 121)		SAND	K K
(6) CONSTRUCTION DETAILS: Casing installed: 18 Diam from +1 ft to 20 ft Threaded 1 14 Diam from 9 ft to 229 ft Welded 13 10 Diam from 524 ft to 625 ft Performance: var and var	Black Hard Basalt	121 130 EM	215 110	SAND	
Casing installed: 18 " plan from +1 (1 to 20 to	Sandy Interbed	130 151 - 5	215 - 789		
Casing installed: 18" Diam from +1 ft. to -20 ft Threaded" Diam. from 9 ft. to -229 ft Welded gg Diam. from 524 ft to 625 ft	Sandstone	151 162			
Welded 2	Interbed (Brown Sand) Sandstone	162 191 [*] 191 215			
Perforations: Yes D No Z	Black Hard Basalt	215 350			
Type of perforator used	Porous Black Hard Basalt	350 371 Cm			
perforations from ft to ft	Black Hard Basalt Porous Black Basalt & Clay	371 543			
Perforations from ft to ft perforations from ft to ft perforations from ft to ft ft to ft to	Black Hard Basalt	- 543 610 ·· map 610 965		BASALT	
aa aa aa aa aa aa	Porous Black Basalt	965 980 P		D13011C 1	
Screens: yes . No go Manufacturer's Name	Black Hard Basalt /	980 985	1 1		PM
Type		i			
Diam Slot size from ft. to ft. Diam Slot size from ft. to ft.					
Gravel nacked: n = n = n					
Gravel packed: Yes No XX Size of gravel			1990 B. C.		
Surface seal: yest No To what depth? 20	DEC 8 - 1977		I I		
Did any strata contain unusable water? Yes 🗆 No 🕅	DL <u>U</u> 0 = 1077		543 - 461		
	DEPARTMENT OF ECOLD IY CENTON REDOKAL CENCE	1	545 401		
Method of scaling strata off	CERTER REPORT CHEICE			BASALT CLAY	SEL
(1) I UMIT: Manufacturer's Name		· · · · · · · · · · · · · · · · · · ·	610 - 394		SEL
X			4 ,		
O (8) WATER LEVELS: Land-surface elevation above mean sea level.					
Static level					
Static level					
(9) WELL TESTS: Drawdown is amount water level is					
 (9) WELL TESTS: Drawdown is amount water level is lowered below static level Was a pump test made? Yes D No D H yes, by whom? 	Work started		1 1	×	
	WELL DRILLER'S STATEMENT:		1 1		
Y field: gal/min. with ft drawdown after hr., """"""""""""""""""""""""""""""""""""	This well was drilled under my jurisdicti true to the best of my knowledge and belie	on and this report is		BASALT	
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)	, where to the best of my knowledge and belie	n. ,		J to the	
measured from well top to water level) Time Water Level Time Water Level Time Water Level	NAME Adcock Air Drilling (Person, firm, or corporation)	(Type or print)	1		UMA
	Address 2033 Brd Avenue, North Le	wiston, Idaho			
	alitat	>			
Date of test	[Signed] Alle After (well Driller)	/			
Artesian flow					
Temperature of water	License No. UUL Date Oct	ober 28, 1977			
(USE ADDITIONAL SI	HEETS IF NECESSARY)	-			
S. F. No. 7356-OS-(Rev. 4-71).		د کی			
and the second sec		1	985 19		

S File Original and First Copy with	ELL REPORT 2451 Application No	Well ID: 2451	Well Name:	Cross Section: B-B'
	WASHINGTON	Surface Elevation: (208f4	Well Depth: 700 ft	Aquifer: Lower SDMB
(1) Official Name Connystic Line Con	Address 12-> 127 2169 52 + Dison PSRO			
(2) LOCATION OF WELL County YAKIHA	St " NE ", Sec 14 T 10 N R 3 WM ;	^φ Τ ^{12φ8}		
(3) PROPOSED USE Domestic [] Industrial [] Municipal []	(10) WELL LOG	25	OVB	OVB
(3) PROPOSED USE Domestic industrial Municipal Irritization of Tevt Net Other ((4) TYPE OF WORK Owners number of well Network Municipal Proved I Network Municipal P	how the hear of sequences and the kind and nature of the material is each distance and the each data of distance of the material is each distance of the material is	35 - 1173	BASALT	EM
Drilled 700 ft Depth of completed well 700 ft (6) CONSTRUCTION DETAILS Casing installed /2 Diam from ft to 35 ft to 71 ft Threaded // Diam from 35 ft to 27/1 ft Welded Diam from ft to 1 ft Perforations Yes No No Yes No Yes	HALD - 105 124 GUER ALLOW ANTONIC 124 125 BRUN CLAY 88 130 205 HALD GRAY ARTSALT Ver 330 VELY 5077 BASALT Ver 330 3 12 MICKET UN MATER (100644)	13¢ - 1¢78	CLAY	RR
Chaining unstatilitie Diam from The to JH if it with the to JH if it it is JH if it JH if JH i	HILD MACACY 3.0 JAO CUET 15A-51-57 CUET 15A-51-57 CUET CLAY MNON B JSG 635 15A-534-7 635 700 	2,\$5 - 1\$\$	BASALT	
Surface seal ves No D To what depth? If the Material used in seal Did any strata contain unusab e water? Yes No D Type of wa er? Method of sealing strata of Depth of strat. Method of sealing strata of Type UIP	CENTRAL REGIONAL OFFICE		D/13/1-0	РМ
(8) WATER LFVELS Land surface slevation above means sea level above means sea level the per square inch Date Artestan pressure rt Artestan pressure Ibs per square inch Date Artestan water is controlled by (Cap value etc.) (Gap value etc.) (9) WELL TESTS Drawdown is amount water level is loweed belaw statis level Was a pump test mader? Yes: No □ Use sby whom?	Work started 19 Completed 19	5570 - 658		
Yield gal/min with ft drawdown after hrg	WELL DRILLER'S STATEMENT This well vas drilled under my jurischetion and thus report is use to the best of my knowledge and belief NAME ADJECK ALL DELLUNG (Person firm or corporation) (Type or print) Address YO33 300 ALL N LEW STON		CLAY	SEL
Date of test - Balter test - Arteslan flow - Temperature of water Was a chemical analy is made? Yes No USE ADDITIONAL SR	[Signed] C-ADLAL Ly JAMEU (Well brikk)7/20 Liccnee No CO/ Date 1877	625 - 573	BASALT	UMA
ECY 050-1 20	· · · · · · · · · · · · · · · · · · ·	700 L 508		

WATER WELL REPORT	CURRENT Notice of Intent No. W150756		243
DODDOT C			OF ECOLOGY
Construction/Decommission ("x" in circle) 175906	Unique Ecology Well ID Tag No. AHP770	<u> </u>	Received
 Construction 	Water Right Permit No. G4-34953	(*	
Decommission ORIGINAL INSTALLATION Notice	Property Owner Name Art DenHoed	()	2 4 2005
of Intent Number	Well Street Address 62002 N. Missimer Rd		
PROPOSED USE: Domestic Industrial Municipal			20.00
DeWater	City Grandview County Yak		MAL REGION
TYPE OF WORK: Owner's number of well (if more than one)	Location Sw 1/4-1/4 Sec 1/4 Sec 5 Twn 10	2N R 23 EW1	M Carde
New well Reconditioned Method Day Bared Driven			M 🔲 one
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Lat/Long (s, t, r Lat Deg L		
DIMENSIONS: Diameter of well <u>12</u> - inches, drilled <u>1718</u> ft.	Still REQUIRED) Long Deg L	ong Min/Se.	c
CONSTRUCTION DETAILS	Tax Parcel No.		<i>k</i>)
	*		9
Installed: I Liner installed 16" Diam from +1 ft to 323' ft	CONSTRUCTION OR DECOMMISSI	ON PROCEDU	URE
Threaded 12" Diam from +1 ft. to 725' ft Perforations: Yes ZNo	Formation: Describe by color, character, size of material a	nd structure, and	the kind and
Type of perforator used	nature of the material in each stratum penetrated, with at le information. (USE ADDITIONAL SHEETS IF NEC	ast one entry for e	ach change of
SIZE of perfsin byin and no of perfsfromft toft	MATERIAL	FROM	то
Screens: Yes No K-Pac Location	MATERIAL Brown Silt	0	3
Manufacturer's Name	Brown Silt Gravel & cobbles	3	14
Type Model No	Brown clay & gravel	14	28
Diam. Slot size from ft. to ft. Diam. Slot size from ft. to ft.	Brown sitty clay	28	66
General/Bilter macked: Ver. 17 No. Size of gravel/and	Brown sandstone	66	96
Materials placed fromft. toft.	Med hard brown gray basalt	96	103
Surface Seal: Yes No To what depth? 725' ft	Hard gray basalt	103	112
Material used in seal coment	Soft tan claystone	112	114
Did any strata contain unusable water?	Sand gravel & cobbles Little water	114	123
Type of water? Depth of strata	Med hard dark gray basalt	123	139
Method of sealing strata off	Very hard gray basalt	139	169
PUMP: Manufacturer's Name	Mud hard fractured dark gray basalt	169	178
ТуреН.Р	Reddish brown sandstone	178	183
WATER LEVELS: Land-surface elevation above mean sea levelft.	Soft brown clay	183	206
Static levelft. below top of well Date	Tan clay	206	234
Artesian pressure lbs. per square inch Date	Tan clay & sandstone layers	234	272
Artesian water is controlled by(cap, valve, etc.)	Tan clay	272	292
WELL TESTS: Drawdown is amount water level is lowered below static level	Basalt med. hard gray	292	326
Was a pump test made? 🗖 Yes 🛛 No If yes, by whom?	Med. hard gray & reddish brown basalt	226	337
Yield: gal/min. with ft. drawdown after hrs.	Little water 10 gpm	326	340
Yield: gal/min. with fl. drawdown after hrs. Yield: gal/min. with fl. drawdown after hrs.	Soft	337	340
Recovery data (time taken as zero when pump turned off) (water level measured from well	Hard gray basalt	340	351
top to water level)	Soft broken gray basalt Little water 30 gpm Hard dark gray basalt	351	423
Time Water Level Time Water Level Time Water Level	Med, hard	423	423
	Med. soft fractured gray & brown basalt		+
Data of test	water 50 gpm	438	446
Date of test	Med. hard gray basalt	446	467
Airtest 2000 gal/min. with stem set at 1700 ft. for 1 hrs.	Hard light gray basalt	467	642
Artesian flow g.p.m. Date	Med. soft gray porus basait some hard gray clay	642	648
Temperature of water Was a chemical analysis made? Yes No	Reddish brown siltstone	648	659
respenses to many many sector and the sector of the sector	Start Date 4-8-05 Comp	eted Date 5-25	-05
			ance with all
WELL CONSTRUCTION CERTIFICATION: I constructed and/or acc Washington well construction standards. Materials used and the informatic Drulter Dirgureer D Trainer Name (Dar), Larry McLanahan Drulter Engureer Trainer Signatur, 2007,	Drilling Company BJ Exploration Co., Inc Address 404 N. Conway Street		
Washington well construction standards. Materials used and the information	Drilling Company BJ Exploration Co., Inc		
Washington well construction standards. Materials used and the informatic Driller Engineer Trainee Name Denil Larry McLanahan Driller/Engineer/Trainee Signalum MMM M.	Drilling Company BJ Exploration Co., Inc Address 404 N. Conway Street City, State, Zip Kennewick, WA 99336 Contractor's	Date 6-2	

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

WATER WELL REPORT Original & 1° copy - Ecology, 2° copy - owner, 3° copy - driller			
	CURRENT Notice of Intent No. W150756		DEPT OF SO
ECOLOGY	Unique Ecology Well ID Tag No. AHP776	6.4	Con Contract
Construction/Decommission ("x" in circle) Construction	Water Right Permit No. G4-34953	Ĕ	14
Decommission ORIGINAL INSTALLATION Notice	Property Owner Name Art DenHoed	E	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
of Intent Number		- (**	à
	Well Street Address 62002 N. Missimer Rd	~	Stoff OFFICE
PROPOSED USE: Domestic Industrial Municipal DeWater Infigation Test Well Other	City Grandview County Yakima		
TYPE OF WORK: Owner's number of well (if more than one)	Location Sw1/4-1/4 Se 1/4 Sec 5 Twn 10N	R_23 EWA or	4 Curde
Very well Reconditioned Method Day Bored Driven	Lat/Long (s, t, r Lat Deg Lat		M Coor
Depend <u>11-78</u> Cable Z Rotary Detted DIMENSIONS: Diameter of well <u>12"/97" inches, drilled</u> <u>1718'</u> ft.	Still REQUIRED) Long Deg Long		
Depth of completed well 1718 ft.	Long Deg Loi	ig Min/Sec	
CONSTRUCTION DETAILS	Tax Parcel No		
Casing Z Welded 24" Diam from +1 ft to 105' ft Installed: Z Liner installed 16" Diam from +1 ft to 323' ft	· · ·		
$\begin{array}{c c} \textbf{Casing} & \hline \textbf{Z} & \text{Weided} & \underline{24^{\prime\prime\prime}} & \overline{\text{Diam from +1}} & \text{ft to } \underline{105^{\prime\prime}} & \text{ft} \\ \hline \textbf{Installed} & \hline \textbf{Z} & \text{Liner installed} & \underline{16^{\prime\prime\prime}} & \overline{\text{Diam from +1}} & \text{ft to } \underline{322^{\prime\prime}} & \text{ft} \\ \hline \hline \textbf{Threade} & \underline{12^{\prime\prime\prime}} & \overline{\text{Diam from +1}} & \text{ft to } \underline{725^{\prime\prime}} & \text{ft} \\ \hline \end{array}$	CONSTRUCTION OR DECOMMISSION		
Perforations: Yes No	Formation: Describe by color, character, size of material and nature of the material in each stratum penetrated, with at least	structure, and the one entry for e	he kind and ach change of
Type of perforator used	information. (USE ADDITIONAL SHEETS IF NECES		
SIZE of perfsin byin and no. of perfsfromft toft	MATERIAL	FROM	TO
Screens: Yes No K-Pac Location	Brown Claystone	659	662
Manufacturer's Name	Greeen Sandstone	662	665
Type Model No Diam. Slot size from ft. to ft.	Green clay	665	691
DiamSlot sizefromfl. tofl.	Green & Brown clay	691	705
Gravel/Filter packed: Yes X No Size of gravel/sand	Brown clay & broken basalt	705	707
Materials placed fromft. toft.	Black porus basalt	707	710
Surface Seal: Yes No To what depth? 725' ft	Hard dark gray basalt (736-737 void)	710	870
Material used in seal comont	Soft black visicular basalt some black & green clay		
Did any strata contain unusable water?	water 300-400	870	878
Type of water? Depth of strata	Dark gray porus basalt Med. hard	878	928
Method of sealing strata off	Hard gray basalt	928	942
PUMP: Manufacturer's Name	Very broken gray basalt some visicular water 198 psi	942	944
-//-	Hard gray basalt	944	963
WATER LEVELS: Land-surface elevation above mean sea levelft.	Med. soft black basalt	963	987
Static levelft. below top of well Date	Med. hard dark gray basalt	987	1026
Artesian pressure lbs. per square inch Date	Med. soft dark gray & reddish brown basalt	1026	1032
Artesian water is controlled by(cap, valve, etc.)	Med. hard dark gray	1032	1036
WELL TESTS: Drawdown is amount water level is lowered below static level	Med. soft reddish brown & dark gray basalt	1036	1043
Was a pump test made? Yes No If yes, by whom?	Med. hard dark gray porus	1043	1053
Yield: gal/min. with ft. drawdown after hrs.	Med. soft dark gray porus basalt	1053	1079
Yield: gal/min. with ft. drawdown after hrs. Yield: gal/min. with ft. drawdown after hrs.	Soft broken black visicular basalt Water 260 psi 77de	1079	1083
Recovery data (time taken as zero when pump turned off) (water level measured from well	Med. hard porus black	1083	1089
top to water level)	Broken porus black basalt 270psi 280psi-1092	1089	1092
Time Water Level Time Water Level Time Water Level	Hard dark gray basalt	1109	1148
	Med. soft black porus basalt	1148	1172
	Hard gray basalt	1172	1185
Date of test	Med. soft black porus basalt Hard gray basalt	1185	1187
Bailer testgal./min. withft. drawdown afterhrs.	Soft black porus basalt some hard dark green clay	110/	
Airtest 2000 gal/min. with stem set at 1700 ft. for 1 hrs.	water 300 psi	1198	1217
Artesian flow g.p.m. Date	Hard dark gray basalt	1217	1242
Temperature of water Was a chemical analysis made? 🗖 Yes 🗖 No		ed Date 5-25	1
WELL CONSTRUCTION CERTIFICATION: I constructed and/or acc			ance with all
Washington well construction standards. Materials used and the information		nd belief.	
Driller Engineer Trainee Name (Print Larry McLanahan	Drilling Company BJ Exploration Co., Inc		
Driller/Engineer Trainee Signature	Address 404 N. Conway Street		
Driller or trainee License No. 0337	City, State, Zip Kennewick, WA 99336		

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

Contractor's

Registration No BJENPCI132QK

Date 6-23-05

Ecology is an Equal Opportunity Employer.

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

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

evation: 1083ft Well Depth: 1718ft Aquifer: WNB
Elevation (ft)
- (\$83
OVB OVB
987
971 BASALT 960 CLAY & GRAVEL
905 BASALT EM
SANDSTONE & CLAY
- 791
BASALT
- 441
378 SAND CONT
BASHUT CUAY
DIANT
BASALT
213
2/3 205 BASALT (UN)
UMA
D 4 C A L T
BASALT
-115 -124 BASALT (UAY MBTN
-134 BASALT (UAY MBIN
BASALT PR
-277 -278
-276 (LATA 10MF
Paral T
BASALT RZ
1

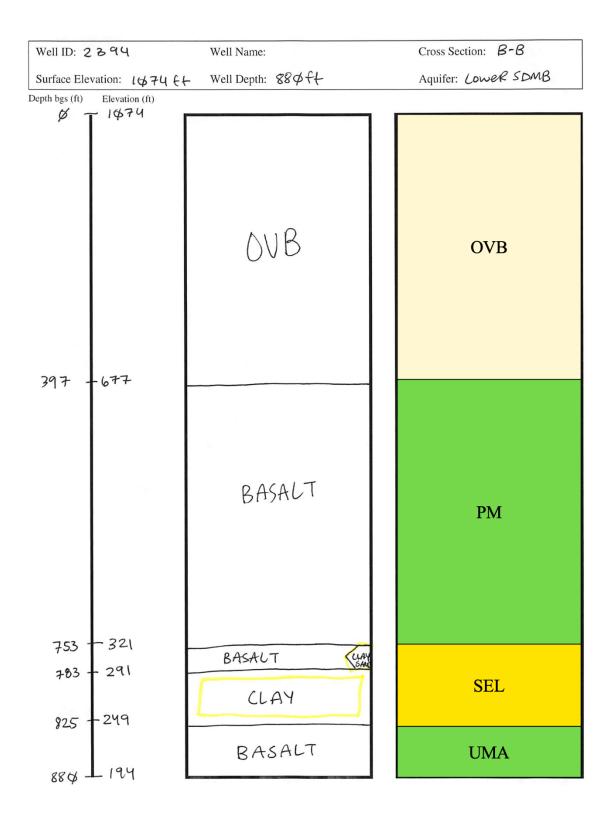
Dep Sec	Original and First Copy with animent of Ecology W. animent of Ecology Owner's Copy d Copy—Driller's Copy		ELL REPORT	Start Card NoC	4 - 3 0	163 P
(1)	OWNER: Name Alice Oosterhof				ernon W	A 982
21	LOCATION OF WELL: County	Yakima	SWA, NEA & NE	NE and 2 T	10 N. R	22
	STREET ADDDRESS OF WELL (or nearest address			* Sec T	10 N., R_	<u>22</u> W.M
(3)			1			_
(3)	Irrigation		(10) WELL LOG or ABANDO			
			Formation: Describe by color, chan thickness of aquifers and the kind and	acter, size of material an nature of the material in ea	d structure, ich atratum	and sho penetrate
(4)	TYPE OF WORK: Owner's number of well (if more than one)		with at least one entry for each change		FROM	то
	Abandoned Deepened Cab	e Driven	Hard pan & boldedrs		0	3
_	Reconditioned Rota	iry Jetted	Caliche & bolders		3	9
(5)	Diameter of well		cemented gravel		9	16
_	Drilled 783 teet. Depth of completed we	<u>770 </u>	Brown clay & sand		16	24
(6)	CONSTRUCTION DETAILS:		Cement gravel		24	
	Casing installed: 10 . Diam. from 0	t. tot.	Stickey brown clay Layers of brown clay	& gravel	<u>31</u> 70	70
	Welded 28 8 Diam. from +2 Liner installed 7 Threaded 7 Diam. from	1. to 770 tt.	Brown clay	a graver	105	155
		ft. toft.	Hard cemented gravel	w/ st of clay	155	290
	Perforations: Yes X No Torch		Hard cemented gravel	& sand	290	296
	SIZE of perforations 1/4 in. by	6 10	Hard bolders Brown clay		296 298	298 301
	128 perforations from 720 m	10750_ft	Gravel & clay		301	305
/8 x	. <u>6 78 perforations from 750 tt</u>	. to <u>770 </u>	Clay w/ st of sand		305	376
		to ft.	Layers of gravel cla	y & sand	376	393
	Screens: Yes No X		Hard sand w/ mica		393	397
	Manufacturer's Name	Model No.	Broken basalt, brown	nale	397	410
	DiamSlot aizefrom		Fractured basalt, bl. Basalt, black bard	ack .	410	545
_	DiamSlot sizefrom	#. to#.	Clevus		545	546
	Gravel pecked: Yes No X Size of gravel		Basalt, weathered		546	560
_	Gravel placed from fl. to	h.	Basalt, black, hard		560	710
	Surface seal: Yes X No To what depth?	455	Fractrued basalt, ha		710	7 <u>5</u> 3 783
	Material used in seal Cement		BLOKEN DASALL W/DIDE	Sand a Cray	_/33	103
	Did any strata contain unusable water? Yes No	pth of strate		PARI		i
	Method of seeling strate off				1	11 .
(7)	PUMP: Manufacturer's Name			1131		1 ++
	Туре:			IIIII FEB • 4		1
(8)	WATER LEVELS: Land-surface elevation					1
	Static level ft. below top of well Date	•		CENTRAL RECO	FECOLOGI	
	Artesian pressure Ibs. per equare inch 1 Artesian water is controlled by	Date		OLATING ALS		
	(Cap,	valve, etc.))	Work started 11/27/90	19. Completed 1/	16/91	19
(9)	WELL TESTS: Drawdown is amount water level is low Was a pump teel made? Yes No 🔀 If yes, by whom	vered below static level				_, 19
	Yield:100gel./min. withft. drawdow	n after hrs.	WELL CONSTRUCTOR CER			
_	"Estimated Airlift "		i constructed and/or accept and its compliance with all Materials used and the inform	Veshington well const	function of t truction at	this well, anderds.
	Recovery data (time taken as zero when pump turned off) (w from well too to water level)	nter level measured	Materials used and the inform knowledge and belief.	nation reported above a	ire true to	my best
		Time Water Level	NAME PONDEROSA DRILL	ING & developm	ENT IN	PRINT)
			Address E. 6010 BROAD	WYA, SPOKANE	WA 99	212
J	Date of test ft, drawdon Baller test ft, drawdon	wn atter bra.	(Signed) Refuer R.	Cittor License N	004	3
	Airtest gal./min. with stem set et Artesian flow g.p.m. Date	. It. for hre.	Contractor's Registration No DO-ND=EI *248JE	(TODELC DITCL	ui)	19

2394	
11010	LL REPORT Start Card No M130762 Unique Nell I D # AFN494 WASHINGTON Nater Right Permit No 64 - 36/63 P

	L SCOON RD SUNNYSIDE, WA
(2) LOCATION OF WELL County YAKIMA	- NE 1/4 NE 1/4 Sec 2 T 10 N R 22 WM
12 STREET ADDRESS OF WELL (or nearest address) 4701 SCOON RD .	
(3) PROPOSED USE INDUSTRIAL	(10) WELL LOG
(4) TYPE OF WORK Owner's Number of well	Formation Describe by color, character size of material
(If more than one) 1	and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with
DEEPENED Method ROTARY	and nature of the material in each stratum penetrated, with
(5) DIMENSIONS Diameter of well 8 inches	** at least one entry for each change in formation
0 illed 97 it. Pepth of completed well 880 ft	MATERIAL FROM TO
	== SOFT BASALT GREEN 83 825
CONSTRUCTION DETAILS Casing installed " Dia from ft to ft	CLAY 825 MEDIUM HARD BASALT 825 860
Casing installed " Dia from ft to ft " Dia from ft to ft " Dia from ft to ft	BASALT HARD 860 880
"Dia from ft to ft	088
Perfore uons NO 	-
· · · · ·	Work started 09/05/01 Completed 09/06/01
(9) WELL 'ESIS Drawnown is anouit water level is lowered below static level 'Ass a pump test inde' NO If yes, by whom? 'Yield ga' /s.n with ft drawdown after hrs	
Recovery data Time Water Level Time Water Level Time Water Level	
Date of rest / / fi drawdown after hra '-'er 40 ge 'min w' stom set at 420 ft for 1 hra Atesian flow g p m Temperaty's of water Was a chomical analysis made' MO	Contractor's

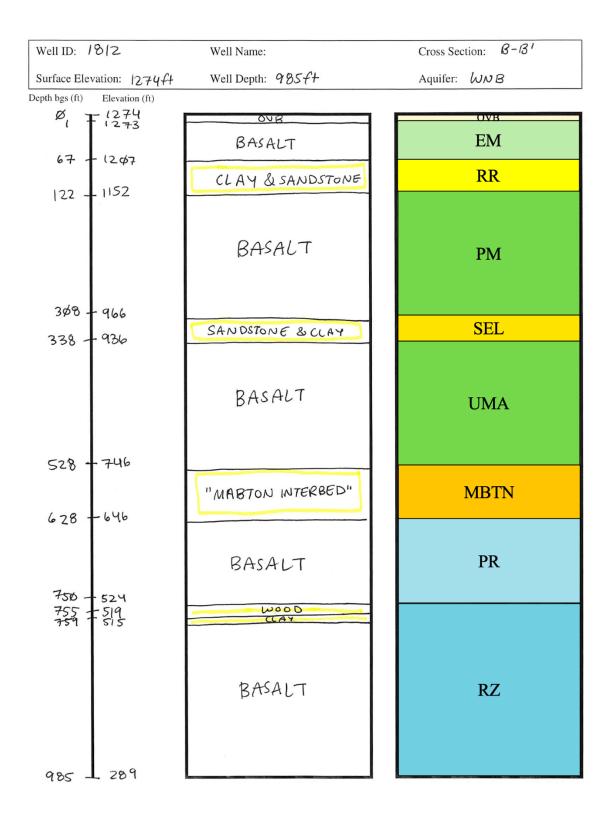
L

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



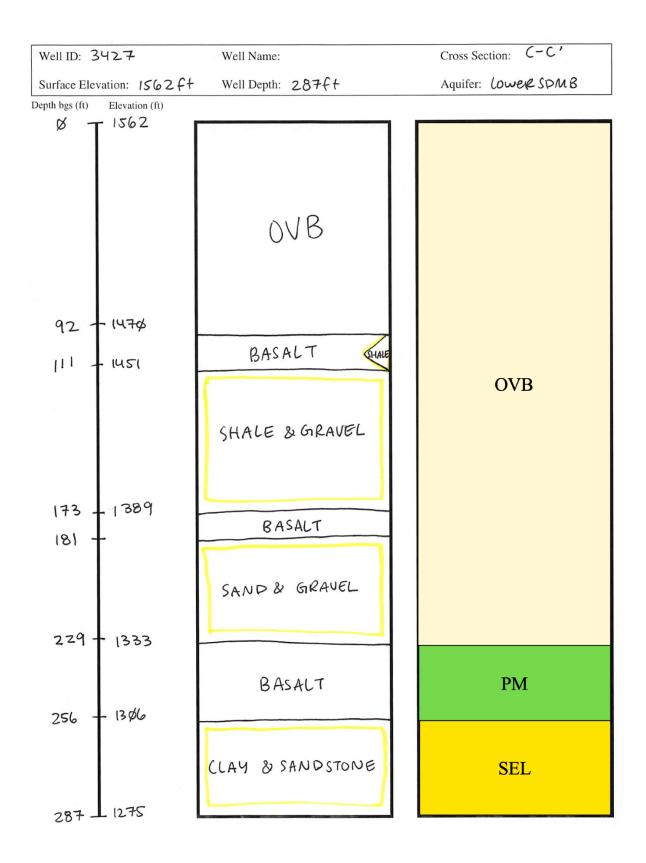
2391	Application No. 4	Well ID: 2391	Well Name:	Cross Section: B-B'
Pile Original and First Copy with 2391 WATER WEI Second Copy - Owner Copy Third Copy - Differ Copy Third Copy - Differ Copy		Surface Elevation: 1078f4	Well Depth: 95¢f+	Aquifer: Lower SDMB
(1) OWNER: Name GLER M. ShEARER	Address Rt. 2 Box 2116 Sunny:	Depth bgs (ft) Elevation (ft) $\mathcal{D} = - \mathcal{D} \mathcal{D} \mathcal{D}$		
dearing and distance from section or subdivision corner		0		
(3) PROFOSED USE: Dument of Test Well Other (4) TYPE OF WORK: Overs's number of well New well Method: Dug Bored Depended Reconditioned Rotary 2 Jetted (5) DIMENSIONS: Diameter of well d' Inches. Drilled J2C r. Depth of completed well r.	(10) WELL LOG: Permiting: Describe by color observer its of material and structure, and material to see the second observer of the material to each material to second observer its of material to each material to second observer its of the material to each material to second observer its of the material to each material to second observer its of the material to each material to second observer its of the material to each material to second observer its of the material to each material to second observer its of the material to each material to second observer its of the material to each material to second observer its of the material to each material to second observer its of the material to each material to second observer its of the material to each material to second observer its of the material to each material to second observer its of the material to each material to each its of the material to each its of the material to each material to each its of the material to each its of the material to each material to each its of the material to each i		OVB	OVB
Casing installed: "Diam. from	и 11 230 250 Виркен Визніт 750 260	260 - 818 287- 791	BASALT	EM
size of performations from 37 0 ft. to 8/10 ft. performations from 37 0 ft. to 8/10 ft. performations from 37 0 ft. to 95 C ft. performations from 1 ft. to 75 C ft.	Boken BACOTT BREW Chay, Sond + Alex Ruch Boy BSC Ba Rock + Blue Chay + Draft 850 870 BASAH BROKEN + Still 870 940	360 - 718	SAND & CLAY	RR
Screens: Yes No Manufacturer's Name Model No. Type No from Diam. Slot size from Diam. Slot size from Gravel packed: yes No Gravel packed: Yes No Gravel packed: yes No Surface seal: Yes No To what depth 34.0 n. Material used in seal. Centers Type of wateri De mbc fills. Depth of strata 31.0 Method of sealing strata of			BASALT	
(7) PUMP: Manufacturer's Name Type: By WATER LEVELS: Land-surface elevation above mean sea level Artesian pressure Artesian water is controlled by (Cap, valve, etc.) (9) WELL TESTS:				РМ
(9) WELL IESIS: Iowered below static level Was spunp tert made? Yes: No II tyses by whom? Yield: gal/min.with ft. drawdown after Intermediate n """"""""""""""""""""""""""""""""""""	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.	807 - 271		
nessured from well top to water level) ' Time Water Level Time Water Level Time Water Level Date of tail	NAME D+R WE Deilling (Person. Arm. or corporation) (Type or print) Address Rt 3 3cx 3121 (Signed) Rozery (Veril Buller)	807 - 271 850 - 228 870 - 200	CLAY & SAND BASALT	SEL
Baier teatfal/min. withf. drawdown afterhrs. Artestan forff	License No. 38.9. Date 9-25. 1077		BASALT	UMA
USE ADDITIONAL SE	REETS IP NECESSARY)	950 L 128		

P F4n Criginal and First Copy with Department of Ecology With	ELL REPORT V Sian Card No 017724	36 5 Constrained of Fostocory 5 Second Copy — Owner's Copy 5 Second Copy — Owner's Copy 5 Second Copy — Owner's Copy 5 State Of 5 St	RAGE #2
Second Copy—Owner's Copy Third Copy—Onlier's Copy STATE OF		Set Tele Criginal and First Copy with Department of Ecology WATER W	ELL REPORT Start Card No
	Water Right Permit No 01- 21175F	Second Copy—Owner's Copy Third Copy—Driller's Copy STATE OF	WASHINGTON 64-29493P
) OWNER: Name Claude P. Minick & John Suhadola	Address Snipes Road Prosser, WA 99350		Water Right Permit No
(2) LOCATION OF WELL: County Benton	NT) OWNER: Name (. Minick	Address
(2a) STREET ADDDRESS OF WELL (or nearest address) Snipes Road		(2) LOCATION OF WELL: County	× × × × × 2 × 9 × 025
		(2a) STREET ADDDRESS OF WELL (or nearest address)	
(3) PROPOSED USE: Domestic Industrial Municipal D x Irrigation Test Well C Other []	(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION	(3) PROPOSED USE: Domestic Industrial Municipal	(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIP
	Formation Describe by color, character, size of material and atructure, 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.		Formation Describe by color, character, size of material and structure, and
(4) TYPE OF WORK: Owner's number of well ((i) more than one) Abandoned	with at least one entry for each change of information.	0	thickness of aquifers and the kind and nature of the material in each stratum pen- with at least one entry for each change of information
	Soil 0 1	(4) TYPE OF WORK: Owner's number of well (if more than one)	MATERIAL FROM 1
	Broken Basalt 1 9	Abandoned New well Method Dug Bored Deepened Cable Driven	Hard grey basalt 759
(5) DIMENSIONS: Diameter of well 12 inches.	Medium Basalt 9 26	Reconditioned Rotary Jetted	medium basalt 765
Drilled	Hard Basalt 26 67	(5) DIMENSIONS: Diameter of wellinches	hard grey basalt 778 8
(6) CONSTRUCTION DETAILS:	Brown clay and sandstone 67 122	Drilledfeet Depth of completed wellft	hard grey fractured 818 8
Casing installed: Diam from ft to ft.	Medium Basalt 122 136	(6) CONSTRUCTION DETAILS:	hard grey 821 8
weided Diam from U ft to 355 m	Brown Basalt 136 186 Medium Basalt 186 192	Casing installed: ' Diam fromft tott	broken basalt little water 836 8 medium basalt broken seams 847 8
	100 112	Welded Diam fromft toft	hard basalt broken seams 847 8
Perforations: Yes Notat	Broken Basalt 192 198 Medium basalt 198 204	Welded Duam fromft toft Liner installed Duam fromft toft	black pourous water 040
Type of perforations in by	Hard Grey Basalt 204 299	Perforations: Yes No	medium basalt 967
SiZE of perforations in. by in.	Brown Basalt 299 308	Type of perforator used	
perforations from ft to ft	Sandstone and clay 308 338		
perforations from ft. to ft.	medium basalt 338 355	perforations fromft toft	
Screens: Yes Noty	hard grey basalt 355 360 broken basalt 360 372		
Manufacturer's Nome			
Type Model No	hard grey basalt 418 428		
Diam Slot size fromft. toft.	brwon broken	Type Model No	-
DiamSlot sizefr. toft	medium basalt436 472		
Gravel packed: Yes No X Size of gravel	hard grey basalt 472_ 528_	DiamSlot sizefromft toft	
Gravel placed from ft. toft.	mahton_innerhed528_628_	DiamSlot sizefromft toft Gravel packed: YesNoSize of gravel	
Surface seal: Yes 🗶 No To what depth? 355	medium basalt		
Material used in seal Cement	medium basalt - broken areas 655 680	Symplemetry To what depth? O Surface seal: Yes No To what depth? If	
Did any strate contain unusable water? Yes NoXX Type of water?	broken basalt 680 686 medium basalt 686 691	O Material used in seal	
Method of sealing strate off Depth of strate		Did any strata contain unusable water? Yes No	
7) PUMP: Manufacturer's Name	broken basalt 699 703	Did any strata contain unusable water? Yes No Type of water? Depth of strata Depth of strata Depth of strata	- 1 7 5 1
Туре:	hard grey 703 _ 709		
B) WATER LEVELS: Land-surface elevation above mean sea level	broken basalt709_714	O (7) PUMP: Manufacturer's Name	
Static level ft. below top of well Date ft.	pourous basaltwater 714 721 broken basalt 721 750	(8) WATER LEVELS. Land-surface elevation	- 28 988
Artesian pressure lbs. per square inch. Date	wood 750 755	0 (8) WATER LEVELS: Land-surface elevation above mean sea level ft	i 7
Artesian water is controlled by(Cap, valve, etc.))		Statc levelft below top of well Dateft Artesian pressureft below top of well Dateft	
WELL TESTS: Drawdown is a mount water level is lowered below static level	green clay 4/27/88 19 Completed 5/28/88 19	Artesian water is controlled by(Cap, valve, etc.))	
Was a pump lest made? Yes No It yes, by whom?	WELL CONSTRUCTOR CERTIFICATION:		Work started, 19 Completed,
Yield: gal./min. with ft. drawdown after hrs.	I constructed and/or accept responsibility for construction of this well.	(9) WELL TESTS: Drawdown is amount water level is lowered below static level Was a pump test made? Yes No If yes, by whom?	
		Was a pump test made? Yes No I if yes, by whom? Yield gal /min with ft drawdown after hrs	WELL CONSTRUCTOR CERTIFICATION:
Recovery data (time taken as zero when pump turned off) (water lavel measured	Materials used and the information provided above arrestored on my best knowledge and beliet.		and its compliance with all Washington well construction stan
from well top to water level) Time Water Level Time Water Level Time Water Level		P Recovery data (time taken as zero when pump turned off) (water level measured	Materials used and the information reported above are true to m knowledge and belief
101	NAME BJ EXPLORATION CO., INC. (PERSON FIRM OF CORPORATION) (TYPE OF PRINT)	from well top to water level)	
	Address 910 TORO PLACE KENNEWICK, WA 99337		NAME (PERSON FIRM, OR CORPORATION) (TYPE OR PR
Date of rest	Audress IONO I DADE KENNEWICK, WA 99337	U	
	(Signed) france in the License No. 0337	<u>عمد المحمد ا</u>	Address
Bailer test gal / min. with ft. drawdown after hrs. Airtest $\underline{500}$ gal / min. with alem set at $\underline{970}$ ft. for hrs.	Contractors	Date of test	(Signed) License No
Arresian flow gai./min. with stem set at/// ft. for hrs. Arresian flow g.p.m. Date	Registration No. <u>BJEXPC11320K</u> Date 6-24 1988	Bailer test gal /min with ft drawdown after hrs	(WELL DRILLER) (WELL DRILLER)
Temperature of water Was a chemical analysis made? Yes No		Airtest	Registration Date 1
	(USE ADDITIONAL SHEETS IF NECESSARY)	Artesian flow g p m Date Temperature of water Was a chemical analysis made? Yes No	
		No No	(USE ADDITIONAL SHEETS IF NECESSARY)
		ECY 050-1-20 (10/87) -1329.	



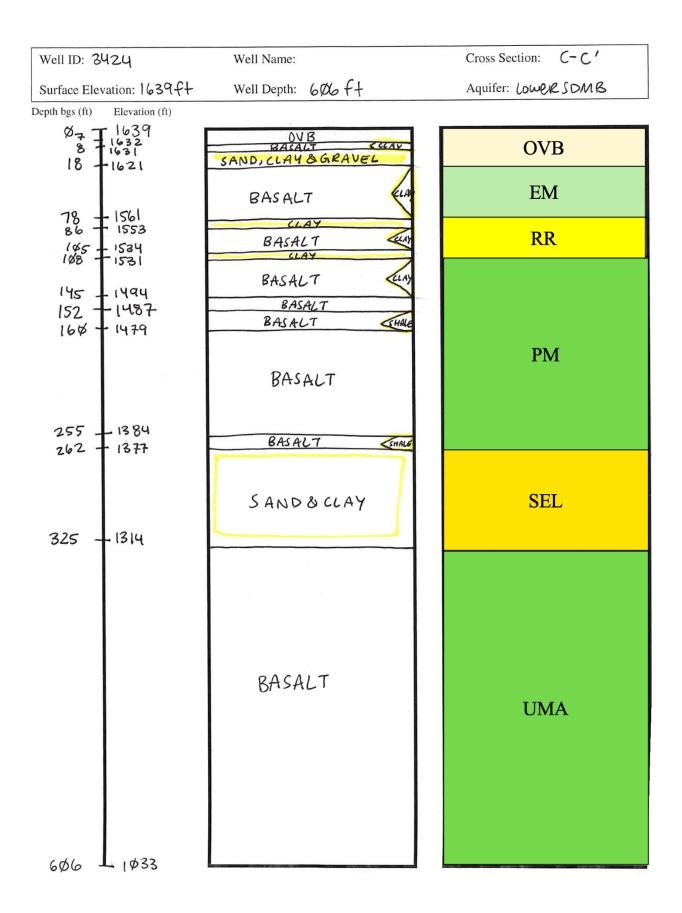
Figures A27-A45. Well reports and stratigraphic interpretations of wells in the C-C' cross-section. The abbreviations used to denote stratigraphic members are as follows: OVB = overburden, EM = Elephant Mountain, RR = Rattlesnake Ridge, PM = Pomona, SEL = Selah, UMA = Umatilla, MBTN = Mabton, PR = Priest Rapids, RZ = Roza, SQC = Squaw Creek, FS = Frenchman Springs, VTG = Vantage, and GRB = Grande Ronde.

(C			WELL	LOG.—Contin	baum	No	A.43	Q
5			3427	WELL					
	DEPARTMENT OF CONSERV AND DEVELOPMENT			Corre-	Stateof	WA-DCP	t of Agri	THICKNESS	DEPTH
WELL LOG	NoApp	11, #43 mit #55	50	LATION		MATERIAL	0	(feet)	(feet)
Date Winte	r 19 44 Per	mit_#5	53				Depth forward		
	G. W. Ludwig			Pump	Test:				
	1 driller's record				Dim: 2	287' x 12"	1		
					SWL: 1	651			
	of WASHINGTON				Dd: 13				
-						300 g.p.	m .		
						12 from		31	
		Diagram of	Castion		<u>Agarne</u>		225 to 2		
	¹ / ₄ sec 27 T. 12 N, R. 21 E.		Section .		Perfor:		220 00 2	9 7	
Drilling Co						12" driv		274-4	
						of 10" pir			
	Drilling drilled Date						be: 40 p	erior.	111
	of Wash. Dept. of	-			<u>10" r</u>			<u></u>	
	lympia, Washington					Deming De			
Land surface, d	atumft.above below				Motor:	Contenal	Marine	<u>Notor</u>	<u>35 h.</u>
CORRE-	Матратат	THICKNESS	DEPTH		· · · · · · · · · · · · · · · · · · ·				
CORRE- LATION	MATERIAL	THICKNESS (fect)	DEPTH (feet)						
(Transcribe dril If material water-be below land-surface of	MATERIAL Iler's terminology literally but paraphrase as auting, so state and record static level if rep latum unless otherwise indicated Correlate g log of materials, list all casings, perforation	(feet) necessary, in ported Give do with stratigray	(feet) parentheses. opths in feet						
Transcribe dri (Transcribe dri If material water-be below land-surface d if feasible. Followin	ller's terminology literally but paraphrase as maing, so state and record static level if rep latum unless otherwise indicated Correlate	(feet) necessary, in ported Give do with stratigray	(feet) parentheses. opths in feet						
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(Transcribe dri If material water-be below land-surface of if feasible. Followin Soil Cemen	ller's terminology literally but paraphrase as ming, so state and record static level if re- latum unless otherwase indicated Correlate g log of materials, hat all casings, perforation t gravel & boulders	(feet) s necessary, in borted Give do with stratigrams, screens, etc 5	(feet) parentheses. opths in feet phic column,) 5						
(Transcribe dri If material water-be below land-surface d if feasible. Followin Soll Cemen Brown	ller's terminology literally but paraphrase as mains, so state and record static level if rep latum unless otherwise indicated Correlate g log of materials, list all casings, perforation it gravel & boulders shale	(feet) s necessary, in ported Give do with stratigray ns, screens, etc 5 12	(feet) parentheses. -pths in feet phic column,) 5 17						
IATION (Transcribe dri If material water-be blow land-surface (if fessible. Followin Soil Cemen Brown Black	ller's terminology literally but paraphrase as mains, so state and record statio level if rep latum unless otherwise indicated Correlate g log of materials, list all casings, perforation t gravel & boulders shale gravel	(feet) is necessary, in ported Give di- with stratigrams, screens, etc 5 12 57	(feet) parentheses. phre column,) 5 17 74 80						
LATION (Transcribe dri If material water-be blow land-surface (f fessible. Followin Soil Cemen Brown Black Brown	Uler's terminology literally but paraphrase as mains, so state and record static level if replation unless otherwise indicated Correlate g log of materials, list all casings, perforation t gravel & boulders shale gravel shale	(feet) i necessary, in orted Give d with stratigra- ns, screens, etc 5 12 57 6	(feet) parentheses. opths in feet phic column,) 5 17 74						
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Burnel Construction Date of present of the state of the	Section: $C - C'$	Cross Section:	Well Name:	3426	V			File Original Department
0 Control of Milling Control o	er: Lower SDME	Aquifer: LOU	Well Depth: 429ff	evation: 1629ft	s		wher's Copy STATE OF WASHINGTON	Second Cop Third Copy
Well top to water level) Time Water Level Time Water Leve	OVB	0		- 1629		1/4_NE_1/4 Sec 25_T_12_N_R_21_VM (1) (1) VELL LOG or DECOMMISSIONNO PROCEDURE DESCRIPTION formation: Describe by cool; character, size of material and structure, and the kind and nature of the material in each structure previated, what a test or entry for each charge of information. Indicate all water encountered. NATERIAL FROM TO TO Soit TO	OF WELL: County Yell Yell DDRESS OF WELL: (or neared address)	 (2) LOCA: (2) STREE TAX P. (3) PROPI (4) TYPE (5) DIMEN (6) CONS (7) Perfor Type o. Screer Materia Diam. Diam. Diam. Diam. Diam. Type o. State I. Artesia Artesia Artesia (9) WELL Wield: Vield: Vield: Vield:
Date of test	UMA	U.	BASALT		- 1	Diffing Company <u>RICK BUTIN</u> Drilling Office (Signed) <u>Berri Parulin</u> License No. 7.9.2 Address [30] LAMACA STEP SULAN Contractor's <u>RickPWD045</u> Dotte 9-31.99 (USE ADDITIONAL SHEETS IF NECESSARY)	Water Level Time Water Level Time Water Level 	Date o Bailer Airtest Artesia

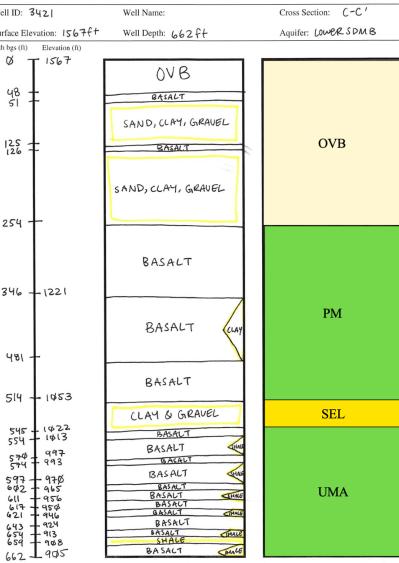
10:25	App=== 10125P	.	P 1			
erand Copy — Owner's Copy	Application No.	and Copy - Owner's Copy		n No		
1) OWNER: Name Simon Martinez	Address					
	- 4 4 Sec 24 T 12N B2/EWM		Address			
ing and distance from section or subdivision corner	annen and annen a second a line and a second a line and a second a second a second a second a second a second a	(2) LOCATION OF WELL: County	- 14 Sec 2.4 T.	12N. R21 WM		
	(10) WELL LOG:	ing and distance from section or subdivision corner				
3) PROPOSED USE: Domestic Industrial Municipal Irrigation Test Well Other		(2) PROPOSED USE: Demote D Industrial D Municipal	(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 penetrailed, with at least one entry for each change of formation.			tial and structure an		
4) TYPE OF WORK: Owner's number of well (if more than one)	MATERIAL FROM TO	We of the matrixed the task Other Translot Trans				
New well 😡 Method: Dug 🔲 Bored 🗋		(4) TYPE OF WORK: Owner's number of well (if more than one)	MATERIAL			
Deepened (Cable Driven D Reconditioned Rotary Jetted D			Grey Basalt	588 60:		
	Coarse gravel 57 Broken Bik Bosalte Clay 78		no Cuttings			
5) DIMENSIONS: Diameter of well 12 inches.	Sand Clav, with gravel 8 18		C-rey Basalt Hard	605 606		
Drilled	Broken Bik Boss Fw/Gol Itche 18 31		no cuttings			
6) CONSTRUCTION DETAILS:	STORTA STA SOLATE GIGTED ST SS	Drilledft. Depth of completed well	/			
Casing installed: 16 " Dia and 0 a 196 a	Broken Blk Basalt Greenshold 3.5 317	(6) CONSTRUCTION DETAILS:				
Casing installed: <u>16</u> Diam. from <u>O</u> ft. to $\frac{196}{326}$ ft. Threaded <u>12</u> Diam. from <u>O</u> ft. to $\frac{326}{326}$ ft.	Broken Blk Bassilt Grey clay 65 28			+		
Welded []	Gred Sticky Clay 78 86	2 Threaded Diam. from ft. to ft.		+		
Perforations: Yes No D	Broken Blk Baselt + Greych 86 105	Welded []		+		
Type of perforator used	Breten Arto-Brey t	Perforations: Yes D No D		+		
SIZE of perforations in. by in.	Grey chy 105 108	Type of perforator used		+		
perforations from ft. to ft.	Broken BIR Basall Grey clay 108 114	SIZE of perforations in. by in.		+		
perforations from	Broken Blk Basait Green shake 114 145	perforations from ft. to ft.				
	Black Basalt 145 152					
Screens: Yes D No D	Black Bosalt Greenshale 152 160					
Manufacturer's Name	Brokin Black Basalt Water 160 162					
Diam. Slot size from ft. to ft.						
Diam		Diam				
Gravel packed: Yes No Size of gravel:	Block Basail Hard 2/5 217					
Gravel placed from ft. to ft.	Broken B/ABasall 217 222	Cravel packed: u. c. u. c. a				
Surface seal: Yes No D To what depth? ft.	Grey clay 262 270					
Material used in seal		Surface seal: Yes No To what depth? ft.		+		
Type of water?	Grey Clay Sticky 276282			+		
Method of sealing strate off.	Grey Sandy Clay 282 300	Type of water? Depth of strata				
(7) PUMP: Manufacturer's Name	L-FEER STIERY CIAY 300 325 1	Method of sealing strata off		+		
Type:	Brokin Blk Bosalt (Water), 325 327					
	Black Basalt 527 539	Time: NP				
(8) WATER LEVELS: Land-surface elevation above mean sea level ft.	Dark Grey Basart Hord 339 367					
Static level						
Arterian water is controlled by						
(Cap, valve, etc.)	Red Basait 576 588	Antonion motor (a controllard but		+		
(9) WELL TESTS: Drawdown is amount water level is lowered below static level	Work started 2/23, 1975 Completed 19	(Cap, valve, etc.)				
Vas a pump test made? Yes 📄 No 🗍 If yes, by whom?		(9) WELL TESTS: Drawdown is amount water level is lowered below static level				
ield: gal./min. with ft. drawdown after hrs.		Was a pump test made? Yes No I If yes, by whom?	Work started 19			
	true to the bost of my knowledge and ballet	Yield gal/min. with ft. drawdown after hrs.	WELL DRILLER'S STATEMENT:			
and the second s	Head - 177		This well was drilled under my jurisdiction	and this report is		
lecovery data (time taken as zero when pump turned off) (water level measured from well top to water level)	NAME		true to the best of my knowledge and belief.			
Time Water Level Time Water Level Time Water Level		Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)	NAME			
	Address	Time Water Level Time Water Level Time Water Level	NAME(Person, firm, or corporation)	(Type or print)		
	Autos	Ė				
e of test	[Simed]		Address			
aller test	[Signed](Well Driller)		[Simed]			
rtesian flowg.p.m. Date	License No. Data 10	Batier test gal./min. with ft. drawdown after	[Signed](Well Driller)			
Temperature of water Was a chemical analysis made? Yes 🗋 No 🗋	License No. Date 19 Copied from duily wook sheet	Artesian flow				
(110 - COMINST - F	HEETS IF NECESSARY IN A- 17- King S	semperature of water was a chemical analysis made? Yes U No U	License No Date			
CY 050-1-20	HEETS IF NECESSARY) I'Y 5.0681 -	(1107 A DOWNOUL OF	EETS IF NECESSARY)			
		USE ADDITIONAL SE	REIS IF NECESSARY)	~		



Bild'Orfginal and First Copy with - Department of Ecology Second Copy - Owner's Copy Tylid Copy - Driller's Copy	WATER WELL REPORT	Permit No. G. 321	IISP day	File (Depar Secon Thurd
(1) OWNER: Name Simon MARTINEZ		Rribox205A 98936		
(2) LOCATION OF WELL: County AK		1 Sec 22 T 12 N. R	11E 0	(1)
ag and distance from section or subdivision corr		23TIZW RAI EWIN	ALC.W.M. S	(2)
		AST IAN NAT EWINT	en i	ŀ
(3) PROPOSED USE: Domestic Industr Irrigation X Test W		or character size of material and sta	<u>x</u> <u>-</u> <u>-</u> <u>-</u>	(3)
	show thickness of aquifers stratum penetrated, with a	or, character, size of material and str and the kind and nature of the mate it least one entry for each change of	formation.	
(4) TYPE OF WORK: Owner's number of w (if more than one) New well K Method: D	T MAT		255 5	(4)
Deepened 🗌 C	Cable & Driven D Rocks Doubles	2.5	<u>7</u> ž	
Reconditioned R	Rotary D Jetted D Cemeny CRAve	27	<u>-27</u>	
(5) DIMENSIONS: Diameter of well	20 16 Constances Grace A Basen Cl	Runiter gRAPEL 31.5	27 31.5 41	(5)
Drilled 662 ft. Depth of completed	20 (16 conthches Que Clar white well 662 th gave Carvel Bass Charle Jake	CAROCK HI	42 E	(-)
(6) CONSTRUCTION DETAILS:	Blue Shale / gRAU	el 42	46 0	(6)
Casing installed: 24 "Diam. from	2 th to 2015 th. Black P.		<u> 48.5</u> 5	(^o)
Threaded 🗋 20	A STACE NIGHT DRAKEN	4x (Bester) 48.5 Soure BackBack 51	6.2 0	
12 Diam Frank H	2 n to 481 n Shale uponel Stage	BbckRix 52	3월 /ba	
Perforations: yes R No	Juecay shale G	Roken Kock 12		1
Type of perforator used 1284 SIZE of perforations 18 to 14 in. b	the 617 the Spice Blue clay game	92	Data Oct	
perforations from	tt. to fill tt.	an Chill gesuel 100		
perforations from	th to the Back Band Grand	Back Bener Rak 114		
	DACK BROKAN BE	SAT 125	- Hug	
Screens: Yes D No 🕰 Manufacturer's Name	Green Clay	-126	<u>144</u> 5	
Type Mod	tel No. R. Gener Stand Shall	L i i i i i i i i i i i i i i i i i i i	157 Lan	
Diam,			173 In	
	Blue Spront / gaave	p3	177 3	· pèris
Gravel placed from		stra	182 5	`
	- Diach who want	DCK N2 1 183.5	183.5 D	
Surface seal: Yes A No D To what de Material used in seal Decture - Pla		e in Street 199	A4 S	5
Did any strata contain unusable water?	Yes I No 2 Duc SAMen		do <u>o</u>	
Type of water?		20		
	574901,011240/61,00	Algos 201	214 50	
(7) PUMP: Manufacturer's Name	HP Mark BRosiegh	aver, Juckstone 216 Ock (water) Sun 76 241	254 0	(7)
	BACK Oestt	- 254	223 ü	
(8) WATER LEVELS: Land-surface elevat above mean sea lev Static level		salt 123	2225	(8)
Artesian pressureIbs. per square inch		2725	1 m m	Static
Artesian water is controlled by	ap, valve, etc.) Black Broken Bas	Hr 309	332 0	Artesia
(9) WELL TESTS: Drawdown is amount lowered below static			þ	-
Was a pump test made? Yes No 🗆 If yes, by wh	om they Service	, 19 Completed	<u>19</u>	(9) 1
Vield 1159 gal/min with 17A ft. drawdow	in after 22 hrs. WELL DRILLER'S)ep	Was a Yield:
" Pump Set 340' 10" Bads 10	Collumn " This well was drille	d under my jurisdiction and this	s report is	
	true to the best of my		Ě	
Recovery data (time taken as zero when pump turn measured from well top to water level) Time Water Level Time Water Level T		Well Drilling		Recove
	(Person,	'hrm.for corporation) (Type or	0	Time
Immediate Recourses	Address ATABOX	2905 Zillah Wa. 95	(75.3 u	
te of test		$L \cup U$	율	1-
test		Well Driffer)	·	Ba
Artesian flowg.p.m. Date		Date 10-31	1000	Artesia
Temperature of water	s mader res [] No K Literise No		, 10.70	Tempe

File pri Departi Second	rinal and First Copy wi nent of Ecology Copy — Owner's Copy opy — Driller's Copy	th ³ 3421		Pose	Marriacz	Na 1	TRAC	792
				WASHINGTON	Permit No	fere	1947E	E.
		5. martine	<u>5 · · · ·</u>	Address .	·			
(2). L	OCATION OF W		corner		J 1/4 Sec 22 T.	2-N., R	21 w м	
(3) ⁻ P	ROPOSED USE:			(10) WELL LOG:				
		Irrigation 🗋 Tes	t Well 🗌 Other 📋	Formation: Describe by color, cha show thickness of aquifers and th stratum penetrated, with at least	racter, size of materi e kind and nature of	al and stru the mater	icture, and ial in each	
(4) T	YPE OF WORK:	Owner's number o	f well					
	New we	(if more than one)	Dug 🗌 Bored 🗋	D O		FROM	то	7
	Deepen		Cable 🗌 Driven 🗌	Black Broker Becstr.	1	309	332	1
	Recondi	tioned []	Rotary 🗌 Jetted 🔲	Black Beakon Besett (meel Sate Col	3950	346	120
(5) D	IMENSIONS:	Diameter of w	ell inches	Darck Baoken Besafr efBh	eghencian_	346	367	<u>, '</u>
	rilled . ft	Depth of complete		Stick & Green Clay	21		379.5	.1
				BuchReen clay as Black B	loken Gesalt	379.5		-
(6) C	ONSTRUCTION	DETAILS:		Black Broken Besat		3815		. '
C	asing installed:	" Diam. from	ft to . ft	But Gacen Clay		437	441	
	Threaded	." Diam. from	ft to ft	Black BROKED BELT, O	ubles Duc			
	Welded	" Diam. from	ft to ft.	Clay and Shale		441	#57	
D	fontions			Black Bear on Bassir of	sine greachy	757	459	
	Type of perforator			STICKY Green Clay		459	472	<u>}</u>
	SIZE of perforation		by 'in.	Blagk Beaken Besstr	<u>a 1</u>	472	473	li -
		tions from	ft to ft.	Sand, GAAvel, BROKEN	KesAlt.	473	475.5	1
	perfora	tions from .	ft to ft	afeen Cauny shale	·	45.5	481	. '
	. perfora	tions from	ft to ft	Black BROKEN Best To	ame water?)	181	495	. `
S	creens: Yes D No	-		Black Basate Static	62	496	510-	
5	Creens: Yes D No Manufacturer's Nan			GREY SANSTONE		510	514	. ,
	Type.		odel No	Koby Brokes Kock,	· · · · · · · · · · · · · · · · · · ·	54	5175	, 1 ⁴
	Diam Slot	size from	ft to ft	Barkeni as/Blue shale Prat	ally armented	5125	523	
in the second	Diam Slot	size from	ft to ft.	47 green clay w/ Blue &	sea shafe	\$3	539	
۴ T	~			ak green shale warde	d	539	543	
, n	ravel packed: Yes Grevel placed from		f gravel -	aK grey/Black STICKY		543	545	
	Gravel placed from	п	to ft.	BLACK BROKEN ROCK		515	554_	
S	urface seal: Yes 🗆	No 🗇 To what	depth? ft.	BROWNAND Black Broken	Pock w/ Blace			
	Material used in se	al		green state		554	562	
		ntain unusable wate		Black Broken Wester w/Blue	aReenshale	562	\$70	
	Type of water?		of strata	BLOK BROKEN Rox - Some	waiculap	570	574	
	Method of sealing s	trata off	<u> </u>	Of WATER (STATI	(90')			
(7) P	UMP: Manufacturer's	Name		Black BRoken Rock of Som	e Bhielagen Stal	594	597	
	Туре: .		нр	BLACK BROKE, ROCK		597	599	
0) TU	AMED I EVELO	I and surface eler		Black Broken Rick Same ye	KILGORSTATE 905		602	
	ATER LEVELS:	Land-surface elev above mean sea l		BLACK BROKAN ROCK W/B	uclassien shale	602	6035	
tatic le		ft below top of we			ine DESKUBE		605	
rtesian	Artesian water is co	lbs per square incontrolled by	ch Date .	heavy outh Pigite	Sand Sama a	inma		
		(Cap, valve, etc)	large Buddees (Black By	H. BRoken usoll	605	611	
9) W	ELL TESTS:	Drawdown is amou lowered below stat	nt water level is	weathered vescular ifg	HUNETZ CRYST 1-6	dia		
		lowered below stat	ic level	Work started	Selft Streed 87.	52-	. 19	
vasa pu 'ield:	amp test made? Yes gal/min with	No If yes, by w ft drawdo		WELL DRILLER'S STAT				
"	gar/min with		whatter hrs				•	
				This well was drilled unde	r my jurisdiction a	and this a	report is	
ecovers	data (time taken as	zero when nump to	rned off) (water level	and to the best of any knowl	sage and benef.			
meas	ured from well top to	water level)	irned off) (water level	NAME (Person, firm, or				
Time	Water Level Time	Water Level	Time Water Level	(Person. firm, or	corporation) (T	ype or pr	int) · ·	
••••••								
			· · · ·	Address	····· ··· ··· ··· ···			
	of test	··· ··· ·· ··	· · · · · · · · ·	R				
9 a te		th ft drawd	own after hrs	[Signed]			÷	
	flow	gpm Date			(Well Driller)		,e-	
empera	ture of water W	as a chemical analys	ns made? Yes 🗌 No 🗌	License No	Date.	24	, 19	
			(USE ADDITIONAL SH	LETS IF NECESSARY)				
CY 050-1-	-20						- C	

Pudoriginal and First Copy with 3421	Page (3) Martinez	Well ID: 3421
Department of Ecology Second Copy - Owner's Copy	ELL REPORT Application No	Surface Elevation: 156
5' 100 + 1'	WAŚHINGTON Permit No	Depth bgs (ft) Elevation (i
(1) OWNER: Name 5. Murtinez	Address	Ø T 1567
(2) LOCATION OF WELL: County	- NE. 4 SW4 Sec. 22 T LAN, R21. WM	¢ 1301
(3) PROPOSED USE: Domestic [] Industrial [] Municipal []	(10) WELL LOG:	1 - Le
Irrigation [] Test Well [] Other		48 +
(4) TYPE OF WORK: Owner's number of well (if more than one)	stratum penetrated, with at least one entry for each change of formation. MATERIAL FROM TO	51 T
New well Deepened Cable Driven	BROWNBRIKERRER- Wellenwled wie cho 6/1 617	
Reconditioned Rotary Jetted	Back BROSEN Rock-Some Vesicula	
(5) DIMENSIONS: Diameter of well	Stuell una we Blue/green der	125 -
Drilledft Depth of completed wellft.	BROWN BROWEN Rock-UCSICURE 621 622	126 -
(6) CONSTRUCTION DETAILS:	DROWSNIK Black PREVEN Rock	
Casing installed: " Diam. from ft. to ft. Threaded " Diam. from ft. to ft.	high y bes icular in some greetz	
Welded	and Pratter-CXT Rensely anothered	
Perforations: Yes D No D	Black and Brown Broker Rock	
Type of perforator usedinin. by in. by	0, - Uesaular -STATIC 86-5 628 634.5	
ft. to ft.	Daie Broken Kocz-basele but Rasty vesiculae	254
	Black Broken Rock-some vesicular	
Screens: Yes No D	Shale STITE 81.5 1643 642	
Manufacturer's Name	Black BROKEN PECK Chunks OF Rounded	
Type Model No Diam	Shik (green) Storia 87' 647 649	
Diam Slot size from ft. to ft.	Green Shale if B bik Browen, Reik Pasnillo pesicular Swh 87 649 651	0111
"Gravel packed: Yes No Size of gravel.	Black Proven Back w/ some Que/	346 - 1221
Gravel placed from ft. to ft. to ft	Que spren Shale 651 654 Que spren Shale 654 659	
Surface seal: yes No To what depth? ft. Material used in seal.	Que green Spale 654 659 Black broken Cark w/ Some	
Did any strata contain unusable water? Yes DNO Type of water?	Bluegreen shale SMILL 86 659 662	
Method of sealing strata off		
(7) PUMP: Manufacturer's Name		481 -
Туре: Н.Р		
(8) WATER LEVELS: Land-surface elevation above mean sea level ft.		
Static level		
Artesian water is controlled by		514 - 1453
(9) WELL TESTS: Drawdown is amount water level is lowered below static level		
Was a pump test made? Yes 📋 No 📋 If yes, by whom?	Work started	545 - 1022
Yield. gal/min. with ft drawdown after hrs	WELL DRILLER'S STATEMENT:	554 - 1413
и и, и и	This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.	and 997
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)	NAME	570 - 993
Time Water Level Time Water Level Time Water Level	(Person, firm, or corporation) (Type or print)	3
	Address.	597 + 970 692 + 965
ite of test		611 - 956
Artesian flow	[Signed]	617 - 954
Temperature of water	License No	621 - 946 643 - 924
	1	654 - 913
(USE ADDITIONAL S ECY 050-1-20	HEETS IF NECESSARY)	659 - 908
		662 - 905

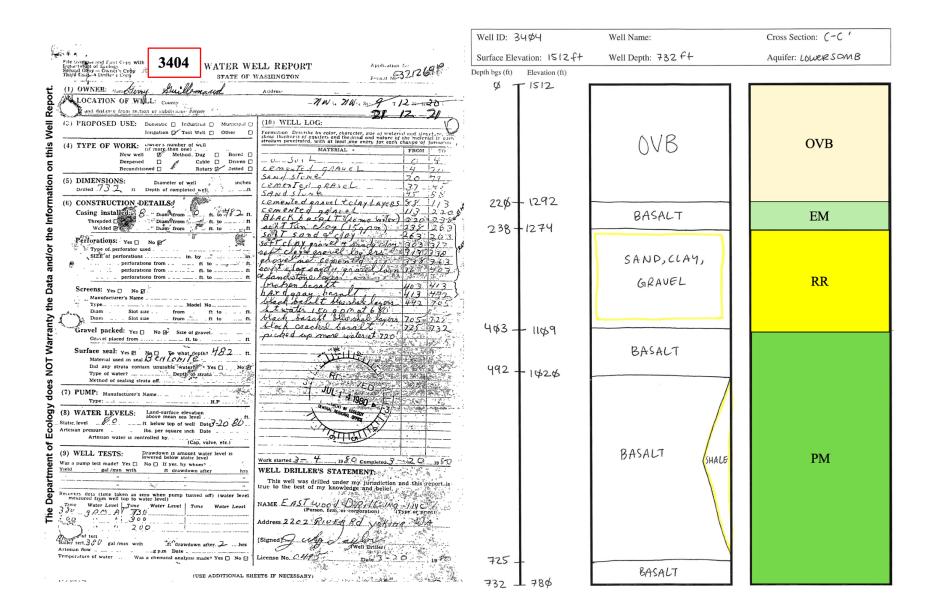


	ELL REPORT Application		Well ID: 3420	Well Name:	Cross Section: $C-C'$
Parti-	WASHINGTON Permit No		Surface Elevation: 1578f+	Well Depth: 255ft	Aquifer: LOWER SDM
(1) OWNER: Name Kim Stiles (2) LOCATION OF WELL: County Yokitec caring and distance from section or subdivision former (3) PROPOSED USE: Domestic & Industrial Irrigation Test Well Other (4) TYPE OF WORK: Owner's number of well Other New well Method: Dug Dorterd Reconditioned Rotarsyn Jetted (5) DIMENSIONS: Diameter of well C inches. Dritted J.S.2.tt. Dephoter of well C inches. (6) CONSTRUCTION DETAILS: E Starsyn Starsyn	Address 620 So 15th Hus -SU & NE & sec 22 T. (10) WELL LOG: Pormation: Describe by color, character, size of mate baraum prinetrated, with at least one entry for each MATERIAL Top Soil -Clay t Greevel layors -Shale t Greevel	G	Depth bgs (ft) Elevation (ft) Ø - 1578	wei Depui. 255+t	
(a) Construction Casing installed:	Grovel Basalt, Block RECEIV JAN 3 1 127 DEPARTMENT OF EL	79		OVB	OVB
(7) PUMP: Manufacturer's Name Type: HP (8) WATER LEVELS: Land-surface elevation above mean sea level	CENTRAL REGISTRAL		198 - 138¢		
(9) WELL TESTS: Drawdown is amount water level is jowered below static level in the drawdown after hrs. Jowered Jowered below the pump turned off) (water level measured from well top to water level) Time Water Level Time Water Level Time Water Level Time Water Level test gal/min. with ft. drawdown after hrs. Artestan flow gp. Date Temperature of water was a chemical analysis mader? Yes □ No. It is not provide the state in the state in the state is the state in the state in the state is state was a chemical analysis mader? Yes □ No. It is not provide the state in the state is state was a chemical analysis mader? Yes □ No. It is not provide the state in the state in the state in the state is not was a chemical analysis mader? Yes □ No. It is not provide the state in the state is not was a chemical analysis mader? Yes □ No. It is not provide the state is not was a chemical analysis mader? Yes □ No. It is not provide the state is not was a chemical analysis mader? Yes □ No. It is not provide the state is not was a chemical analysis mader? Yes □ No. It is not provide the state	Work started D=C 15. 19.75 completed D WELL DRILLER'S STATEMENT: This well was drilled under my jurisdiction true to the best of my knowledge and belief. NAME <i>Eechosci Dr.</i> 11.3c (Person, hrm, or corporation) Address 2262 <i>River Rocci</i> [Signed] <i>Updull Confluence</i> (Well Driller) License No. 21.3 Date Dece	and this report is <u>The c</u> (type or print) <u>Yakima</u>		BASALT	РМ
(USE ADDITIONAL SE					

and First Copy with Mad Copy — Owner's Copy Ad Copy — Owner's Copy STATE OF WE STATE OF WE		Well ID: 3411	Well Name:	Cross Section: C-C'
	ASHINGTON Permit No.	Surface Elevation: 1489ft	Well Depth: 782ff	Aquifer: WNB
) OWNER: Name ROGER HART	Address RT 1 BOX 205 H	Depth bgs (ft) Elevation (ft)	Wen Depui. 702ft	Aquitor. Vere to
LOCATION OF WELL: County YAKIMA		Ø - 1489		
tring and distance from section or subdivision corner	(10) WELL LOG:	φ - 1461		
) PROPOSED USE: Domestic 🙀 Industrial 🗋 Municipal 🗆 Irrigation 🗟 Test Well 🗇 Other			0110	
	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 structure penetrated, which at-least one entry for each change of formation.		OVB	OVB
TYPE OF WORK: Owner's number of well 2 New well Z Method: Dug Bored	TOP SOIL 0 6	90 - 1399		
Deepened Cable Driven Reconditioned Retary Jetted	CLECHE TYPE CEMENT GRAVEL 6 8	90 - 1311		
5) DIMENSIONS: Diameter of well 8 inches	MOXEE SILT, SAND, GRAVEL, CONGLOMERATE 8 21	1 1	BASALT	БИ
Drilled 782 ft. Depth of completed well 782 ft.	DEC. ROCK & BLDRS. 21 35 CEMENT GRAVEL & BLDRS. 35 63		pristici	EM
6) CONSTRUCTION DETAILS:	HD. TAN CLAY & GRAVEL & HLDR LNS. 63 90	170 - 1319		
Casing installed: 10 "Diam. from +1 ft. to 20 ft. Threaded 3 "Diam. from +2 ft. to 561 ft.	CREV. EROKEN GRAY BASALT 90 128 GRAY ANDESITIC CREV, BASALT & SCOR. 128 170 U		SHALE, CONGLOMERATE	RR
Threaded Diam. from ± 2	GRAY & HLACK SHALE. SLOUGHING BADEY 170 188 A	202-1287	PARCE CASICONIERATE	KK
Perforations: Yes D Nox	LIGHT TAN CONGLOMERATE " 188 202 $\&$ $\&$ GRAY CREV. BASALT & BLK SHALE 202 212^{-1}	212 -1277	BASALT SHALE	
Type of perforator used	GRAY CREV. BASALT (V.H. & FAULTED # 212 368 for	1 1		
SIZE of perforations	LITE TAN SANDY CLAY (P.U.W. FR. 300) (368 398) ELUE SANDSTONE & SAND T.R. WATER 398 406			
perforations from	BLUE SANDSTONE & SAND T.R. WATER 1398 406!		BASALT	PM
	TAN CLAY, GRAVEL & SAND (400GPM) 498 556 -		0/(=/(0 /	
Screens: Yes II No (RAN ON 60' OF 7") Manufagturer, Nam JOHNSON Type 2 SLT 5.5. WIRE Magin No8" TELESC. Diam 6 7 July size 25 from // ft. to /82 ft.	GRAY BASALT & CLAY (BROKEN) (FRACT 556 558 BROKEN BASALT W. SHALE - 558 602	368 - 1121		
Type 23 SL193.5. WIRE Model No.8" TELESC. Diam. 6 7 Stor size 25 from 772 ft. to 782 ft.	FRACT. GRAY BASALT 602 727	560 - 1121		
Diam Siot size from ft, to ft.	BLUE SANDY CLAY SHALE (727 772 BLUE SAND & WATER (727 7780)			
Gravel packed: Yes Nog	BLK EBOKINN ROCK & SAND(COURSE) 780 782			
Grevel placed from	10' OF SCREENS, SET HERE ON 60' OF .365 WALL 7" I.D.		SAND, CLAY, GRAVEL	
Surface seal: Yes K No To what depth? 20 ft. Material used in seal CEMENT (10 ^a)	RISER & FACTORY PACKER & LEFT HAND BACK OFF		SAND, CCA IT OFFAUEL	SEL
Did any strata contain unusable water? Yes X No Type of water? V.SANDY Depth of strata 21	NIPPLE.		1	
Method of sealing strata off. CASED	SEE DAY LOGS			
7) PUMP: Manufacturer's Name				
Type:	WELL ON DEVELOPING PROD. IN EXCESS OF 800 GPM @ 780' WITH AIR LIFT & APROX. 300 GPM @ 300'	556 - 933		·
B) WATER LEVELS: Land-surface elevation above mean sea level			BASALT SHALE	
above mean sea teven			BASALT	
Artesian water is controlled by		6¢2 - 887	X	
WELL TESTS: Drawdown is amount water level is lowered below static level	Work started 8/6/79 19 Completed 8/31/79 19			
as a pump test made? Yes No If yes, by whom? eld: gal./min. with ft. drawdown after, hrs.	WORK STATEMENT:			UMA
eld: gal/min.with ft. drawdown after, hrs.		I I	BASALT	
u u u u	This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.			
ecovery 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	NAME RIEBE WELL DRILLING			
Time water Level Time water Level Time Water Level	(Person, firm, or corporation) (Type or print)	1 1		
Drocuss	Address TAKIMA, WASH. Benter from 511 or	727-762		
The of test	(Signed) the Ticke	,_, ,		
				MDTN
emperature of water	License No		SAND & CLAY	MBTN
DEPARTMENT OF ECHORY CENTRAL RESCUENT ADDITIONAL SH		I I		

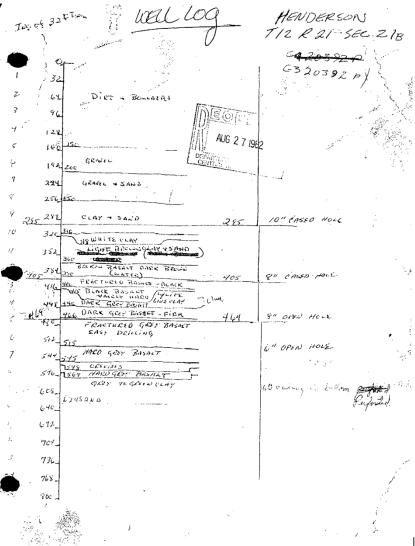
	LL REPORT Application 80 26465
	VASHINGTON Permit No
(1) OWNER: Name William J. Fot	Address &TI DOY 207N Muxee, WAA8936
(2) LOCATION OF WELL: County AA just	SEWAF user 112 N. R2 I WM.
(a) PROPOSED USE: Domestic [] Industrial [] Municipal []	(10) WELL LOG:
(3) TROPOSED USE: Domestic [] IndustrialMunicipal Irrigation Test Well N Other	
	Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and vature of the material in each stratum penetrated, with at least one entry for each change of formation.
(4) TYPE OF WORK: Owner's number of well 2. New well By Method: Dug Dered D	MATERIAL FROM TO
Despend Cable Driven Reconditioned Rotary Detted	Top Soil 0 2 yndrel 2 15
	ledisk furner clay 15 30
(5) DIMENSIONS: Diameter of well P inches.	Carle brown scindstone 30 55
(6) CONSTRUCTION DETAILS:	Inoter block basel 88 190EM
Casing installed: 8 " Diam. from O r. to 732 r.	Vilue green septraling = 190 228 det
Threaded 🗌 🧹 " Diam, from ft. to ft.	Solid ist suff 597
Welded B	broken basalts delive shale 297 338
Perforations:	Juchen blick webapter states 50 36752
SIZE of perforations in, by in,	and broth 567 370
perforations from	broken placka alak Lugen 320 405
perforations from ft. to ft.	may Allock bosalt Layen 405 432
Screens: Yes No 12	protein bleck prodite black 445 575 30
Manufacturer's Name	burd black boralt 575 595
Diam Slot size from ft. to ft.	red basatt (watere) 645 648
Gravel packed: Yes D No B Size of gravel:	broton back bogalt 648 650
Gravel placed from ft. to ft.	hard gray rock 650 655
Surface seal: Yes No D To what depth? 200 ft.	some weter about 2 88'
Surface seal: Yes No To what depth? 200 ft. Material used in seal S & M TO NI C Did any strate contain unusable water? Yes No B	gased above water out
Type of water? Depth of strats	but more about 505' soggal
Method of sealing strata off	125 gal at 555, 150 gat a
(7) PUMP: Manufacturer's Name	
(8) WATER LEVELS: Land-surface elevation above mean sea level	100 + 3 1980 1111
Artesian pressurelbs. per square inch Date Artesian water is controlled by	9131 <u>1</u>
(Cap, vaive, etc.)	CEN 30
(9) WELL TESTS: Drawdown is amount water level is lowered below static level	Work started 8-28, 1979. completed 9-17, 1979
Was a pump test made? Yes [] No [] If yes, by whom? Yield: gal./min. with ft. drawdown after	WELL DRILLER'S STATEMENT:
n n n n	This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level) Turnet Water Level Time Water Level Thime, Water Level	NAME FAST Wood Drilling INC. (Person, firm, or corporation) (Type or print)
400 get at \$50 300 get at 400-	a and really
Time: Water Level Time Water Level Time Water Level 40 Jack of 550 Jack of 460- 350 Al. 4 550 200 36: 440	Address > So 2 Mi Der Ra YALIMM CUT.
	[Signed] gens Aufor
*of-test	(Well Driller)
Additional and the second seco	a 18 70
raf-test set 35 O gal/min, witht/drawdown atter 2 hrs. Artesian flow gp.m. Date Temperature of water Was a chemical analysis made? Yes □ No B	License No. 0 495 Date 9 - 18 , 1979

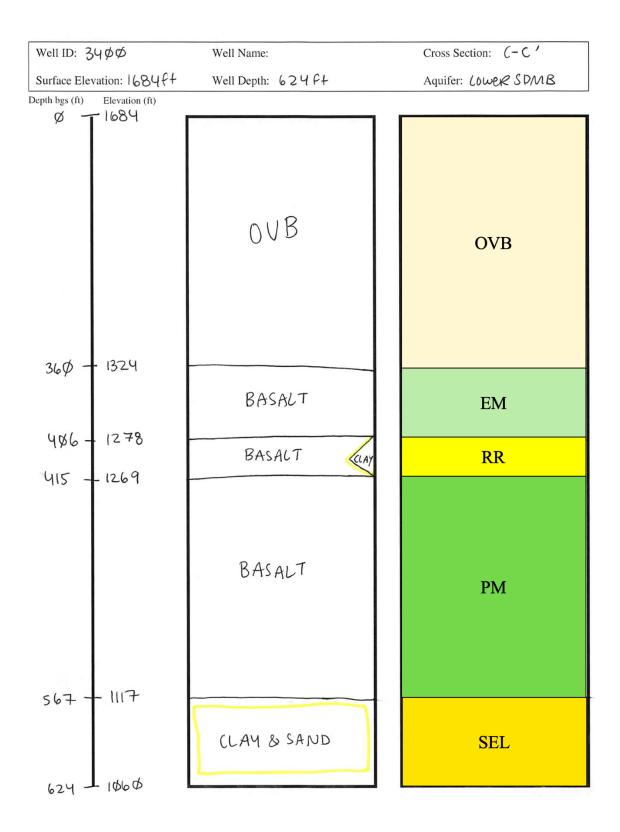
		Cross Section: C-C'
Well ID: 3406	Well Name:	
Surface Elevation: 1538FF	Well Depth: 655 FF	Aquifer: LOWERSDMB
Depth bgs (ft) Elevation (ft) I $\not O - 1538$		
	ONB	OVB
88 - 145Ø	0.00	010
00 - 100	BASALT	EM
19¢ - 1348		
[-(φ	SAND & CLAY	
	SAND & CENT	RR
293 - 1245 294 - 1244	BASALT	
	BASALT SHALE	РМ
338 - 1200 350 - 1188	BASALT	
367 + 1171	BASALT	SEL
4\$5 - 113'S	BASALT	
445 - 1¢93	Branci	
	BASALT SHALE	
		UMA
575 - 963	BASALT	UMA
595 - 943		
	BASALT	
645 - 893	- BACALT	
622 7 882	BASALT	



		Well ID: 3402	Well Name:	Cross Section: C-C'
File Original and First Copy with Department of Ecology Second Copy – Owner's Copy Third Copy – Driller's Copy STATE OF W/		Surface Elevation: 1581 ft	Well Depth: 58064	Aquifer: LOWER SDMB
(1) OWNEB: Name Tom Montgomery (2) LOCATION OF WELL: County Yakima	Address 804 £. lest Viola, Takima - ME & NW & see 21 f 12N.R21EW M. (10) WELL LOG: Formatics. Describe op court, narracter, max of subtervit and structure, and More threaders of sector of the final of the final of the final of MATERIAL FROM to 2 Soil, Brn, Sandy 0.3 Soil, J. K. Brn, Sandy 3 90 Clay, Uk, 32n, 90 130 Basalt, BL., Fractured 10, 260	Depth bgs (ft) Elevation (ft) Ø T IS81	OVB	OVB
(6) CONSTRUCTION DETAILS: Casing installed: 5. □ Jam from □.ft. to 4.72. ft. Threaded □ □ Jam from 1.ft. to .ft. Weided ③ □ Jam from .ft. to .ft. Perforations: Yee □ No ③ Type 0 perioration used. SIZE of perforations in .by .ft. perforations from .ft. to .ft. Screens: Yee □ Ao ℚ	Basalt, Blk. Hard 275. 290 Sandstone, Brn, Soft 290, 310 Sandstone, White 310 Sandstone, White 310 Sandstone, Cravel, Lygatized320 377 Sandstone, Gravel, Smail 370 Basalt, Fix, Hard 466 State 570 Sandstone, State 570 Sandstone, State 570	13Ø - 1451	BASALT	EM
Method of sealing strats of 7) PUMP: Manufacturers Name Type: 8) WATEB LEVELS: Land-surface elevation accove mean sea level. 5-27-77: ticesian pressure Artesian water is controlled by (Cap. valve, etc.)	RFCEIVED AUG 5 1977 DEPARTMENT OF ECOLOGY GENTRAL REJURAL OFFICE	29¢ — 1291	SAND & GRAVEL	RR
Zas a pump test madef Yes [] Nožį it yes, hy whom? """"""""""""""""""""""""""""""""""""	Work started 5-27-77 10 WELL DRILLER'S STATEMENT: This well was drilled under my jurisdiction and this report is rue to the best of my knowledge and belief. NAME B & B Well Drilling (Person. firm, or corporation) Address. Rt. 7. Bax. 600-A, Takima, Wash. 389(Signed) <i>Hamay</i> Burling (Well Driller) Jense No. 0037 Date 6-3-77 19	466	BASALT	PM
USE ADDITIONAL SHEE	TŞ IF NBCESSARY)	580 LIDON		

File Original and Fir t Copy ith Department of Ecology Second Copy — Owner's Copy Third Copy — Driller's Copy			LL REPORT	Application Permit No.		
(1) OWNER: Name H	ENDERSON		Address			
(2) LOCATION OF WEL				NE 4 Sec 21 T.	7	
ing and distance from section	or subdivision corner					3
(3) PROPOSED USE:	omestic 🗍 Industrial	Municipal	(10) WELL LOG:			
	rigation 👩 Test Well		Formation: Describe by color, c	haracter, size of materia	and stru	cture, and
(4) TYPE OF WORK:	wner's number of well		Formation: Describe by color, c show thickness of aquifers and stratum penetrated, with at lea	ist one entry for each c	hange of	al in each formation.
New well	Method: Dug	Bored	MATERI		FROM	то
Deepened Recondition		ie 🗌 Driven 🗍 ury 🗌 Jetted 🔲	- DIRT & BOULD	14C5	150	150
(5) DIMENSIONS:			- GRAVEL & S		. 200	
Drilled 624 it D	Diameter of weil		CIAN SAND			310
				·		318_
(6) CONSTRUCTION DE			Beka RACA	t (WATER)	318	360
Casing installed: 10	" Diam. from Q.	It. to	1p Fract. Black	BASAIT	390	
	" Diam. from .576	ft. to 624 ft.	BIACK BASA	IT V. HARD	406	415
Perforations: Yes 😥	No D		- BIDE CIA	Bacut	415	11110
Type of perforator use	d		DARK Gre DARK Gra	BASALT (FIRM)	415	<u>~140</u> ~166
SIZE of perforations	in. by	to 624 rt	fract. Cree	BASAIT	466	
perforation	s from ft.	to ft.	- HARO Ger	Beselt	515	545
	s from ft.	to ft.	Mild M MARD Grey	Bacult	<u>545</u> 548	<u>548</u> 567
Screens: Yes D No 🖉 Manufacturer's Name			Gry to G	ten Clay	567	
Туре	Model 1	ło	SAN'D	1	624	
Diam. Slot size	from	ft. to ft.				
Diam.'					- 1	
Gravel packed: Yes Gravel placed from	No 🖉 Size of grav	el;				
Surface seal: Yes D N Material used in seal	lo 🗌 To what depth	? ft.				
Did any strata contain	unusable water?	Yes No 🗆				
Type of water? Method of sealing strat	a off	ta				
7) PUMP: Manufacturer's Na						
Type:		. H.P				_
8) WATER LEVELS:	and-surface elevation					
tatic levelft.	below top of well Da	te				
rtesian pressure	s. per square inch Da	te				
Alvesial water is contra	(Cap, v	alve, etc.)				
9) WELL TESTS: Dr	awdown is amount was wered below static leve	ter level is				
7as a pump test made? Yes 🗋 N			Work started			
ield: gal./min. with	ft. drawdown af	er hrs.	WELL DRILLER'S STA			
			This well was drilled une true to the best of my know	fer my jurisdiction a wledge and belief.	nd this r	eport is
ecovery data (time taken as zer- measured from well top to wat		off) (water level				1.00
Time Water Level Time	Water Level Time	Water Level	NAME TAKEN FR.	or corporation) (T	K or pri	nt)
			Address		pri	
			AAAA 693		•••	
Date of test			[Signed]			
ailer testgai./min. with rtezian flow				(Well Driller)		
emperature of water Was a	chemical analysis mad	e? Yes 🗆 No 🗆	License No	Date.		19





H	Well ID: 3397	Well Name:	Cross Section: $C - C'$
Application No 371114 Martinez Well #2 (DOE #6) 3397	Surface Elevation: 1443 f+	Well Depth: 862ft	Aquifer: Lower SOMB
Location NE ₂ Section 20 T12N R21E STON Permit No 32/1/4	Depth bgs (ft) Elevation (ft) $\cancel{9}$ $\cancel{1443}$		
UDCA W DAN MARTINEZ CENTER & Sty sec 20 T/ 2N. R2/EWM.	Ø T 1445		
C (APROPOSED USE: Domestic] Industrial Municipal D. [(19) WELL LOG:			
Irrgainon Test Well Other Formation. Describe by concer, baracter, sace of maternal and structure, and holds that concerns a set of maternal and structure, and holds that concerns a set of audiers and the kind and stature of the maternal in sech structure prior sech change of formation. Test Well (4) TYPE OF WORK: Owner's number of well (a) MATERNAL FROM TO			
Reconditioned Book of Robert Jeffeld			
5) DIMENSIONS: Diameter of well inches Require Sand & Clay 170 240	2	OVB	OVB
0 Drilled ft. Depth of completed well			015
Casing installed: / b. "Diam. from Q. tt. to 14. tt. Brown & Block Corruled B-D 340. Threaded J. Z. "Diam. from tt. to 44. tt. Broken, Brown and Back Basalt 30 200 cm			
Welded Diam. from ft. to A. Perforations: Yes No No No A. Welded Diam. from ft. to A. Gruwe A. Gruwe A. Gruwe A. Gruwe A. Gruwe A. Correct Sandy Charg. , 4/0 425			
Size of perforations in. by in. Plus Candy Clark Clark			
perforations from to to the stand Bursel 1672 Org	346 - 356 -	BASALT	EM
Streen Syree No D Streen Grey Hard Bailt Green Grey Bosh Ltt B13 862	03¢ -	SAND, CLAY, GRAVEL	RR
The model No. Contraction of the model No. The plan. Slot size Slot size from ft. to ft.	425 - 1018	BASALT	PM
Q fGravel packed: yes No Size of gravel	448 - 995 -	UNSRUT	F IVI
Surface seal: Yes No To what depth?			
Did any strata contain unusable water? Yes [] No [] Type of water? Depth of strata		SAND	
(1) PUMP: Manufacturer's Name		હ્ય	SEL
b Type: H.P. c (8) WATER LEVELS: Land-surface elevation b identification b nt		CLAY	
Artesian pressure ibs. per square inch Date			
Artesan water is controlled by	672 - 771		
Vield. gal/min. with ft drawdown after hrs WELL DRILLER'S STATEMENT:			
true to the best of my knowledge and belief.		RACALT	
Time Water Level Time Water Level Time Water Level (Person, firm of corporation) (Type or print)		BASALT	
Address			UMA
Signed	808-	CLAY	
(USE ADDITIONAL SHEETS IF NECESSARY)	0.0	BASALT	
	862 581	01-110	

file Original and First Copy with Department of Ecology Second Copy — Owner's Copy Third Copy — Driller's Copy	WATER WELL REPORT	Application No.	
	STATE OF WASHINGTON	Permit No Cert 3	07-A
(1) OWNER: Name Ludwig, W ^m F.	Address Moxee , Was	hington .	
LOCATION OF WELL: County	Yakima SE 4	NE 14 Sec 19 T. 12 . N., R	21 ww
ag and distance from section or subdivision cor			
(3) PROPOSED USE: Domestic [] Indust	rial D Municipal D (10) WELL LOG:		
Irrigation X Test V		character, size of material and stru	ucture, an
	show thickness of aquifers and stratum penetrated, with at le	character, size of material and stri d the kind and nature of the mater east one entry for each change of	formation
(4) TYPE OF WORK: Owner's number of v (if more than one). New well (2) Method: I		A C. eta	
	Cable D Driven D	udvig 🖊 641.	•••
Reconditioned [Rotary _ Jetted _ ; Soil	61	
(5) DIMENSIONS: Diameter of well	1.2. inches. Cement gravel	10	. 2
Drilled	well	26 allow	5
(6) CONSTRUCTION DETAILS:	Clay & gravel, Brown shale		9
Casing installed: 12." Diam. from		26	12
Threaded10. " Diam. from 3	77. ft. to	10	13
Welded8" Diam. from	25. ft to8.38. ft Lime shell	18	14
Perforations: Yes C No C 8		10	15 16
Type of perforator used	Broken Basalt	8	16
SIZE of perforations	by in. Brown shale	10	17
perforations from		6	18
perforations from		11	19
Screens: Yes D No D	Gumbo	13 2	20
Manufacturer's Name.	Brown shale	18	21 22
Type Mod	Di Onen Dabait	6	23
Diam Slot size from Diam Slot size from	the the Drown Blance	8	24
	Brown sandy sha	,	24
Gravel packed: Yes No Size of a Gravel placed from ft. ta	Brown shale Brown send	11	25
	Brown shale	4 18	26
Surface seal: Yes No D To what de	epth? ft. Lime shell	4	28 28
Material used in seal Did any strata contain unusable water?	Yes No No Broken basalt		28
Type of water? Depth of	strata Brown sandy sha	le 10	- 29
Method of sealing strata off		8	30
(7) PUMP: Manufacturer's Name	Blue shale Basalt	2	30
Туре:	Blue shale	15	32
(8) WATER LEVELS: Land-surface elevat above mean sea lev	Cross and	4	32' 33'
Static level	Date Basalt	ž	340
Artesian pressure		3	34
Artesian water is controlled by	p, valve, etc.) Blue shale	2	34
(9) WELL TESTS: Drawdown is amount lowered below static	water level is		
Was a pump test made? Yes 🔯 No 🗆 If yes, by wh field 300 gal/min with 170 ft drawdow		, 19 Completed 8./.]	
		ATEMENT:	
··· ·· ·· ·· ··	This well was drilled u	under my jurisdiction and this	report i
	and to the best of my ki	lowledge and belief.	
Recovery data (time taken as zero when pump turn measured from well top to water level) Time Water Level Time Water Level T	MAME G.W. I	Ludwig	
Time Water Level Time Water Level T	me Water Level NAME	n, or corporation) (Type or p	orint)
		ntannum Rd Union Gap	>
		-	
Date of test gal /min. with	wn afterhrs. [Signed]	(We)) Delli	
rtesian flow Date			
Cemperature of water Was a chemical analysis		Date	19

STATE OF V	I A COMPLETION	PAGE 2 Application No . Permit No	
(1) OWNER: Name WM F. Ludwig	Address		
LOCATION OF WELL: County	- SE WE is se	19 TIZ N B	21
ing and distance from section or subdivision corner		C.A	-1. W.
(3) PROPOSED USE: Domestic 🗆 Industrial 🗆 Municipal 🗌	(10) WELL LOG:		
Irrigation [] Test Well [] Other		and material and struc	ture o
	Formation: Describe by color, character, so show thickness of aquifers and the kind a stratum penetrated, with at least one ent	nd nature of the materia	il in ea
(4) TYPE OF WORK: Owner's number of well (if more than one) New well Method. Dug Bored	MATERIAL	FROM	то
New well Dethod. Dug Deced Decepened Cable Driven D	Basalt	8	35
Reconditioned Rotary Jetted	Blue clay	2	35
(5) DIMENSIONS: Diameter of well inchase	Green shale	8	36
(5) DIMENSIONS: Diameter of well inches. Drilled	Blue clay	25	38
	Gray sand (water)	5	39
(6) CONSTRUCTION DETAILS:	Green shale	13	40
Casing installed: " Diam. from ft. to ft	Gray sand (water)	7	43
Threaded Diam. from ft. to ft.	Green shale	27	- 44
Welded	Hard Shell	. 3	44
Perforations: Yes D No D	Gray sand Green shale	20	47
Type of perforator used	Green sandy hard shale	5	4
SIZE of perforations	Green shale	Á	4
	Hard Shell	2	48
	Black basalt	28	50
Screens: Yes D No D	Green shale	29	53
Manufacturer's Name.	Blue sandy shale	10	54
Type Model No	Green shale	7	5
Diam	Hard sandy green shale	7 16	56 57
	Green clay	10	58
Gravel packed: Yes No Size of gravel.	Green sandy shale Sandy shale streaks	53	6
Gravel placed from ft. to ft.	Gray shale	Ĩ	6
Surface seal: Yes No D To what depth? ft.	Sandy shale streaks	8	6
Material used in seal	Sandy gray shale	31	6
Did any strata contain unusable water? Yes D No D Type of water? Depth of strata	Gray sand & water	6	6
Method of sealing strata off.	Shale & sand streaks	54	7.
(7) PUMP: Manufacturer's Name	Hard shell	3	7
Type:	Gray shale Broken basalt & creves		7
	Sand & boulders	. 20	7
above mean sea level	Green shale	í	7
Static level ft. below top of well Date	Hard black basalt	79	8
Artesian water is controlled by (Cap, valve; etc.)	Column basalt, gray	38	9
	Black basalt	9	9
(9) WELL TESTS: Drawdown is amount water level is lowered below static level	Work started	ompleted	
Was a pump test made? Yes D No D If yes, by whom?	WELL DRILLER'S STATEMEN		
	This well was drilled under my j		
и и и р	true to the best of my knowledge a	nd belief.	eport
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	NAME(Person, firm, or corport	ation) (Type or pr	
		(1)pe or pr	
	Address		
Date of test	[Signed](Well		
	[Signed]		

		Well ID: 3395	Well Name:	Cross Section: C-C'
3395	PAGE 3	Surface Elevation: 1415f+	Well Depth: 1709ft	Aquifer: WNB
Department of Ecology With WATER WE	Application No.	Depth bgs (ft) Elevation (ft) $\emptyset - 1415$		
(1) OWNER: Name WM F. Luthoric	Address - SE. W. DE W. See [9 T. 12. N. R21. W.M. (10) WELL LOG: Formation: Describe by color, character, and of material and attracture, and itratum persented, with at site one entry for each change of formation. Hard sandy shale 5 917 Black basalt & shale 83 1000 Shale with basalt streaks 85 1085 Rard black basalt 46 1131 Conglormant, basalt, water 19 1150 Sand, rock, black 62 1212 Bard basalt 95 1307	160 - 1265 160 - 1267 164 - 1287 228 - 1287 228 - 1887 299 -	OVB AASALT SHALE & LEME BASALT SHALE BASALT BASALT BASALT BASALT BASALT BASALT BASALT BASALT CLAY, SHALE, SAND	OVB
Casing installed: "Diam. from ft. to ft. Threaded	Sand, rock streaks & water 33 1340 Hard gray shell 3 1343	481 - 934 569 - 966	BASALT	PM
Welded " Diam. from ft Perforations: Yest No Type of perforator used	Gray sand & rock, water 12 1355 Brown sand & rock 59 1414 Gray shale, sand streaks, water 15 1429	756 659	CLAY, SHATE, SAND	SEL
Type of perforator used	Bale211450Hard gray rock511501Creves water raise11502Hard gray basalt561558Hard gray basalt, water, drilled111ke column rock451603Hard gray basalt241627Black sand11668Hard rock41672Green shale & oil showings11673Hard basalt24127Hard prock41673Hard basalt241709Hard basalt241713	782 - 633 786 - 629 912 - 503 917 - 498 1000 - 415 1100 - 205 1212 - 203 1307 - 108	BASALT SAND & SHALE BASALT BASALT BASALT BASALT BASALT BASALT BASALT	UMA
(8) WATER LEVELS: Land-surface elevation above mean sea level	Work started19Completed19 WELL DRILLER'S STATEMENT: This well was drilled under my jurisdiction and this report is	(5¢287	SAND & SHALE	MBTN
n n n Recovery data (time taken as zero when pump turned off) (water level nessured from well top to water level) nump turned off) (water Level Time Water Level Time Water Level Time Water Level Date of test	true to the best of my knowledge and belief. NAME. (Person, firm, or corporation) (Type or print) Address. [Signed]	1769	BASALT	PR

	Well ID: 3394	Well Name:	Cross Section: C-C'
File Original and First Copy with 3394 HALLING WARDEN WARDEN HALLING #5/H2	Surface Elevation: $1509f+$	Well Depth: 1551 f+	Aquifer: WNB
	Depth bgs (ft) Elevation (ft)		
Stord Copy – Owners Copy Third Copy – Driller's Copy (1) OWNER: Name S. Martinez Livestoćk Inc. Address Rte. Dox Sof Viewace, Wa. 9	^Ø T ^{15Ø9}	Same Salada a saladir a sala	
2) LOCATION OF WELL: County SHIP ST 1050 17. T12 N. T	в.21		
(3) PROPOSED USE: Domestic Industrial Municipal (10) WELL DEGRIMENT OF ECOLOGY	-Q	OVB	OVB
(3) PROPOSED USE: Domestic ☐ Industrial ☐ Municipal ☐ 109 WELL ELONGUINEIT OF DODOUT Trigation 27 Test Well ☐ Other ☐ Formation: Decretion science of the middle of the kind and nature of the middle of the middl	ructure, and		
(4) TITE OF WORK. (I(pape than one)	$\frac{1}{100}$ 264 - 1245		
New well X Method: Dug December Overburden	0 231		
Reconditioned Rotary & Jetter Clay, Gravel & Boulders 4	5 132	BASALT CLAY	EM
(5) DIMENSIONS: Diameter of well $17\frac{1}{2}$ inches. Clay & Gravel 13 Drilled 800 ft. Depth of completed well 1551 ft. Easalt & Clay 26	4 384 6 384 - 1125		
(6) CONSTRUCTION DETAILS: Sand, Gravel & Clay 38	4 454 ent	SAND, GRAVEL, CLAY	RR
Casing installed: 20 Diam. from 0 to 1. to 23 n. Basalt-black 54	2 582		
	4 705		
Berferetiens: _ SEE BELOW Beeslt block & Cloy	8 760 SE	BASALT	
SIZE of perforations _2/10 in. by _2 in. Basalt-gray 77	7 800	BASACI	PM
perforatione from 96	0 960		
Basalt- black w/b 96.	2 993 768 - 861		
Manufacturer's Name Nodel No Dasalt-black w/b 105:	$\frac{31056}{61066}$ 777 - 732	BASALT CLAY	SEL
Diam. Slot size from ft. to tt. Basalt-gray & Gravel w/b 108	3 1120-11-		
Basalt-black 112	0 1281 1 1308	BASALT	
Gravel placed from ft. to ft. Basalt-grav 1300	8 1 360	DASALI	
Surface sear: Yes X No D To what depth? R. Basalt-black hard 139	$\frac{1}{1}$ $\frac{1}{1447}$ $\frac{1}{2}$ $\frac{1}{1531}$ w/ 96% - 549		
Did any strata contain unusable water? Yes \square No $[X]$ DaSalt-DiK. & Gravel Stc. 21 1144	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	CLAY	
Method of sealing strata off		BASALT	
(7) PUMP: Manufacturer's Name By Others 12" Perforated Casing 40 ft. 96	1 1001 1883 426	LLAY	
	$1 1061 \\ 1 1121 \\ 1 12\phi - 389$	BASALT GRAVE	
Static level 16.6 ft below top of well Date 7/10/79 20 ft. 128	11301 11381		UMA
	1 1511		
(9) WELL TESTS: Drawdown is amount water level is towered below static level out	79		
was a pump test made? Yes∑ No ☐ If yes, hy whom? Others yield: gal/min, with ft. drawdown after hrs. WELL DRILLER'S STATEMENT:	hadang Albuman	BASALT	
<u>" " "</u> This well was drilled under my jurisdiction and the true to the best of my knowledge and belief.	is report is	UTONC I	
Time Water Level Time Water Level Time Water Level (Person, firm, or corporation) (Type or			
Address É . 3410 Ninth Ave. Spokane	, Wa.9920: 1447 - 62		
The gal/min, with tt drawdown after hrs. [Signed]			
	-	PACAL T	MOTH
Arthain flow gpm. Date Bate License No. 0162 Date7/26/79.	, 19	BASALT GRAVE	MBTN
(USE ADDITIONAL SHEETS IF NECESSARY)			
ECY 050-1-20	155142	BASALT	PR

	DOE C-3	3392	Well ID: 3392	Well Name:	Cross Section: C-C'
'ile Original and First Copy with Jepartment of Ecology econd Copy — Owner's Copy 'hird Copy — Driller's Copy	WATER WELL REPORT Application : STATE OF WASHINGTON Permit No.	No 3392	Surface Elevation: 155ØF+	Well Depth: 764ff	Aquifer: Lower SDMB
(1) OWNER: Name) LOCATION OF WELL: County	JAKima _SW & SW & See Ub TI		Depth bgs (ft) Elevation (ft) $\emptyset 155\phi$		
(4) TYPE OF WORK:	Industrial Municipal [] (10) WELL LOG: Test Well-OV Other [] Formaticin. Describe by color, character, iste of mature of er of well of the kind of a dature of arterian preserved, with a least one entry for each of the arterian preserved, with a least one entry for each of arterian preserved, with a least one entry for each of arterian preserved, with a least one entry for each of arterian preserved, with a least one entry for each of the least one entry for each of arterian preserved, with a least one entry for each of the least one entry for each of	FROM TO 2 215 315 280	215 1335	ÓVB	OVB
Type of perforations and the second s	In. by		28¢ - 127¢	BASALT	EM
Diam. Stot size fro Diam. Stot size fro Gravel packed: Yes □ No 39 S	Model No. m ft. to ft. m ft. to ft. BASHLT BLK MED / LVB. LIMIH SINGL HANDUNTS OF SHALE RULF	550 640 640 701	420-1130	SAND, GRANEL, CLAY	RR
Gravel placed from Surface seal: yes gr No to to barran used in seal. SEC Did any strata contain unusable Type of water?. De Method of sealing strata off.	pth of strata		436 - 1124 435 - 1115	BASALT SAND	
(7) PUMP: Manufacturer's Name. Type: (8) WATER LEVELS: Land-surface Static level T. below top of Artesian pressure	elevation /54/ ft CENTICE			BASALT	
Was a pump test made? Yes [] No [] If yes, Yield: gal./min. with ft. dr.	wedown after hrs. WELL DRILLER'S STATEMENT:	and this report is	55¢ - 1¢\$\$¢\$	BASALT STAND	РМ
Recovery data (time taken as zero when pun measured from well byo to water level) Tune Water Level Time Water Leve Date of test Baller test 15_sal/min. wtb. 260 n. d. Artesian flow pun. Du Temperature of water Was a chemical a	nawdown after 1	yAking	64ø - 91ø	BASALT SHALE	
FCY 050-1-20	USE ADDITIONAL SHEETN IF NECESSARY		704 - 846		

-	WAILK WE dCopy-Owners Copy dCopy-Owners Copy OWNER: Name. Sebastian Charron	Address U		
*2)	LOCATION OF WELL: County Yakima	Fredericado a sectoremente en entre en entre en entre	2 N. 15	2 <i>G</i> WM
_	nng and distance from section or subdivision corner PROPOSED USE: Domestic [] Industrial [] Municipal []	(10) WELL LOG:	P	
(0)	Irrigation 🗭 Test Well 🗌 Other	Formation Describe by color, character, size of material show thickness of aquifers and the kind and nature of t stratum penetrated, with at least one entry for each cl	l and struche materi	cture, and al in each
(4)	TYPE OF WORK: Owner's number of well (if more than one) New well Method Dug Bored	MATERIAL	FROM	TO
	Deepened Cable Driven	Top soil silt, sandy, brown	0	15
	Reconditioned Rotary Jetted	conglomerate, brown, firm	15	19
(5)	DIMENSIONS: Diameter of well 16 inches. Drilled 2213 ft Depth of completed well 2205 ft	clay, tan, soft	19	. 38
		cong. br. firm	38 51	51
(6)	CONSTRUCTION DETAILS:	cong. clay w/ gravel, reddish br.~ cong. brown	63	63 92
	Casing installed: 16 ." Diam from +1 ft to 524 ft	clay, light br. w/ small gravel	91	104
	Threaded10 "Diam from 50.3, ft to 851 ft Welded8" Diam from 437 ft to 1248 ft	cong. lt. br. med. soft	104	137
	101 1210	cong. lt. br.	137	167
	Perforations: Yes □ No ⊐ ^C Type of perforator used	clay, sand, tan w/ sticky lenses	167 188	188
	SIZE of perforations in. by	cong. lt. br. clay, lt. br. w/ sand, gravel, and	100	216
		sticky lenses	216	318
		clay, blue, very sticky	318	327
		cong. blue, firm	327	338
	Manufacturer's Name	clay, blue, w/ pea gravel, v. stick clay, green, sticky to sandy	<u> </u>	343 360
	Type	sandstone, graygreen, v. firm	360	370
1	Diam Slot size from ft to . ft Diam Slot size from ft to ft.	clay, gray green, soft	370	372
ير .		clay, greenish, gravel, sand, stick		449
	Gravel packed: Yes No 2 Size of gravel . Gravel placed from	clay, sandy, dark gray	440	459
		cday, with gravel, shale, sticky sandstone, blue gray, v. firm	459 479	479
	Surface seal: Yes No D To what depth? 55 ft Material used in Seal benronite	sand, silt, clay, blue green	495	515
	Did any strata contain unusable water? Yes 🗌 No 🛛	clay, shale, w/ gravel, dark green	515	520
	Type of water? Depth of strata	basalt, weathered, w/ dark clay	- 520	530
		basalt, black, hard basalt, crevice w/ dark clay	530	532
(i)	PUMP: Manufacturer's Name LAY 11/2 Type - TAJRIJANK - HP300	generally clay shale interbed w/	532	535
		narrow sandstone, clay layers	€ 535	770
	water Levels: Land-surface elevation above mean sea level c level . 171	sandy layers, green to gray	,	
	c level . 171	clay, gray	770	828
	Artesian water is controlled by . (Cap, valve, etc)	basalt, red, fractured; clay, gray, sticky	828 830	830 837
(0)		clay, black, w/ basalt fragments	837	847
	WELL TESTS: Drawdown is amount water level is lowered below static level	Work started 11/17. , 19.77 Completed 1/	18	, 19 80
was Yielo	a pump test made? Yes 🛱 No 🗍 If yes, by whom? 🚁 Yie 1 3024 gal /min with 280 ft drawdown after 47 hrs	WELL DRILLER'S STATEMENT:		
	10 D D	This well was drilled under my jurisdiction a	nd this i	report is
		true to the best of my knowledge and belief.		
	very data (time taken as zero when pump turned off) (water level neasured from well top to water level) ne Water Level Time Water Level Time Water Level	NAME Cessel Well Drilling (Person firm, or corporation) (T	ype or pr	
		Address 1308 Voelker Yakima, Wn.	ype or pr	
-				···· ·· ·· · ·
Baile	r test	[Signed] (Well Driller)		
	an flow	License No. 0073. Date 1/14/	81	19

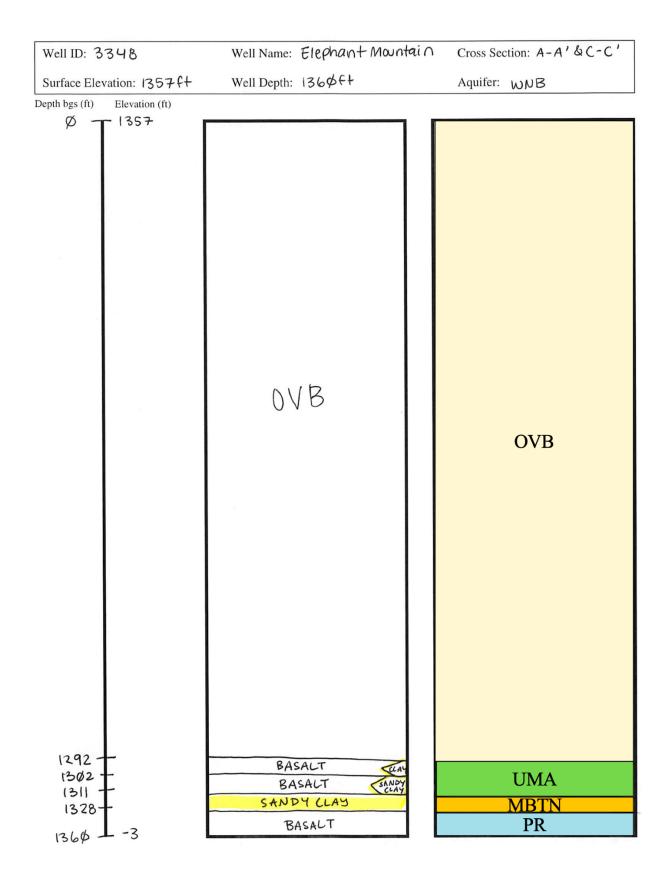
File Original and Department of E Second Copy - D Third Copy - D	d First Copy with cology Owner's Copy riller's Copy	3345	WATER WE	Application 2 VASED TONCE 2 1981 Permit No. (507
(1) OWNER	B: Name S_	Gastian	Charron	ACT DEC 2 1 1301		
	ION OF WEL			TARTAGENS & TAS W 18 Sec 13 T/	2 N R	C ww
aring and dis		or subdivision corn	er	OT PARIE		
(3) PROPO			ial 🗋 Municipal 🗍	(10) WELL LOG:		
		rrigation Test W		<u> </u>	and stru	cture, and
		wear's sumber of a		Formation: Describe by color, character, size of materia show thickness of aquifers and the kind and nature of i stratum penetrated, with at least one entry for each c	he materi hange of	al in each
(4) TYPE (DF WORK: () New well	if more man one) Method: D	ug 🗋 Bored 🗖	MATERIAL	FROM	то
	Deepened	_ c	able 🗋 Driven 🖸	basalt, black	847	856
	Recondition	ned 🗆 R	otary 🗋 Jetted 🗍	basalt, gray, hard	856 947	947
(5) DIMEN		Diameter of well		basalt, brown, w/ brown clay basalt, broken, w/ gray clay	969	969 - 979
		Depth of completed	wellft.	baselt, black	979	985
(6) CONST	RUCTION DE	TAILS:		basalt, black., broken w/ gray cla	985	1025
	installed:	" Diam, from	ft. to ft.	basalt, gray	1025	1041
	aded 🔲	" Diam. from	ft. to ft.	beselt, broken, black w/ crevice	1041_	1052
We	lded 🔲	" Diam. from	ft. to ft.	baselt, black, broken, w/ blk cly baselt, black	1052	1112
Perfora	tions: Yes 🗆	No 🗅		baselt, black w/ green shale	1118	1127
Тур	e of perforator use	M		baselt, black w/ gray shale	1127	1130
		ns from	y	alsy, gray, sticky	1130	1135
	perforatio	ns from	ft. to ft.	shalè, green		1138
	perforation	ns from	ft. 10 ft.	baselt, static rose from 144 to 14	1138	
Screens	Yes No D				1144	1144
Man	ufacturer's Name			basalt, black, broken w/ red clay	1160	1192
		Mode		basalt, blk, broken w/ gray slay	1192	1204
Dia			ft. to ft.	basalt, black broken w/ red clay	1204	1217
	packed: Yes 🗆	No D Size of	tevel:	baselt, blk,broken, w/ gray clay	1217	1222
	vel placed from		ñ.	baselt, blk, firm baselt, gray	1222	1228
Surface	seal: v. n	No [] To what de	nthi f	basalt, gray black loss of cutings		
Mat					1325-	1335
		in unusable water? Depth of	Yes No 🖸	basalt, blk, hard	1335	1469
Met		ta off		basalt, blk, fractured	1469	1490
(7) PUMP: Typ		lame		baselt, blk, harder	1490	1690 1747
(1) I UMII.	Manufacturer's F	Name		baselt, blk	1747	1762
	B LEVELS:	Land-surface elevat	ion	basalt, blk, s/ green elgy, loss of	1762	1789
		above mean sea lev t. below top of well		-outtings, possibly s/ water		1874
		lbs. per square inch		basalt, blk, nod, hard	1789	1091
Arte	mian water is cont	trolled by	p, valve, etc.)	bestity-humpony;	1891	1898
(9) WELL Was a pump ter Yield:	TECTC. I				1070	
(9) WELL		Drawdown is amount owered below static No [] If yes, by wh		Work started		19
Yield:	gal./min. with	ft. drawdown		WELL DRILLER'S STATEMENT:		
				This well was drilled under my jurisdiction	and this	report i
" Recovery data				true to the best of my knowledge and belief.		
measured f	(time taken as ze rom well top to w ter Level Time		ine Water Level	NAME	Type or p	rint)
				Address		
				Augures		••••••••
date of tes	t	······································		[Signed]		
Bailer test		ft. drawdor	wn afterhrs.	(Well Driller)		
			madet Yes D No D	License No		, 19
-						-
		(USE ADDITIONAL S	HEFTS IF NECESSARY) RY	ə I/I#	01
ECY 050-1-20				1-0		-

г				Well ID: 3345	Well Name:	Cross Section: C-C'
File Original and First Copy with Department of Ecology Second Copy — Owner's Copy Third Copy — Driller's Copy	3345 WATER WE	LL REPORT	Application No.	Surface Elevation: 1338ft	Well Depth: 2213++	Aquifer: GRB
1) OWNER: Name Set	Charron'	Address	Permit No	Depth bgs (ft) Elevation (ft) $\emptyset - 1338$		
4) TYPE OF WORK: Our New well Despaced Reconditioner 5) DIMENSIONS: Drilled ft Def 6) CONSTRUCTION DET Casing installed: Welded Welded Perforations: Yes N SIZE of perforation used. SIZE of perforations	Method: Dug Bored Cable Drives d Rotary Jetted Dameter of well Inches. rgth of completed well ft "Diam. from ft. to ft. o	(10) WELL LOG: Tormstinn: Deservice by color, character throw thickness of gaugitra and the king traum perstands, with at least one MATERIAL baselt, brown, deteriors honeycomb baselt, burnt going to b black baselt baselt, blk baselt, blk v/ green als green alsy clay, brown	rsom ro ted, w/ 1874 1898 1874 1898 1928 1920 1970 1985 1925 1985 2079 2083 2101 2083 2101 2116 2125 2131 2165 2151	520 - 318 530 - 808 532 - 806 828 - 510 830 - 508 847 - 491	OVB BASALT BASALT CLAY & SANDSTONE BASALT BASALT	OVB
perforationa perforationa Screens: yes No Manutacturer's Name	from ft to ft strom ft to ft Model No. ft to from ft to ft No ft to ft	olay, brown, w/ grean ah caving some clay shale, brown clay shale, brown clay shale going to blk caving hedly cant gat sample	2165 2162 2182 2200 besalt,7	847 - 361	BASALT BASALT BASALT BASALT BASALT BASALT BASALT BASALT BASALT	UMA
Surface seal: Yes I No Material used in seal Did any strata contain	unusable water? Yes 🗂 No 📮	MEGIGIMI		1138 - 260 1138 - 260 1144 - 194 1222 - 116	BASALT BASALT BASALT	MBTN PR
(7) PUMP: Manufacturer's Nat Type: (8) WATER LEVELS:	And-surface elevation bove mean sea level			12-2 110	BASALT	RZ
9) WELL TESTS: Dri low as a pump test made? Yes D No ield: gal./min. with	rawdown is amount water level is wared below static level o f yes, by whom? ft. drawdown atter hra.	WELL DRILLER'S STATEM	y jurisdiction and this report is	1762 424 1789 451	BASALT CUM	SOC
ecovery data (time taken as zero measured from well top to wate	o when pump turned off) (water level er level) Water Level Time Water Level	NAME			BASALT	FS
Sate of test		[Signed]	reli Driller) 	2116781 2125787 2200862	BASALT (U	VTG
CY 050-1-20	USE ADDITIONAL SE	EFTS IF NECESSARY)	K82 1/11/07	22,000 -862 22,13 -875	BASALT	GRB

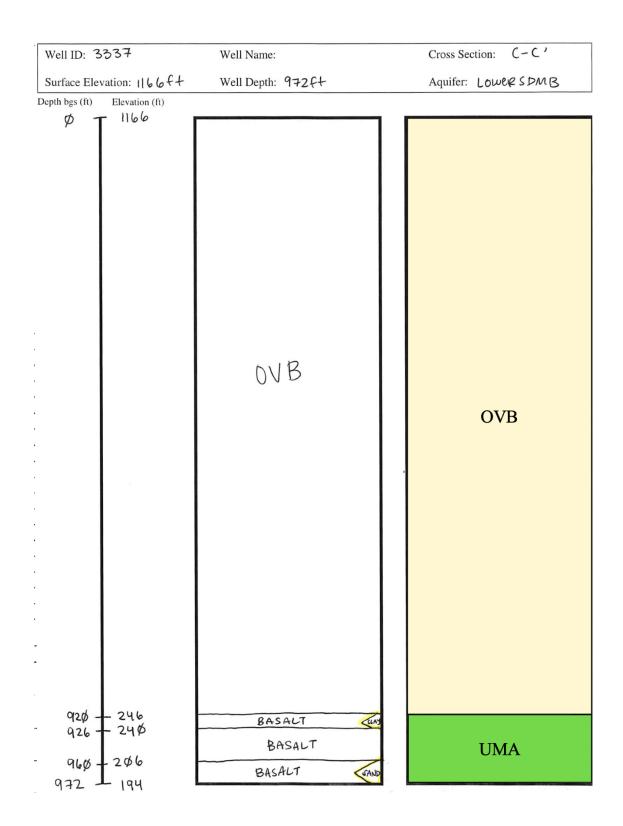
Second Copy - Owner's Copy MAY 31 1988 STATE OF W	LL REPORT Replication No. 3347	This Grignal and First Copy with Strate Grignal and First Copy with This Grignal and First Copy This Grignal and First Copy STATE OF W	LL REPORT Application N ASHINGTON Permit No .	io .
(1) OWNER: Name ROY FARMS INC.	Addres 401 WALTERS ROAD NOXEE			C = /
(2) LOCATION OF WELL: County YAKIMA (2)	A SE 1/2 SE 1/2 Sec 15 T12 N. R20 EWM	Δ ⁽¹⁾ OWNER: Name ROY FARMS INC.	Address 401 WALTERS RD MOXE	E. WH.
ing and distance from section or subdivision corner		(2) LOCATION OF WELL: County Making	WA _ SE 1 DE 1 sec 15 _ T.1	2.N, R. 206W.M
PROPOSED USE: Domestic	(10) WELL LOG: aye of 2	and distance from section or subdivision corner	0	
Irrigation Test Well [] Other	Formation: Describe by color observed aive of meterical and structures and	PROPOSED USE: Domestic Industrial Municipal	(10) WELL LOG: Baye 20/2	\sim
	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.	Irrigation Test Well Other	Formation · Describe by color, character, size of material	and structure, and
(4) TYPE OF WORK: Owner's number of well (if more than one)	MATERIAL FROM TO		Formation. Describe by color, character, size of material show thickness of aquifers and the kind and nature of th stratum penctrated, with at least one entry for each ch	he material in each lange of formation.
New well 🖉 Method: Dug 🗌 Bored 🗌	Soll 0 3	6 (4) TYPE OF WORK: Owner's number of well (if more than one)	MATERIAL	FROM TO
Deepened Cable Driven Reconditioned Retary Jetted	CALICHE 35	S New well □ Method: Dug □ Bored □	BASALT SOFT GRAY	1442 1465
	SAND 56	Operation Description Cable Driven Reconditioned Rotary Jetted		1465 1490
(3) DIMENSIONS: Diameter of well		~		1490 1500
Drilled 1786 ft. Depth of completed well 1786 ft.	SAND 8 40	E (5) DIMENSIONS: Diameter of well inches	BASALT GRAY	1500 1548
(6) CONSTRUCTION DETAILS:	CLAY 40 92	Drilled		1548 1568
	SAND 92 96	(6) CONSTRUCTION DETAILS:		1568 1573
Casing installed: 20 "Diam. from $T2$ rt. to -98 rt. Threaded D (6 "Diam. from $T2$ -rt. to -626 rt.	CL2Y + SAND 96 150	Casing installed: Diam from ft. to ft		1573 1600
Threaded _ /6 " Diam. from 12 to 626 th. Welded _ /2 " Diam. from 555 th to //55 th.	GRAVEL + CLAY 150 265	Threaded		1600 1685-
	CLAY 265 380	Welded		1685 1730
Perforations: Yes 🗆 No 🛃	CLAY & SAND 380 450			1730 1738
Type of perforator used	_CLAY HARD 450 520	Perforations: Yes D No D Type of perforator used	BASALT GRAY	1738 1786
perforations from ft. to ft.	CLAY & SAND MUD LOSS 520 525	Type of perforator used		
perforations from ft. to ft.	<u>CLAY BROWN</u> 525 545 CLAY BLUE 545 575	perforations from ft. to ft.	· · · · · · · · · · · · · · · · · · ·	· · · · · ·
perforations from	BASALT W/ BLUCLAY 575 610	Q		
Screens: Yes D No 2	BLUE GLAY W/ GRAVEL 610 650	2 perforations from		•
Manufacturer's Name	RROWN CLAY 650 680	Screens: Yes D No D		· · ·
Type	BLUE CLAY 680 690	C Manufacturer's Name		
Diam,	BROWN CLAY 690 705	Type Model No		
	BLUE W BLOCH BASALT 705 845	L Duran Glating from fit to fit		, ,
Gravel packed: Yes D No g Size of gravel:	BROWN CLAY 845 851	50.		
Gravel placed from ft. to ft.	BLUE SAND 851 940			
Surface seal: Yes or No D To what depth? 100 ft.	SAND 3TONE 940 1040	Gravel placed from ft. to ft.		
Material used in seal PARTLAMD CEMENT	BASALT BLACK 1040 1050	Surface seal: Yes No To what depth? ft.	-	
Did any strata contain unusable water? Yes 🗌 No 😭		Material used in seal		
Type of water?	, CLAY 1065 1100	Did any strata contain unusable water? Yes 🗌 No 🗋		
	BASALT BLACH 1100 1124	O Type of water? Depth of strata Method of sealing strata off		
(7) PUMP: Manufacturers Name Type: 07 12* + 16' C35/NG	<u>BROWN CLAY</u> 1124 1130 BLUE GLAY 1130 1148	>		· · ·
Туре: 12- г / с статиче	BAJALT BLACK HIYO 1168	6 (7) PUMP: Manufacturer's Name		
(8) WATER LEVELS: Land-surface elevation above mean sea level	BASALT + CLAY STONE 468 1200	Туре: Н.Р		
Static level 236'91 tt. below top of well Date 5-16-88	RED SCORIB (200 1230	U ~(8)-WATER LEVELS: Land-surface elevation above mean sea level		
Artesian pressure	BROWN SCORIB 1130 1255	Static level		
Artesian water is controlled by	GRAY BASALT 1255 1442			
	LOWTIDUED	Artesian pressure		
(9) WELL TESTS: Drawdown is amount water level is lowered below static level	Work started 10-5 1987. Completed 5-17 1988			
Was a pump test made? Yes No No I If yes, by whom?	WELL DRILLER'S STATEMENT:	10wered below static level	Work started	
		Was a pump test made? Yes D No I If yes, by whom? Yield: gal/min. with ft drawdown after hrs	WELL DRILLER'S STATEMENT:	
- GPM ± GNE GALLON	This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.	Go Yield: gal/min. with it drawdown atter hrs		
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)			This well was drilled under my jurisdiction a true to the best of my knowledge and belief.	and this report is
Time Water Level Time Water Level Bine Beter Level	NAME LERRY BURD WELL PRILLING INC	Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)	51 D 1 1 1 1 1 1 1	
	(Person, firm, or corporation) (Type or print)	measured from well top to water level) Time Water Level Time Water Level Time Water Level	NAME - [Larry Burd Well Drilling (Person, firm, or corporation) (7	4, Inc)
	Address 5543 SW DOUGLES		(Person, firm, or corporation) (T	spe or print)
	Perin Letan ORE 9780	•	Address 5543 S.W. Douglas Renchedon, OR 98801 [Signed] [Larry Bund]	
/ste of test	[Signed] Jong Bund (Well Driller)	2	rendieton , UK 98801	
		i of test	[Signed] Larry Burd]	
Lian flow	License No. 00 62 Date 5-20 , 19.88	B. & test	(then briner)	
Temperature of water	17.00.00 January 19.00.00	yan flow	License No. DOL 2 Date 5-2	20 19.88
				,
(UST ADDITIONAL ST				
S. F. No. 7334-OS-(Rev. 4-71).		(USE ADDITIONAL SE	IEETS IF NECESSARY)	
		S. F. No. 7356-OS-(Rev. 4-71).	2042	د 🐵 ۲

		Well ID: 3347	Well Name:	Cross Section: C-C'
		Surface Elevation: 14\$3 FF	Well Depth: 2802ft	Aquifer: GRB
3347 VATER WELL R acond Copy-Owner's Copy nid Copy-Dimer's Copy OWNER: Name_ Roy FARMS		Depth bgs (ft) Elevation (ft) Ø T 14Ø3	ONB	
12) LOCATION OF WELL: County YAK/MA (2a) STREET ADDORESS OF WELL: conserved address) 401 WALTER (2a) STREET ADDORESS OF WELL: conserved address) 401 WALTER (3) PROPOSED USE: Domestic Industriel Municipal (10) Will (3) PROPOSED USE: Domestic Industriel Municipal (10) Will (4) TYPE OF WORK: Overar mathematic of will // EACHAM UFLL With at least with a test well Other Bored (b) Dimension One Relation Or Dug Bored OT OT (c) DIMENSIONS: Duamater of well // EAX // EXX 9 // Inches. OT OA (c) DIMENSIONS: Duamater of well // EXX 9 // Inches. OA (d) Comstraint One Data IS: Completed well 2010 m A	SEN SEN SOC 15 T. 12 N. R. 20W.M.	575 - 828 61ø - 793 7ø5 - 698 845 - 558	BASALT CLAY CLAY CLAY SAND	OVB
O Cesting installed: 7,2,00: Diam. from 1,10. 7,1 7,2 Weided Diam. from n. to n. to n. f. 7,2 Uner installed: Diam. from n. to n. f. 7,2 Uner installed: Olam. from n. to n. f. 7,2 Thread Olam. from n. to n. f. 7,2 Thread Olam. from n. to n. f. 7,2 Type of perforsitions: Yes No.2 GY GY Streene: Yes n. by n. f. GY Distributions from n. to n. f. GY Streene: Yes No.2 GY Manufacturer's Name GY GY GY	M. SABAT MED MBL K. BASALT MED /881 1/985 K. BASALT MED /985 2015 K. BASALT MARD 2015 BASALT MARD 2015 BASALT MARD 2015 BASALT MARD 2126 BASALT MARD 2121 K. BASALT MARD 2121 K. BASALT MARD 2123 M. BASALT MARD 2132 K. BASALT MARD 2235 K. BASALT MARD 2235 K. BASALT MARD 2235 K. BASALT MARD 2235 K. BASALT MARD 2242 K. BASALT MED 2242 K. BASALT MED 2657 K. BASALT MED 2657	1040-363 1050-353 1100-303 1124-279 1148-255 1168-235 1200-203 1200-203	CLAY SIGNO BASALT (LAY BASALT CLAY BASALT BASALT SCORIA	UMA MBTN PR
Diam Stori size from ft to rt. Ho Gravel packed: Ves No Size of gravel 2.6 <td< th=""><th>LE CEMENTED BACK TO 10' WITH NEAT SEMENT PLOG- P & BOTTOM OF 95" LINER MENTED WITH DEAT CEMENT SUMT</th><th>1864461 1865 462</th><th>BASALT GRAVEL</th><th>RZ SOC</th></td<>	LE CEMENTED BACK TO 10' WITH NEAT SEMENT PLOG- P & BOTTOM OF 95" LINER MENTED WITH DEAT CEMENT SUMT	1864461 1865 462	BASALT GRAVEL	RZ SOC
Tor (9) WELL TESTS: Gravedown is amount water level is lowered below static level O Was a pump test made? Yes No[40] If yes, by whom? U Vield: gal./min.with ft, drawdown after ftra.	MAY - 1999		BASALT	FS
Precovery data (time taken as a servine pump turned oit) (water level measured know Contract Time Water Level Contract Time Water Level Contract Contract Address Contract Contract Contract	Hedge and belief. Hold MAN DRILLING CORPO DELEGGER REAL OF COMPONING E3410 974 AUE SPOKENE WA CHUCHESTIC ON A LICENSON 0189	26161213 2657 1254 2602 1399	CLAY & SAND	VTG GRB

		3348	Elepha	nt Mountai	n Well			
Pile Original and First Copy with Department of Ecology Second Copy – Owner's Copy Third Copy – Driller's Copy STATE OF W	Augustion No.							
(1) OWNER: Name DEPT of NAT- Rosoupar (2) LOCATION OF WELL: County VANMA	States IN CONTRACTOR Sec 16 T/2 N. R.20 W		•	. CAS	Domestic a	LL DRILLIN	G	
ig and distance from section or subdivision corner		÷1 ₹	LARRY CASSE	۲ L	1308 SOUTH	DELKER AVENUE	PHONE 4	53-2560
(3) PROPOSED USE: Domestic	(10) WELL LOG: Elephant MT # 1 Formation: Describe by color, channeline size of material and sinuchure, how shows of any color, this kind a focure of the material is stratum penetraied, with at least one entry for each change of format	this this	Cont of N	atural Resourses		Dom	nit # G4-25817P	H .
New well Imore han one) Imore han one) Imore han one) New well Imore han one) Imore han one) Imore han one) Deepened Cable Driven Reconditioned Rotary Jetted	MATERIAL FROM TO	o		t. Well # 1	SEC.16 T.12			8 ×
(5) DIMENSIONS: Diameter of well 16 inches. Drilled 13.76 ft. Depth of completed well 13.69 ft.	AEMARNS!	- Burg				500		
(6) CONSTRUCTION DETAILS:	Cemented TUPABottom at		FROM	TO	THICKNESS 3	FOR Top Soil	AATION	
Casing installed: <u>/6</u> · Diam. from <u>+1</u> tt. to <u>1294</u> Threaded <u>12</u> · Diam. from <u>/26</u> 2tt. to <u>/322</u> n. Welded <u>1</u> · Diam. from <u>tt. to</u> <u>1</u>	Coninted hole TO 1335'	or the	- 3 12	12 282	9 270	Boulder, sand, Clay, sandy w/s	clay,conglomerate sm gravel,brown	
Perforations: Yes No Type of perforation used. SIZE of perforations in. by		ta and/or	270 362 392 426	362 392 426 462	92 30 32 36	Clay,brown w/ Clay,gray, w/ Clay,brown, w, Clay,brown, v	large gravel /sm gravel ery sticky	
perforations fromft. toft. toft. toft. toft. toft. toft. toft. toft. toft.		the Data	462 492 595	492 595 602	30 103 7	Clay, brown, s Shale,green Clay,gray,w/s	sandy,w/sm gravel n gravel,sticky	
Manufacture's Name. Type. Model No. Diam. Slot size from fl. to fl. Diam. Slot size from fl. to fl.		Warranty 1	602 617 634 683	617 634 683 782	10 17 51 99	Clay,brown,st Clay,green w/ Clay,brown w/ Shale,green		
Gravel packed: Yes I No Size of gravel:		T Mar	923	906 923 928	124 17 5	Shale, green w, Shale, green, s; Shale, green, v	and lenses	
Surface seal: Yes & No D To what depth? 30 ft. Material used in seal Center T Did any strata contain unusable water? Yes D No D		does NOT	928 943 1020	943 1020 1073	15 77 53 33 32 21	Shale,green w Shale,green w Clay,green,st	/small gravel /sand lenses icky	
Type of water?			1073 1106 1138	1106 1138 1159	33 32 21		ry sticky ry sticky w/s gra	vel
Type: HP (8) WATER LEVELS: Land-surface elevation above mean sea level		Ecology	1159 1185 1218	1185 1218 1292	26 33 74	Clay,green,sa Clay,green,ve Clay,green,sa	ry sticky	
Static level 204 ft. balow top of well Date Artesian pressure libs, per square inch Date Artesian water is controlled by (Cap, valve, etc.)		د	1292 1302 1311	1 302 1 311 1 328	10 9 17	Decomposed, bas Basalt, broken Compacted san	saltw/dark clay h w/clay,black d,sandy clay cavi	ng
(9) WELL TESTS: Drawdown is amount water lavel is Owsred below static level Was a pump test mader Yes No 1 If yes, by whom?	Work started		1328	1360	32	Basalt,redish	to black some ho	neycomb
Was a pump test made? Yes ? No if yes, by whom?. Yield: gal./min. with ft. drawdown after hra. "390 ± 21.21" "	WELL DRILLER'S STATEMENT: This well was drilled under my jurisdiction and this report true to the best of my knowledge and belief.	Department	Static:	226				
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	The to the best of my knowledge and belief. NAME Cassel Curl DHIII (Person, firm, or corporation) (Type or print)	The T	Casing:	16" + 1 to 1296' 12" 1322'	· .	D	EGEIV	
nessured from well top to water level) Time Water Level Time Water Level Time Water Level Time Water Level	Address 1308 Uoi H or Valima					M	FEB 2 5 1981	
Artesian flow g.p.m. Date how and the second	[Signed]	PI			accept	as well rep	TTMENT OF 1009	
(USE ADDITIONAL SE	erets if necessary) DK 7.15.81 -	•			·	2.26.81 DK		



	ELL REPORT 3337 Application No	Company and Company	LL REPORT Application No 94 774 79579
0		(1) OWNER Name MONA AND CAPL ALLWARDT	R#1 BN 157 MOLES WAL 98936
(1) OWNER: Name MONA and CALL ALNUALD	TAddress N#1 BOX 157 HOLEE, WN 98936	$\frac{(1) \text{ OWNER Name for the NAME of the County } (2) \text{ LOCATION OF WELL County } YAKiMA$	- 14 Stul 14 Sec 9 T 12N R 2 CWM
(2) LOCATION OF WELL: County YAKIMA	- 54 14 Sec. 9 T 12 N. R. & O. W.M. N	* (2) LOCATION OF WELL County THAT MAT	POW S FORMO 45 FT TAN & ROLLIO
S Rearing and distance from section or subdivision corner 1155 4T. 1	FOM S. BOUND. 45FT. FROM E. BOUND. MAL	,	(10) WILL I OG
) PROPOSED USE: Domestic [] Industrial [] Municipal []) PROPOSED USE Domestic Diadustrial Municipal D	
Trigation Test Well Other	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 penetratad, with at least one entry for each change of formation.	• Irrigation Test Well Other	Poimation 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
(4) TYPE OF WORK: Owner's number of well 2		(4) TYPE OF WORK Owner a number of well (if more than one)	MATERIAL FROM TO
O New well 1 Method; Dug O Bored O	MATERIAL FROM TO		SAND (WATEL) 810 810
T Despend Cable A Driven C Reconditioned Rotary Jetted		New weil Method Duc Bored Deceptened Cable Driven Reconditioned Rotary Jetted	BROWN CLAY, HARD 870 905
	HARD PPN AND SAND STONE 10 18		CEMENTED SHUT & GRAVEL 905 905
(5) DIMENSIONS: Diameter of well \$4 - 265 inches	SANA CEARC	(5) DIMENSIONS Diameter of well inches Drilled ft Depth of completed well ft	SAND W/ LAYERS UF GAMEL SOS 920
Drilled 972 ft. Depth of completed well 765 ft.	THE STATED GRAVE ATHE 21 TO		BLACK BASALT, FRATURD W/ CLAY 920 926 MULTI-COLORED BASALT 926 970
(6) CONSTRUCTION DETAILS:	BROWN CLAY 40 63	o (b) CONSTRUCTION DETAILS	BLACK BASALT, HAAD 940 958
 Casing installed: <u>10</u> "Diam. from - 1, ft. to <u>8</u>.20 ft. Threaded <u>8</u> "Diam. from <u>4</u>.25, ft. to <u>12.20 ft.</u> 	GREEN CARY, STICKY 63 125 54ND 175 179	Crsing installed Diam from ft to ft	RASAIS SULT EDATTURED 458 900
D Threaded B Diam. from 4:55 It. to 220 ft.	GREEN CARY 1.78 225	Threaded □ Diam from ft to ft Welded □ Diam from ft to ft	BLACK BASALT, SUFT WY JOX 460 912
Welded # Diam. from	BLACK SAND, FINE 225 299	7	SAND - POURD CEMENT
Perforations: Yes C No 🙀	CLAY 229 270	Perforations Yes No D	PLUG IN BUTTOM.
SIZE of perforations	REAL CLAY METTICAL GRADE 270 284	Type of perforator used SIZE of perforations in by in	
perforations from		perforations from it to ft	
ge perforations from		perforations from tt to tt perforations from tt to tt	
\$	GLAY CLAY W/ CENTE TO GRAVEL 350 410	£	
Screens: Yes D No Manufacturer's Name	GRAVEL & SAND (WATER) 410 420	Screens Yes No D Manufacturer & Name	
C Manufacturer's Name Model No.	BLUE GACIN GLAY T SANI) 420 488	Type Model No	
Diam. Slot size from ft. to ft.	SAND 458 492. GRZY CLAY, STUCKY 492 550	Diam Slot size from ft to ft	
Diam. Slot size from ft. to ft.	GREEN CLAY 550 500	Diam Slot sile from ft to ft	
Gravel packed: Yes O No g Size of gravel:	CLAY 540 540	Gravel packed Yes D No D Size of gravel	
Gravel placed from ft. to ft.	CLAU + LAUSES OF SAND -590 648	Gravel placed from ft to ft	
Surface seal: Yes R No D To what depth? 300 ft.	LIGHT GREEN CLITY - 648 665	Z Surface seal YLS NO D To what deptn? ft	
0 Material used in seal C2MCWT T SHAD GACAT O Did any strata contain unusable water? Yes No M	SANO. 665 676 CLAY 640 714	Material used in seal	
Type of water?	MULTI-COLORD GEALL (WATER 714 717	Did any strata contain unusable water? Yes No Type of water? Depth of strata	
> Method of scaling strata off	SAND 717 725	> Nethod of sealing strata off	
0 (7) PUMP: Manufacturer's Name	BLUE GREEN CLAY, STICKY 720 740	(7) PUMP Manufacturer s Name	
О Туре: К.Р.	GARVEL W/ SAND (WATEL) 746 750	о тур. нр	
(8) WATER LEVELS: Land-surface elevation	CLAY, STICKY 750 765 SAND 765 770	O Land surface elevation above mean sea level ft	
Static level 2 tt. below top of well Date Hill 15.192	CLAY 770 775	5 Static level ft below top of well Date	
Artesian pressureibs. per square inch Dateibs.	SAND 775 797	Artesian pressure Ibs per square inch Date	
(Cap, valve, etc.)	CLAY , STICKY 797 810	Artesian water is controlled by (Cap value etc.)	
(9) WELL TESTS: Drawdown is amount water level is	(CCAVT.) Work started May 16 10 77 Completed NCV', 10 19 77	(9) WELL TESTS Drawdown is imount water level is lowered below state level	
Was a pump test mader Yes M No I If yes, by whom? EUSSERAS		Was a pump test made? Yes No I If yes by whom?	Work started MAY 16 1977 Completed NOL', 10 1977
Wield: 700 gal/min. with /76 ft. drawdown after 7 hrs.		Yield gal/min with ft drawdown after his	WELL DRILLER'S STATEMENT
$ = \frac{500 - 130}{350} = 100 - 1100 = 100 = 1000 = 1000 = 1000 = 1000 = 1000 = 10000 = 10000 = 10000 = 10000 = 10000 = 100000 = 100000000$	This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.	۵	This well was drilled under my jurisdiction and this report is
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)		2	true to the best of my knowledge and belief
Time Water Level Time Water Level Time Water Level	NAME A THIN THE ZUCK	Reco cry data (time taken as zero when pump turned off) (water level measured from well top to water level)	NAME LYNN A TAYLOR
6 2 min Full	(Person. firm, or corporation) (Type or print)	C. Fine Water Level Time Water Level Time Water Level	(Person firm or corporation) (Type or print)
a Becouse;	Address RH 1, BOY 201 T Moxse, NU 98436	Õ l	Address R#1, Tow 207 MoxEE, WAR 98536
E	In the astrong	2	
Date of test _k.S.s	[Signed] X 47230 (1. Vaylor (Well Beller)	F > Date of test er test gal/min with ft drawdown after ars	[Signed] June a Varker
Artesian flow	121.55 71 24 07		
Temperature of water.	Lacense No. C. S. Date. / 19. A.	Temperature of water Was a chemical analy is mide? Yes [] No []	LICCINSE No 06 55 Date 7100, 27 1977
(USE ADDITIONAL S	HETTE IF NECESSARY)		1
ECY 050-1-20	Continuel .	5 F No 7356-OS-(Rev 4 71) (USE ADDITIONAL SE	IEDTS IF NECESSARY)
	CDATING C		



File Original and First Copy with Department of Ecology Second Copy — Owner's Copy Third Copy — Driller's Copy		ELL REPORT washington	Application I Permit No .		2520
(1) OWNER: Name A. J. Bru	-10++c	Address RT. 1, BX1	43 Moxre		
LOCATION OF WELL: County.	Yakimi		NE 1 Sec 1 5 T./	2 n., r	20 мм
		(10) WELL LOG;			
	ndustrial [] Municipal [?est Well []. Other []	the second	character size of matama	and str	
		Formation: Describe by color, show thickness of aquifers and stratum penetrated, with at le	the kind and nature of t ast one entry for each cl	he mater ange of	formation.
(4) ITE OF WORK. (If more than o	ne)	MATER		FROM	ŢO
, Deepened	Cable 🛛 Driven 🗆	soil		0	3
Reconditioned	Rotary 🗍 Jetted 🗌			4	72
(5) DIMENSIONS: Diameter of	well 12. inches.	clay (green) clay (grey small	Lund	13	107
Drilled /035 ft Depth of compl	eted well. 1035 ft.	Basalt (broken-		100	120
(6) CONSTRUCTION DETAILS:		Basalt (black h	encycomb water)	14B	
Casing installed: /2 " Diam from	+1 1 152 "	Basalt (med. hay	<i>с</i> р,	117	150
Threaded D /O. " Diam. from	ft. to 4419 ft.	Basalt (nard)		151	167
Welded 🔀" Diam. from	ft to ft.	Basalt (broken) Basalt (hard)		168	172
Perforations: Yes 🗆 No 🚂		Basalt (broken,)	-d)	182	
Type of perforator used SIZE of perforations		Bassil (drew) B	acte travel) clay	186	
SIZE of perforations	in. by	Bossop (green	clay '	343	
perforations from .	. ft to ft.	Barratt (grey)	c lay	351	
perforations from	. ft to ft.	Bazalt (61ach by	eken med)	396	441
Screens: Yes D No 2		Basalt (" hay			465
Manufacturer's Name	Model No	Basart (med).		466	478
Diam Slot size . from	. ft. to ft.	Basalt (hard)		479	
Diam Slot size from	. ft. to ft.	Basalt (med) Basalt (bard)		571	720
	e of gravel	Basalt (" der	wice)	721 728	727
Gravel placed from	ft. to ft	Clay (grey)		733	735
Surface seal: Yes X No . To wh	at depth? 140 ft.	Basalt Chard, 0	decla)		910
Material used in seal Clay. Did any strata contain unusable wa	ater? Yes 🗌 No 🕱	Baselt (baselt Baselt (bard)		911	914
Type of water? Dept	h of strata	Basalt (broken		915	1005
Method of sealing strata off .		Basolt (grey - 1			1035
(7) PUMP: Manufacturer's Name					
Туре:	. НР				
(8) WATER LEVELS: Land-surface e above mean se	levation ft	1 dell to the			
Static level . 56 ft below top of	well Date 10-8-88	OK ILRA 10	-11-15		
Artesian pressure					
	(Cap, valve, etc)				
(9) WELL TESTS: Drawdown is an lowered below s	ount water level is	Work started Dec	112 0	7	
Was a pump test made? Yes 🔊 🛛 No 🔲 If yes, b	y whom? HCKIOnd		1977 Completed OC	<u>r</u>	19.78
rield. /500 gal/min with 194 ft draw	down after 8 hrs	WELL DRILLER'S STA			
" Sp Cap "7.7 9PM		This well was drilled un true to the best of my kno	der my jurisdiction ar wledge and belief	nd this i	report is
Recovery data (time taken as zero when pump measured from well top to water level)	turned off) (water level			1	-
Time Water Level Time Water Level	Time Water Level	NAME HEATY B	or corporation) (Ty	ling	7
· · · · · · · · · · · · · · · · · · ·		Address 70. Box 165	yakima W	12. 98	3907
Date of test	· · · · · · · · · · · · · · · · · · ·	(Signad) Tolen L.	Rail		
	wdown after. hrs	[Signed] / Lenry	(Well Driller)		• •
	lysis made? Yes 🗆 No 🎘	License No. 00.53	Date 10-14	•	46

WATER WELL REPORT	3349		
Dispania (International State Copy - Ecology, 2 nd copy - owner, 3 rd copy - driller	CURRENT		
Construction/Decommission ("x" in circle) 452 605	Notice of Intent No. W268415		
X Construction 452 603	Unique Ecology Well ID Tag No. AHP715		
Decommission ORIGINAL INSTALLATION	Water Right Permit No. G4-25207P		
Notice of Intent Number	Property Owner Name Evans Fruit		
PROPOSED USE: Domestic Industrial Municipal DeWater Inrigation Test Well Other	Well Street Address PO Box 70		
TYPE OF WORK: Owner's number of well (if more than one)			
New well Reconditioned Method: Down Bornd Driven			
Deepened Cable Botary Jetted	Location NW 1/4-1/4 NE 1/4 Sec 18 Twn12		
DIMENSIONS: Diameter of well 8" inches, drilled 7.7/8" ft. Depth of completed well 1540 ft.	(s, t, r Still REQUIRED)	,	Or WWM
CONSTRUCTION DETAILS	Latil and Lat Day		
Casing Welded 10 " Diam. from +1 ft. to 305 ft.	Lat/Long Lat Deg Lat M		
$\begin{array}{c c} \textbf{Casing} & \blacksquare & Welded & 10 & " & Diam. from +1 & ft. to & \underline{305} & ft. \\ \hline \textbf{Installed} & \blacksquare & Liner installed & \underline{8} & " & Diam. from +1 & ft. to & \underline{469} & ft. \\ \hline \end{array}$	Long Deg Long	Min/Sec	
Threaded " Diam. From ft. to ft.	Tax Parcel No. (Required) 201218-12001		
Perforations: Yes X No	CONSTRUCTION OR DECOMMISSION PROCI	DURE	
Type of perforator used	Formation: Describe by color, character, size of material and nature of the material in each stratum penetrated, with at least		
	of information. (USE ADDITIONAL SHEETS IF NECESSA	RY.)	r-each
Screens: Yes No K-Pac Location	MATERIAL	FROM	1 T
Type Model No.	Broken black porous basalt	786	789
Diam. Slot size from ft. to ft.	Very hard light gray basalt	789	84
Diam. Slot size from ft. to ft.	Soft porous gray basalt trace of green clay	847	85
Gravel/Filter packed: Yes X No Size of gravel/sand	Hard gray basalt	852	86
Materials placed fromft.	Broken dark gray basalt Hard gray basalt	862 864	86
Surface Seal: x Yes No To what depth? 305 ft.	Med soft porous black basalt 160 psi	867	88
Material used in seal cement	Med hard brown basalt	883	88
Did any strata contain unusable water?	Med hard gray porous basalt	886	89
Type of water? Depth of strata	Med soft gray fractured basalt 170 psi	893	90
Method of sealing strata off	Hard light gray basalt	906	93
PUMP: Manufacturer's Name	Med hard gray basalt / Received	935	95
Туре: Н.Р.	Med soft porous dark gray basalt	953	95
WATER LEVELS: Land-surface elevation above mean sea level fl.	Med hard dark gray basalt JUN Z b ZUI	955	96
Static level ft. below top of well Date	Med soft black porous basalt	497/	97
Artesian pressureIbs. per square inch Date		S-86	98
Artesian water is controlled by (cap, valve, etc.)	Hard dark gray basalt	989	99
WELL TESTS: Drawdown is amount water level is lowered below static level	Broken black porous basalt & some clay	995	99
Was a pump test made? Yes No If yes, by whom?	Fractured black basalt 260 psi	999	10
Yield: gal./min. with fl. drawdown after hrs. Yield: gal./min. with fl. drawdown after hrs. Yield: gal./min. with fl. drawdown after hrs.	Hard gray basalt	1012	10
Yield: gal./min. with ft. drawdown.after hrs.	Soft black & some reddish brown porous basalt	1036	10
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)	280 psi 73 deg		-
top to water level) Time Water Level Time Water Level Time Water Level	Med hard black basalt Soft porous black basalt 290 psi	1049	10
The second state second state second	Med hard black basalt	1061	10
	Very hard light gray basalt	1089	110
	Med hard gray basalt broken some green clay	1100	11
Date of test	Hard dark gray basalt	1103	11
Bailer Test gal./min. with ft. drawdown after hrs.	Med soft black basalt	1138	11
Airtest 250 gal./min. with stem set at 1540 ft. for 1 hrs.	Med hard black basalt	1158	113
Artesian flow g.p.m. Date			

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	Drilling Company BJ Exploration & Drilling Co., INC
	Address 404 N Conway St
Driller or trainee License No. 0321	City, State, Zip Kennewick , WA , 99336
IF TRAINEE: Driller's License No:	Contractor's
Driller's Signature:	Registration No. BJEXPI132QK Date 6-22-12

ECY 050-1-20 (Rev 06/08) [f you need this document in an altenate 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.

				C. C. Flori
3				Surface Elevation
	33	10		Depth bgs (ft) El
WATER WELL REPORT		47		$\phi - 1$
DIPATIVIALON ECOLOGY Original & ft copy - Ecology, 2 nd copy - owner, 3 nd copy - driller	CURRENT			Ψ
	Notice of Intent No. W268415			
Construction/Decommission ("x" in circle) Construction 452605				120-1
Construction 45 200 5	Unique Ecology Well ID Tag No. AHP715			
Notice of Intent Number	Water Right Permit No. G4-25207P			142 - 1
PROPOSED USE: Domestic Industrial Municipal	Property Owner Name Evans Fruit			
	Well Street Address PO Box 70			186 - 9
TYPE OF WORK: Owner's number of well (if more than one)	City Cowiche County	Yakima		
	Location NW 1/4-1/4 NE_1/4 Sec. 18 Twn 12	_R 20_	EWM Check	- X
Image: Septend □.cable Image: Septend Image: Jetted DIMENSIONS: Diameter of well 8" inches, drilled 7.7/8" ft. Dipth of completed well 1540 ft. ft. ft.	(s, t, r Still REQUIRED)		or wwm □ One	
CONSTRUCTION DETAILS	Lat/Long Lat Deg Lat N			
Casing \boxtimes Welded 10 " Diam. from +1 ft. to 305 ft. Installed: \Box Liner installed $\underline{8}$ " Diam. from +1 ft. to $\underline{469}$ ft.		Min/Sec		
Installed: Liner installed 8 " Diam. from +1 ft. to 409 ft. Threaded ft. Diam. From ft. to ft. to ft.	Tax Parcel No. (Required) 201218-12001	11112 000		442 - 7
Perforations: Yes X No	CONSTRUCTION OR DECOMMISSION PRO	COURE		
Type of perforator used	Formation: Describe by color, character, size of material as	id structure, an	d the kind and	
SIZE of perfsin. byin. and no. of perfsfromft_ toft_	nature of the material in each stratum penetrated, with at le of information. (USE ADDITIONAL SHEETS IF NECESS	ast one entry f ARY.)	or each change	
Screens: Yes XNo K-Pac Location	MATERIAL	FROM	TO	
Type Model No	Hard gray basalt	1181	1229	
Diam. Slot size from fL to fL Diam. Slot size from fL to fL	Med soft gray porous basalt trace of green clay Med soft porous black basalt 74deg 310 psi	1229	1250	
Diam. Slot size from ft. to ft. Gravel/Filter packed: Yes X No Size of gravel/sand	Med hard fractured black basalt	1277	1296	733 - 4
Materials placed from ft. to ft.	Med hard dark gray basalt	1296	1336	735 T 4
Surface Seal: X Yes No To what depth? 305 ft.	Med soft broken dark gray basalt with some green & gray clay	1336	1342	75 - 4
Material used in seal cement	Hard gray basalt	1342	1401	
Did any strata contain unusable water? Yes No Type of water? Depth of strata	Med hard dark gray basalt	1401	1414	
Type of water? Depth of strata Method of sealing strata off	Soft porous black basalt	1414	1436	847-3
PUMP: Manufacturer's Name	Med hard gray basalt Hard gray basalt	1436	1500	852 - 3
Туре: Н.Р	Med hard black basalt	1534	1540	852 0
WATER LEVELS: Land-surface elevation above mean sea level ft.				
Static levelft. below top of well Date				
Artesian pressure Jbs. per square inch Date Artesian water is controlled by (cap, valve, etc.)		<u> </u>	+	989-18
Artesian water is controlled by (cap, valve, etc.) WELL TESTS: Drawdown is amount water level is lowered below static level				995 - 1
Was a pump test made? Yes No If yes, by whom?				
Yield:gal/min. withft. drawdown afterhrs. Yield:gal/min. withft. drawdown afterhrs.	8" casing to 469	+	+ - 1	999-1
Yield: gal./min, with ft. drawdown after hrs.	8" casing to 469 7 7/8" hole to 1,540'	<u>8</u>		
Recovery data (time taken as zero when pump turned off) (water level measured from well	Received	7		1100 - 7
top to water.level) Time Water Level Time Water Level Time Water Level	JUN 2 6 201	2	+	
				1143 - 7
		č.		
	Reinert			1229
Date of test	AEGION			1229
Date of test	BIRM REGION C	+		
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. Arresian flow g.p.m. Date		622.12		1250
Bailer Test gal/min. with ft. drawdown after hrs Airtest 250 gal/min. with stem set at 1540 ft. for 1 hrs.	Start Date <u>4-19-12</u> Completed Da	te <u>5-22-12</u>		1250
Bailer Testabl.nin. withfl. drawdown afterhrs Artext 250gal/min. with stem set athothrs. Artesian Rowgp.n. Datefl. Temperature of waterWas a chemical analysis made? Yes No	Start Date 4-19-12 Completed Da			1250
Baller Test pal./min. with ft. drawdown after hrs. Airtest 250 gal./min. with stem set at 1540 ft. for	Start Date <u>4-19-12</u> Completed Date of the second start Date <u>4-19-12</u> Completed Date of the second start			1250
Bailer Test gal/min. withft_drawdown afterhrs. Artest 250_gal/min. with sem set at [540ft_forhrs. Artesian flow g.p.m. Date Temperature of water Was a chemical analysis made? Yes No WELL CONSTRUCTION CERTIFICATION: 1 constructed and/or accept responsibility No	Start Date <u>4-19-12</u> Completed Date of the second start Date <u>4-19-12</u> Completed Date of the second start	Washington		1250
Baller Tes pal./min. with ft_ drawdown after hes Airnest 250 gal./min. with stem set at 1540 ft or hes. Arcesian flow pp.m. Date Temperature of water Was a chemical analysis made? Yes No WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility construction standards. Materials used and the information reported above are true Diriller/Digniener/Trainee Name (pp.m) Larry McLanahan Titler/Tegniener/Trainee Signature ZMMW MN:	Start Date <u>4-19-12</u> Completed Day for construction of this well, and its compliance with all te to my best knowledge and belief. Drilling Company BJ Exploration & Drilling	Washington		1250
Bailer Testabl.nin. withfl. drawdown afterhrs Artext 250gal/min. with stem set athothrs. Artesian Rowgp.n. Datefl. Temperature of waterWas a chemical analysis made? Yes No	Start Date <u>4-19-12</u> Completed Date of this well, and its compliance with all te to my best knowledge and belief. Drilling Company Bl Exploration & Drilling Address <u>404</u> N Conway St	Washington Co., INC	well	1250
Baller Tes pal./min. with ft_ drawdown after hes Airnest 250 gal./min. with stem set at 1540 ft_ for hes. Arcesian flow pp.m. Date Temperature of water Was a chemical analysis made? Yes No WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility construction standards. Materials used and the information reported above are true Diriller/Digniener/Trainee Name (pp Larry McLanahan Titler/Tenjerer/Trainee Signature Comp	Start Date <u>4-19-12</u> Completed Date for construction of this well, and its compliance with all te to my best knowledge and belief. Drilling Company BJ Exploration & Drilling Address <u>404</u> N Conway St	Washington Co., INC	well	1250

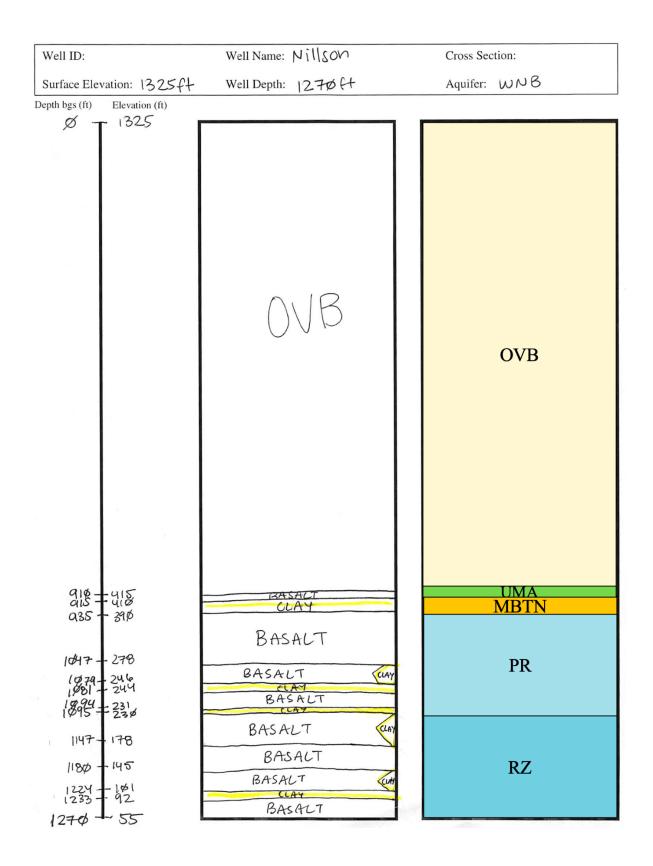
Well ID: 3349	Well Name:	Cross Section: C-C'
Surface Elevation: 1175 f+	Well Depth: 1540Ff	Aquifer: WNB
Depth bgs (ft) Elevation (ft)		
Ø T 1175	OVB	OVB
2 0 + 1055	BASALT CLAY	TD (
142 - 1033 186 - 989	BASALT	EM
	CLAY	RR
	BASALT	РМ
733 - 442 735 - 440	CLAY	SEL
841 328 852 - 323	BASALT BASALT BASALT	UMA
989-186	CLAY	MBTN
989 - 186 995 - 188 999 - 176	BASALT CLAY	
999 - 170	BASALT	
11\$\$ - 75 11\$\$ - 72	BASALT CLAY	
	BASALT	PR
122954	BASALT CUM	
1250	BASALT	
1336161	BASALT CUM	
	BASALT	RZ
1540 I -365		Bernard Barness and Barness

ECY 050-1-20 (Rev 06/08) [f you need this document in an altenate 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.

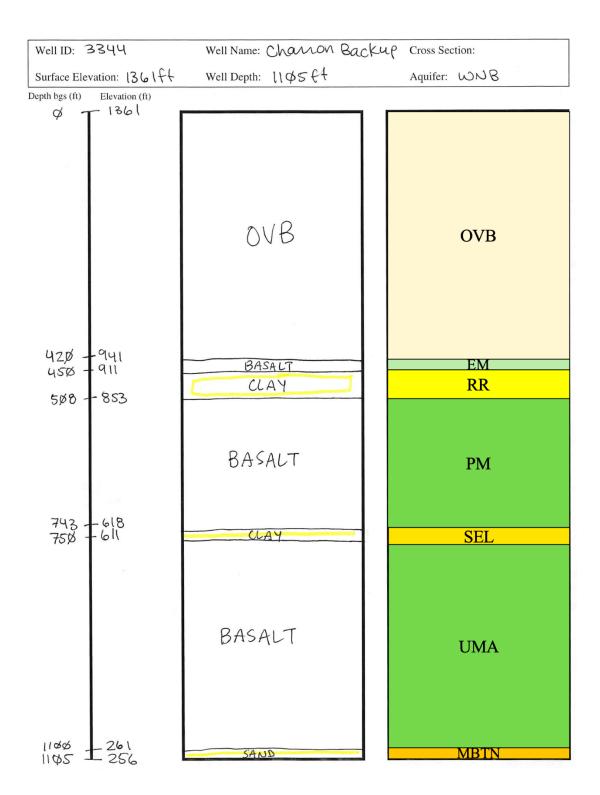
The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

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.

						• Flease print, sight and return	to the Department of Ecology		
	Please print, sign and return	to the Department of Ecology	× * * * * *			OF F	COLOGY		
			Nillso	on Wel			Current		
•			1 1115		•	Water Well Report	WP CUITENL		
	Water Well Report	Current							
	Original - Ecology Ili sony - guran 12 sony dellar ()	Voluce of Intent No W150741				ICOLOGY	8 2004 Unique Ecology Well ID Tag No AHP784		
	Water Well Report Original - Ecology 1st copy - owner 2nd copy - driller	ved \			Ę	Construction/Decommission			
Report.	Construction/Decommission	Unique Ecology Well ID Tag No A	HP784		8	Construction	Waten Right Permit No G4 29667P		
ō	Construction All6 1	8 Water Right Permit No G4 29667P			0	Decommission ORIGINAL INSTALLATION Notice	Property Owner Name Roy Farms Inc		TR
<u>a</u>	Decommission ORIGINAL INSTALLATION Notice		J	2	Å	of Intent Number			210
ş	of Intent Number	Property Owner Name Roy Farms Inc Well Street Address 401 Walters Rd	U/-	۷		153566 Of Intent Number	Well Street Address 401 Walters Rd		
<u>u</u>	153566 of Intent Number	Well Street Address 401 Walters Rd			Well	PROPOSED USE Domestic Industrial Municipal DeWater Imagation Test Well Other	City Moxee County Yaku		
-	PROPOSED USE Domestic Industrial Municipal CAR	-City Moxee County	Yakıma		ž	Dewater I imgation Test Well Other			
Well	DeWater I imgation Test Well Other					TYPE OF WORK Owner s number of well (if more than one)	Location E 1/4 SE 1/4 Sec 14 Twn 12		
>	TYPE OF WORK Owner s number of well (if more than one)	Location E E 1/4 SE 1/4 Sec 14 1	wn 12 R 20 EWI	M 🖌 cucle	.0	New well Reconditioned Method Dug Bored Digmen		ww	M one
s			ww	M	this	□ New well ☐ Recondutored Method Dug Bored Drey Depened Depened Determined De	Lat/Long (str Lat Deg La	t Mm/Sec _	
this	New well Z Reconditioned Mathod Dug Bored Driven	Lat/Long (str Lat Deg	Lat Min/Sec _		-	DIMENSIONS Dameter of well 12 inches dalled 12 & -# 97/8	still REQUIRED) Lana Daa		
Ξ	DIMENSIONS Diameter of well 12 inches dailed 12 & # 97k "	still REQUIRED)			5	Depth of completed well 1270 ft	still REQUIRED) Long Deg Lo	ng Mın/Se	c
u	Depth of completed well 1270 fi	Long Deg	Long Min/Se	c	Ē	CONSTRUCTION DETAILS	Tax Parcel No		
	CONSTRUCTION DETAILS	Tax Parcel No			5	Casing 2 Welded 12 " Diam from +1 fi to 942 ff			
2	Casing Weided 12 Diam from +1 ft to 942 ft				÷	Installed Linerinstalled Diam from ft to ft	CONSTRUCTION OR DE COMMISSI	NBROCED	TIDE
÷.	Installed Linerinstalled Diam from ft to ft	CONSTRUCTION OR DECOM	MISSION PROCED	NIDE	ធ		Formation Describe by color character size of material and		
a		Formation Describe by olor character size of ma			E	Perforations Yes No	nature of the material in each stratum penetrated, with at least	t one entry for e	ach change of
F	Perforations Yes No	nature of the material in each stratum penetrated, we	that least one entry for e	such change of	5	Type of perforator used	information indicate all water encountered (USE ADDITIO	AL SHEETS IF	NECESSARY)
Information	Type of perforator used	information indicate all water encountered (USE A	DDITIONAL SHEETS IF	NECESSARY)	Information	SIZE of perfsin by in and no of perfs from ft toft	MATERIAL	FROM	то
¥	SIZE of perfsin by in and no of perfsft toft	MATERIAL	FROM	TO	<u> </u>	Screems Yes VNo KPac Location	Med hard broken brown & black basalt	1040	1047 -
<u> </u>	Screens Yes No K Pac Location	Brown Silt	0	4-	o	Manufacturer's Name	Med soft fractured brown basalt & hard green clay	1.0.0	1
e	Manufacturer's Name	Sand gravel & cobbles	4	7	÷	Type Model No	little water 175ps	1047	1079
÷	Type Model No Diam. Slot aze from ft to ft	Sandy Clay	7	15		Dam Slot sze from ft to ft Diam Slot sze from ft to ft	Hard green clay	1047	1079
	DiamSlot azefromfl tofl DiamSlot azefromfl tofl	Tan shcky clay	15	72	ō	Diam Slot sze from ft to ft. Gravel/Filter packed Yes Z No Size of gravel/sand	Med hard black basalt		1081
and/or	Gravel/Filter parkad Yes No Size of gravel/sand	Dark brown coarse sandstone	72	79	and/or	Matenals placed from ft to ft		1081	
5	Matenais placed from ft to ft	Brown clay	72	86	Ĕ		Hard green clay	1094	1095
Ē	Surface Seal. Z Yes No To what depth? 942 ft			106		Surface Seal: Z Yes No To what depth? 942 ft.	Med hard black basalt with green clay seams	1095	1147
		Sandstone & day layers brown	86		D	Matenal used in seal _cement	Med hard black basalt porus	1147	1180
E	Matenal used in seal _cem ent	Sand & fine gravel brown	106	110	at	Did any strata contain unusable water?	Med hard black basalt & green clay seams	1180	1191
Data	Did any strata contain unusable water?	Dark green clay	110	116	Data	Type of water? Depth of strata	Soft black porus basalt with blue green clay		
	Type of water? Depth of strata	Fine gravel & sand black with green clay	116	178		Method of sealing strata off	Little water 190 psi	1191	1196
the	Method of sealing strata off	Green clay	178	185	the	PUMP Manufacturer's Name	Med soft black basalt with green clay seams	1196	1224
윤	PUMP Manufacturer's Name Type H P	Sandstone dark green	185	190		Туре НР	Hard green clay	1224	1233
	ТуреНР	Fine gravel & sand black with gren clay	190	199	Warranty	WATER LEVELS Land surface devation above mean sea level #	Med hard black basalt		
Warranty	WATER LEVELS Land surface elevation above mean sea level fi	Black sandstone & har i dark green clay laver	199	224	Ē	Satucievel 203 ft below top of well Date	Med hard black basalt	1233	1270
E	Statucievel 203 ft below top of well Date	Green clay	224	260	g				_
2	Artesan pressure Ibs per square inch Date	Black sandstone & hard dark green clay	260	397	Ξ	Artesan pressure ibs per square inch Date			
a	Artesan water is controlled by		397	425	Š	Arteaan water is controlled by (cap, valve, etc.)			
Z	(cap, valve etc)	Light green clay Green sandstone	425	425		WELL TESTS Drawdown is amount water level is lowered below static level			
-	WELL TESTS Drawdown is amount water level is lowered below static level				H -	Wasa pump test made? Yes No If yes by whom?	12' casing to 942		
NOT	Wasa pump test made? 🗆 Yes 📄 No If yes by whom?	Fine gravel sand some ; reen clay	450	538	NOT		9 7/8 to 1270	1	1
¥	Yieldgal /min withft_drawdown afterhrs	Green clay	538	545	z	Yieldgal /min withfi drawdown afterhrs Yieldgal /min withfi drawdown afterhrs			+
<u> </u>	Yield gal Aman with ft drawdown after hrs Yield gal Aman with ft drawdown after hrs	Green sandstone	545	586	Ś	Yield gal /min with ft drawdown after hrs			+
does		Greeen clay	586	598	نة	Recovery data (time taken as zero when pump turned off) (water level measured from well			+
ŏ	Recovery data (time takin as zero when pump turned off) (water level measured from well top to water level)	Green clay & sandstone layers some brown &			<u> </u>	top to water level)			
σ	Time Water Level Time Water Level Time Water Level	gray clay	598	630	P	Time Water Level Time Water Level Time Water Level		L	
		Green clay & green sandy clay layers	630	846	2			-	
Ecology		Gray sandstone	846	864	ologi				
<u> </u>	Date of test	Fine gravel sand & clay	864	885	ž	Date of test			
0		Black & green claystone	885	910	8	Bailer testgal /mm. withft_drawdown after hrs			
		Hard gray basalt	910	915	ш	Aurtest 200 gal /min with stem set at 1260 ft for 1 hrs			
	Airtest 200 gal /min with stem set at 1260 ft for 1hrs		915		-				
ę	Arteaan flow gpm Date	Reddish brown clay & broken rock		935	of				+
	Temperature of water Was a chemical analysis made? 🗖 Yes 🗖 No	Hard light gray basalt	935	1040	ť	Temperature of water Was a chemical analysis made? Yes No			1
E.		Start Date 6 28 04	Completed Date 7 26	04	2		Start Date 6-28 04 Complet	ed Date 7 26	04
۳.	WELL CONSTRUCTION CERTIFICATION I constructed and/or ac	ant remonstruktiv for construction of these	well and sta samely		Ĕ	WELL CONSTRUCTION CERTIFICATION I constructed and/or acc	ent responsibility for construction of this well on	d ite oomeke	maa with all
5	Washington well construction standards Matenals used and the information	on reported shows are true to my best know	dedoe ond helvef	arice with all	다. 	Washington well construction standards Matenals used and the information	on reported above are true to my best knowledge a	nd belief	nee with an
L.	Dniler/Engineer/Tranee Name (Pnnt) Lagry McLanahan				ar	Dnller/Engneer/Trainee Name (Print) Lary McLanahan	Dnling Company BJ Exploration Co., Inc.	vener	
å	Driver/Engineer/Trainee Signature Auny N'	Driling Company BJ Exploration Co., Inc.			ä	Diller/Engineer/Trainee Signature Tany mc			
Department	Druer/Engineer trainee Signature runny M	Address 404 North Conway Speet			Department	Dellaration inance organize journy in the	Address 404 North Conway Street		
	Dniler or trainee License No 0337	City State Zip Kennewick, WA 99336				Dniller or trainee License No 0337	City State Zip Kennewick, WA 99336		
e	ITRAINEE	Contractor s	~		e	If TRAINEE	Contractor s	~	
The	Driller's Licensed No	Registration No BJEXPCI132OK		1-04	ع.	Driller's Licensed No	Registration No BJEXPCI132OK	Date 0-	11-04
-	Driller + Signature			0 1 20 (Rev 2/03)		Driller s Signature		ECY 050	0 1 20 (Rev 2/03



	Charron Backup Well							
· [File Original and First Copy with Department of Ecology Second CopDeniar's Copy Third Copy-Differ's Copy Third Copy-Differ's Copy	LL REFURI	64615 A	a Re	cond Copy - Owner's Copy_ / M	Start Cerd No ELL REPORT WOOLE WELL WASHINGTON Weller Right Permit No. 64-313:	W044888	
Ĕ	(1) OWNER: Name_ Bob_Charron	Address_201 Desmarais Rd., M	oxee. WA		OWNER: Name Charles 12 11 15	Address Moxee, WA 201 Demaraes Rd.		
ell Report.	2) LOCATION OF WELL: County YAKIMA 25 990	<u> </u>	<u>12 _{N., R} 20 _{W.M.}</u>	Si ~/2	OWNEH: Name_cattorne_farms Location of well: county_Yakima STREET ADDRESS OF Well (or nearest address) NOV 2 3 199	* . NE 1/4 NW 1/4 Sec 13	_T_12_N,R	а <u>20</u> wм.
Š		(10) WELL LOG or ABANDONMENT PROCEDU Formation Describe by color, character, size of material in thickness of aquifors and the kind and nature of the material in		0 3		(10) WELL LOG or ABANDONMENT PROCED		
is	(4) TYPE OF WORK: Owner's number of well	thickness of aquifers and the kind and nature of the material in with at least one entry for each change of information.	each stratum penetrated,	ation ®		Formation Describe by color, character, size of material and struct and the kind and nature of the material in each stratum penetrate change of information	d, with at least one	e entry for each
Ē	Abandoned Dew well Dew Method: Dug Dew Bored Dev	MATERIAL) TYPE OF WORK: Owner's number of well 2	MATERIAL	FROM	то
ō	Deepened Cable Driven Reconditioned Rotary X Jetted D	top soil caleche	8 40 EM?	E Lorm	Abandoned Deepened Cable Driven	Clay - green and tan		1110
5		tan & brwon clay w/gravel			Reconditioned 🗅 Rotary 🕅 Jetted 🗆	Hard gray basalt		1141
Ť	(5) DIMENSIONS: Diameter of well inches	green & tan clay		u (5	,			1175
Ĕ	Drilledfeet Depth of completed wellft.	sand, gravel, clay green	200 420	_ 1	Drilledfeet Depth of completed well7/_7	Gray basalt (hard) Soft blk & brn basalt		1202
Inform	(6) CONSTRUCTION DETAILS:	clay w/ gravel & basalt	420 450	ort @		Black basalt - med		1302
Ē	Casing installed: <u>20</u> • Diam. from <u>0</u> ft. to <u>30</u> ft Welded <u>XX</u> <u>16</u> • Diam from <u>7</u> 12. ft to <u>570</u> ft.	brown clay w/ rock	450 508	<u>≗</u>	Casing installed: Diam from 560 ft to 787	* Softer basalt black		1318
ē	Welded XX <u>16</u> · Diam from <u>+</u> 12. It to <u>570</u>	black tan basalt hard grey basalt, fract.	508 550 550 571	and	Welded Diam fromft to	Basalt med hard black		1502
문	Perforations: Yes No X	comont - 16" casing				Soft black basalt		1548
2	Type of perforator used	cement - 16" casing Drlg. 14 3/4" grey basalt	570 581 M	Data	Perforations: Yes No D Type of perforator used	Med basalt black		1586
and/or	SIZE of perforations in. by in	black basalt water-med	581 583	Ō	SIZE of perforations	- Soft black Harder grav basalt		1607
ã	perforations fromft_toft_	swl 220 grey basalt med	583	the	perforations from ft to	* Softer black w/gray and tan cl		1618
, a	perforations from ft. to ft	lost cac. Drlg w/air			perforations from ft to	* Soft black basalt w/ grav clay		1680
Data	perforations from ft. to ft.	black basalt w/ clay	583 588	arranty	perforations from ft to	Hard gray basalt		1709
	Screens: Yes No <u>XX</u> Manufacturer's Name	grey basalt hard	588 675	<u>a</u>	Screens: Yes No	Med black basalt		1740
the	Manufacturer's Name	fract. basalt grey basalt hard	675 683 PM	E .	Manufacturer's Name	Hard gray basalt	1740	1796
5	Diam Slot size from ft to ft	basalt w/ clay green	694 705	Ŝ	Type Model No 7 DiamSlot size fromft to	Black basalt w/ gray clay		1810
£	Diam Slot sizefromtt_tott	basalt soft fract.	705 742	÷ ۲	Diam Slot size from ft to	Soft green clay w/ basalt	1810	1827
Гa	Gravel packed: Yes No XXSize of gravel	clay soft	743 750 Sel	<u>9</u> -	Gravel packed: Yes No Size of gravel	Tan & brown clay - soft Soft black coal and rock	1007	1837
Warran	Gravel placed from ft. to ft	basalt w/ clay soft	750 774	ŝ	Gravel placed from ft to	Gray basalt w/ shale		1860
	Surface seal: Yes No XX To what depth?ft.	basalt fract. black	774 820	aop doe	Surface seal: Yes No To what depth? 4/0	. Softer black & brown basalt, r		
NOT	Material used in soal	hard grey basalt fract.			Material used in seal	Basalt gray hard	1873	1883
Z	Did any strata contain unusable water? Yes No XX	basalt soft black basalt black fract.	834 845	ž	Did any strata contain unusable water? Yes No	Black vesacular basalt		1900
s	Type of water?Depth of strata	basalt grey hard	865 875 UM	Vgo	Type of water? Depth of strata	Gray basalt med hard		2015
8	Method of sealing strata off	basalt grey very hard	875 1003	8	Method of sealing strata off	Black med basalt Hard gray basalt	2015_	2024
σ	(7) PUMP: Manufacturer's Name NOT INSTALLED	basalt w/ clay soft black		ш 7		- Softer black_basalt	2024	2038
Ecology	Туре НР	basalt med. black	1020 1043 IM	້ ອີ	Туре Н Р	Soft black & brown basalt		2038
ê	(8) WATER LEVELS: Land-surface elevation above mean sea level ft	basalt grey med to hard	1043 1100	8) H) WATER LEVELS: Land-surface elevation above mean sea level	Black basalt med	2071	2117
8	Static level 220ft. below top of well Date	sand top of mobton	1100 1105 MB	<u>او</u>	WATER LEVELS: Land-surface elevation		T.D.	•
	Artesian water is controlled by (Ceo, valve, etc.))			ş.	Artesian pressure Ibs per square inch Date			
P,		Work started 10-24-92 19 Completed 1-2	26-93 19	partmer	(Cap, valve, etc.)	Work Started 6/10/94 . 19 Completed	7-16	1994
Ħ	(9) WELL TESTS: Drawdown is amount water level is lowered below static level Was a pump test made? Yes NoXX If yes, by whom?			e e) WELL TESTS: Drawdown is amount water level is lowered below static level			
e	Yield: gal./min with ft drawdown after hrs	WELL CONSTRUCTOR CERTIFICATION: I constructed and/or accept responsibility for con			Was a pump test made? Yes Y	•		
Ð	11 11 11 11 11 11 11 11 11	and its compliance with all Washington well co Materials used and the information reported abov	onstruction standards.	The		compliance with all Washington well construction st	andards Material	als used and
partment	Recovery data (time taken as zero when pump turned off) (water level measured	Materials used and the information reported abov knowledge and belief.	e are true to my best	5 -	10 10 10 10	" the information reported above are true to my best ki	owledge and bel	hef
å	from well top to water level) Time Water Level Time Water Level Time Water Level			Dep Dep	Recovery data (time taken as zero when pump turned off) (water level measured from we top to water level)	NAME Aqua Drilling'& Engeneeri	ng	
5		NAME Aqua Drilling & Enginee	TYPE OR PRINT)		Time Water Level Time Water Level Time Water Level			
۳.		Address 3130 15th Ave. SE Albar	y, OR 97321			_ Address 120 Crestview DP., Colvi	11e, WA	
-	Date of test			⊢ {``		(Signed) Know Kathaway	License No _1	532
	Bailer test gal /min with ft_drawdown after bra	(Signed) Lawly Jathurgens	e No. 1532	. ~	Date of test	- (mean printing "		
	Bailer test gal /min with ft drawdown after hrs Airtest gal /min with stem set at ft. for hrs.				Bailer testgal /min with ft drawdown after ht	S Contractor's Registration	1111	614
	Artesian flow gai / min with stem set at ft. for hrs.	Registration No. <u>CCI-414-991</u> Date	, 19		Airtestgal /min with stem set at ft for he Artesian flow gip m Date	Registration AQUADEL 02:503 Date No		_ 1994
	Temperature of water Was a chemical analysis made? Yes No				Temperature of water Was a chemical analysis made? Yes No	USE ADDIŢIONAL SHEETS IF NEO	ESSARY)	
	ECY 050-1-20 (10/87) -1329- 0 4	(USE ADDITIONAL SHEETS IF NECE		EC	L 050-1-20 (2/93) ** f • 🏎	1.1		0
-				1		and the second s		· · · · · · · · · · · · · · · · · · ·



APPENDIX B

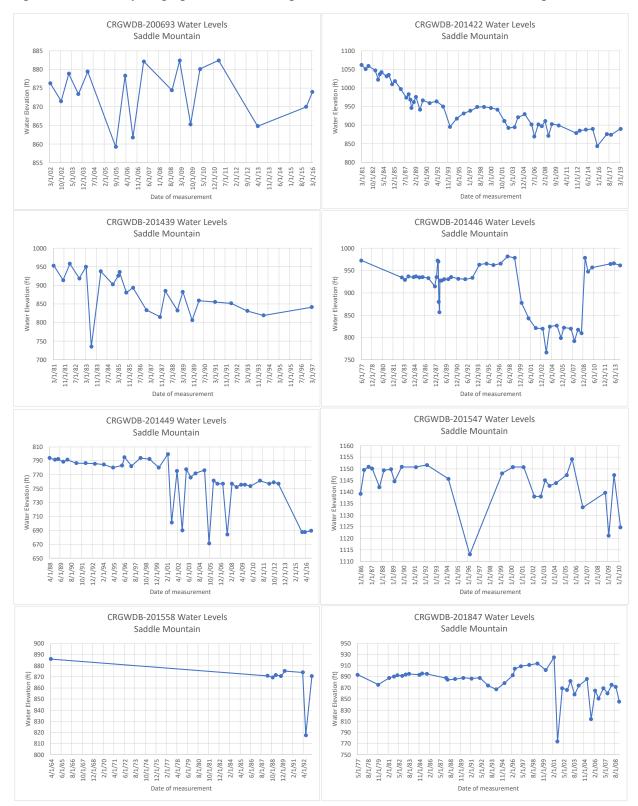
HISTORIC GROUNDWATER LEVELS

Table B1. Groundwater level trends in Saddle Mountain Basalt wells (1964-2019).

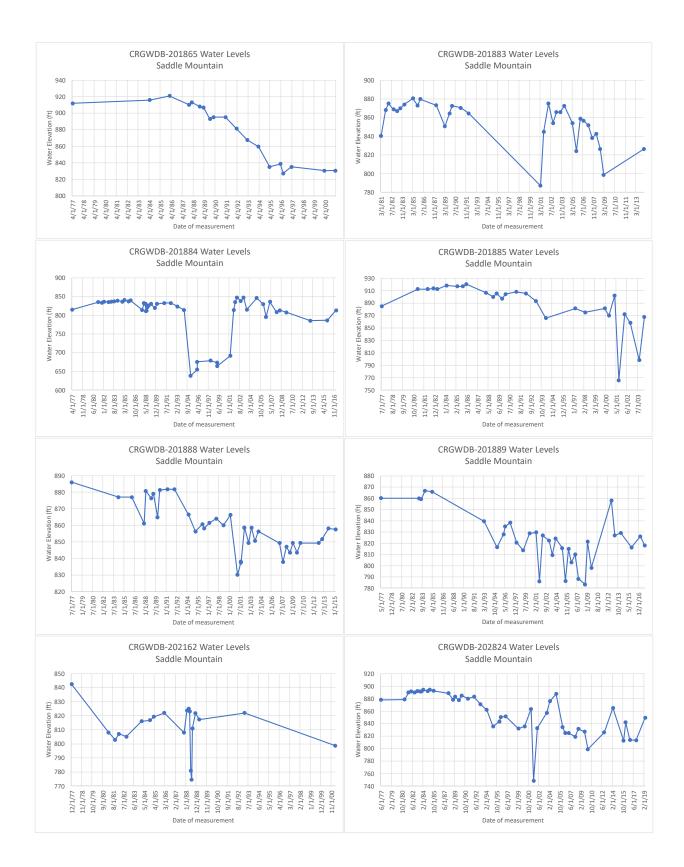
Saddle Mountain											
Well ID	Latitude	Longitude	Surface Elevation	Well Depth	Trend	Rate (ft/yr)					
CRGWDB-201417	46.51393	-120.377	1299	400	Declining	-6.31					
CRGWDB-201422	46.49345	-120.3638	1059.07	683	Declining	-4.64					
CRGWDB-201439	46.4873	-120.3577	1143.54	1158	Declining	-7.34					
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					
				Standar	d Deviation	3.405875					
				Sta	ndard Error	0.655461					

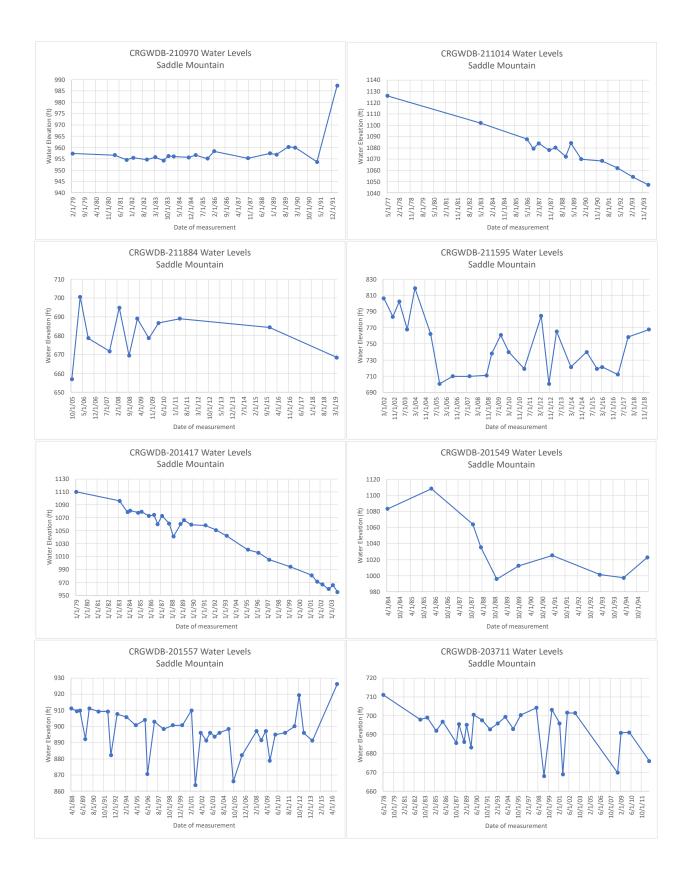
Management											
		l l	Nanapum								
Well ID	Latitude	Longitude	Surface Well Depth Trend		Trend	Rate (ft/yr)					
CRGWDB-201475	46.46888	-120.2676	1199	1400	Declining	-8.69					
CRGWDB-201712	46.3113	-119.8794	1158	923	Declining	-3.25					
CRGWDB-201846	46.44667	-120.2261	1283	1945	Declining	-10.55					
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					
				Standa	rd Deviation	3.42772856					
				Sta	andard Error	0.76646341					

Table B2. Groundwater level trends in Wanapum Basalt wells (1974-2019).

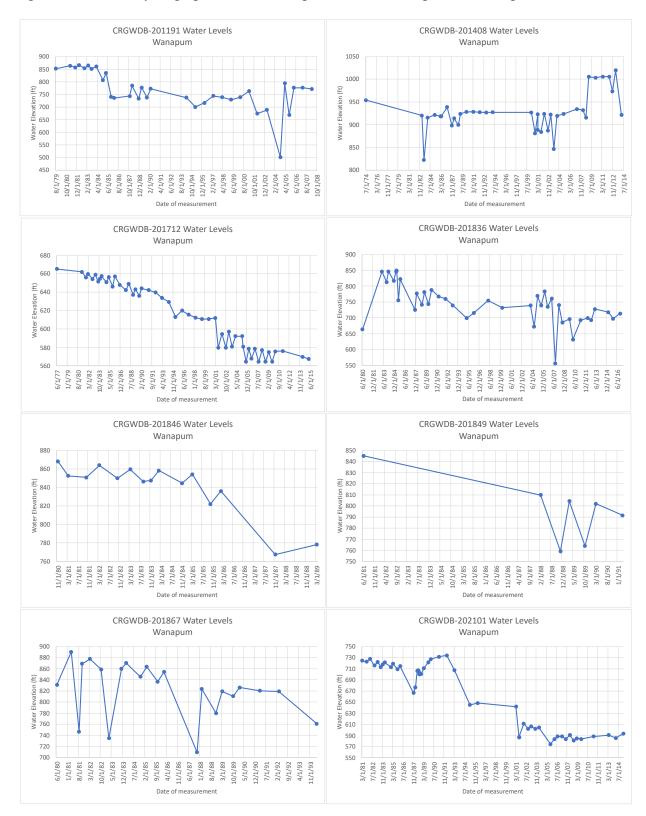


Figures B1-B27. Hydrographs of wells completed in the Saddle Mountain Basalt aquifer.

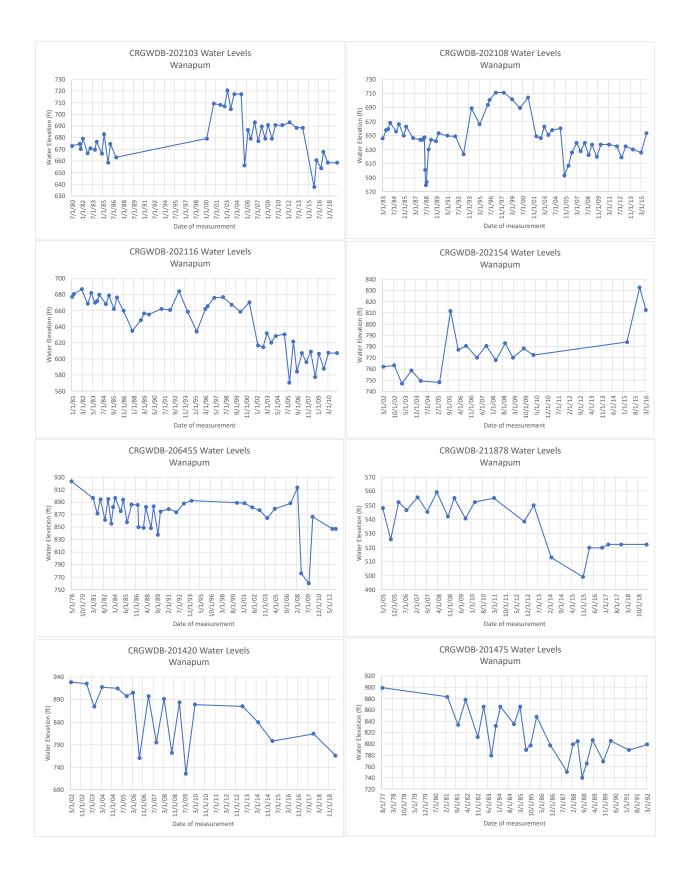








Figures B28-B47. Hydrographs of wells completed in the Wanapum Basalt aquifer.





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					

		Member 1	hicknesses (ft)		Depth to Top of Member (ft, bgs)			
A-A' Cross-Section	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 C2. Member thickness (ft) and top boundaries (ft bgs) of the wells in the A-A' cross-section.

								B-B' C	ross-Secti	on 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 C3. Wells used to illustrate the B-B' cross-section. Aquifers and completion units are color-coded to the stratigraphy.

			Member T	hicknesses (ft	Depth to Top of Member (ft, bgs)			
B-B' Cross-Section	Number of wells	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 C4. Member thickness (ft) and top boundaries (ft bgs) of the wells in the B-B' cross-section.

	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 <i>,</i> 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						
Completion Unit	RZ	UMA	PR	GRB	GRB	PR	UMA	PR	PM	PM	PM	MBTN	SEL	UMA	UMA	PM	SEL	UMA	UMA

Table C5. Wells used to illustrate the C-C' cross-section. Aquifers and completion units are color-coded to the stratigraphy.

			Member T	hicknesses (ft)	Depth to	o Top of Mem	ber (ft, bgs)
C-C' Cross-Section	Number of Wells	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 C6. Member thickness (ft) and top boundaries (ft bgs) of the wells in the C-C' cross-section.

Average Aquifer Thickness (ft)									
Aquifer	Lower Yakima	Number of	Standard	Moxee	Number of	Standard			
Aquilei	Valley	wells	Error	Valley	Wells	Error			
Upper Saddle	196	17	15.945	143	10	23.447			
Mountain	190	17	15.945	145	10	25.447			
Lower Saddle Mountain	567	11	38.557	789	3	130.095			
Wanapum	788	3	112.623	1228	2	240.500			

Table C7 Average aquifer thicknesses	(ft) of the Upper and Lower Saddle Mount	ain Basalt and Wananum Basalt aquifers
Tuble C7. Tiverage aquifer unexhesses	(it) of the opper and Lower baddle mount	an Dasari and Wanapani Dasari aquiters.

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

Rattlesnake Ridge Interbed

Pomona Basalt

 Selah Interbed data: SEL by Location t = -1.2001, df = 8.8147, <u>p-value = 0.2614</u> 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, <u>p-value = 0.7153</u> alternative hypothesis: true difference in means is not equal to 095 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, <u>p-value = 0.6206</u> 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, <u>p-value = 0.6861</u> 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, <u>p-value = 0.003638</u> 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

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, <u>p-value = 0.6573</u> alternative hypothesis: true difference in means is not equal to 095 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 = 0.6425alternative hypothesis: true difference in means is not equal to 095 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, <u>p-value = 0.1553</u>

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 longterm 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.

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			

Table E1. Aquifer testing design in the Wanapum aquifer in Moxee Valley.



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						
Stop	Time Frame	Time Elapsed	Average Flow			
Step	(min)	(min)	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 ft²/day was calculated using Equation D2 for the WNB aquifer in

Moxee Valley.

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

Table E4. Manual water level measurements at the Nillson Well before and after the Nillson Well Step Test.

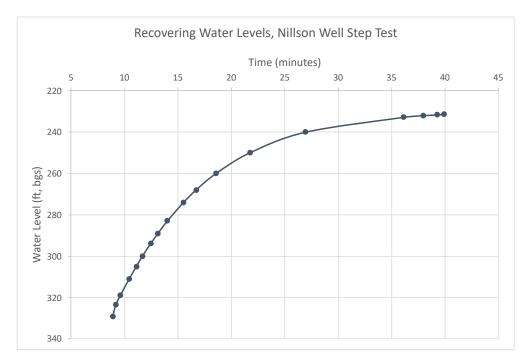


Figure E3. Water level measurements during recovery of the Nillson Well after the 3.5-hour step test. It took about 40 minutes for water levels to return to the static water level of 231.4 ft.

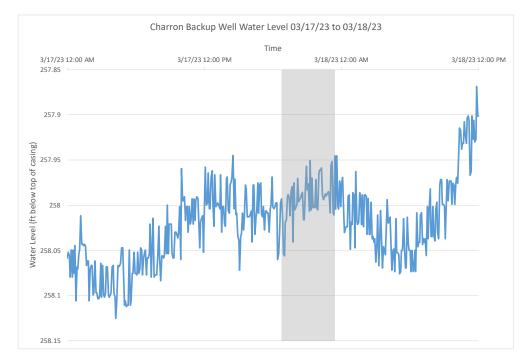


Figure E4. Water level (ft below top of casing) at the Charron Backup Well from 03/17/23 to 03/18/23. The gray box represents the timeframe of the 3.5-hour Nillson Well Step Test. Note the vertically exaggerated scale of the y-axis. The water levels have been compensated with barometric pressure data.

$$K = \frac{r_c^2 \ln \frac{R_e}{R}}{2L_e} \frac{1}{t} \ln \frac{h_0}{h_t}$$

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.

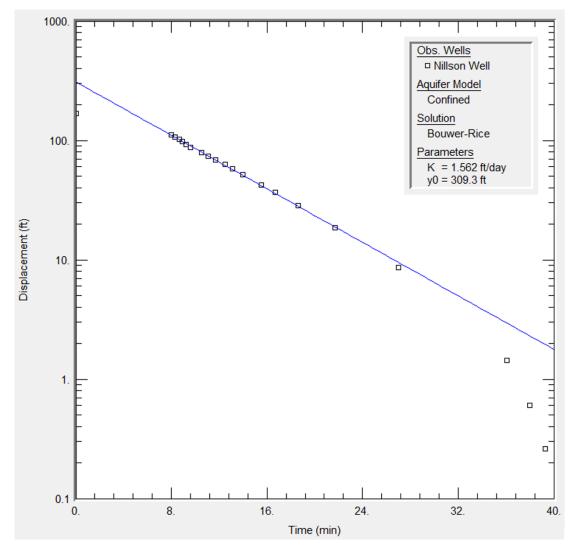


Figure E5. AQTESOLV confined aquifer Bouwer-Rice solution (blue line) on water level displacement measurements during recovery after the Nillson Well Step Test. This analysis produced a hydraulic conductivity value for the Wanapum aquifer (1.562 ft/day) and a maximum drawdown (y0) estimation for the 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 ^aBouwer 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 (ft²/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 ft²/day (Germiat and Flynn, 2005) and 1,918 ft²/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).

$$s = \frac{Q}{4\pi T}W(u)$$

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.

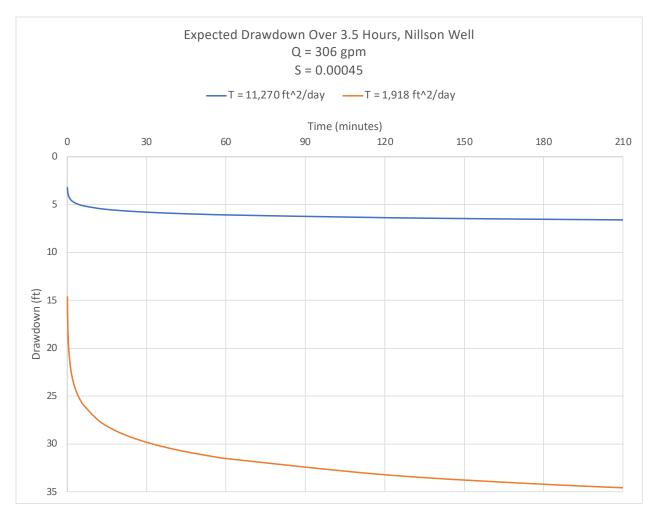


Figure E6. Expected drawdown over 3.5 hours of pumping at 306 gpm at the Nillson Well, based on the average pumping rate during the Nillson Well Step Test for a transmissivity of 11,270 ft²/day (Germiat and Flynn, 2005) and 1,918 ft²/day from the Bouwer and Rice (1976) solution. Drawdown is expected 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.

$$T = \frac{Q}{(h_0 - h)} \frac{2.3}{4\pi} \log \frac{2.25T_e t}{r^2 S}$$

Equation E6. Theis (1963) equation for estimating transmissivity (T) in ft²/day based on the specific capacity $\left(\frac{Q}{h_0-h}\right)$ in ft²/day and radius (r) of a pumping well, and the aquifer's expected transmissivity (T_e) in ft²/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 ft²/day from the specific capacity $\left(\frac{Q}{h_0-h}\right)$ in ft²/day.

Transmissivity Comparisons							
	Previous es	timates	Calculated from Nillson Step Test Recovery				
	Germiat and	Repasky	Bouwer and	Theis (1935)	Razack and		
	Flynn (2005)	(1993)	Rice (1976)	THEIS (1955)	Huntley (1991)		
Transmissivity (ft ² /day)	11,270	10,000	1,920	2,380	1,130		

Table E6. Transmissivity (ft²/day) comparisons of previous estimates to calculations based on the Nillson Well Step Test recovery of the Wanapum aquifer.

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.