Alternative Evaluation Summary for Large On-Site Sewage System (LOSS)

PREPARED IN ACCORDANCE WITH
WAC 246-272B-02000 and -03000

for

Community of Packwood

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Located in
Section 22, T13N, R9E
Lewis County, Washington

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Information is presented below as a supplement to the Predesign Report for Large On-Site Sewage Systems completed for the community of Packwood, Washington. Addressed in the following report are various alternatives for the different components of the LOSS system. The alternatives evaluated were determined based on the chosen service area, previous studies that have been conducted in the area, general knowledge of and experience with sewer system design, and various other factors. A summary of the alternatives analysis is presented below.

The purpose of this report is to provide a new analysis and an update of information that has been previously examined in other studies. These studies include the 2002 Wastewater Facility Plan prepared by Gray and Osborne, and the Packwood Sewer Facility Plan Summary Report, prepared by Skillings and Connolly, Inc. in 2010.

The Gray and Osborne Facility Plan was intended to provide a comprehensive analysis of many different options the community of Packwood may have for a wastewater collection, treatment and disposal sewer system. Four different service area alternatives, three different collection system types, three sewage treatment systems and various disposal areas and methods were considered as part of this study. Two service area alternatives, which included an area with 26 service connections and an average annual flow of 8375 gpd and an area that would have 62 service connections and deliver an average annual flow of 20,210 gpd, were concluded to be viable options for the Packwood LOSS system. The recommended collection, treatment and disposal method for both of these service area alternatives was a grinder pump low-pressure pumped collection system, a Recirculating Gravel Filter (RGF) treatment method and disposal to a drainfield located at the Menosha Forest Products Property.

The purpose of the Skillings Connolly report was to provide a synopsis of the Gray and Osborne Facility Plan, as well as to compile applicable analytic considerations used throughout each chapter of the report and to provide current recommendations on how these considerations may be used or changed in the future. The major conclusions determined by this study, as compared to the Gray and Osborne report, were recommendations for a service area to provide 60 service connections, with an average annual flow rate of 37,500 gpd. A pumped collection, using a Septic Tank Effluent Pump (STEP) or grinder type system, an RGF treatment system and disposal to a drainfield were also recommended as part of this study.

A thorough cost comparison between these previous studies and current recommendations made by this study are presented as part of this report. However, it was not within this study's scope to analyze previous study's assumptions.

Summary of Service Area and Wastewater Design Flow

Much of the effort put into this study was to determine the most ideal initial area of service for the LOSS. Information from a public opinion survey was used as well as local knowledge and the selected service area was based on positive initial response from potential users. The focus of the service area is on the downtown commercial area, due to the higher overall demand and need from these locations. Residential units were then individually added to the service area, and were chosen based on feasibility of being able to connect to the system, as well as a desire to be able to connect. Major commercial establishments including the Cowlitz River Lodge, Peter's Inn, Tatoosh Food Mart, Four-U Realty, Blue Spruce Saloon, Packwood Inn, Packwood RV Park and Campground, Assembly of God, and Blanton's Market are all included in the proposed service area. An initial outline of the selected service area includes service to an estimate of 115 units, with 73 residential and 42 commercial connections included in the service area. See attached exhibit outlining the service area and responses to past surveys.

To aid in more accurately determining wastewater flows for the service area, water meter readings were collected and analyzed. Knowledge of the area indicates that Memorial Day and Labor Day weekends are typically the busiest times of the year in Packwood due to a large flea market that is held over those weekends. To account for the predicted temporary increase in wastewater flow that would have to be accounted for in the LOSS design, additional water meter readings were taken over Labor Day weekend in 2012 for all of the major commercial establishments in the area. Data from 2011 and 2012 for all users was also analyzed to come up with a peaking factor and to account for a large variation in flow throughout the year in the design of the LOSS.

A summary of the conclusions from this analysis is presented below:

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- A total of 115 connections were used in the calculation of wastewater flow. The calculated overall average annual and design flow for the system is roughly 24,000 gpd; this figure is consist#nt with previous studies based on the size of the selected service area.
- Data from 2011 and 2012 shows August as consistently being the highest use month, with a slight peak in use over Labor Day weekend. Using a flowrate of twice the average daily annual flow (2 x 24,000 gpd = 48,000 gpd) as a maximum daily flowrate sufficiently accounts for this peak use timeframe and will adequately cover other peaks in usage that occur throughout the year.

- Calculation of an Equivalent Daily Unit (EDU), which is what a typical residential unit uses in a day, was performed to be able to help scale initial and long term costs based on a user's share of total system usage. To calculate an EDU, potential users were separated into residential and commercial categories. Then, the average residential water use between April of 2011 and March of 2012 was set equal to one EDU. The EDU for each commercial user was then calculated by comparing this number to their overall average use. Individual costs can be scaled to have commercial establishments pay based on their share of use for both initial costs of system installation as well as future use and operation costs.
- One EDU was calculated to equal roughly 155 gallons per day per unit, with commercial establishments contributing an average of 2.3 EDUs to the system and the largest establishments in the range of 3-10 EDUs.
- A total number of 171 EDU's were calculated for the system.
- LOSS systems of this size typically require a minimum of 270 gpd per unit design flow per WAC 246-272B-06150. Given that the calculated EDU is based on actual flow data, it may be possible to submit a deviation request to the Washington Department of Health to have the minimum EDU value lowered to the 155 gpd/unit value.
- To meet the peak demand during Labor Day Weekend, the drainfield was slightly oversized to handle a flow of 53,300 gpd, which is the maximum daily flowrate; this figure was calculated by adding 2 x the average daily use for residential users, and 1.5 x the maximum monthly flow for commercial users. An alternative to this would be to install a surge tank to provide additional storage during peak use.

A summary of flows and EDU's for the system is provided in the table below.

	Average Annual Flow (gpd)	Maximum Daily Flow (gpd)	Total Number of EDUs
Commercial	**12,635**	**30,620**	**98**
Residential	**11,325**	**22,650**	**73**
Total	**23,960**	**53,270**	**171**

Collection System

A number of collection system types were investigated and evaluated for overall feasibility to serve the LOSS. These system types include:

- Conventional gravity system
- Vacuum system
- Pressure system, driven by either Septic Tank Effluent Pump (STEP) or grinder pump

Factors considered for each system included design flow rate, service area and collection layout, topography, system reliability, ease of future system expansion, and initial installation and future operation and maintenance costs.

a. Gravity

Gravity sewer systems have a long and proven history of being able to provide a reliable and economical system for collection and delivery of sewage. The primary advantage of gravity systems is their reliability and low operation and maintenance costs because of fewer mechanical parts in the system needing to be maintained and replaced. The topography of Packwood is such that there is a slight increase in elevation through the middle part of the town, in the area where the sewer main would be installed. However, looking at the overall layout of what a gravity system would look like for Packwood, the depth of excavation and the need for installation of lift stations, and the extra cost associated with these items, does not make a gravity system prohibitively difficult or unreasonably costly. Also, in past studies, it has been thought that since the Washington State Department of Transportation would not allow the closure of Highway 12 to install a sewer system that two sewer mains would have to be run through the service area, with one on either side of the highway; this was mainly due to the high cost of needing to bore the sewer line under the highway. Now that directional boring is a fairly common construction practice, the need for two sewer mains along the highway is not applicable, thereby eliminating much of the length and cost of sewer main previously thought to be needed for the LOSS project.

One of the drawbacks of a traditional gravity system is typically higher initial costs than other systems. A gravity sewer must be constructed on a down gradient minimum slope, and therefore deeper excavation than is required for other systems is needed for installation. Other initial costs such as larger diameter pipe and the need for lift stations can greatly increase the initial costs of a gravity system. However, if the system does not require an excessive number of lift stations or unreasonably deep excavations, the overall reliability of a gravity sewer typically provides lower long-term operation and maintenance costs, usually resulting in a lower overall cost for the project.

The topography of Packwood does not prohibit the possibility of a gravity system, and there would not be a need to run two sewer mains down Highway 12 to make the system work. The operation and maintenance costs will be considerably lower than other collections systems, making the long-term costs associated with this option substantially lower. Because of these reasons, a gravity type collection system is a viable alternative to consider for the Packwood LOSS.

b. **Vacuum**

Vacuum sewer systems can provide advantages over traditional gravity systems. Mains can be installed at shallower elevations, making future connection to the system and repairs easier than for gravity sewers. Also, vacuum systems do not require a pump to be installed at every connection point, which would be a cost savings over typical pumping systems. A vacuum sewer system can outperform low-pressure sewers utilizing grinder pumps. Power is only required at the vacuum station, whereas grinder pumps require a power source at each service connection. Standby power at the vacuum station ensures uninterrupted service during power outages, whereas standby power is not practical or cost effective for each grinder pump service connection.

Among the disadvantages of a vacuum sewer system are the higher operation and maintenance costs associated with maintaining the vacuum interface valves and vacuum pump station equipment. A vacuum sewer system requires skilled maintenance personnel, and repair or replacement of vacuum interface valves is required at periodic intervals and more effort is involved in maintaining the vacuum and sewage pumps in the main vacuum collection stations. Vacuum systems can be designed to suit a variety of site conditions but have limited capabilities for transporting wastewater uphill, 15 to 20 feet being the limit of elevation increase. Since delivery to the Hanna property will require an elevation increase of roughly 40 feet, a lift station would likely have to be installed as with the other collection options. Another drawback to the vacuum system is the need to lease or purchase additional land for placement of the vacuum station building. The size of a typical vacuum station building is approximately 25-feet by 30-feet and with setbacks and other planning considerations, the building footprint would fill a typical lot in Packwood. The building would also have to be located along Highway 12, which may not be appealing from an aesthetic or environmental point of view.

A vacuum system would be a possibility for the collection component of the LOSS. However, additional land would likely have to be acquired for the installation of a vacuum station building. A lift station would also have to be installed to deliver sewage to the treatment and disposal site. Also, the reliability of these systems over time is much lower than a gravity system, so operation and maintenance costs are higher. Therefore, a vacuum system is not the recommended collection choice for the Packwood LOSS.

c. Pressure

A pressurized system, using either individual STEP or grinders as the pumping mechanism, is another collection option for the LOSS design. Systems of this type are made up of smaller diameter piping, and can be installed in a much shallower bed than a gravity system. Due to the smaller pipe needed, shallower excavation depths required and less surface restoration work involved, initial installation costs for this type of system would be lower than for a gravity system. Also, like the gravity system, the disruption of Highway 12 would be fairly minimal, due to the ability to bore under the road. Future expansion of the system would also be easier with this type of system over the other two.

The main drawbacks to a pressure system are the high individual connection installation costs, as well as the long-term operation and maintenance costs. It is likely that most or all of the septic tanks currently in operation in Packwood would not meet current Department of Health regulations. A LOSS project proposing to use a STEP type collection system would have to show that each individual septic tank meets current health requirements for use. Therefore, it is likely that each service connection to the LOSS would need to have the tanks that are currently in use either replaced or repaired. A grinder type system does not require the use of septic tanks for operation, but each connection would require a separate grinder pump as well as a holding tank. Grinder pumps are typically relatively costly due to higher horsepower requirements and the need for grinding capabilities required for operation. Finally, since there are more individual components involved with these systems, they are usually less reliable and need individual parts replaced or repaired more often than what is expected for other types of systems.

Due to the high cost of each individual connection as well as the likely higher operation and maintenance costs and the service disruption associated with part replacement and repair time, a pressurized system is not recommended as the collection choice for the Packwood LOSS.

Treatment and Disposal Location Alternatives

Many sites have been previously examined for treatment and suitability feasibility based on site size, soil type, slope, proximity to surface water and floodplain and proximity to the most densely developed areas of town. As part of this study, out of the many sites considered, Lewis County checked with property owners on interest level to provide a treatment and disposal location for the LOSS. A summary of sites considered and notes on each site's viability is provided in the table below. A map of these sites and a previously compiled Site Visit Summary Report are provided as attachments to this report.

Previously Considered Sites

Site ID	Owner	Size (Acres)	Notes
1	Michael & Kristin Tucker (previously Plum Creek)	71.74	Poor soil for disposal
2	WA State Parks	174.64	Sufficient area outside of floodplain, not previously considered further due to need to cross the Cowlitz River.
3	Sharon Hanna	43.84	
4	William Tribble	35.46	No particular reason identified for not considering this parcel further during previous reports. Later determined to be too far from the proposed service area.
5	Dana Jones	35.11	Wholly within Floodplain, not suitable
6	Bruce & Sylvia Kirkham	40.00	Not previously considered further due to Hall Creek crossing.
7	Hampton Lumber Mills	29.21, 17.30, 54.95	Wholly within Floodplain, not suitable

New Potential Sites

A	Sharon Hanna	30.99	Sufficient area outside of floodplain, silt loam may not be suitable, need field investigation
B	Menosha Development	20.00	Too far from Service Area
C	United States of America	29.28	Too far from Service Area
D	Timber Services	23.61	Too far from Service Area
E	State of Washington	90.79	Sufficient area outside of floodplain, not easily obtained

Using this information, as well as further consultation with property owners, the list of possible sites has been narrowed down to the two sites described below.

a. Hanna Property - Site 3

The Hanna Property, Site 3, was identified in previous studies as being a potential site for a LOSS and still appears to be a suitable site. The landowner has expressed concerns about the sewage delivery path requiring the elimination of some of the forested areas on the property.

These concerns have been investigated and it has been determined there is an area clear of trees to east of the creek that appears to have suitable soils.

Additional coordination with the landowner will be required to determine if this property is attainable as fee ownership or easement for a LOSS. Other parcels for sale in the area suggest that the land has a market value of roughly $8000-$10,000 per acre.

Initial nitrate balance calculations show a concentration of 1.13 mg/l nitrate nitrogen at the drainfield point of compliance (POC), compared to an upgradient ground water nitrate concentration of 0.25 mg/l. Per WAC 246-272B-06350, if the difference between the initial upgradient nitrate concentration and concentration at the POC is greater than 2.0 mg/l, then advanced treatment of the sewage must be applied prior to effluent disposal. Since the nitrate concentration is shown to be less than this, an advanced treatment system may not be required at this site. Additional site investigations and consultation with the Department of Health will be required to make a final determination on whether treatment is required or not.

Challenges: The site is located across a large creek from the service area which may require a directional bore. There is no evidence of power at the site and this would therefore be an added expense. There is another smaller creek flowing to the north of the available area that would need to be looked at closer for susceptibility of flooding. Based on initial observations, this should not be an issue given the steep grade of the creek. Due to the creek existing in the vicinity of where the drainfield would be located, it may not be possible to meet minimum setback distances from surface water required to help protect water quality. The path to the service area may have to cross through WSDOT property and available access to these lands may be at an added expense, or not allowed at all.

Benefits: The separation from residential dwellings and wells may make this site more favorable. Based on hand dug shallow holes and available soils data from the Soil Resource Report provided in Attachment I, it appears that the disposal area would be relatively small. A well near this site was sampled for bacteria and nitrates with acceptable results as provided in Attachment H. The slope and soil profile of the site indicate that less initial treatment will be required before disposal of the effluent. An overall lower elevation than other sites considered means that less pumping would be required to deliver sewage to the treatment area.

b. Washington State Parks

An area to the west of the Cowlitz River that is owned by Washington State Parks was visited and examined further to determine suitability for a LOSS. Based on the site visit, it appears as though this site may have a suitable location and appropriate soil types for installation of a LOSS. The site is a very thickly vegetated making backhoe soil profiles difficult without disturbing vegetation. It is also difficult to determine if there is a potential for flooding as there are several older channels in the area that do not appear to flow regularly, but this is a large parcel of land, so these areas should be able to be avoided with a LOSS.

Challenges: This site is located across the Cowlitz River from the downtown service area, which would require the installation of a pipe crossing the river on the bridge. Additionally, if gravity collection is used then this site would require a longer force main to transport sewage from the south end of the service area. The neighbors on the down gradient side of this parcel not only do not want to connect to the sewer, but they are on shallow wells and may be concerned with

the effects of disposing the sewage above them. Available hydroligic records from the area indicate that the groundwater should be flowing more south-easterly so this should be something that can be overcome. This site would likely require more treatment than the Hanna property due to a gentler slope and lower hydraulic conductivity. It has been previously thought that this site would be available at no cost to the county. However, recent talks have indicated the Washington State Parks Department is no longer funded through the State general fund and is attempting to be financially self-sufficient thus they no longer give property away. Acquisition of this land would now have to take place either through purchase or long-term lease.

Initial nitrate balance calculations show a concentration of 12.42 mg/l nitrate nitrogen at the drainfield POC (point of compliance), compared to the upgradient ground water nitrate concentration of 0.30 mg/, as seen from the water test sample results, which is significantly greater difference than the Hanna property. Therefore, additional treatment would have to be performed before effluent disposal could occur. The additional treatment beyond what is required for the Hanna property may require more operation and maintenance of the system to stay in compliance.

Benefits: Communication with Lewis County has indicated that this site may easily be acquired from the State of Washington for a LOSS. A well near this site was sampled for bacteria and nitrates with acceptable results attached. Power lines are immediately adjacent to the parcel and access is very good for ease of maintenance. If it can be shown that the LOSS would provide a public benefit, the overall cost of the land may be reduced by up to 30% off of fair market value.

Sewage Treatment Options

Additional treatment of wastewater is required when an increase of 2 mg/l nitrate above background water quality is likely to occur when utilizing drainfield disposal. In larger drainfield systems, secondary treatment is usually necessary, although initial calculations of nitrogen levels indicate that secondary treatment may not be required for the Packwood system.

a. **Sequencing Batch Reactor (SBR)**

The SBR system has become increasingly popular over the past few decades; this is mainly due to advances in digital control systems. Precise timing and accurate monitoring is achieved continuously and can be monitored remotely, allowing for optimized reaction times to take place. An SBR is a variation of the activated sludge biological treatment process. Aerobic bacterial flocs in a healthy state are referred to as activated sludge. While aerobic floc has a metabolic rate approximately ten times higher than anaerobic sludge, it can be increased even further by exposing the bacteria to an abundance of oxygen. Compared to a septic tank, which takes several days to reduce organic material, an SBR tank can reduce the same amount of organic material in approximately four to six hours, which allows for a much higher degree of process efficiency. In areas with poor groundwater conditions, a conventional septic tank drainfield system is not typically allowed due to the potential to further degrade the groundwater. The SBR system investigated for Packwood uses the biological treatment to produce effluent with less than 7 ppm nitrogen. Discharging this treated effluent to existing groundwater will significantly reduce the impact the effluent will have on the aquifer compared to the current use of individual on-site septic systems.

The SBR system's control panel is equipped with a Programmable Logic Controller (PLC) which allows for efficient and effective remote access and operation. The PLC provides for master control of the SBR system from off site. The system's diagnostic computer utilizes pumps, floats, probes to monitor concentrations and flow meters to monitor the flow rates. The PLC, in conjunction with the program, inputs the design parameters for the operation of the system and will adjust itself based upon readings from the floats, pumps and meters to maintain these parameters. The system communicates with the outside world through a telephone and internet connection. Operation and Maintenance costs for the SBR system are greatly reduced because of the remote monitoring capabilities.

b. Membrane Biological Reactor (MBR)

An MBR is the combination of a membrane process like microfiltration or ultrafiltration with a suspended growth bioreactor. The MBR system is similar to an SBR system in that both use an activated sludge process. The main difference between these systems is the method of separating the mixed liquor from the treated wastewater. An MBR uses a membrane as a physical barrier for separation, whereas an SBR system relies on gravity settling for this process. The MBR filtration performance inevitably decreases with filtration time. This is due to the deposition of soluble and particulate materials onto and into the membrane, attributed to the interactions between activated sludge components and the membrane, which means that operation and maintenance costs are relatively high to maintain the filter system compared to the SBR system.

c. Recirculating Gravel Filter (RGF)

Recirculating gravel filters provide biodegradation or decomposition of wastewater constituents by bringing the wastewater into close contact with a well-developed aerobic biological community attached to the surfaces of the filter media. The media is contained in a watertight vessel either below the surface of the ground or wholly or partially elevated in a containment vessel. Proper function requires that influent to the filter be distributed over the media in frequent, cycled uniform doses. In order to achieve accurate dosing, these systems require a timed dosing with associated pump chambers, electrical components, and distribution network. This frequent, cycled dosing provides a constantly wetted media. The effluent is collected in the bottom of the filter and returned to the recirculating/mixing tank where it mixes with fresh septic tank effluent or a portion of the effluent is discharged to the drainfield. Flow splitting mechanisms are used to control recirculation, flow splitting and discharge to the drainfield. The treated wastewater is discharged to an approved drainfield, usually a conventional sub-surface drainfield. Recirculating gravel filters are suitable for treating residential strength wastewater. Recirculating gravel filter effluent may be discharged to a soil profile containing as little as 24 inches of vertical separation from groundwater.

Effluent Disposal Options

a. **Re-use and Reclamation**

Treated effluent can be re-used in a number of ways. It could be used for sprinkle application to fields such as alfalfa or grass. It could also be used to irrigate golf course areas, or used for drip irrigation of trees. The level of disinfection and treatment required by DOH generally increases with the higher probability of contact with humans. An obvious advantage of this system is being able to put the water towards a beneficial use. However, the two areas considered for LOSS sites do not contain any land used for agricultural or recreational purposes, or have either of these nearby. Therefore, land application of effluent would provide very little benefit to the public. Also, land application would require a higher level of treatment and increased sampling over a subsurface disposal method due to more stringent water quality standards. Due to the increased costs associated with a higher level of treatment and sampling frequency, combined with a lack of public benefit, this is not an ideal disposal option for the LOSS.

b. Subsurface Effluent Discharge

Large On-site Sewer Systems commonly use subsurface drainfields as a way to dispose of treated effluent. Some of the reasons that make drainfields an attractive choice are the large volume of wastewater that is typically able to be disposed of, a lower amount of primary and secondary treatment required before disposal than other options, relatively low operation and maintenance costs and not having to excessively monitor effluent.

The ability of a specific site to be able to deliver sufficient treatment of effluent before reaching groundwater is based on a number of factors including soil type, ground slope and hydraulic gradient, groundwater characteristics, depth to groundwater and other factors. The overall size required for the drainfield is based on these features. For LOSS projects with a design flow of less than 100,000 gpd, the Washington State Department of Health regulates the requirements for the LOSS. Either of the properties considered will meet the Department of Health requirements for the location of a LOSS drainfield and replacement area. The overall treatment and disposal area, estimated to be roughly 6 acres, includes all required appurtenances for the system and a primary disposal area, initially calculated to be 445 feet x 260 feet, which is approximately 2.7 acres. The estimated area required for the LOSS is well within the area available for development of the LOSS at both the Hanna and Washington State Parks sites.

Project Costs

To further help determine the most appropriate option for Packwood, costs for collection, treatment and disposal were estimated. As previously discussed, the only viable disposal option was determined to be a drainfield, so a cost comparison between the disposal options was not completed, and only the cost of the drainfield disposal method is presented here. The material quantities and items presented in these estimates are based on the recommended alternative. Unit price sources included the Washington State Department of Transportation unit bid analysis web site, cost estimates obtained from product vendors, contractors, and consultants, and experience with similar projects. When possible, unit prices were based on similar projects in the region. Reports previously produced specifically for the Packwood sewer project were also used to aid in the cost estimates. Specifically, the Gray & Osborne, Inc., Destination Packwood Association, June 2002 and the Skillings Connolly, Inc., Packwood Sewer Facility Plan Summary Report, May 2010 were used as guides to assist with some of the unit pricing.

These cost estimates are intended to provide an indication of the level of funding needed for implementation of the LOSS project. These cost estimates incorporate appropriate contingencies to account for uncertainty, lack of detail in the design, and professional judgment. Factors such as inflation, changes in utility rates, changes in usage, or alterations to the system are not taken into consideration for the purpose of this study. Finally, the costs presented here do not examine various funding options that may be available through a variety of sources to help complete the project. A summary of the costs between the three studies is provided below, with detailed breakdown of all costs attached separately. Costs are broken into the total initial construction costs, annual operation and maintenance costs. All three cost categories are also broken down by cost per EDU. As previously described, this would be the costs for a typical residential usage. Commercial establishments with larger usage could multiply their EDU by this number to calculate their overall share of the costs. The total flow for the systems analyzed in previous studies was divided by 155 gpd to determine the equivalent EDU's so an accurate comparison between all studies could be made.

Item	Cost Comparison				
	Gray and Osborne		Skillings Connolly	Territorial Landworks	
	STEP System	Gravity Sewer System	RTF System	Pressure System	Gravity System
Total Cost Collection	$ 1,533,753.40	$ 3,574,196.88	$ 1,915,000.00	$ 3,467,668.50	$ 2,432,734.00
Total Cost T & D	$ 2,103,000.00	$ 2,103,000.00	$ 1,627,350.00	$ 790,904.25	$ 790,904.25
Total Cost	$ 3,636,753.40	$ 5,677,196.88	$ 3,542,350.00	$ 4,258,572.75	$ 3,223,638.25
Total Cost O & M	$ 66,670.00	$ 64,120.00	$ 72,370.00	$ 78,710.00	$ 75,907.50
Cost /EDU installed	$ 45,682.43	$ 61,331.55	$ 51,697.00	$ 24,903.93	$ 18,851.69
Cost/EDU O&M	$ 944.45	$ 924.90	$ 723.70	$ 460.29	$ 443.90
Cost/EDU O&M/Mo.	$ 78.70	$ 77.07	$ 60.31	$ 38.36	$ 36.99

Conclusion and Recommended Plan

The Packwood LOSS Feasibility Study was conducted because the Packwood community has long been in need of a community-wide sewer system upgrade. Development in the community has been limited due to inadequate wastewater treatment at many of the commercial and residential establishments in the area. Previous studies have been performed to come up with a viable solution, but no idea has yet come to fruition due to limited financial resources, or various other reasons. The hope of this study is that with a service area defined both by need and desire, more accurate flow data, new technology and various other factors, the idea of a community-wide sewer system for Packwood will be able to be realized.

The three types of collection systems that were looked at in this study were a traditional gravity sewer system, a vacuum system, and a pumped system. Gravity systems have a long and proven history, and are known to be more reliable and have less long-term costs because of fewer system failures than the other two systems. Previous studies have concluded that a gravity collection system was not feasible because, due to the topography, a gravity sewer would be too deep. It has also been thought that there would be need to have gravity mains on both sides of the highway due to the high cost of boring the highway. However, improvements in technology and construction methods do not cause the depth of sewer main or the need to bore under the highway to be a prohibitive financial burden. Looking at the long-term costs of each system, along with the assumption that there will be fewer unforeseen future costs with a gravity system, it is recommended that a traditional gravity sewer system be chosen as the collection system for the Packwood LOSS.

Three treatment systems were also examined for the Packwood LOSS Feasibility Study. A sequencing batch reactor, a membrane biological reactor, and a recirculating gravel filter are three systems that would have the ability to provide sufficient treatment for the LOSS before the disposal of effluent. An SBR and an MBR are fairly similar systems, with the main difference being the physical barrier in an MBR system providing separation, which can break down over time, resulting in higher maintenance costs. A RGF system would perform sufficiently for the system, but has higher initial construction costs. All three systems looked at would be an acceptable alternative to provide

treatment for the system. Therefore, since an SBR system should provide the lowest initial and long-term costs, it is the recommended treatment medium for the system.

Out of the three disposal systems reviewed, which were surface water discharge, re-use and reclamation and subsurface disposal, the only one which was considered a feasible alternative was subsurface disposal. The higher amount of treatment needed for the other methods would cause the treatment system to be much more costly. Also, the amount of available land for a drainfield and adequate site conditions make a subsurface disposal system a clear choice for a disposal system. Because of this, the other methods were not broken down by specific system costs.

Regarding the disposal area, it is recommended that the Hanna site be chosen over the State Parks area. The overall cost of the system will be lower at the Hanna site, mainly due to the cost of the river crossing at the State Parks site. The lower hydraulic gradient at the Parks site leads to a higher nitrate increase, so treatment will be more of an issue than at the Hanna site. There are also more unknowns at the Parks site, such as possible drainage paths running through the disposal area, as well as the area being located in the vicinity of residential homes that may be opposed to having the facility located nearby. However, these factors do not exclude the Parks site from being a feasible alternative, and further planning for the LOSS could still include the Parks site as an option for treatment and disposal.

The total cost for the Packwood LOSS, based on the gravity collection system, an SBR treatment facility and a subsurface drainfield disposal system, is summarized as follows:

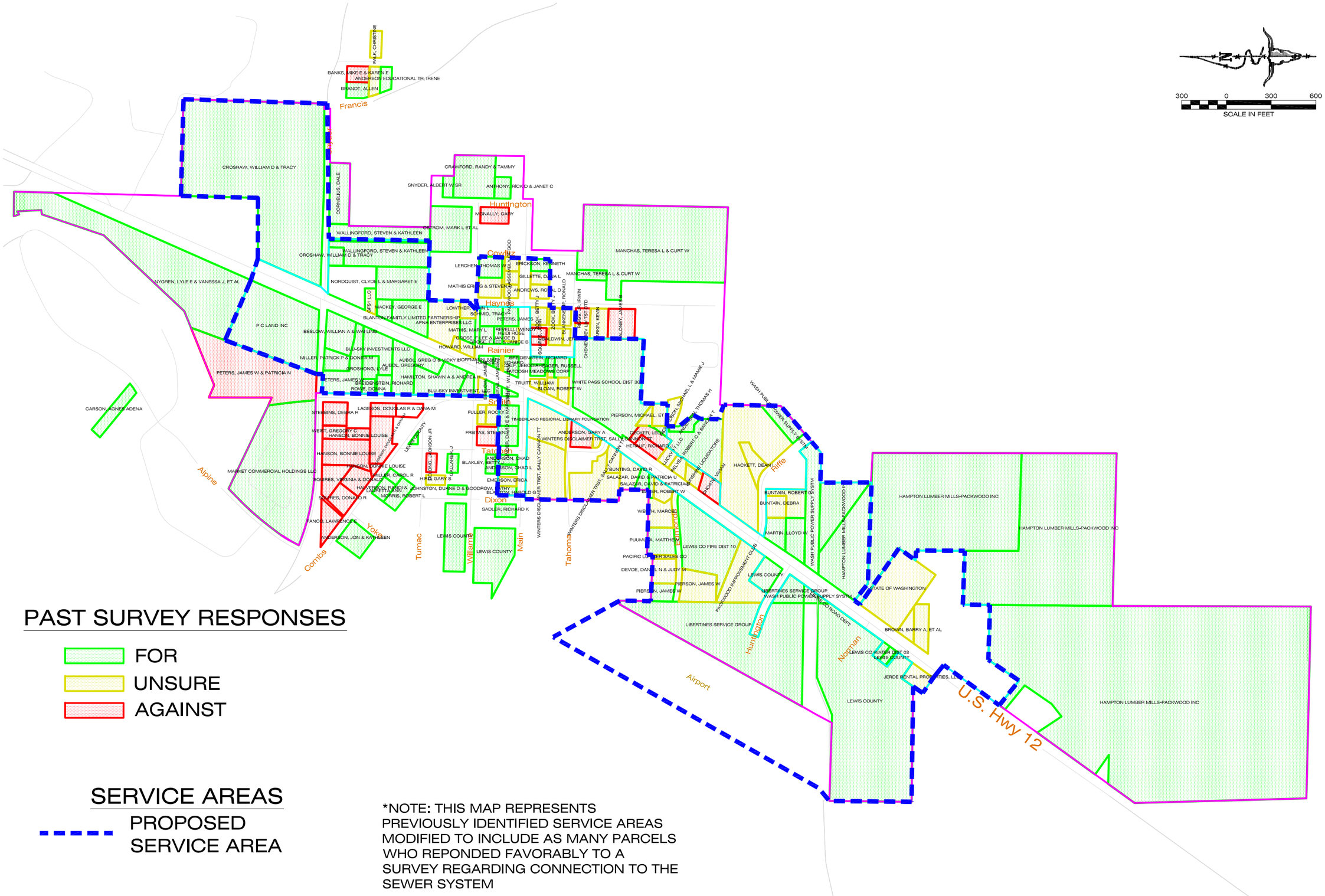
Territorial Landworks Treatment and Collection Cost Estimates	**Alternatives include the same number of residences and commercial locations**				
	Pumped Collection	**Gravity Sewer Collection**	**SBR Treatment & Drainfield Disposal**	**Total Cost Pressure**	**Total Cost Gravity**
Number of Service Connections	115	115	115		
Number of EDU's	171	171	171		
Average Annual GPD	23,960	23,960	23,960		
Max. Day GPD	53,270	53,270	53,270		
Total Cost-Treatment & Disposal			$ 790,904.25	**$ 4,258,572.75**	**$ 3,223,638.25**
Total Cost for Collection	$ 3,467,668.50	$ 2,432,734.00			
Total Annual O and M Cost	$ 18,590.00	$ 15,787.50	$ 60,120.00	**$ 78,710.00**	**$ 75,907.50**
Total Annual Cost Septage Handling	Included above	Included above	Included Above		
Cost per EDU installed	$ 20,278.76	$ 14,226.51	$ 4,625.17	**$ 24,903.93**	**$ 18,851.69**
Cost per EDU per year for O and M	$ 108.71	$ 92.32	$ 351.58	**$ 460.29**	**$ 443.90**
Cost per EDU/mth O&M				**$ 38.36**	**$ 36.99**

A complete breakdown of all costs is also attached. The costs listed do not consider any financing, grants, or bond options that may be available.

List of Attachments:

- **Potential Service Area Map**
- **Collection System Map**
- **Potential Disposal and Treatment Sites**
- **Cost Analysis Details**
- **Commercial and Residential Flow Data**
- **Nitrate and Hydraulic Conductivity Calculations**
- **Hydraulic Gradient Analysis**
- **Well Logs**
- **Soil Resource Report**
- **Nitrate and Bacteriological Water Sample Analysis**

Potential Service Area Map



PAST SURVEY RESPONSES

- FOR
- UNSURE
- AGAINST

SERVICE AREAS

PROPOSED SERVICE AREA

*NOTE: THIS MAP REPRESENTS PREVIOUSLY IDENTIFIED SERVICE AREAS MODIFIED TO INCLUDE AS MANY PARCELS WHO REPONDED FAVORABLY TO A SURVEY REGARDING CONNECTION TO THE SEWER SYSTEM

TERRITORIAL LANDWORKS, INC.
Civil Engineering • Surveying • Land Use Consulting
www.territoriallandworks.com
PO Box 3851
Missoula, MT 59806
Ph: (406) 721-0142
Fax: (406) 721-5224

PLOT DATE: 3/28/2013 3:31 PM

REVISIONS DATE

DESIGNED:
DRAFTED: TG
CHECKED:
DATE: 08.13.2012

LOCATION: PACKWOOD, WA

PREPARED FOR: LEWIS COUNTY

PROJECT NAME: PACKWOOD LOSS STUDY
LEWIS COUNTY, WASHINGTON

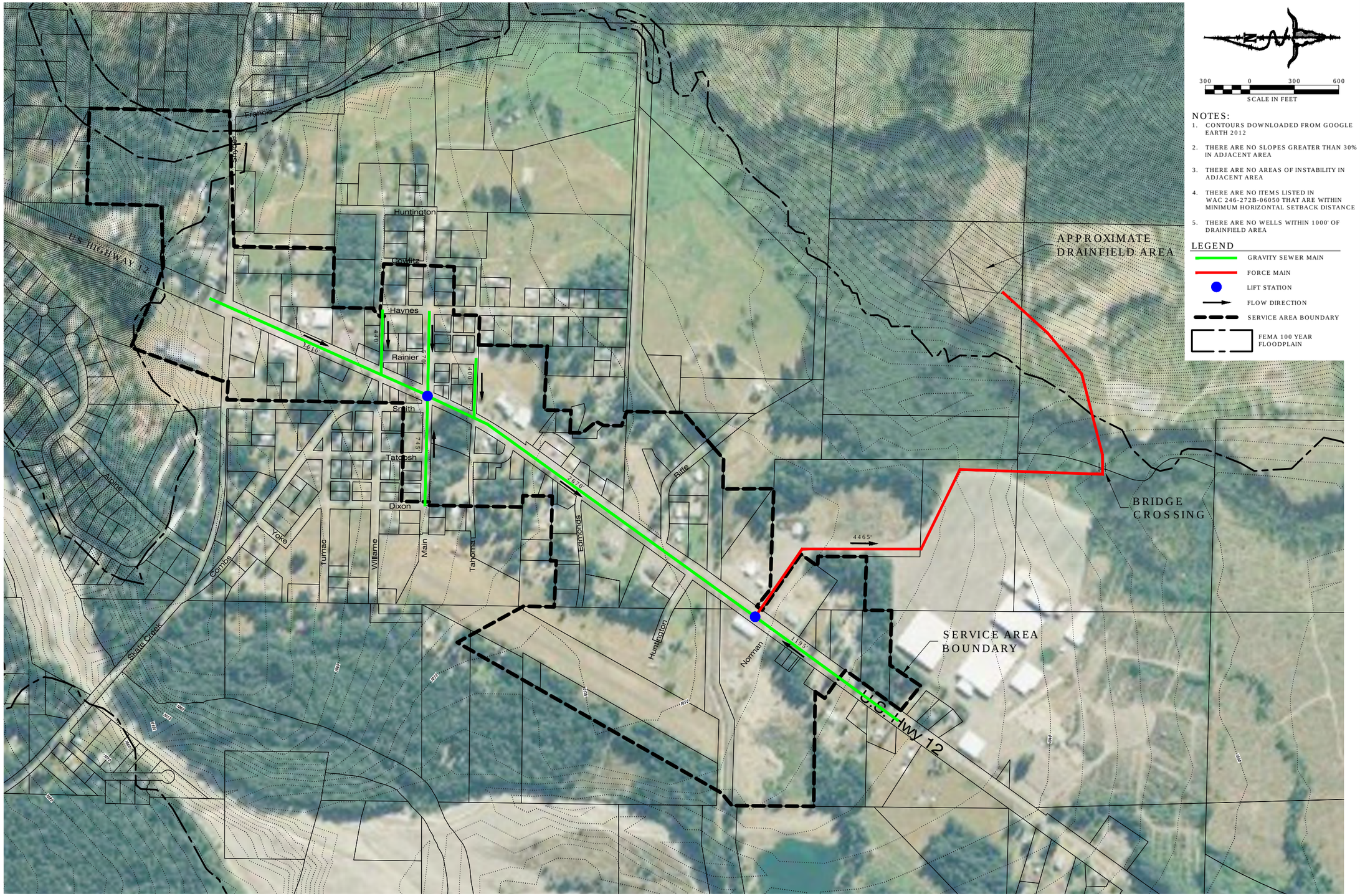
SHEET TITLE: POTENTIAL SERVICE AREA

PROJECT NO. 12-2913

SHEET: 1 OF 1

DWG LOCATION: T:_ACTIVE FILES\2012 PROJECTS\2913 - LEWIS COUNTY PACKWOOD LOSS PLAN\DWG\10.30.2012-SERVICE AREA.MAP.DWG

Collection System Map



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SCALE IN FEET

NOTES:

1. CONTOURS DOWNLOADED FROM GOOGLE EARTH 2012
2. THERE ARE NO SLOPES GREATER THAN 30% IN ADJACENT AREA
3. THERE ARE NO AREAS OF INSTABILITY IN ADJACENT AREA
4. THERE ARE NO ITEMS LISTED IN WAC 246-272B-06050 THAT ARE WITHIN MINIMUM HORIZONTAL SETBACK DISTANCE
5. THERE ARE NO WELLS WITHIN 1000' OF DRAINFIELD AREA

LEGEND

- GRAVITY SEWER MAIN
- FORCE MAIN
- LIFT STATION
- FLOW DIRECTION
- SERVICE AREA BOUNDARY
- FEMA 100 YEAR FLOODPLAIN

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Missoula, MT 59806
Ph: 406/721-0142
Fax: 406/721-5224

REVISIONS | DATE

DESIGNED:
DRAFTED:
CHECKED:
DATE:

LOCATION:

PREPARED FOR:

PROJECT NO: 12-2913

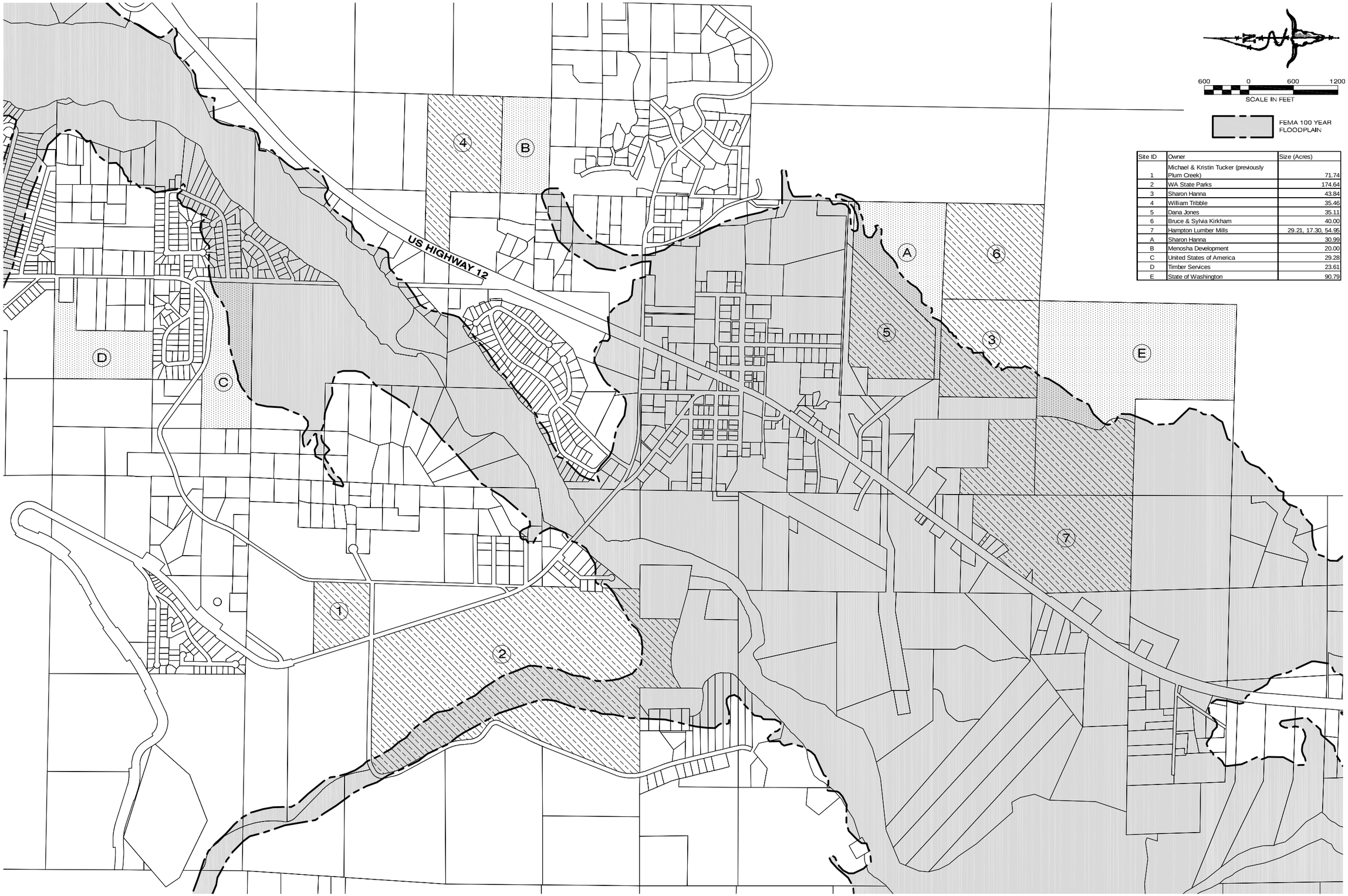
PROJECT NAME: LEWIS COUNTY - PACKWOOD

SHEET: 1 OF 1

SHEET TITLE: GRAVITY COLLECTION SYSTEM

PLOT DATE: 3/23/2013 8:30 AM
DWG LOCATION: T:\LANDWF\FRED\2012 PROJECTS\2913 - LEWIS COUNTY PACKWOOD LOS PLAN\DWG\SHT-1913.DWG

Potential Disposal and Treatment Sites



600 0 600 1200

SCALE IN FEET

FEMA 100 YEAR FLOODPLAIN

Site ID	Owner	Size (Acres)
1	Michael & Kristin Tucker (previously Plum Creek)	71.74
2	WA State Parks	174.64
3	Sharon Hanna	43.84
4	William Tribble	35.46
5	Dana Jones	35.11
6	Bruce & Sylvia Kirkham	40.00
7	Hampton Lumber Mills	29.21, 17.30, 54.95
A	Sharon Hanna	30.99
B	Menosha Development	20.00
C	United States of America	29.28
D	Timber Services	23.61
E	State of Washington	90.79

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Fax: 406/721-3294

PLOT DATE: 5/1/2012 2:53 PM

REVISIONS DATE

DESIGNED:
DRAFTED:
CHECKED:
DATE:

PROJECT NO.:

PROJECT NAME: LEWIS COUNTY - PACKWOOD

SHEET: 1 OF 1

SHEET TITLE: FEMA 100 YEAR FLOOD PLAIN

LOCATION:

PREPARED FOR:

DWG LOCATION: Z:_ACTIVE FILES\2012 PROJECTS\2012 - LEWIS COUNTY PACKWOOD LOSR FLAND\GIS\FEMA.DWG

Cost Analysis Details

Territorial Landworks, Inc.
(406) 721-0142

CLIENT: Lewis County
PROJECT: Lewis County Packwood LOSS Plan

PO Box 3851
Missoula, MT 59806

Gray and Osborne	Alternative 2 (includes only downtown core)					Alternative 3 (includes US Hwy 12 and Main St)				
	STEP Collection	Gravity Sewer Collection	RGF Treatment & Drainfield Disposal	Total Cost STEP	Total Cost Gravity	STEP Collection	Gravity Sewer Collection	RGF Treatment & Drainfield Disposal	Total Cost STEP	Total Cost Gravity
Number of Service Connections	26	26	26			62	62	62		
Number of ERU's *	54	54	54			130	130	130		
Average Annual GPD	8,375	8,375	8,375			20,210	20,210	20,210		
Maximum Month GPD	14,500	14,500	14,500			35,000	35,000	35,000		
Total Cost-Treatment & Disposal			$ 1,169,000.00	**$ 1,888,569.92**	**$ 2,389,889.24**			$ 2,103,000.00	**$ 3,636,753.40**	**$ 5,677,196.88**
Total Cost for Collection	$ 719,569.92	$ 1,220,889.24				$ 1,533,753.40	$ 3,574,196.88			
Total Annual O and M Cost	$ 6,860.00	$ 6,500.00	$ 14,900.00	**$ 21,760.00**	**$ 21,400.00**	$ 15,470.00	$ 12,920.00	$ 33,700.00	**$ 49,170.00**	**$ 46,620.00**
Total Annual Cost Septage Handling			$ 7,300.00	**$ 7,300.00**	**$ 7,300.00**			$ 17,500.00	**$ 17,500.00**	**$ 17,500.00**
Cost per EDU installed	$ 13,317.41	$ 22,595.56	$ 21,635.22	**$ 34,952.64**	**$ 44,230.79**	$ 11,763.08	$ 27,412.20	$ 33,919.35	**$ 45,682.43**	**$ 61,331.55**
Cost per EDU for O and M	$ 126.96	$ 120.30	$ 410.87	**$ 537.83**	**$ 531.16**	$ 118.65	$ 99.09	$ 825.81	**$ 944.45**	**$ 924.90**
Cost per EDU/mth O&M				**$ 44.82**	**$ 44.26**				**$ 78.70**	**$ 77.07**

Skillings Connolly	Alternatives based on previous assessment by Gray and Osborne					
	LP Grinder Collection	STEP Collection	RGF Treatment Drainfield Disposal	RTF Treatment & Drainfield Disposal	Total Cost RGF	Total Cost RTF
Number of Service Connections	60	60	60	60		
Number of ERU's * and **	242	242	242	242		
Low Average Annual GPD	30,000	30,000	30,000	30,000		
Max. Average Annual GPD	45,000	45,000	45,000	45,000		
Total Cost-Treatment & Disposal			$ 1,654,000.00	$ 1,627,350.00	**$ 1,654,000.00**	**$ 1,627,350.00**
Total Cost for Collection	$ 1,915,000.00	$ 1,915,000.00			**$ 3,569,000.00**	**$ 3,542,350.00**
Total Annual O and M Cost	unknown	unknown	$ 48,500.00	$ 49,370.00	**$ 48,500.00**	**$ 49,370.00**
Total Annual Cost Septage Handling			$ 24,000.00	$ 23,000.00	**$ 24,000.00**	**$ 23,000.00**
Cost per EDU installed	$ 7,915.33	$ 7,915.33	$ 6,836.53	$ 6,726.38	**$ 52,230.00**	**$ 51,697.00**
Cost per EDU for O and M			$ 299.67	$ 299.13	**$ 725.00**	**$ 723.70**
Cost per EDU/mth O&M			$ 24.97	$ 24.93	**$ 60.42**	**$ 60.31**

*** Number of ERU's are based upon TLI's estimate of *average annual demand/EDU***
TLI's EDU = 155 GPD

Territorial Landworks	Alternatives include the same number of residences and commercial locations				
	Pumped Collection	Gravity Sewer Collection	SBR Treatment & Drainfield Disposal	Total Cost Pumped	Total Cost Gravity
Number of Service Connections	115	115	115		
Number of EDU's	171	171	171		
Average Annual GPD	23,960	23,960	23,960		
Max. Day GPD	53,270	53,270	53,270		
Total Cost-Treatment & Disposal			$ 790,904.25	**$ 4,258,572.75**	**$ 3,223,638.25**
Total Cost for Collection	$ 3,467,668.50	$ 2,432,734.00			
Total Annual O and M Cost	$ 18,590.00	$ 15,787.50	$ 60,120.00	**$ 78,710.00**	**$ 75,907.50**
Total Annual Cost Septage Handling	Included above	Included above	Included Above		
Cost per EDU installed	$ 20,278.76	$ 14,226.51	$ 4,625.17	**$ 24,903.93**	**$ 18,851.69**
Cost per EDU for O and M	$ 108.71	$ 92.32	$ 351.58	**$ 460.29**	**$ 443.90**
Cost per EDU/mth O&M				**$ 38.36**	**$ 36.99**

Territorial Landworks, Inc.
(406) 721-0142

CLIENT: Lewis County
PROJECT: Lewis County Packwood LOSS Plan

PO Box 3851
Missoula, MT 59806

	Cost Comparison				
	Gray and Osborne		Skillings Connolly	Territorial Landworks	
Item	STEP System	Gravity Sewer System	RTF System	Pumped System	Gravity System
Total Cost Collection	$ 1,533,753.40	$ 3,574,196.88	$ 1,915,000.00	$ 3,467,668.50	$ 2,432,734.00
Total Cost T & D	$ 2,103,000.00	$ 2,103,000.00	$ 1,627,350.00	$ 790,904.25	$ 790,904.25
Total Cost	$ 3,636,753.40	$ 5,677,196.88	$ 3,542,350.00	$ 4,258,572.75	$ 3,223,638.25
Total Cost O & M	$ 66,670.00	$ 64,120.00	$ 72,370.00	$ 78,710.00	$ 75,907.50
Cost /EDU installed	$ 45,682.43	$ 61,331.55	$ 51,697.00	$ 24,903.93	$ 18,851.69
Cost/EDU O&M	$ 944.45	$ 924.90	$ 723.70	$ 460.29	$ 443.90
Cost/EDU O&M/Mth	$ 78.70	$ 77.07	$ 60.31	$ 38.36	$ 36.99

PACKWOOD - ENGINEER'S ESTIMATE					
Project Name: Lewis County Packwood LOSS Plan					
Project Number: 12-2913					
Owner: Lewis County, Washington					
Consultant: Territorial-Landworks, Inc.					
Item	Description	Qty.		Unit Cost	Total
GRAVITY COLLECTION SYSTEM- HANNA PROPERTY					
1	Trench Safety System	1	LS	$1,000.00	$1,000.00
2	Asphalt Pavement Repair	660	TN	$150.00	$99,000.00
3	Crushed Surfacing Top Course	1320	CY	$40.00	$52,800.00
4	8" Gravity Sewer	7630	LF	$42.00	$320,460.00
5	48" Manhole, 8 ft or less	20	EA	$4,000.00	$80,000.00
6	6" HDPE Force Main	4465	LF	$32.00	$142,880.00
7	Air Relief Valve	4	EA	$4,000.00	$16,000.00
8	48" Manhole, Additional Height	20	LF	$160.00	$3,200.00
9	Solid Manhole Cover	20	EA	$470.00	$9,400.00
10	Lift Station	2	EA	$265,000.00	$530,000.00
11	Directional Boring	150	LF	$75.00	$11,250.00
12	Driveway Repair	1	LS	$10,000.00	$10,000.00
13	Creek Crossing	100	LF	$75.00	$7,500.00
15	4" Side Sewer to Property Line	2190	LF	$30.00	$65,700.00
16	6" Side Sewer to Property Line	1260	LF	$28.00	$35,280.00
17	4" Service connection	73	EA	$350.00	$25,550.00
18	6" Service connection	42	EA	$500.00	$21,000.00
				Subtotal	$1,431,020.00
				Mobilization (8%)	$114,481.60
				Traffic Control (3%)	$42,930.60
				Dewatering (5%)	$71,551.00
				Contingency (20%)	$286,204.00
				Sales Tax (9%)	$128,791.80
				Legal, Engineering, Admin (25%)	$357,755.00
				Total Initial Project Cost	**$2,432,734.00**

O & M Cost Estimate	
Main Cleaning and Flushing	$3,287.50
Lift Station Inspection	$8,000.00
Lift Station Cleaning	$2,000.00
Repair and Replacement	$2,500.00
Total Annual O & M Costs	**$15,787.50**

PACKWOOD - ENGINEER'S ESTIMATE					
Project Name: Lewis County Packwood LOSS Plan					
Project Number: 12-2913					
Owner: Lewis County, Washington					
Consultant: Territorial-Landworks, Inc.					
Item	Description	Qty.		Unit Cost	Total
PUMPED COLLECTION SYSTEM- HANNA PROPERTY					
1	Trench Safety System	1	LS	$1,000.00	$1,000.00
2	Asphalt Pavement Repair	660	TN	$150.00	$99,000.00
3	Crushed Surfacing Top Course	560	CY	$40.00	$22,400.00
4	3" HDPE Force Main	2155	LF	$25.00	$53,875.00
5	4" HDPE Force Main	5475	LF	$28.00	$153,300.00
6	6" HDPE Force Main	4465	LF	$32.00	$142,880.00
7	Lift Station	2	EA	$265,000.00	$530,000.00
8	Air Vac Assemblies	5	EA	$3,000.00	$15,000.00
9	Flushing Connections	6	EA	$1,200.00	$7,200.00
10	Blow-off Assemblies	2	EA	$1,200.00	$2,400.00
11	Driveway Repair	1	LS	$10,000.00	$10,000.00
12	1.25" Service Connection w/ Valve Box	115	EA	$300.00	$34,500.00
13	Tank and Pump w/ service	73	EA	$6,000.00	$438,000.00
14	Tank and Pump for High Flow w/ service	42	EA	$12,000.00	$504,000.00
15	20" Diameter Bored Crossing	250	LF	$75.00	$18,750.00
16	Creek Crossing	100	LF	$75.00	$7,500.00
				Subtotal	$2,039,805.00
				Mobilization (8%)	$163,184.40
				Traffic Control (3%)	$61,194.15
				Dewatering (5%)	$101,990.25
				Contingency (20%)	$407,961.00
				Sales Tax (9%)	$183,582.45
				Legal, Engineering, Admin (25%)	$509,951.25
				Total Initial Project Cost	**$3,467,668.50**

O & M Cost Estimate	
Labor	$3,120.00
Power	$5,000.00
Repair and Replacement	$3,720.00
Septic Tank Pumping	$6,750.00
Total Annual O & M Costs	**$18,590.00**

PACKWOOD - ENGINEER'S ESTIMATE					
Project Name: Lewis County Packwood LOSS Plan					
Project Number: 12-2913					
Owner: Lewis County, Washington					
Consultant: Territorial-Landworks, Inc.					
Item	Description	Qty.		Unit Cost	Total
VACUUM COLLECTION SYSTEM					
1	Trench Safety System	1	LS	$1,000.00	$1,000.00
2	Asphalt Pavement Repair	660	TN	$150.00	$99,000.00
3	Crushed Surfacing Top Course	560	CY	$40.00	$22,400.00
4	8" Vacuum Main	5475	LF	$45.00	$246,375.00
5	4" Vacuum Main	2155	LF	$35.00	$75,425.00
6	3" Service Lateral	75	EA	$400.00	$30,000.00
7	8" Isolation Valve	20	EA	$1,250.00	$25,000.00
8	AIRVAC 5' PE Valve Pit Package	75	EA	$4,590.00	$344,250.00
9	Single Buffer Tank	1	EA	$5,350.00	$5,350.00
10	Special Tools	1	SET	$4,830.00	$4,830.00
11	Spare Parts	1	SET	$6,530.00	$6,530.00
12	Trailer Mounted Vacuum Pump	1	EA	$24,000.00	$24,000.00
13	AIRVAC Standard Skit Model 30-20	1	LS	$243,400.00	$243,400.00
14	Equpiment Installation	1	LS	$13,500.00	$13,500.00
15	Wiring/Piping, etc.	1	LS	$46,700.00	$46,700.00
16	Vacuum Station (Building) and Land	1	LS	$300,000.00	$300,000.00
17	Emergency Generator	1	EA	$25,000.00	$25,000.00
18	Odor Control: Bio-Mass Filter Bed	1	LS	$25,000.00	$25,000.00
19	20" Diameter Bored Crossing	150	LF	$43.00	$6,450.00
20	Driveway Repair	1	LS	$10,000.00	$10,000.00
10	Lift Station	1	EA	$265,000.00	$265,000.00
21	Creek Crossing	100	LF	$75.00	$7,500.00
				Subtotal	$1,826,710.00
				Mobilization (8%)	$146,136.80
				Traffic Control (3%)	$54,801.30
				Dewatering (5%)	$91,335.50
				Contingency (20%)	$365,342.00
				Sales Tax (9%)	$164,403.90
				Legal, Engineering, Admin (25%)	$456,677.50
				Total Initial Project Cost	**$3,105,407.00**

O & M Cost Estimate	
Labor	$13,000.00
Power	$6,240.00
Repair and Replacement	$9,000.00
Total Annual O & M Costs	**$28,240.00**

PACKWOOD - ENGINEER'S ESTIMATE					
Project Name: Lewis County Packwood LOSS Plan					
Project Number: 12-2913					
Owner: Lewis County, Washington					
Consultant: Territorial-Landworks, Inc.					
Item	Description	Qty.		Unit Cost	Total
SBR TREATMENT SYSTEM					
1	Excavation	1165	CY	$15.00	$17,475.00
2	Backfill	500	CY	$2.50	$1,250.00
3	Grade and 3/4" minus	120	Ton	$17.25	$2,070.00
4	Cushion	120	Ton	$15.50	$1,860.00
5	Floor Concrete	55	CY	$170.00	$9,350.00
6	Wall Concrete	80	CY	$170.00	$13,600.00
7	Pump Truck	16	HR	$150.00	$2,400.00
8	steel - Slab	2000	LB	$1.00	$2,000.00
9	steel - 8' Tall Wall	1400	LB	$1.00	$1,400.00
10	Screen	1	LS	$550.00	$550.00
11	Lids	1	LS	$20,000.00	$20,000.00
12	Crane	12	HRS	$100.00	$1,200.00
13	Risers and Pipe Hangers	1	LS	$2,000.00	$2,000.00
14	Pumps	1	LS	$25,000.00	$25,000.00
15	Filter Unit and Compressor	1	LS	$40,000.00	$40,000.00
16	Control Panel with PLC	1	LS	$18,000.00	$18,000.00
17	Turbidimeter, UV, Metering Pumps. and Electronic Valves	1	LS	$18,000.00	$18,000.00
18	Plumbing	1	LS	$7,000.00	$7,000.00
19	Inspections/Certifications	1	LS	$5,000.00	$5,000.00
20	Labor and Incidentals	1	LS	$100,000.00	$100,000.00
21	Electrical	1	LS	$25,000.00	$25,000.00
22	Phone Line	1	LS	$1,500.00	$1,500.00
23	Control House Construction	1	LS	$25,000.00	$25,000.00
24	Access Road Crossing and Construction	1	LS	$65,000.00	$65,000.00
				Subtotal	$404,655.00
				Mobilization (8%)	$32,372.40
				Contingency (20%)	$80,931.00
				Sales Tax (9%)	$36,418.95
				Legal, Engineering, Admin (25%)	$101,163.75
				Total Initial Project Cost	**$655,541.10**

O & M Cost Estimate	
Labor	$29,120.00
Power	$12,000.00
Sludge Pumping	$8,000.00
Repair and Replacement	$8,000.00
Permit Renewal	$3,000.00
Total Annual O & M Costs	**$60,120.00**

PACKWOOD - ENGINEER'S ESTIMATE					
Project Name: Lewis County Packwood LOSS Plan					
Project Number: 12-2913					
Owner: Lewis County, Washington					
Consultant: Territorial-Landworks, Inc.					
Item	Description	Qty.		Unit Cost	Total
MBR TREATMENT SYSTEM					
1	Clearing and Grubbing	1	LS	$16,000.00	$16,000.00
2	Site work and excavation	1	LS	$65,000.00	$65,000.00
3	Enviroquip package MBR	1	LS	$300,000.00	$300,000.00
4	Pole building	1	LS	$54,000.00	$54,000.00
5	Electrical	1	LS	$75,000.00	$75,000.00
6	Access Road Crossing and Construction	1	LS	$65,000.00	$65,000.00
7	Piping and Fittings	1	LS	$20,000.00	$20,000.00
				Subtotal	$595,000.00
				Mobilization (8%)	$47,600.00
				Contingency (20%)	$119,000.00
				Sales Tax (9%)	$53,550.00
				Legal, Engineering, Admin (25%)	$148,750.00
				Total Initial Project Cost	**$963,900.00**

O & M Cost Estimate	
Labor	$41,600.00
Power	$12,000.00
Membrane Replacement	$3,000.00
Repair and Replacement	$7,300.00
Discharge Permit Renewal	$5,000.00
Total Annual O & M Costs	**$68,900.00**

PACKWOOD - ENGINEER'S ESTIMATE					
Project Name: Lewis County Packwood LOSS Plan					
Project Number: 12-2913					
Owner: Lewis County, Washington					
Consultant: Territorial-Landworks, Inc.					
Item	Description	Qty.		Unit Cost	Total
RGF TREATMENT SYSTEM					
1	Clearing and Grubbing	1	LS	$16,000.00	$16,000.00
2	Site Work, Excavation	1	LS	$65,000.00	$65,000.00
3	Tanks	1	LS	$14,000.00	$14,000.00
4	Recirculation Pumps	3	EA	$17,500.00	$52,500.00
5	RGF Concrete	223	CY	$650.00	$144,950.00
6	RGF Media	1	LS	$21,000.00	$21,000.00
7	RGF Piping and Accessories	1	LS	$25,000.00	$25,000.00
8	In-Line Filter	1	LS	$30,000.00	$30,000.00
9	UV Disinfection System	1	LS	$12,000.00	$12,000.00
10	Effluent Flow Meters	2	EA	$5,000.00	$10,000.00
11	Electical	1	LS	$75,000.00	$75,000.00
12	Access Road Crossing and Construction	1	LS	$65,000.00	$65,000.00
13	Piping and Fittings	1	LS	$65,000.00	$65,000.00
				Subtotal	$595,450.00
				Mobilization (8%)	$47,636.00
				Contingency (20%)	$119,090.00
				Sales Tax (9%)	$53,590.50
				Legal, Engineering, Admin (25%)	$148,862.50
				Total Initial Project Cost	**$964,629.00**

O & M Cost Estimate	
Labor	$24,960.00
Power	$12,000.00
Repair and Replacement	$15,000.00
Discharge Permit Renewal	$5,000.00
Total Annual O & M Costs	**$56,960.00**

PACKWOOD - ENGINEER'S ESTIMATE					
Project Name: Lewis County Packwood LOSS Plan					
Project Number: 12-2913					
Owner: Lewis County, Washington					
Consultant: Territorial-Landworks, Inc.					
Item	Description	Qty.		Unit Cost	Total
DRAINFIELD DISPOSAL SYSTEM- HANNA PROPERTY					
1	Land Purchase	6	AC	$8,500.00	$51,000.00
2	Drainfield System	10654	LF	$3.25	$34,625.50
3	Distribution Valve Assembly	2	EA	$5,600.00	$11,200.00
4	Forcemain from Treatment Plant to Drainfield	100	LF	$35.00	$3,500.00
				Subtotal	$100,325.50
				Mobilization (8%)	$8,026.04
				Contingency (20%)	$20,065.10
				Sales Tax (9%)	$9,029.30
				Legal, Engineering, Admin (25%)	$25,081.38
				Total Initial Project Cost	**$162,527.31**

PACKWOOD - ENGINEER'S ESTIMATE					
Project Name: Lewis County Packwood LOSS Plan					
Project Number: 12-2913					
Owner: Lewis County, Washington					
Consultant: Territorial-Landworks, Inc.					
Item	Description	Qty.		Unit Cost	Total
GRAVITY COLLECTION SYSTEM- WASHINGTON STATE PARKS					
1	Trench Safety System	1	LS	$1,000.00	$1,000.00
2	Asphalt Pavement Repair	660	TN	$150.00	$99,000.00
3	Crushed Surfacing Top Course	1320	CY	$40.00	$52,800.00
4	8" Gravity Sewer	7630	LF	$42.00	$320,460.00
5	48" Manhole, 8 ft or less	20	EA	$4,000.00	$80,000.00
6	6" HDPE Force Main	4630	LF	$32.00	$148,160.00
7	Air Relief Valve	4	EA	$4,000.00	$16,000.00
8	48" Manhole, Additional Height	20	LF	$160.00	$3,200.00
9	Solid Manhole Cover	20	EA	$470.00	$9,400.00
10	Lift Station	2	EA	$265,000.00	$530,000.00
11	Directional Boring	150	LF	$75.00	$11,250.00
12	Driveway Repair	1	LS	$10,000.00	$10,000.00
13	River Crossing	1	LS	$25,000.00	$25,000.00
15	4" Side Sewer to Property Line	2190	LF	$30.00	$65,700.00
16	6" Side Sewer to Property Line	1260	LF	$28.00	$35,280.00
17	4" Service connection	73	EA	$350.00	$25,550.00
18	6" Service connection	42	EA	$500.00	$21,000.00
				Subtotal	$1,453,800.00
				Mobilization (8%)	$116,304.00
				Traffic Control (3%)	$43,614.00
				Dewatering (5%)	$72,690.00
				Contingency (20%)	$290,760.00
				Sales Tax (9%)	$130,842.00
				Legal, Engineering, Admin (25%)	$363,450.00
				Total Initial Project Cost	**$2,471,460.00**

O & M Cost Estimate	
Main Cleaning and Flushing	$3,315.00
Lift Station Inspection	$8,000.00
Lift Station Cleaning	$2,000.00
Repair and Replacement	$2,500.00
Total Annual O & M Costs	**$15,815.00**

PACKWOOD - ENGINEER'S ESTIMATE					
Project Name: Lewis County Packwood LOSS Plan					
Project Number: 12-2913					
Owner: Lewis County, Washington					
Consultant: Territorial-Landworks, Inc.					
Item	Description	Qty.		Unit Cost	Total
PUMPED COLLECTION SYSTEM- WASHINGTON STATE PARKS					
1	Trench Safety System	1	LS	$1,000.00	$1,000.00
2	Asphalt Pavement Repair	660	TN	$150.00	$99,000.00
3	Crushed Surfacing Top Course	560	CY	$40.00	$22,400.00
4	3" HDPE Force Main	2155	LF	$25.00	$53,875.00
5	4" HDPE Force Main	5475	LF	$28.00	$153,300.00
6	6" HDPE Force Main	4630	LF	$32.00	$148,160.00
7	Lift Station	2	EA	$265,000.00	$530,000.00
8	Air Vac Assemblies	5	EA	$3,000.00	$15,000.00
9	Flushing Connections	6	EA	$1,200.00	$7,200.00
10	Blow-off Assemblies	2	EA	$1,200.00	$2,400.00
11	Driveway Repair	1	LS	$10,000.00	$10,000.00
12	1.25" Service Connection w/ Valve Box	115	EA	$300.00	$34,500.00
13	Tank and Pump w/ service	73	EA	$6,000.00	$438,000.00
14	Tank and Pump for High Flow w/ service	42	EA	$12,000.00	$504,000.00
15	20" Diameter Bored Crossing	250	LF	$75.00	$18,750.00
16	River Crossing	1	LS	$25,000.00	$25,000.00
				Subtotal	$2,062,585.00
				Mobilization (8%)	$165,006.80
				Traffic Control (3%)	$61,877.55
				Dewatering (5%)	$103,129.25
				Contingency (20%)	$412,517.00
				Sales Tax (9%)	$185,632.65
				Legal, Engineering, Admin (25%)	$515,646.25
				Total Initial Project Cost	**$3,506,394.50**

O & M Cost Estimate	
Labor	$3,120.00
Power	$5,000.00
Repair and Replacement	$3,720.00
Septic Tank Pumping	$6,750.00
Total Annual O & M Costs	**$18,590.00**

PACKWOOD - ENGINEER'S ESTIMATE					
Project Name: Lewis County Packwood LOSS Plan					
Project Number: 12-2913					
Owner: Lewis County, Washington					
Consultant: Territorial-Landworks, Inc.					
Item	Description	Qty.		Unit Cost	Total
DRAINFIELD DISPOSAL SYSTEM- HANNA PROPERTY					
1	Land Purchase	6	AC	$5,950.00	$35,700.00
2	Drainfield System	10654	LF	$3.25	$34,625.50
3	Distribution Valve Assembly	2	EA	$5,600.00	$11,200.00
4	Forcemain from Treatment Plant to Drainfield	100	LF	$35.00	$3,500.00
				Subtotal	$85,025.50
				Mobilization (8%)	$6,802.04
				Contingency (20%)	$17,005.10
				Sales Tax (9%)	$7,652.30
				Legal, Engineering, Admin (25%)	$21,256.38
				Total Initial Project Cost	**$137,741.31**

Commercial and Residential Flow Data

PACKWOOD - COMMERCIAL FLOW ANALYSIS

Project Name: Lewis County Packwood LOSS Plan

Project Number: 12-2913

Owner: Lewis County, Washington

Consultant: Territorial-Landworks, Inc.

MAP#	Name	Comm = C or Residential = R	Mar-11 Use (gpd)	Apr-11 Use (gpd)	May-11 Use (gpd)	Jun-11 Use (gpd)	Jul-11 Use (gpd)	Aug-11 Use (gpd)	Sep-11 Use (gpd)	Oct-11 Use (gpd)	Nov-11 Use (gpd)	Dec-11 Use (gpd)	Jan-12 Use (gpd)	Feb-12 Use (gpd)	Mar-12 Use (gpd)	Ave	EDU
442	PACKWOOD H/C	C	-	2.5	10.2	0.2	10.2	10.2	1.0	3.0	-	-	-	0.2	0.2	**3.1**	1.0
706	PRESBYTERIAN THRIFT	C	21.4	10.5	16.7	15.0	14.5	12.5	19.7	12.5	14.2	13.0	13.2	12.7	11.7	**13.6**	1.0
403	GREG AUBOL	C	-	-	113.7	0.5	-	18.2	58.6	-	-	-	-	-	-	**15.7**	1.0
439	BESLOW'S AUTO	C	36.4	17.2	22.9	15.0	20.4	28.7	24.4	13.7	9.7	13.7	14.5	9.5	11.7	**16.6**	1.0
622	PACKWOOD R.V. PARK	C	-	-	79.8	26.4	34.7	29.4	32.9	-	-	-	-	-	-	**16.7**	1.0
520	NW EXPRESSIONS	C	15.2	6.2	26.9	25.2	37.2	42.1	33.2	6.5	13.7	9.0	24.7	6.2	1.7	**19.1**	1.0
506	PACKWOOD SPIRITS	C	24.9	12.5	7.5	5.0	5.0	17.7	67.6	23.7	6.5	3.2	4.5	72.1	56.3	**23.1**	1.0
634.2	COWBOY COFFEE	C	14.0	13.0	19.9	18.5	24.2	23.7	26.9	14.2	21.4	23.7	21.2	49.6	30.9	**23.6**	1.0
770	SUNSHINE LIQUIDATORS	C	31.4	13.0	16.2	14.0	9.5	9.2	18.9	15.5	41.9	53.1	52.4	52.9	49.1	**28.4**	1.0
766	CLIFF DROPPERS	C	28.2	19.7	44.4	41.1	61.6	68.8	60.1	27.7	17.5	30.2	24.4	25.7	31.2	**37.2**	1.0
601	TIMBERLAND LIBRARY	C	19.2	16.5	33.2	23.7	91.3	136.4	71.8	18.0	16.2	17.7	19.2	16.0	19.7	**39.4**	1.0
438	TOM RUCKER	C	-	-	24.7	129.9	152.6	193.2	11.7	0.5	0.7	-	-	-	-	**42.2**	1.0
450	US POST OFFICE	C	106.2	40.1	46.4	95.5	21.2	75.0	38.9	42.6	45.9	28.7	43.1	35.2	49.4	**46.2**	1.0
402.1	HAIR WE ARE	C	48.1	41.1	80.8	49.9	43.1	63.1	81.5	42.6	45.1	43.6	41.9	44.4	38.6	**50.6**	1.0
762	SKYO LODGE C/O B	C	-	-	-	-	-	-	-	-	-	84.8	192.0	162.1	204.5	**52.9**	1.0
515	GFS 1 / SHERR MASON	C	14.2	36.4	125.7	48.6	94.2	19.4	92.8	109.0	36.7	25.7	27.7	34.2	27.4	**55.7**	1.0
662	S.S.A.	C	264.3	64.8	62.3	179.5	69.8	54.9	69.8	37.4	77.3	32.4	22.4	27.4	24.9	**59.4**	1.0
703	DONNA'S HAIRSTYLING	C	106.5	48.9	74.6	52.9	54.9	83.3	63.6	98.0	109.5	33.4	47.4	17.7	48.6	**60.2**	1.0
428	JON'S B&B	C	42.6	56.3	92.0	69.1	198.5	302.2	122.2	16.0	20.4	19.9	29.2	20.9	24.7	**79.8**	1.0
446	PACKWOOD AUTO	C	158.3	66.6	107.0	159.6	103.7	104.7	102.2	73.8	77.8	68.1	125.7	72.1	97.0	**95.2**	1.0
651	L / C FIRE HALL #10	C	59.8	189.5	149.6	94.7	104.7	109.7	184.5	54.9	124.7	57.3	52.4	32.4	49.9	**99.0**	1.0
634.1	BAKER INSURANCE	C	60.1	69.1	74.3	450.0	82.0	106.0	143.4	53.1	46.4	44.1	42.4	47.1	54.9	**99.7**	1.0
654	PACKWOOD SR/CTR	C	131.1	121.9	165.1	106.2	103.2	148.4	158.3	79.3	76.5	88.3	73.3	109.2	104.0	**109.6**	1.0
766.1	CLIFF DROPPERS	C	228.1	98.2	99.7	127.4	208.9	207.9	154.6	99.0	55.4	101.2	58.1	75.3	94.0	**113.4**	1.0
652	PACKWOOD IMP	C	18.0	36.2	1,085.1	11.5	16.7	61.1	243.3	25.9	30.4	27.4	28.7	17.7	55.4	**134.7**	1.0
437	FOUR-U REALTY	C	155.1	67.1	69.3	209.9	476.5	489.7	248.6	77.5	70.3	77.5	63.3	67.8	71.8	**163.5**	1.1
663	S.S.A.	C	337.6	662.2	418.6	633.3	162.6	175.5	89.5	93.0	47.1	88.5	95.0	101.5	134.1	**222.0**	1.4
500	BUTTER BUTTE COFFEE	C	473.7	164.3	171.0	195.2	272.5	236.6	234.4	326.9	166.6	263.0	220.7	199.0	271.8	**223.7**	1.4
502	DICK HANCOCK	C	43.9	55.9	272.5	289.2	1,086.8	221.4	209.4	74.1	72.6	142.9	159.1	133.6	149.4	**235.6**	1.5
440	BLUE SPRUCE SALOON	C	360.8	257.8	402.2	284.5	402.9	455.8	754.5	285.0	320.9	375.5	374.0	266.0	371.5	**374.0**	2.4
443	PACKWOOD HOTEL	C	269.5	186.5	372.5	478.0	646.8	797.6	599.9	298.7	378.7	383.5	275.3	249.6	353.6	**412.7**	2.7
533	ASSEMBLY OF GOD	C	597.9	192.5	206.7	190.0	391.7	1,294.8	297.5	343.1	266.8	305.2	289.7	881.4	971.7	**462.8**	3.0
611	PACKWOOD R.V. PARK	C	334.9	158.6	990.4	1,280.3	1,885.0	321.4	154.1	88.3	148.4	218.2	227.6	159.3	155.8	**475.7**	3.1
510	BLANTONS MARKET	C	412.9	308.2	550.8	384.0	666.7	831.0	526.8	430.3	438.1	473.0	473.0	419.1	493.9	**492.7**	3.2
730	WHITE PASS SCHOOL	C	52.4	266.8	47.4	34.9	57.3	52.4	69.8	3,453.3	2,027.1	37.4	29.9	37.4	49.9	**506.6**	3.3
402	TATOOSH FOOD MART	C	492.9	419.9	446.8	594.9	786.4	773.7	695.1	510.6	464.0	588.9	383.5	406.4	498.2	**539.9**	3.5
300	DEAN CROSHAW	C	311.7	251.8	254.3	416.4	448.8	1,052.2	97.2	688.2	139.6	1,259.1	1,009.8	376.5	857.7	**563.2**	3.6
504	RANDY HOWARD	C	473.7	378.0	634.6	623.6	949.2	960.7	1,027.5	387.5	388.7	535.8	466.5	469.2	575.7	**608.0**	3.9
605	PACKWOOD R.V. PARK	C	184.5	134.6	1,914.9	2,341.2	2,199.1	905.1	954.9	566.0	344.1	229.4	300.0	329.1	763.0	**902.6**	5.8
505	PACKWOOD INN	C	698.1	541.1	830.3	1,314.0	1,977.2	2,662.9	2,249.0	1,094.6	670.7	917.5	458.8	471.2	558.5	**1,129.8**	7.3
215	COWLITZ RIVER LODGE	C	1,685.5	1,306.5	1,578.3	1,214.3	2,852.4	4,465.6	3,211.4	1,463.6	1,037.2	1,286.6	1,159.4	1,122.0	1,426.2	**1,818.4**	11.7
406	PETERS INN	C	2,441.0	2,343.7	2,677.8	2,154.2	2,650.4	2,790.0	2,772.6	2,119.3	2,062.0	2,076.9	1,855.0	1,827.6	1,052.2	**2,168.4**	14.0
		Total (GPD)	**10,754.2**	**8,675.6**	**14,417.0**	**14,397.3**	**19,474.4**	**20,412.2**	**16,074.3**	**13,166.5**	**9,930.7**	**10,077.6**	**8,798.8**	**8,457.4**	**9,840.7**	**12,634.7**	**98**
		Total (Gal/Mo)	**322,627.36**	**260,266.60**	**432,508.56**	**431,917.64**	**584,232.88**	**612,365.16**	**482,228.12**	**394,996.36**	**297,920.92**	**302,326.64**	**263,963.28**	**253,721.60**	**295,220.64**		

Total	**4.6**	**MGY**
Ave Annual	**12,634.7**	**GPD**
Max Day - 1= 2 X Ave	**25,269.4**	**GPD**
Max Month (August)	**20,412.2**	**GPD**
Max Day - 2 = 1.5 X Max Mo	**30,618.3**	**GPD**

PACKWOOD - RESIDENTIAL FLOW ANALYSIS

Project Name: Lewis County Packwood LOSS Plan

Project Number: 12-2913

Owner: Lewis County, Washington

Consultant: Territorial-Landworks, Inc.

MAP#	Name	Comm = C or Residential = R	Apr-11 Use (gpd)	May-11 Use (gpd)	Jun-11 Use (gpd)	Jul-11 Use (gpd)	Aug-11 Use (gpd)	Sep-11 Use (gpd)	Oct-11 Use (gpd)	Nov-11 Use (gpd)	Dec-11 Use (gpd)	Jan-12 Use (gpd)	Feb-12 Use (gpd)	Mar-12 Use (gpd)	Ave	EDU
460	KENNY JANS	R	0.2	115.9	162.1	198.0	424.6	71.1	110.2	129.9	148.1	128.4	124.4	66.6	**138.0**	1.0
740	DAVID SCHMIDT	R	105.5	108.7	109.0	173.5	347.3	127.4	111.0	139.6	156.6	107.5	101.2	117.7	**140.1**	1.0
731	KENNETH E. BETHJE	R	119.7	61.8	90.5	372.5	518.6	273.3	45.1	45.6	50.4	44.1	46.1	53.9	**141.5**	1.0
725	THEO HERMANN	R	82.0	110.2	140.6	271.8	314.9	182.8	83.3	101.2	96.5	101.0	81.8	158.6	**141.8**	1.0
456	CHAD ANDERSON	R	91.5	121.7	181.0	198.0	186.5	146.9	112.0	141.1	129.2	127.9	131.1	172.3	**142.9**	1.0
789	JEFF BROWN	R	81.8	164.6	146.9	136.1	117.2	172.8	155.8	164.1	143.9	153.1	166.8	138.9	**143.2**	1.0
734	RICKY D. LEE	R	123.7	126.2	210.7	273.8	163.1	133.4	119.2	124.9	115.2	112.0	117.9	124.4	**143.4**	1.0
400	DEBBIE STEBBINS	R	118.2	88.8	108.5	237.4	485.0	317.9	61.3	72.1	63.6	61.6	84.8	69.1	**145.3**	1.0
453	JIMMIE HANSON	R	62.3	57.3	90.5	86.5	466.5	463.8	112.7	113.2	84.3	50.1	62.8	118.2	**145.3**	1.0
493	JON ANDERSON	R	153.6	166.8	176.0	202.5	156.3	147.4	118.7	128.2	167.6	133.1	110.2	134.6	**147.5**	1.0
454	ERICA M. EMERSON	R	130.4	161.1	169.0	326.9	172.5	129.2	109.7	100.0	188.0	106.2	112.2	130.2	**150.9**	1.0
643	DAN DEVOE	R	-	26.7	-	-	7.0	196.2	252.8	278.3	306.9	282.5	269.5	292.0	**157.1**	1.0
660	JIM FLINT	R	112.2	331.9	131.9	150.6	195.7	304.2	123.4	112.7	146.1	124.4	106.7	109.0	**160.2**	1.0
610	BARBIE DAY	R	61.6	107.7	273.0	218.4	578.5	232.9	71.8	84.3	91.0	71.8	70.1	90.5	**160.4**	1.0
513	GEORGE MACKEY	R	96.2	165.1	180.8	153.3	155.8	342.1	152.3	121.4	136.9	134.6	145.4	179.0	**161.3**	1.0
722	DANIEL BAIER	R	139.1	138.9	189.7	336.8	487.4	237.4	84.3	90.5	88.8	81.3	70.6	83.0	**166.7**	1.0
707	VICTOR CORTEZ	R	176.5	160.8	157.3	177.0	197.5	181.5	133.1	121.7	222.4	162.1	147.9	201.5	**167.6**	1.0
552	RICK ANTHONY	R	61.1	94.0	120.4	392.0	562.7	298.7	88.5	72.6	153.3	81.3	96.7	48.9	**170.2**	1.0
540	ALVIN MATHIS	R	122.2	123.4	178.8	286.7	253.1	451.3	107.7	125.2	110.5	134.6	70.8	115.2	**170.9**	1.0
522	TERRI GRAY	R	143.6	153.8	160.3	178.8	186.5	199.2	180.3	189.2	208.7	182.3	161.1	176.8	**174.3**	1.0
447	STEVE FREITAS	R	134.1	124.4	159.8	339.3	513.4	164.1	125.2	123.7	133.9	98.0	97.5	130.9	**176.2**	1.0
732	IRWIN RIGGS	R	224.9	155.1	175.3	196.5	214.2	197.0	167.3	179.5	170.8	170.5	140.9	173.5	**178.0**	1.0
744	DAVID CLEMENT	R	103.5	137.9	176.0	257.6	155.8	238.9	198.2	93.0	228.4	210.9	183.0	185.0	**178.2**	1.0
459	DUANE JOHNSTON	R	16.5	128.4	185.8	328.6	372.5	527.6	582.7	71.3	-	-	-	-	**181.9**	1.0
457	BETTY BLAKLEY	R	133.1	157.6	130.7	599.1	547.5	251.8	61.8	93.0	80.0	29.9	43.6	94.0	**182.7**	1.0
637	DONALD MULLINS	R	114.2	320.4	369.3	423.4	467.3	31.2	18.0	131.4	78.5	97.5	34.2	233.6	**190.6**	1.0
746	P.C.C.A. DREW REEDER	R	109.7	226.1	154.3	236.4	175.8	306.4	148.6	215.7	196.0	204.7	213.2	143.4	**191.5**	1.0
449	ROBERT ZANDERS	R	111.2	125.4	158.8	287.2	503.9	160.3	87.8	127.2	203.7	365.8	89.8	110.5	**191.6**	1.0
444	ROCKY FULLER	R	105.2	260.1	291.7	209.2	147.1	80.3	91.0	78.5	864.4	115.2	70.8	64.3	**195.4**	1.0
441	SHAWN HAMILTON	R	107.0	153.6	114.4	187.7	273.0	358.5	177.3	198.7	208.7	371.5	217.2	158.8	**207.7**	1.0
410	RICHARD BREIDENSTEIN	R	193.0	183.0	209.9	204.7	343.3	238.4	196.2	212.2	223.4	200.5	118.2	212.2	**208.4**	1.0
779	ROBERT BUNTAIN	R	67.6	172.3	149.8	210.2	902.3	462.0	81.8	68.1	185.5	144.6	64.6	83.3	**213.0**	1.0
408	TRACY SCHMIDT	R	40.1	19.7	213.7	864.2	876.9	327.4	67.8	65.6	23.9	51.1	45.4	103.0	**221.8**	1.0
455	HAL BLANTON	R	46.6	146.6	276.0	823.0	715.3	303.4	73.3	91.0	134.1	76.8	78.5	64.1	**232.5**	1.0
773	JOHN SHRINER	R	118.4	165.6	262.0	525.8	380.0	380.0	155.8	138.1	164.6	174.8	171.5	202.5	**233.4**	1.0
546	PAMELA J. DOLLAR	R	243.6	251.1	279.0	281.7	231.6	206.9	260.3	235.9	256.1	230.4	198.7	205.2	**236.8**	1.0
465	JACK DELONG	R	162.1	147.9	299.7	419.6	502.7	307.4	171.5	194.7	184.8	157.6	159.8	173.0	**236.8**	1.0
727	BRENDA VAN HORN	R	109.2	671.0	1,062.2	171.3	129.4	246.6	208.9	84.3	105.2	85.8	63.3	78.3	**247.8**	1.0
742	TERESA REDFIELD	R	89.5	138.4	345.3	1,099.8	774.2	384.7	108.5	108.5	134.1	112.7	108.2	129.7	**290.4**	1.0
777	LLOYD MARTIN	R	105.2	146.4	130.2	118.2	131.1	131.9	104.5	103.7	96.2	98.0	101.7	100.0	**112.4**	1.0
646	JERRY PIERSON	R	39.4	84.8	88.3	152.1	170.0	120.7	82.0	112.4	185.0	131.1	102.0	102.0	**112.6**	1.0
458	DAVE SMITH	R	115.9	138.1	157.3	168.3	120.9	107.0	99.5	151.8	120.2	101.0	104.0	100.2	**122.0**	1.0
537	TOM LERCHEN	R	91.0	106.5	123.9	169.8	338.3	116.7	93.7	99.5	108.7	83.3	66.3	106.5	**123.6**	1.0
429	JON ANDERSON	R	276.3	104.2	325.6	347.6	209.4	96.2	30.7	32.2	57.3	40.6	27.9	27.4	**129.5**	1.0
426	DONALD SQUIRES	R	95.5	105.0	273.5	382.5	490.7	202.0	137.6	84.0	105.0	63.6	75.5	84.3	**172.5**	1.0

709	JOHN & ELIZABETH SQUIRES	R	78.8	68.3	131.4	84.8	70.3	94.7	89.3	88.0	72.8	79.5	64.6	88.0	**83.1**	1.0
542	CHARLES MITCHELL	R	50.4	183.5	119.7	123.7	116.9	71.8	53.4	60.8	64.8	63.8	56.3	63.1	**84.5**	1.0
772	VIVIAN CHOATE	R	96.5	37.4	67.1	338.6	156.8	254.1	23.2	33.2	11.7	18.2	31.9	26.4	**90.0**	1.0
490	DONALD POWELL	R	103.2	93.5	86.0	108.2	115.2	109.7	92.0	87.8	84.5	51.9	87.8	119.9	**93.7**	1.0
508	CLYDE NORDQUIST	R	54.9	145.1	111.5	119.4	57.6	139.4	68.6	120.9	144.4	70.6	52.1	61.8	**94.2**	1.0
702	MAREE LERCHEN	R	82.5	129.7	83.8	102.7	87.8	131.1	90.5	89.0	101.2	99.5	95.0	64.8	**95.1**	1.0
745	ROBIN GARDNER	R	97.0	102.7	100.2	102.7	101.5	108.2	101.2	54.6	169.5	120.2	92.5	114.4	**104.0**	1.0
521	MARY LOU MATHIS	R	99.5	80.8	122.9	262.0	160.6	84.3	66.3	68.3	90.3	92.3	59.3	103.0	**106.0**	1.0
530	KAYLA CAIN	R	83.0	111.7	111.5	5.5	156.6	118.7	120.4	69.1	110.0	45.6	188.2	190.2	**107.7**	1.0
401	DONNA JOHNSON	R	39.6	45.1	45.9	47.1	184.5	57.6	45.9	41.1	54.4	205.7	69.6	55.1	**73.3**	1.0
714	BETTY ZOOK	R	72.8	67.8	65.8	69.8	74.6	226.6	67.3	46.1	22.9	66.1	23.4	89.8	**73.4**	1.0
554	RANDY CRAWFORD	R	51.4	93.0	50.6	83.5	121.9	116.9	77.8	65.1	83.3	64.1	79.5	52.4	**77.2**	1.0
670	CHRIS JERDE	R	62.8	2.2	4.2	19.4	296.0	134.9	62.6	47.6	53.1	66.8	119.2	117.2	**81.1**	1.0
602	COUG ANDERSON	R	51.9	66.8	62.6	70.6	93.5	202.5	93.0	119.9	65.3	49.9	49.9	64.8	**81.4**	1.0
713	BETTY ZOOK	R	77.0	92.0	76.8	81.8	104.5	96.7	89.8	79.8	74.6	57.8	79.8	93.0	**82.5**	1.0
609	DOUG WOOG	R	56.6	67.8	66.3	81.5	80.0	70.1	55.9	63.3	58.6	76.3	54.9	66.3	**65.6**	1.0
607	JOHN CORNELL	R	20.9	57.8	37.4	56.6	121.7	140.9	71.1	71.1	57.8	96.0	74.8	36.2	**69.2**	1.0
715	BERNARD SCHMITZ	R	59.8	57.3	50.6	52.9	80.3	67.8	53.6	52.1	25.4	27.4	154.1	173.0	**70.2**	1.0
436	HAROLD BLANTON	C	337.8	235.9	746.3	634.3	636.5	553.5	94.7	99.0	346.1	87.0	89.5	102.0	**325.7**	1.0
738	BARBARA PROFFITT	R	264.0	308.4	337.3	670.2	653.3	540.6	452.5	450.8	315.4	280.0	190.2	223.7	**385.2**	1.0
645	JERRY PIERSON	R	212.4	190.5	219.9	435.6	533.6	658.0	551.3	600.4	639.8	515.6	491.7	459.5	**452.7**	1.0
726	DIANE DURALL	R	53.9	52.9	51.4	48.6	42.9	49.9	46.9	31.2	38.1	29.9	33.2	34.9	**42.2**	1.0
735	KEVIN PARKIN	R	49.9	43.6	42.6	46.9	88.0	94.7	39.6	33.9	29.4	29.7	48.6	32.7	**47.6**	1.0
743	ED SMITH	R	27.7	22.7	26.4	97.2	38.9	22.7	12.5	110.0	132.4	28.2	44.6	18.2	**47.8**	1.0
448	CHARLES WEST	R	29.4	62.3	46.1	64.8	90.3	41.6	34.7	38.6	38.1	38.4	49.6	61.8	**49.0**	1.0
452	MICHAEL GOTCHY	R	276.8	278.8	408.4	454.3	503.7	531.1	339.8	502.2	972.9	533.8	377.0	435.1	**461.4**	1.0
717	TOM & LIZ MINKS	R	11.0	43.1	2.5	7.0	35.7	37.4	29.4	17.7	139.1	13.0	56.1	27.9	**34.5**	1.0
631	DAVID BUNTING	R	33.2	33.9	31.4	294.2	532.1	177.3	24.7	22.2	20.4	22.9	43.4	110.2	**110.6**	1.0
		Total	**7,469.0**	**9,729.5**	**12,396.4**	**17,938.5**	**20,998.6**	**15,489.3**	**8,811.2**	**8,713.5**	**11,072.9**	**8,725.9**	**7,710.9**	**8,731.2**	**11,324.9**	**73**
		Total (Gal/Mo)	**224,070.88**	**291,884.56**	**371,890.64**	**538,156.08**	**629,958.12**	**464,680.04**	**264,335.72**	**261,403.56**	**332,186.80**	**261,777.56**	**231,326.48**	**261,934.64**		
		Total	**4.1**	**MGY**												
		Ave Annual	**11,324.9**	**GPD**												
		Flow per EDU	**155.1**	**GPD**												
		Max Day = 2 X Ave	**22,649.9**	**GPD**												

Nitrate and Hydraulic Conductivity Calculations

WASHINGTON DEPARTMENT OF HEALTH
LEVEL 1 NITRATE BALANCE FOR LARGE ON-SITE SEWAGE SYSTEM

Project name:	**Lewis County Packwood L.O.S.S. Plan- Hanna Property**
Address, city and county:	**Packwood, Lewis County**
Completed by (name and title):	**Trey Graft, E.I./ Andrea Day, P.E.**
Date:	**March 7, 2013**

Input Values	Factor	Units	Values	Instructions	Information Source
Nitrate concentration in precipitation	N_R	mg/l as N	0.24	Default	Default
Total nitrogen concentration in wastewater	N_W	mg/l	60	Default - residential strength	Default- no additional treatment for reduction considered yet.
Soil denitrification	d	unitless	0.1	Default	Default
Aquifer thickness	b	ft	20	Default or aquifer thickness if known	Use 20 or actual, whichever is smaller. Actual is 100 feet per wellhead protection plan
Drainfield area	A_D	ft^2	86,000	Primary drainfield area	100% calculated area (not %150)
Distance from drainfield to property boundary	D_{pb}	ft	0	Measure in direction of GW flow	Start with 0 first and see if it works per instructions.
Aquifer width	W_A	ft	405	Perpendicular to GW flow	Based on drainfield dimensions. Assumed d.f. perpendicular to flow.
Aquifer hydraulic conductivity	K	ft/day	719.0	Measured or literature value	Taken from K Calculation worksheet.
Hydraulic gradient	i	ft/ft	0.033	If unknown, use 0.010	See attached calculations.
Recharge	R	in/yr	19.69	Recharge will be a % of ppt	35% of annual rainfall for western part of state- per instructions.
Nitrate concentration of upgradient ground water	N_B	mg/l	0.25	Prefer sampling data	water sampling results taken on 2012-07-02
Wastewater volume	V_W	gpd	23,960	Design flows or measured volume	Calculated design flow.
Output Values					
Groundwater nitrate value	N_{GW}	mg/l as N	1.13	Point of Compliance (POC)	
Groundwater nitrate value	$N_{GW\ ALT}$	mg/l as N	1.13	Alternative POC	

DOH 337-070 Concentration difference: OK without further treatment

WASHINGTON DEPARTMENT OF HEALTH

LEVEL 1 NITRATE BALANCE FOR LARGE ON-SITE SEWAGE SYSTEM

Project name:	**Lewis County Packwood L.O.S.S. Plan- State Parks Site**
Address, city and county:	**Packwood, Lewis County**
Completed by (name and title):	**Trey Graft, E.I./ Andrea Day, P.E.**
Date:	**11.25.2012**

Input Values	Factor	Units	Values	Instructions	Information Source
Nitrate concentration in precipitation	N_R	**mg/l as N**	**0.24**	**Default**	Default
Total nitrogen concentration in wastewater	N_W	**mg/l**	**60**	**Default - residential strength**	Default- no additional treatment for reduction considered yet.
Soil denitrification	**d**	**unitless**	**0.1**	**Default**	Default
Aquifer thickness	**b**	**ft**	**20**	**Default or aquifer thickness if known**	Use 20 or actual, whichever is smaller.
Drainfield area	A_D	**ft^2**	**86,000**	**Primary drainfield area**	100% calculated area (not %150)
Distance from drainfield to property boundary	D_{pb}	**ft**	**0**	**Measure in direction of GW flow**	Start with 0 first and see if it works per instructions.
Aquifer width	W_A	**ft**	**405**	**Perpendicular to GW flow**	Based on drainfield dimensions. Assumed d.f. perpendicular to flow
Aquifer hydraulic conductivity	**K**	**ft/day**	**109.1**	**Measured or literature value**	Taken from K Calculation worksheet. Need to review.
Hydraulic gradient	**i**	**ft/ft**	**0.012**	**If unknown, use 0.010**	Taken from Lewis County Wellhead Protection Program
Recharge	**R**	**in/yr**	**19.69**	**Recharge will be a % of ppt**	35% of annual rainfall for western part of state- per instructions.
Nitrate concentration of upgradient ground water	N_B	**mg/l**	**0.3**	**Prefer sampling data**	water sampling results taken on 2012-07-02
Wastewater volume	V_W	**gpd**	**23,960**	**Design flows or measured volume**	Calculated design flow.
Output Values					
Groundwater nitrate value	N_{GW}	**mg/l as N**	**12.42**	**Point of Compliance (POC)**	
Groundwater nitrate value	$N_{GW\ ALT}$	**mg/l as N**	**12.42**	**Alternative POC**	

DOH 337-070 Concentration difference: Not OK without further treatment Revised: July 2012

HYDRAULIC CONDUCTIVITY

Lewis County
Packwood LOSS- Hanna Site

GROUND WATER AND WELLS
(p. 1021 Driscoll) Modified Jacobs Equation

TRANSMISSITIVITY

Q/s = T/1500 Unconfined Aquifers (not overlain by silt or fine-grained unit)
T = Transmissitivity of the well, in ft^2/day
Q = Pumping rate in gpm
s = Drawdown in well, in ft (static water level - pumping water level)
T =(Q(1500)/s)/7.48

Variables form Driller's Log: ABW618

Q (gpm) =	33.00
s (ft) =	4.00

Calculated Transmissitivity

T (ft^2/day) =	**1658.25**

HYDRAULIC CONDUCTIVITY

K = T/b Hydraulic Conductivity (feet/day)
T = Tranmissitivity
b = Aquifer thickness, equal to screened interval or 10 feet

Calculated Hydraulic Conductivity

b (ft) =	10.00
T (ft^2/day) =	1658.25
K (ft/day) =	**165.83**

HYDRAULIC CONDUCTIVITY

Lewis County
Packwood LOSS- Hanna Site

GROUND WATER AND WELLS
(p. 1021 Driscoll) Modified Jacobs Equation

TRANSMISSITIVITY
Q/s = T/1500 Unconfined Aquifers (not overlain by silt or fine-grained unit)
T = Transmissitivity of the well, in ft^2/day
Q = Pumping rate in gpm
s = Drawdown in well, in ft (static water level - pumping water level)
T =(Q(1500)/s)/7.48

Variables form Driller's Log: Snyder

Q (gpm) =	60.00
s (ft) =	6.00

Calculated Transmissitivity

T (ft^2/day) =	**2010.00**

HYDRAULIC CONDUCTIVITY
K = T/b Hydraulic Conductivity (feet/day)
T = Tranmissitivity
b = Aquifer thickness, equal to screened interval or 10 feet

Calculated Hydraulic Conductivity

b (ft) =	10.00
T (ft^2/day) =	2010.00
K (ft/day) =	**201.00**

HYDRAULIC CONDUCTIVITY

Lewis County
Packwood LOSS- Hanna Site

GROUND WATER AND WELLS
(p. 1021 Driscoll) Modified Jacobs Equation

TRANSMISSITIVITY

Q/s = T/1500 Unconfined Aquifers (not overlain by silt or fine-grained unit)
T = Transmissitivity of the well, in ft^2/day
Q = Pumping rate in gpm
s = Drawdown in well, in ft (static water level - pumping water level)
T =(Q(1500)/s)/7.48

Variables form Driller's Log: Cheney

Q (gpm) =	50.00
s (ft) =	0.50

Calculated Transmissitivity

T (ft^2/day) =	**20100.00**

HYDRAULIC CONDUCTIVITY

K = T/b Hydraulic Conductivity (feet/day)
T = Tranmissitivity
b = Aquifer thickness, equal to screened interval or 10 feet

Calculated Hydraulic Conductivity

b (ft) =	10.00
T (ft^2/day) =	20100.00
K (ft/day) =	**2010.00**

HYDRAULIC CONDUCTIVITY

Lewis County
Packwood LOSS- Hanna Site

GROUND WATER AND WELLS
(p. 1021 Driscoll) Modified Jacobs Equation

TRANSMISSITIVITY

Q/s = T/1500 Unconfined Aquifers (not overlain by silt or fine-grained unit)
T = Transmissitivity of the well, in ft^2/day
Q = Pumping rate in gpm
s = Drawdown in well, in ft (static water level - pumping water level)
T =(Q(1500)/s)/7.48

Variables form Driller's Log: Charles Horner

Q (gpm) =	50.00
s (ft) =	2.00

Calculated Transmissitivity

T (ft^2/day) =	**5025.00**

HYDRAULIC CONDUCTIVITY

K = T/b Hydraulic Conductivity (feet/day)
T = Tranmissitivity
b = Aquifer thickness, equal to screened interval or 10 feet

Calculated Hydraulic Conductivity

b (ft) =	10.00
T (ft^2/day) =	5025.00
K (ft/day) =	**502.50**

AVERAGE K VALUE:	719.83

HYDRAULIC CONDUCTIVITY

Lewis County
Packwood LOSS- State Parks Site

GROUND WATER AND WELLS
(p. 1021 Driscoll) Modified Jacobs Equation

TRANSMISSITIVITY

Q/s = T/1500 Unconfined Aquifers (not overlain by silt or fine-grained unit)
T = Transmissitivity of the well, in ft^2/day
Q = Pumping rate in gpm
s = Drawdown in well, in ft (static water level - pumping water level)
T =(Q(1500)/s)/7.48

Variables form Driller's Log: AFC 119

Q (gpm) =	100.00
s (ft) =	39.00

Calculated Transmissitivity

T (ft^2/day) =	**515.38**

HYDRAULIC CONDUCTIVITY

K = T/b Hydraulic Conductivity (feet/day)
T = Tranmissitivity
b = Aquifer thickness, equal to screened interval or 10 feet

Calculated Hydraulic Conductivity

b (ft) =	10.00
T (ft^2/day) =	515.38
K (ft/day) =	**51.54**

HYDRAULIC CONDUCTIVITY

Lewis County
Packwood LOSS- State Parks Site

GROUND WATER AND WELLS
(p. 1021 Driscoll) Modified Jacobs Equation

TRANSMISSITIVITY
Q/s = T/1500 Unconfined Aquifers (not overlain by silt or fine-grained unit)
T = Transmissitivity of the well, in ft^2/day
Q = Pumping rate in gpm
s = Drawdown in well, in ft (static water level - pumping water level)
T =(Q(1500)/s)/7.48

Variables form Driller's Log: UNKNOWN

Q (gpm) =	20.00
s (ft) =	4.00

Calculated Transmissitivity

T (ft^2/day) =	**1005.00**

HYDRAULIC CONDUCTIVITY
K = T/b Hydraulic Conductivity (feet/day)
T = Tranmissitivity
b = Aquifer thickness, equal to screened interval or 10 feet

Calculated Hydraulic Conductivity

b (ft) =	10.00
T (ft^2/day) =	1005.00
K (ft/day) =	**100.50**

HYDRAULIC CONDUCTIVITY

Lewis County
Packwood LOSS- State Parks Site

GROUND WATER AND WELLS
(p. 1021 Driscoll) Modified Jacobs Equation

TRANSMISSITIVITY
Q/s = T/1500 Unconfined Aquifers (not overlain by silt or fine-grained unit)
T = Transmissitivity of the well, in ft^2/day
Q = Pumping rate in gpm
s = Drawdown in well, in ft (static water level - pumping water level)
T =(Q(1500)/s)/7.48

Variables form Driller's Log: ABW641

Q (gpm) =	44.00
s (ft) =	4.00

Calculated Transmissitivity

T (ft^2/day)	**2211.00**

HYDRAULIC CONDUCTIVITY
K = T/b Hydraulic Conductivity (feet/day)
T = Tranmissitivity
b = Aquifer thickness, equal to screened interval or 10 feet

Calculated Hydraulic Conductivity

b (ft) =	10.00
T (ft^2/day) =	2211.00
K (ft/day) =	**221.10**

HYDRAULIC CONDUCTIVITY

Lewis County
Packwood LOSS- State Parks Site

GROUND WATER AND WELLS
(p. 1021 Driscoll) Modified Jacobs Equation

TRANSMISSITIVITY
Q/s = T/1500 Unconfined Aquifers (not overlain by silt or fine-grained unit)
T = Transmissitivity of the well, in ft^2/day
Q = Pumping rate in gpm
s = Drawdown in well, in ft (static water level - pumping water level)
T =(Q(1500)/s)/7.48

Variables form Driller's Log: AHL397

Q (gpm) =	25.00
s (ft) =	7.00

Calculated Transmissitivity

T (ft^2/day)	**717.86**

HYDRAULIC CONDUCTIVITY
K = T/b Hydraulic Conductivity (feet/day)
T = Tranmissitivity
b = Aquifer thickness, equal to screened interval or 10 feet

Calculated Hydraulic Conductivity

b (ft) =	10.00
T (ft^2/day) =	717.86
K (ft/day) =	**71.79**

HYDRAULIC CONDUCTIVITY

Lewis County
Packwood LOSS- State Parks Site

GROUND WATER AND WELLS
(p. 1021 Driscoll) Modified Jacobs Equation

TRANSMISSITIVITY
Q/s = T/1500 Unconfined Aquifers (not overlain by silt or fine-grained unit)
T = Transmissitivity of the well, in ft^2/day
Q = Pumping rate in gpm
s = Drawdown in well, in ft (static water level - pumping water level)
T =(Q(1500)/s)/7.48

Variables form Driller's Log: AHL398

Q (gpm) =	25.00
s (ft) =	5.00

Calculated Transmissitivity

T (ft^2/day)	**1005.00**

HYDRAULIC CONDUCTIVITY
K = T/b Hydraulic Conductivity (feet/day)
T = Tranmissitivity
b = Aquifer thickness, equal to screened interval or 10 feet

Calculated Hydraulic Conductivity

b (ft) =	10.00
T (ft^2/day) =	1005.00
K (ft/day) =	**100.50**

AVERAGE K	109.1

Hydraulic Gradient Analysis

Appendix H

Hydraulic Gradient Three Point Solution Worksheet

Instructions to determine groundwater (GW) gradient and flow direction based on static water elevations (SWE) of 3 wells.

SITE NAME: Packwood - Hanna Site

A. Record elevation difference and horizontal distances (HD) between the wells:

Well	Topographic Elevation (ft)		Depth to Static Water (ft bgs*)		SWE (ft)	Wells		HD (ft)
#1	1115	-	6	=	1109	#1 to #2	=	2145
#2	1056	-	10	=	1046	#2 to #3	=	2080
#3	1049	-	11'7"	=	1037'5"	#3 to #1	=	2990

* bgs = below ground surface

B. Plot the well locations on a scaled diagram

SCALE: _____" = _____'

- see attached.

C. Perform the following calculations:

1. Calculate the position between the High Static Water Elevation (HSWE) well and the Low Static Water Elevation (LSWE) well where the SWE is the same as the ISWE.

   (a) HSWE 1109 minus LSWE 1037'5" = (a) 71'7" (ft)

   (b) Horizontal distance between HSWE well and LSWE well 2290 divided by (a) 71'7"

   = (b) .32 (ft/ft)

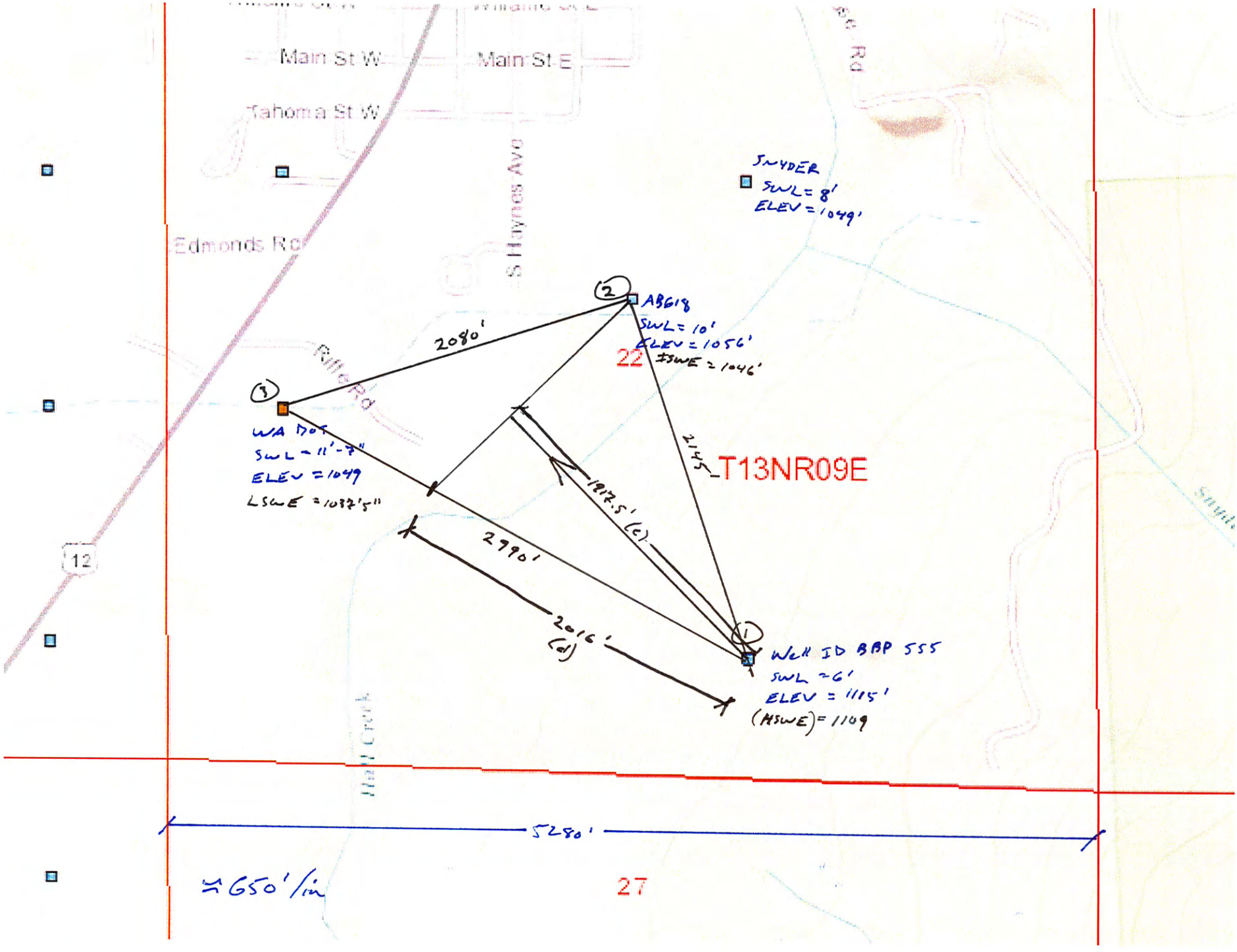
   (c) HSWE 1109 minus ISWE 1046 = (c) 63 (ft)

   (d) (b) .32 x (c) 63 = (d) 2016 (ft) (= the horizontal distance between the HSWE well and LSWE well that is equal to the ISWE).

2. Measure the distance (d) from the HSWE well along the line between it and the LSWE well, and plot that position on the diagram.
3. Draw a straight line from the ISWE well to position (d) on the well location diagram. This represents the water level contour line along which the SWE is the same as the ISWE well.
4. Draw a line perpendicular to the ISWE contour line through the HSWE well location on the well location diagram. This is the ground water flow direction (high to low). The distance along this groundwater flow line from the HSWE well to the ISWE contour line is (e).

D. Calculate the Hydraulic Gradient (HG) of the groundwater by dividing (c) by (e).

(c) 63 divided by (e) 1917.5 = HG 0.0329 (ft/ft)


Main St W
Main St E
Tahoma St W
Edmonds Rd
S Hayes Ave
Rifle Rd
12
SNYDER
SWL = 8'
ELEV = 1049'
2
ABG18
SWL = 10'
ELEV = 1056'
HSWE = 1046'
2080'
3
WA DOT
SWL = 11'-7"
ELEV = 1049
LSWE = 1037'5"
1817.5' (c)
2145'
T13NR09E
2790'
2016' (d)
1
WELL ID BBP 555
SWL = 6'
ELEV = 1115'
(HSWE) = 1109
5280'
≈ 650'/in
22
27

Appendix H

Hydraulic Gradient Three Point Solution Worksheet

Instructions to determine groundwater (GW) gradient and flow direction based on static water elevations (SWE) of 3 wells.

SITE NAME: Packwood - State Parks Site

A. Record elevation difference and horizontal distances (HD) between the wells:

Well	Topographic Elevation (ft)		Depth to Static Water (ft bgs*)		SWE (ft)	Wells		HD (ft)
#1	1107	-	16	=	1091	#1 to #2	=	2098
#2	1076	-	6	=	1070	#2 to #3	=	1905
#3	1078	-	9	=	1069	#3 to #1	=	2046

* bgs = below ground surface

B. Plot the well locations on a scaled diagram

SCALE: _____" = _____'

- See attached

C. Perform the following calculations:

1. Calculate the position between the High Static Water Elevation (HSWE) well and the Low Static Water Elevation (LSWE) well where the SWE is the same as the ISWE.

   (a) HSWE 1091 minus LSWE 1069 = (a) 22 (ft)

   (b) Horizontal distance between HSWE well and LSWE well 2046 divided by (a) 22 = (b) 93 (ft/ft)

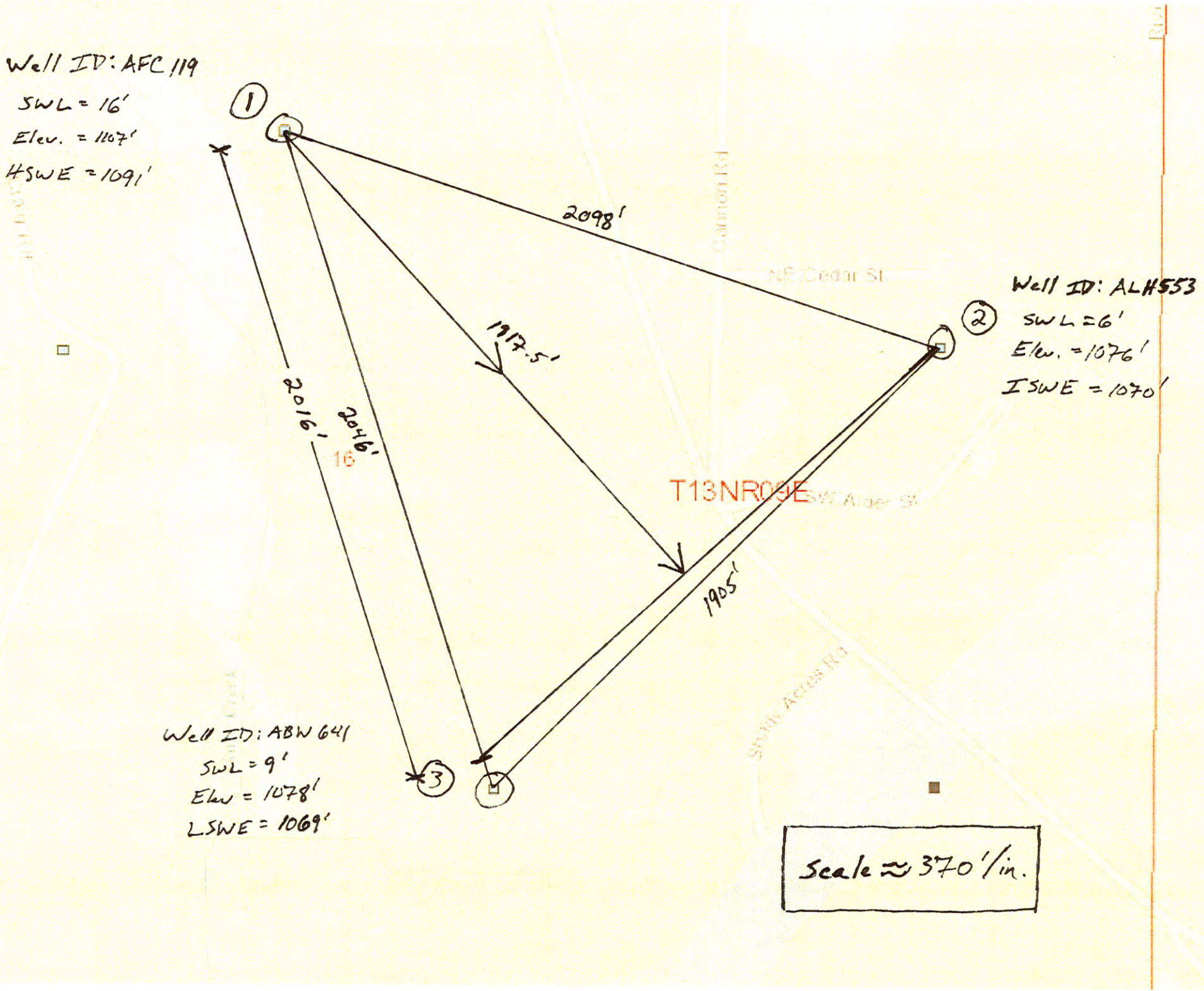
   (c) HSWE 1091 minus ISWE 1070 = (c) 21 (ft)

   (d) (b) 93 x (c) 21 = (d) 1953 (ft) (= the horizontal distance between the HSWE well and LSWE well that is equal to the ISWE).

2. Measure the distance (d) from the HSWE well along the line between it and the LSWE well, and plot that position on the diagram.
3. Draw a straight line from the ISWE well to position (d) on the well location diagram. This represents the water level contour line along which the SWE is the same as the ISWE well.
4. Draw a line perpendicular to the ISWE contour line through the HSWE well location on the well location diagram. This is the ground water flow direction (high to low). The distance along this groundwater flow line from the HSWE well to the ISWE contour line is (e).

D. Calculate the Hydraulic Gradient (HG) of the groundwater by dividing (c) by (e).

(c) 21 divided by (e) 1790 = HG 0.0117 (ft/ft)


Well ID: AFC 119
SWL = 16'
Elev. = 1107'
HSWE = 1091'
1
2098'
2
Well ID: ALH553
SWL = 6'
Elev. = 1076'
ISWE = 1070'
1917.5'
2016'
2046'
16
T13NR09E
1905'
3
Well ID: ABW 641
SWL = 9'
Elev = 1078'
LSWE = 1069'
Scale ≈ 370'/in.

Well Logs

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

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. W058497

UNIQUE WELL I.D. # ABW618

Water Right Permit No. _____

(1) OWNER: Name Bruce Smith Address P. O. Box 454, Packwood, Wa. 98361

(2) LOCATION OF WELL: County Lewis - 1/4 1/4 Sec 22 T. 13N N, R 9E WM.

(2a) STREET ADDRESS OF WELL (or nearest address) 129 Williams W, Packwood, Wa. 98361

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

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

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

(5) DIMENSIONS: Diameter of well 6 inches. Drilled 41 feet. Depth of completed well 41 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6 " Diam. from +1 XXX ft. to 41 ft.
Welded ☒ " Diam. from _____ ft. to _____ ft.
Liner installed ☐ Threaded ☐ " Diam. from _____ ft. to _____ ft.

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

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

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

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

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

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 10 ft. below top of well Date _____
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (Cap, valve, etc.)

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

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

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test 33 gal./min. with 4 ft. drawdown after 1 hrs.
Airtest _____ gal./min. with stem set at _____ ft. for _____ hrs.
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? Yes ☐ No ☒

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

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

MATERIAL	FROM	TO
Brown topsoil	0	3
Brown clay small to cobbles	3	16
Brown clay cemented	16	24
Gray clay hard	24	27
Brown clay sand gravel	27	37
Brown clay sand fine	37	39
Brown clay course sand gravel water bearing	39	41

Work Started 11/8 19 95 Completed 11/10 19 95

WELL CONSTRUCTOR CERTIFICATION:

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

NAME Royer Park Electric, Inc. (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)

Address P. O. Box 699, Morton, Wa 98356

(Signed) _____ (WELL DRILLER) License No. 1341

Contractor's Registration No. ROYERPE193PZ Date 12/4/95 19 ____

(USE ADDITIONAL SHEETS IF NECESSARY)

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ECY 050-1-20 (9/93) * * I

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

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

WATER WELL REPORT
STATE OF WASHINGTON

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

(1) OWNER: Name A. W. SNYDER SR. Address 144 MAIN ST E PACKWOOD, WASH.

(2) LOCATION OF WELL: County LEWIS NW 1/4 SW 1/4 NE 1/4 Sec 22 T 13 N., R 9E W.M.
Bearing and distance from section or subdivision corner

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

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

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 47 ft. Depth of completed well 46 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6 " Diam. from +1 ft. to 46 ft.
Threaded ☐ " Diam. from ..... ft. to ..... ft.
Welded ☑ " Diam. from ..... ft. to ..... ft.

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

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

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

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

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

(8) WATER LEVELS: Land-surface elevation above mean sea level .... ft.
Static level 8 ft. below top of well Date 10-27-78
Artesian pressure ..... lbs. per square inch Date .....
Artesian water is controlled by ..... (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☑ No ☐ If yes, by whom? DRILLER
Yield: 60 gal./min. with 6 ft. drawdown after 2 hrs.
" " " " "
" " " " "

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

Time	Water Level	Time	Water Level	Time	Water Level

Date of test 10-27-78
Bailer test ..... gal./min. with ..... ft. drawdown after ..... hrs.
Artesian flow ..... g.p.m. Date .....
Temperature of water ..... Was a chemical analysis made? Yes ☐ No ☑

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

MATERIAL	FROM	TO
SANDY TOPSOIL	1	4
CEMENTED SAND & GRAVEL	4	9
COARSE SAND & GRAVEL SOME WATER	9	12
SAND & GRAVEL WITH DECAYED WOOD	12	15
FINE SAND A LITTLE WATER	15	22
FINE SAND GRAY CLAY WATER	22	38
FINE SAND TO COARSE SAND & GRAVEL HARDPAN AT 47 FT.	38	47

RECEIVED
FEB 13 1979
DEPARTMENT OF ECOLOGY
SOUTHWEST REGIONAL OFFICE

Work started 10-23 19 78 Completed 10-27 19 78

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

NAME CHARLES W. GILL WELL DRILLING
(Person, firm, or corporation) (Type or print)
Address 4010 JACKSON HIGHWAY CHEHALIS
[Signed] Charles W. Gill
(Well Driller)
License No. 818 Date 10-27 19 78

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

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

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

WATER WELL REPORT
STATE OF WASHINGTON

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

(1) OWNER: Name Jim Cheney Address Rt. 246 Parkwood Wa. 98361

(2) LOCATION OF WELL: County Lewis NW¼ SE¼ SE¼ Sec. 21 T. 13 N., R. 2E W.M.
Bearing and distance from section or subdivision corner

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

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

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 31 ft. Depth of completed well 31 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6" Diam. from +1 ft. to 31 ft.
Threaded ☐ ..." Diam. from ... ft. to ... ft.
Welded ☑ ..." Diam. from ... ft. to ... ft.

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

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

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

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

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

(8) WATER LEVELS: Land-surface elevation above mean sea level ... ft.
Static level 14 ft. below top of well Date 3-29-77
Artesian pressure ... lbs. per square inch Date ...
Artesian water is controlled by ... (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☑ No ☐ If yes, by whom? Driller
Yield: 40 gal./min. with 14 ft. drawdown after 2 hrs.
" " " " "
" " " " "

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

Time	Water Level	Time	Water Level	Time	Water Level

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

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

MATERIAL	FROM	TO
Sandy Loam	0	5
Cemented Gravel Or Hard Pan With Some Bldrs.	5	24
Sand Run Sand And Gravel - to Large Pea Gravel - Water	24	31

RECEIVED
JAN 9 1978
DEPARTMENT OF ECOLOGY
SOUTHWEST REGIONAL OFFICE

Work started 3-21 19 77 Completed 3-29 19 77

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

NAME Gill Well Drilling Co.
(Person, firm, or corporation) (Type or print)
Address 4012 Jackson Hwy Chehalis Wa 98532

[Signed] George R. Gill
(Well Driller)

License No. 0153 Date 3-29 19 77

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

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

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

WATER WELL REPORT
STATE OF WASHINGTON

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

(1) **OWNER:** Name Charles Horner Address 12821-US Hwy 12 - Randle Wa. 98377

(2) **LOCATION OF WELL:** County Lewis - TL 2-6-Pt. NW¼ NE¼ Sec. 28 T. 13 N., R. 4E W.M.

Bearing and distance from section or subdivision corner

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

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

(5) **DIMENSIONS:** Diameter of well 6 inches.
Drilled 34 ft. Depth of completed well 34 ft.

(6) **CONSTRUCTION DETAILS:**
Casing installed: 6 " Diam. from +1 ft. to 34 ft.
Threaded ☐ ..... " Diam. from ..... ft. to ..... ft.
Welded ☑ ..... " Diam. from ..... ft. to ..... ft.

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

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

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

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

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

(8) **WATER LEVELS:** Land-surface elevation above mean sea level .... ft.
Static level 9 ft. below top of well Date 11-21-23
Artesian pressure ..... lbs. per square inch Date .....
Artesian water is controlled by ..... (Cap, valve, etc.)

(9) **WELL TESTS:** Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☑ No ☐ If yes, by whom? Driller
Yield: 50 gal./min. with 8 ft. drawdown after 2 hrs.
" " " "
" " " "

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

Time	Water Level	Time	Water Level	Time	Water Level

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

(10) **WELL LOG:**

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

MATERIAL	FROM	TO
Top Soil & Clay	0	5
Cement Gravel	5	22
Glacial Till with Some Boldrs	22	32
Sand & Gravel with Water	32	34

Work started 11-17, 19 23 Completed 11-21, 19 23

WELL DRILLER'S STATEMENT:

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

NAME George P. Gill - Well Drilling
(Person, firm, or corporation) (Type or print)

Address 3988 Jackson Hwy Chehalis, 98532

[Signed] George P. Gill
(Well Driller)

License No. 0153 Date 11-21, 19 23

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

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

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

WATER WELL REPORT
STATE OF WASHINGTON

Start Card No. W121802
UNIQUE WELL I.D. # AFC 119
Water Right Permit No. _____

(1) OWNER: Name Bob Buttorff Address 3756 No. 30th Tacoma 98407

(2) LOCATION OF WELL: County Lewis NO 240 ft 5890 FT W of Lot 3 1/4 1/4 Sec 18 T 13 N R 2 E WM

(2a) STREET ADDRESS OF WELL: (or nearest address) 130 Creekside Ln Packwood

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

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

(5) DIMENSIONS: Diameter of well 6 inches
Drilled 60 feet. Depth of completed well 60 ft.

(6) CONSTRUCTION DETAILS
Casing installed: ☑ Welded 6 5/8 " Diam. from +1 ft. to 59 ft.
☐ Liner installed _____ " Diam. from _____ ft. to _____ ft.
☐ Threaded _____ " Diam. from _____ ft. to _____ ft.

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

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

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

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

(7) PUMP: Manufacturer's Name Goulds
Type: Submers. 8GC H.P. 3/4

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 16 ft. below top of well Date 3-3-00
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (Cap, valve, etc.)

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

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airtest Log gal./min. with stem set at 55 ft. for 1 hrs.
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? ☐ Yes ☑ No

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION
Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Soil	0	5
Soil + Loose Rock	5	15
Boulders, Sand, and gravel	15	60
The Color of These Formations was White To Light gray		

RECEIVED
APR 04 2000
DEPARTMENT OF ECOLOGY
APR 11 2000

Work Started 3-1 19 00 Completed 3-3 19 00

WELL CONSTRUCTION CERTIFICATION:
I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.
NAME King Bros Drilling Inc (Person, Firm, or Corporation) (Type of Print)
Address 1434 SR 122 Silver Creek
(Signed) Eldon C King License No. 0243
Contractor's Registration No. KingBDI124DC Date 3-5 00

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20 (7/97)

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

WATER WELL REPORT
STATE OF WASHINGTON

Application No. ..... Permit No. 90198Z

(1) OWNER: Name CHARLES A BURGESON Address 16400 SOUTHCENTER PKWY WA 98

(2) LOCATION OF WELL: County Lewis Shady Lane ¼ ¼ Sec 16 T 13 N, R 2 E W.M.
Bearing and distance from section or subdivision corner Rockwood WA.

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

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

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 36 ft. Depth of completed well 36 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6 " Diam. from 0 ft. to 36 ft.
Threaded ☐ ..... " Diam. from ..... ft. to ..... ft.
Welded ☑ ..... " Diam. from ..... ft. to ..... ft.

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

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

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

Surface seal: Yes ☑ No ☐ To what depth? 10 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes ☐ No ☑
Type of water? ..... Depth of strata .....
Method of sealing strata off .....

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

(8) WATER LEVELS: Land-surface elevation above mean sea level ..... ft.
Static level 9 ft. below top of well Date .....
Artesian pressure ..... lbs. per square inch Date .....
Artesian water is controlled by ..... (Cap, valve, etc.)

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

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

Time	Water Level	Time	Water Level	Time	Water Level

Date of test .....
Bailer test 20 gal./min. with 4 ft. drawdown after 1 hrs.
Artesian flow ..... g.p.m. Date .....
Temperature of water ..... Was a chemical analysis made? Yes ☐ No ☐

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

MATERIAL	FROM	TO
Brown Light Clay Sand Some Cobbles	0	3'
Brown Clay Hard	3'	7'
Boulder 11" Diam.	7'	8'
Brown Clay Hard	8'	11'
Gray Cemented Sand	11'	21'
Gray Clay Soft	21'	25'
Brown Clay Some Small Cobbles	25'	32'
Brown Clay Sand	32'	33'
Brown Clay Sand	33'	35'
Blackcomb Water Bearing Black Sand Small Gravel	35'	36'

RECEIVED
NOV 18 1985
DEPARTMENT OF ECOLOGY

Work started 11-4- 1985 Completed 11-12- 1985

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

NAME Royer Park Elec. INC.
(Person, firm, or corporation) (Type or print)
Address P.O. Box 16 Glenoma WA.
[Signed] James R. Jeffries
(Well driller)
License No. 1341 Date 11-15 1985

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

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

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

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. W060715

UNIQUE WELL I.D. # ABW641

Water Right Permit No. _____

(1) OWNER: Name ~~Kory KYHLE~~ KORY KHILE Address 109 Fairway Dr., Packwood, Wa.

(2) LOCATION OF WELL: County Lewis SW 1/4 SE 1/4 Sec 16 T. 13N N., R 9E W.M.

(2a) STREET ADDRESS OF WELL (or nearest address) Cannon Rd. Riverside Tract, Packwood

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

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

(5) DIMENSIONS: Diameter of well 6 inches. Drilled 41 feet. Depth of completed well 41 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6 " Diam. from +1 ft. to 41 ft.
Welded ☒ Liner installed ☐ Threaded ☐ _____ " Diam. from _____ ft. to _____ ft.
_____ " Diam. from _____ ft. to _____ ft.

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

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

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

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

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

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 9 ft. below top of well Date _____
Artesian pressure _____ lbs. per square inch Date _____
Artesian water is controlled by _____ (Cap, valve, etc.)

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

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test 44 gal./min. with 4 ft. drawdown after 1 hrs.
Airtest _____ gal./min. with stem set at _____ ft. for _____ hrs.
Artesian flow _____ g.p.m. Date _____
Temperature of water _____ Was a chemical analysis made? Yes ☐ No ☒

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

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

MATERIAL	FROM	TO
Brown light clay sand	0	3
Brown clay soft small cobbles	3	12
Brown clay hard boulders	12	14
Brown cemented sand hard	14	26
Gray clay hard	26	31
Brown clay fine sand	31	38
Brown clay course sand gravel water bearing	38	41

Work Started 12/16/95 19. Completed 12/17/95 19

WELL CONSTRUCTOR CERTIFICATION:

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

NAME Royer Park Electric, Inc. (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)

Address P. O. Box 699, Morton, Wa. 98356

(Signed) Kurt B. Taylor (WELL DRILLER) License No. 1341

Contractor's Registration No. ~~RB~~YERPE193PZ Date 12/17/95 19

(USE ADDITIONAL SHEETS IF NECESSARY)

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

ECY 050-1-20 (9/93)

WATER WELL REPORT

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

Construction/Decommission ("x" in circle) 139137
☒ Construction
○ Decommission ORIGINAL CONSTRUCTION Notice of Intent Number

CURRENT Notice of Intent No. WIL8495

Unique Ecology Well ID Tag No. AHL397

Water Right Permit No. N/A

Property Owner Name Allen & Maureen Franz

Well Street Address 365 Craig Rd.

City Packwood County Lewis

Location NE 1/4 - 1/4 SW 1/4 Sec 16 Twn 13N R 9 (EWM) or WWM circle one

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

Tax Parcel No. _____

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

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

DIMENSIONS: Diameter of well 6 inches, drilled 40 ft. Depth of completed well 20 ft.

CONSTRUCTION DETAILS
Casing ☒ Welded 6" Diam from +5 ft. to 20 ft
Installed: ☐ Liner installed _____" Diam. from _____ ft to _____ ft
☐ Threaded _____" Diam from _____ ft. to _____ ft

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

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

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

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

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

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 11 ft. below top of well Date 9-3-03
Artesian pressure _____ lbs per square inch Date _____
Artesian water is controlled by _____ (cap, valve, etc.)

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

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

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airtest 25 gal./min. with stem set at 18 ft for 1 hrs.
Artesian flow _____ g.p.m. Date 9-3-03
Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No

CONSTRUCTION OR DECOMMISSION PROCEDURE
Formation. Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. Indicate all water encountered. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
Gravel, cobbles	0	3
Sand & gravel	3	13
Silty sand & gravel - wb	13	20
Silty sand Brown - wb	20	27
Rock - wb 4gpm Brown Hard	27	31
Granite Gray Very Hard	31	40

RECEIVED
SEP 0 8 2003
Washington State Department of Ecology

Start Date 9-2-03 Completed Date 9-3-03

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

☒ Driller ☐ Engineer ☐ Trainee Name (Print) Chris Jones

Driller/Engineer/Trainee Signature Chris Jones

Driller or Trainee License No. 2253

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

Drilling Company Moerke & Sons Pump & Drilling

Address 1296 NW Maryland Ave.

City, State, Zip Chehalis, WA 98532

Contractor's Registration No. MOERKSP072N5 Date 9-4-03

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

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

WATER WELL REPORT

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

Construction/Decommission ("x" in circle)
(X) Construction 139134
( ) Decommission ORIGINAL CONSTRUCTION Notice of Intent Number

CURRENT Notice of Intent No. W 168496
Unique Ecology Well ID Tag No. AHL398
Water Right Permit No. N/A
Property Owner Name Robert Armstrong
Well Street Address 365 Crady Rd
City Packwood County: Lewis
Location NE 1/4 - 1/4 SW 1/4 Sec. 16 Twn. 15N R. 9 (E)WM circle one
Lat/Long: (s,t,r still REQUIRED) Lat Deg ____ Lat Min/Sec ____ Long Deg ____ Long Min/Sec ____
Tax Parcel No.

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

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

DIMENSIONS: Diameter of well 6 inches, drilled 24 ft. Depth of completed well 19 ft.

CONSTRUCTION DETAILS
Casing Installed: (X) Welded 6" Diam from +5 ft. to 19 ft.
( ) Liner installed ____" Diam from ____ ft. to ____ ft.
( ) Threaded ____" Diam from ____ ft. to ____ ft.

Perforations: ( ) Yes (X) No
Type of perforator used
SIZE of perfs ____ in by ____ in and no. of perfs ____ from ____ ft. to ____ ft.

Screens: ( ) Yes (X) No ( ) K-Pac Location
Manufacturer's Name
Type Model No.
Diam ____ Slot Size ____ from ____ ft. to ____ ft.
Diam ____ Slot Size ____ from ____ ft. to ____ ft.

Gravel/Filter packed: ( ) Yes (X) No ( ) Size of gravel/sand
Materials placed from ____ ft. to ____ ft.

Surface Seal: (X) Yes ( ) No To what depth? 18 ft.
Materials used in seal Bentonite
Did any strata contain unusable water? ( ) Yes (X) No
Type of water? Depth of strata
Method of sealing strata off

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

WATER LEVELS: Land-surface elevation above mean sea level ____ ft.
Static level 12 ft. below top of well Date 9-4-03
Artesian pressure ____ lbs. per square inch Date
Artesian water is controlled by (cap, valve, etc.)

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

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test ____ gal./min. with ____ ft. drawdown after ____ hrs.
Airtest 25 gal./min. with stem set at 17 ft. for 1 hrs.
Artesian flow ____ g.p.m. Date 9-4-03
Temperature of water ____ Was a chemical analysis made? ( ) Yes (X) No

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

MATERIAL	FROM	TO
Gravel & Cobbles	0	3
Sand, gravel, cobbles	3	13
Sand & gravel wb	13	20
Rock Brown Hard	20	24

RECEIVED
SEP 0 8 2003
Washington State Department of Ecology

Start Date 9-3-03 Completed Date 9-4-03

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

(X) Driller ( ) Engineer ( ) Trainee Name (Print) Chris Jones
Driller/Engineer/Trainee Signature Chris Jones
Driller or Trainee License No. 2253

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

Drilling Company Moerke's Sure Pump & Drilling
Address 1284 NW Maryland Ave
City, State, Zip Chehalis, WA 98532
Contractor's Registration No. MOERKSPD72N5 Date 9-4-03

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

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

BBP 555

430067

WATER WELL REPORT

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

DEPARTMENT OF ECOLOGY State of Washington

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

☒ Construction

☐ Decommission *ORIGINAL INSTALLATION*

Notice of Intent Number _____

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

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

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

DIMENSIONS: Diameter of well 6 inches, drilled 345 ft. Depth of completed well 345ft.

CONSTRUCTION DETAILS

Casing ☒ Welded 6" Diam. from +2 ft. to 180 ft.

Installed: ☒ Liner installed 4" Diam. from 165 ft. to 345 ft.

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

Perforations: ☒ Yes ☐ No

Type of perforator used Grinder

SIZE of perfs 1/4in. by 2 in. and no. of perfs 40from 335ft. to 345ft.

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

Manufacturer's Name _____

Type _____ Model No. _____

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

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

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

Materials placed from _____ ft. to _____ ft.

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

Material used in seal Bentonite

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name _____

Type: _____ H.P. _____

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

Static level 6ft. below top of well Date 10/7/11

Artesian pressure _____ lbs. per square inch Date _____

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

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

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

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

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

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

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

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

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

Airtest 60 gal./min. with stem set at 340ft. for 1hrs.

Artesian flow _____ g.p.m. Date 10/7/11

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

CURRENT

Notice of Intent No. W 301846

Unique Ecology Well ID Tag No. BBP 555

Water Right Permit No. N/A

Property Owner Name Bruce & Sylvia Kirkham

Well Street Address0 US Highway 12

City Packwood County Lewis

Location SW1/4-1/4 SE1/4 Sec 22 Twn 13 R 9 EWM ☒ Or WWM ☐

(s, t, r Still REQUIRED)

Lat/Long Lat Deg ____ Lat Min/Sec ____

Long Deg ____ Long Min/Sec ____

Tax Parcel No. (Required)035233000000

CONSTRUCTION OR DECOMMISSION PROCEDURE

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

MATERIAL	FROM	TO
Sandy clay, Gravel, Rocks		
Boulders Brown Hard	0	64
Sand, gravel, rocks Red		
Very soft	64	105
Rocks, gravel Black Soft	105	122
Clay & gravel Gray Soft	122	125
Clay Gray Soft	125	136
Clay, gravel, boulders		
Brown Soft	136	152
Granite Gray Hard	152	280
Granite Gray Very hard	280	343
Granite-wb Gray Hard	343	345

RECEIVED

OCT 24 2011

WA State Department of Ecology (SWRO)

Start Date 9/30/11 Completed Date 10/7/11

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

☒ Driller ☐ Engineer ☐ Trainee Name (Print) Chris Jones

Driller/Engineer/Trainee Signature Chris Jones

Driller or trainee License No. 2253

IF TRAINEE: Driller's License No:

Driller's Signature:

Drilling Company Moerke & Sons Pump & Drilling, Inc.

Address 1162 NW State Avenue

City, State, Zip Chehalis , WA, 98532

Contractor's Registration No. MOERKSP072N5 Date 10/10/11

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

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

WATER WELL REPORT

STATE OF WASHINGTON

85573

Notice of Intent A 53151

UNIQUE WELL ID # HAND DUG

Water Right Permit No.

(1) OWNER Name WA DEPT OF TRANSPORTATION Address

(2) LOCATION OF WELL: County LEWIS NW 1/4 SW 1/4 Sec 22 T 13 N R. 2E WM

(2a) STREET ADDRESS OF WELL (or nearest address) MAINT. SHED (WSDOT) SR12, PACKWOOD, WA

TAX PARCEL NO.:

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

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

(5) DIMENSIONS: Diameter of well 48" Conc Casing inches
Drilled feet Depth of completed well 12'-10" ft

(6) CONSTRUCTION DETAILS
Casing Installed: N/A
☐ Welded " Diam from ft to ft
☐ Liner installed " Diam from ft to ft
☐ Threaded " Diam from ft to ft

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

Screens: ☐ Yes ☐ No ☐ K-Pac Location
Manufacturer's Name N/A
Type Model No.
Diam Slot Size from ft to ft
Diam Slot Size from ft to ft

Gravel/Filter packed: ☐ Yes ☐ No ☐ Size of gravel/sand
Material placed from N/A ft to ft

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

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

(8) WATER LEVELS Land-surface elevation above mean sea level ft
Static level 11'-7" ft below top of well Date 1/11/01
Artesian pressure lbs per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

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

Time	Water Level	Time	Water Level	Time	Water Level

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

(10) WELL LOG or DECOMMISSIONING PROCEDURE DESCRIPTION
Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. Indicate all water encountered.

MATERIAL	FROM	TO
Decommissioning Well		
Hand Dug Well		
12'-10" Below ground surf	0	12'-10"
CASING SIZE - 4' Dia		
Precast Conc. Casing		
STATIC water ELEV.		
11'-7" Below ground surf		
INSTALLED concrete	0	8'-5"
Seal		
installed chlorinated	8'-5"	12'-10"
pea gravel		

RECEIVED
JAN 23 2001
DEPARTMENT OF ECOLOGY
WELL DRILLING UNIT

Work Started 1/11/01 Completed 1/11/01

WELL CONSTRUCTION CERTIFICATION:

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

Type or Print Name Richard G. Hensley License No 27409
(Licensed Driller/Engineer)

Trainee Name License No

Drilling Company WSDOT

(Signed) Richard G. Hensley License No 27409
(Licensed Driller/Engineer)

Address 1911 Rush Rd, Chehalis, WA

Contractor's Registration No Date

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20 (11/98)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (360) 407-6600. The TDD number is (360) 407-6006

WATER WELL REPORT

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

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

○ Construction

○ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* 2056062

CURRENT
Notice of Intent No. W 254 364

Unique Ecology Well ID Tag No. ALH 553

Water Right Permit No. _____

Property Owner Name Ben + Dawn Potter

Well Street Address 114 Cedar St

City Packwood County Lewis

Location NE 1/4-1/4 SE 1/4 Sec 16 Twn 13 N R 9 (EWM or WWM) circle one

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

Tax Parcel No. 009800037000

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

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

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

DIMENSIONS: Diameter of well 6 inches, drilled 35 ft. Depth of completed well 28 ft.

CONSTRUCTION DETAILS

Casing Installed: ☑ Welded 6 " Diam. from +3 ft. to 28 ft. ☐ Liner installed _____ " Diam. from _____ ft. to _____ ft. ☐ Threaded _____ " Diam. from _____ ft. to _____ ft.

Perforations: ☐ Yes ☑ No

Type of perforator used _____

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

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

Manufacturer's Name _____

Type _____ Model No. _____

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

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

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

Materials placed from _____ ft. to _____ ft.

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

Material used in seal Bent Chips

Did any strata contain unusable water? ☐ Yes ☑ No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name _____

Type: _____ H.P. _____

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

Static level 6 ft. below top of well Date 7-9-07

Artesian pressure _____ lbs per square inch Date _____

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

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

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

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

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

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

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

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

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

Airtest 60 gal./min. with stem set at 25 ft. for 1 hrs.

Artesian flow _____ g.p.m. Date _____

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

CONSTRUCTION OR DECOMMISSION PROCEDURE

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

MATERIAL	FROM	TO
Top Soil + Large Gravel	0	12
Large Gravel	12	29
Hard Rock	29	35

RECEIVED
JUL 11 2007
Washington State Department of Ecology

Start Date 7-3-07 Completed Date 7-6-07

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

☑ Driller ☐ Engineer ☐ Trainee Name (Print) Bill Dover

Driller/Engineer/Trainee Signature B. Dover

Driller or trainee License No. 2846

Drilling Company Chehalis Well Drilling

Address 1905 Harrison Ave

City, State, Zip Centralia, WA 98531

Contractor's Registration No. CHEHAWD123NU4 Date 7-6-07

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

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

Soil Resource Report

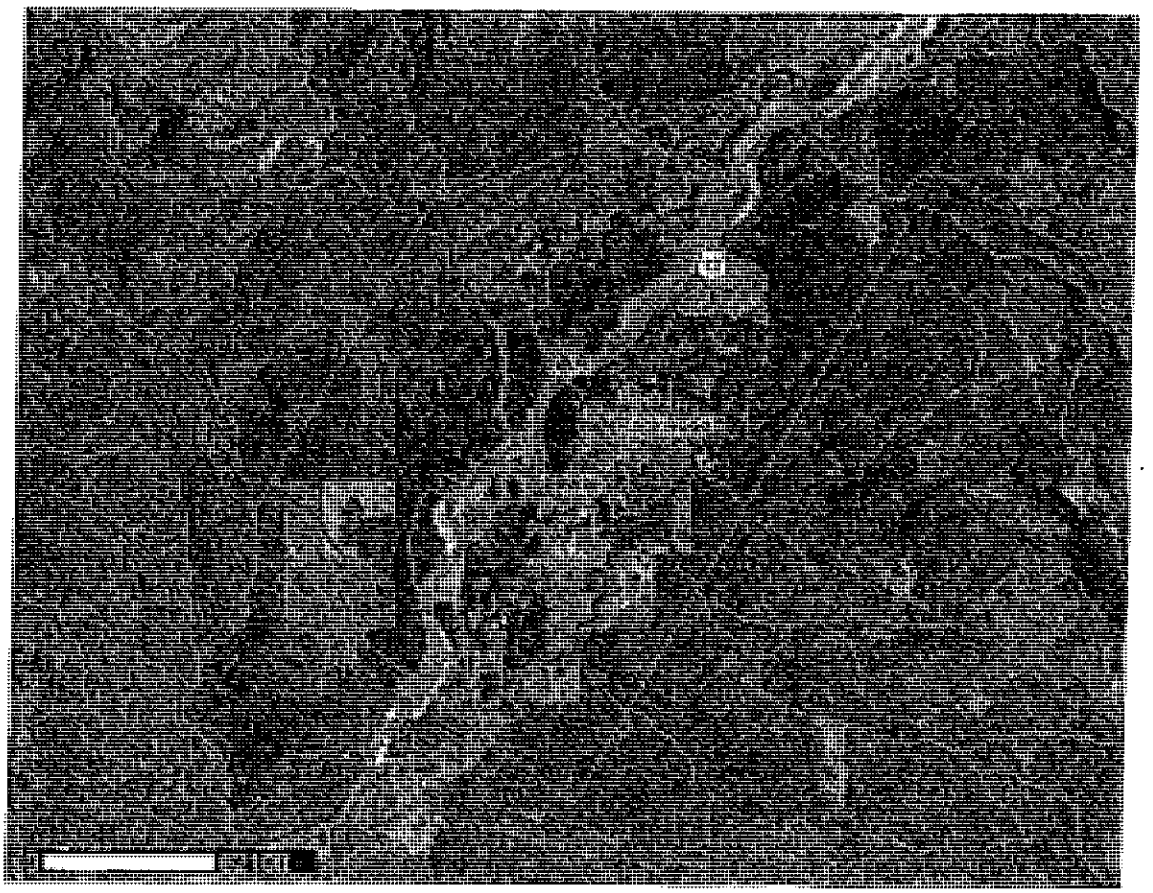
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Gifford Pinchot National Forest Area, Washington, and Lewis County Area, Washington



April 20, 2012

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://soils.usda.gov/sqi/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://soils.usda.gov/contact/state_offices/).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Soil Data Mart Web site or the NRCS Web Soil Survey. The Soil Data Mart is the data storage site for the official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the

individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

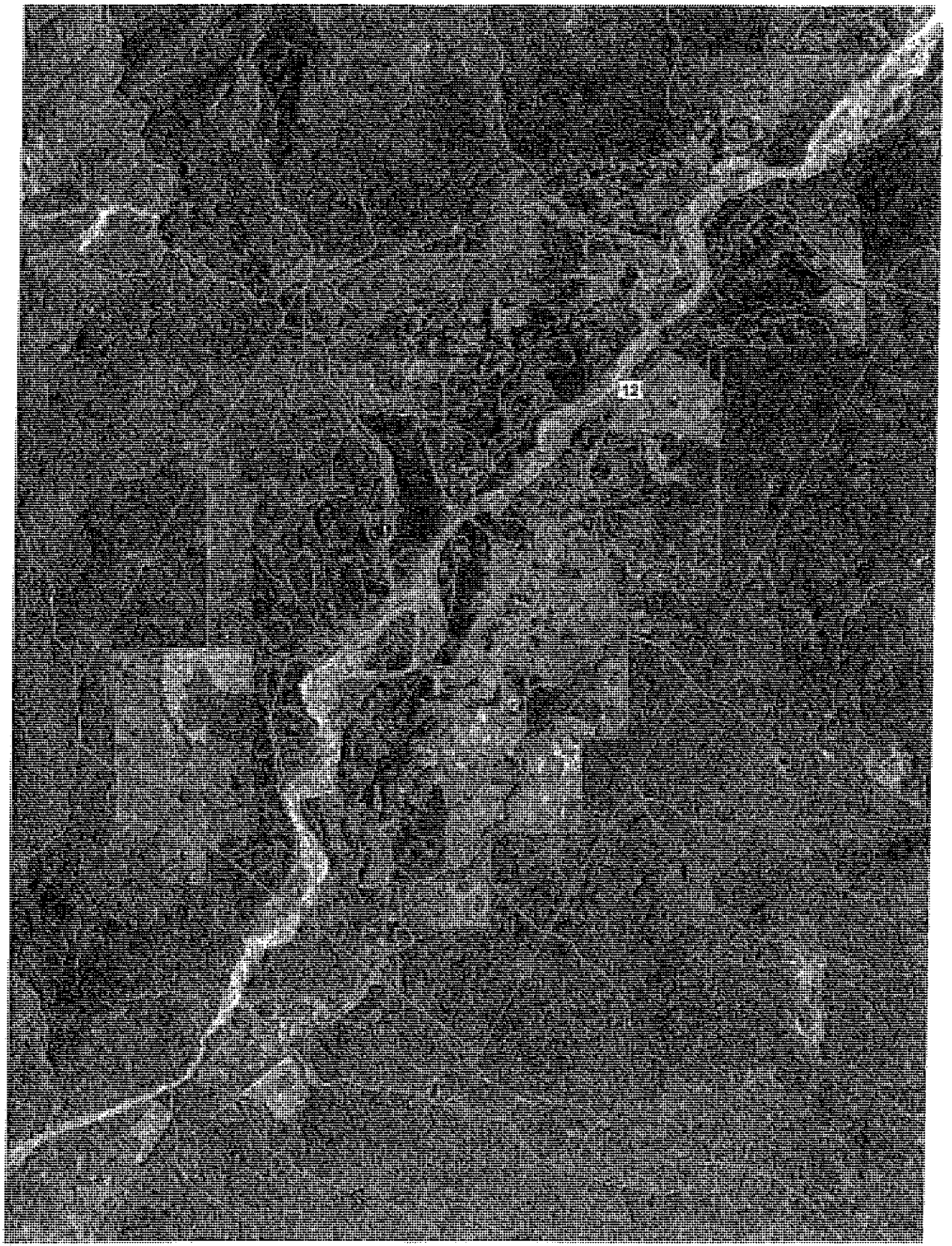
While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features
- Cities

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads

MAP INFORMATION

Map Scale: 1:38,100 if printed on B size (11" × 17") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 10N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Gifford Pinchot National Forest Area, Washington
Survey Area Data: Version 1, Dec 15, 2010

Soil Survey Area: Lewis County Area, Washington
Survey Area Data: Version 8, Jul 1, 2010

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Date(s) aerial images were photographed: 7/23/2006; 8/5/2006

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Gifford Pinchot National Forest Area, Washington (WA760)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
NOTCOM	No Digital Data Available	1,382.0	19.0%
Subtotals for Soil Survey Area		1,382.0	19.0%
Totals for Area of Interest		7,279.4	100.0%

Lewis County Area, Washington (WA641)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
4	Aquic Xerofluvents, overflow	177.6	2.4%
49	Cinebar silt loam, 0 to 8 percent slopes	113.3	1.6%
50	Cinebar silt loam, 8 to 15 percent slopes	21.2	0.3%
51	Cinebar silt loam, 15 to 30 percent slopes	4.8	0.1%
92	Greenwater loamy sand	746.9	10.3%
123	Ledow sand	324.4	4.5%
136	Nesika loam, 2 to 5 percent slopes	3.3	0.0%
138	Netrac sand, 2 to 5 percent slopes	923.3	12.7%
139	Netrac sand, 5 to 15 percent slopes	116.0	1.6%
140	Nevat sand, 5 to 15 percent slopes	751.5	10.3%
141	Nevat sand, 15 to 30 percent slopes	743.2	10.2%
142	Nevat sand, 30 to 65 percent slopes	707.2	9.7%
144	Nevat-Rock outcrop complex, 65 to 90 percent slopes	130.6	1.8%
166	Pits	21.9	0.3%
170	Puget silt loam	36.4	0.5%
180	Riverwash	288.6	4.0%
198	Schneider very gravelly silt loam, 65 to 90 percent slopes	14.3	0.2%
203	Schneider-Rock outcrop complex, 65 to 90 percent slopes	22.3	0.3%
204	Schooley silt loam	180.6	2.5%
207	Siler silt loam	243.0	3.3%
247	Xerorthents, spoils	54.5	0.7%
W	Water	272.5	3.7%
Subtotals for Soil Survey Area		5,897.4	81.0%
Totals for Area of Interest		7,279.4	100.0%

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly

indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Gifford Pinchot National Forest Area, Washington

NOTCOM—No Digital Data Available

Minor Components

Notcomm

Percent of map unit: 100 percent

Lewis County Area, Washington

4—Aquic Xerofluvents, overflow

Map Unit Setting
Mean annual precipitation: 25 to 90 inches
Mean annual air temperature: 46 to 54 degrees F
Frost-free period: 160 to 200 days

Map Unit Composition
Aquic xerofluvents and similar soils: 90 percent
Minor components: 10 percent

Description of Aquic Xerofluvents

Setting
Landform: Flood plains, terraces

Properties and qualities
Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: About 12 to 36 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water capacity: Very low (about 3.0 inches)

Interpretive groups
Land capability (nonirrigated): 4w

Typical profile
0 to 8 inches: Sand
8 to 20 inches: Fine sand
20 to 60 inches: Very cobbly sand

Minor Components

Riverwash
Percent of map unit: 10 percent
Landform: Flood plains

49—Cinebar silt loam, 0 to 8 percent slopes

Map Unit Setting
Elevation: 50 to 2,000 feet
Mean annual precipitation: 50 to 75 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 160 to 250 days

Map Unit Composition
Cinebar and similar soils: 100 percent

Description of Cinebar

Setting
Landform: Hillslopes, ridges, structural benches
Parent material: Loess and slope alluvium mixed with volcanic ash

Properties and qualities
Slope: 0 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very high (about 16.1 inches)

Interpretive groups
Land capability (nonirrigated): 2e

Typical profile
0 to 12 inches: Silt loam
12 to 60 inches: Silt loam

Minor Components

Klaber
Percent of map unit:
Landform: Depressions

Lacamas
Percent of map unit:
Landform: Terraces

50—Cinebar silt loam, 8 to 15 percent slopes

Map Unit Setting
Elevation: 50 to 2,000 feet
Mean annual precipitation: 50 to 75 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 160 to 250 days

Map Unit Composition
Cinebar and similar soils: 100 percent

Description of Cinebar

Setting

Landform: Structural benches, ridges, hillslopes
Parent material: Loess and slope alluvium mixed with volcanic ash

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very high (about 16.1 inches)

Interpretive groups

Land capability (nonirrigated): 3e

Typical profile

0 to 12 inches: Silt loam
12 to 60 inches: Silt loam

Minor Components

Klaber

Percent of map unit:
Landform: Depressions

Lacamas

Percent of map unit:
Landform: Terraces

Scamman

Percent of map unit:
Landform: Terraces

51—Cinebar silt loam, 15 to 30 percent slopes

Map Unit Setting

Elevation: 50 to 2,000 feet
Mean annual precipitation: 50 to 75 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 160 to 250 days

Map Unit Composition

Cinebar and similar soils: 100 percent

Description of Cinebar

Setting

Landform: Hillslopes, ridges
Parent material: Loess and slope alluvium mixed with volcanic ash

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very high (about 16.1 inches)

Interpretive groups

Land capability (nonirrigated): 4e

Typical profile

0 to 12 inches: Silt loam
12 to 60 inches: Silt loam

Minor Components

Scamman

Percent of map unit:
Landform: Terraces

92—Greenwater loamy sand

Map Unit Setting

Elevation: 100 to 1,800 feet
Mean annual precipitation: 50 to 70 inches
Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 130 to 170 days

Map Unit Composition

Greenwater and similar soils: 95 percent
Minor components: 5 percent

Description of Greenwater

Setting

Landform: Flood plains, terraces
Parent material: Alluvium derived from andesite and pumice

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches

Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.7 inches)

Interpretive groups
Land capability (nonirrigated): 3s

Typical profile
0 to 7 inches: Loamy sand
7 to 60 inches: Sand

Minor Components

Fluvaquentic humaquepts
Percent of map unit: 5 percent
Landform: Depressions

123—Ledow sand

Map Unit Setting
Elevation: 80 to 1,200 feet
Mean annual precipitation: 50 to 80 inches
Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 125 to 200 days

Map Unit Composition
Ledow and similar soils: 90 percent
Minor components: 6 percent

Description of Ledow

Setting
Landform: Flood plains, terraces

Properties and qualities
Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water capacity: Low (about 4.1 inches)

Interpretive groups
Land capability (nonirrigated): 4w

Typical profile
0 to 8 inches: Sand
8 to 20 inches: Fine sand
20 to 24 inches: Silt loam
24 to 60 inches: Fine sand

Minor Components

Puget
Percent of map unit: 3 percent
Landform: Flood plains

Riverwash
Percent of map unit: 3 percent
Landform: Flood plains

136—Nesika loam, 2 to 5 percent slopes

Map Unit Setting
Mean annual precipitation: 50 to 70 inches
Mean annual air temperature: 48 degrees F
Frost-free period: 125 to 175 days

Map Unit Composition
Nesika and similar soils: 100 percent

Description of Nesika

Setting
Landform: Fans
Parent material: Alluvium and volcanic ash

Properties and qualities
Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 7.5 inches)

Interpretive groups
Land capability (nonirrigated): 2e

Typical profile
0 to 8 inches: Loam
8 to 22 inches: Loam
22 to 60 inches: Loam

Minor Components

Klaber

Percent of map unit:
Landform: Depressions

138—Netrac sand, 2 to 5 percent slopes

Map Unit Setting

Mean annual precipitation: 50 to 70 inches
Mean annual air temperature: 48 degrees F
Frost-free period: 125 to 175 days

Map Unit Composition

Netrac and similar soils: 95 percent
Minor components: 5 percent

Description of Netrac

Setting

Landform: Terraces
Parent material: Glacial outwash and volcanic ash

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.6 inches)

Interpretive groups

Land capability (nonirrigated): 4s

Typical profile

0 to 7 inches: Sand
7 to 21 inches: Loamy fine sand
21 to 60 inches: Extremely gravelly sand

Minor Components

Riverwash

Percent of map unit: 5 percent
Landform: Flood plains

139—Netrac sand, 5 to 15 percent slopes

Map Unit Setting
Mean annual precipitation: 50 to 70 inches
Mean annual air temperature: 48 degrees F
Frost-free period: 125 to 175 days

Map Unit Composition
Netrac and similar soils: 100 percent

Description of Netrac

Setting
Landform: Terraces
Parent material: Glacial outwash and volcanic ash

Properties and qualities
Slope: 5 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.6 inches)

Interpretive groups
Land capability (nonirrigated): 4s

Typical profile
0 to 7 inches: Sand
7 to 21 inches: Loamy fine sand
21 to 60 inches: Extremely gravelly sand

140—Nevat sand, 5 to 15 percent slopes

Map Unit Setting
Mean annual precipitation: 50 to 70 inches
Mean annual air temperature: 48 degrees F
Frost-free period: 125 to 175 days

Map Unit Composition
Nevat and similar soils: 100 percent

Description of Nevat

Setting

Landform: Structural benches, mountain slopes
Parent material: Colluvium from basic igneous rocks and volcanic ash

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: 40 to 60 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 4.4 inches)

Interpretive groups

Land capability (nonirrigated): 4s

Typical profile

0 to 8 inches: Sand
8 to 41 inches: Gravelly sandy loam
41 to 45 inches: Unweathered bedrock

141—Nevat sand, 15 to 30 percent slopes

Map Unit Setting

Mean annual precipitation: 50 to 70 inches
Mean annual air temperature: 48 degrees F
Frost-free period: 125 to 175 days

Map Unit Composition

Nevat and similar soils: 100 percent

Description of Nevat

Setting

Landform: Mountain slopes, ridges
Parent material: Colluvium from basic igneous rocks and volcanic ash

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: 40 to 60 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 4.4 inches)

Interpretive groups
Land capability (nonirrigated): 4e

Typical profile
0 to 8 inches: Sand
8 to 41 inches: Gravelly sandy loam
41 to 45 inches: Unweathered bedrock

142—Nevat sand, 30 to 65 percent slopes

Map Unit Setting
Mean annual precipitation: 50 to 70 inches
Mean annual air temperature: 48 degrees F
Frost-free period: 125 to 175 days

Map Unit Composition
Nevat and similar soils: 100 percent

Description of Nevat

Setting
Landform: Mountain slopes
Parent material: Colluvium from basic igneous rocks and volcanic ash

Properties and qualities
Slope: 30 to 65 percent
Depth to restrictive feature: 40 to 60 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 4.4 inches)

Interpretive groups
Land capability (nonirrigated): 7e

Typical profile
0 to 8 inches: Sand
8 to 41 inches: Gravelly sandy loam
41 to 45 inches: Unweathered bedrock

144—Nevat-Rock outcrop complex, 65 to 90 percent slopes

Map Unit Setting
Mean annual precipitation: 50 to 70 inches
Mean annual air temperature: 48 degrees F

Frost-free period: 125 to 175 days

Map Unit Composition
Nevat and similar soils: 60 percent
Rock outcrop: 25 percent

Description of Nevat

Setting
Landform: Mountain slopes
Parent material: Colluvium from basic igneous rocks and volcanic ash

Properties and qualities
Slope: 65 to 90 percent
Depth to restrictive feature: 40 to 60 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 4.4 inches)

Interpretive groups
Land capability (nonirrigated): 7e

Typical profile
0 to 8 inches: Sand
8 to 41 inches: Gravelly sandy loam
41 to 45 inches: Unweathered bedrock

Description of Rock Outcrop

Setting
Landform: Mountain slopes

Properties and qualities
Slope: 65 to 90 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups
Land capability (nonirrigated): 8s

166—Pits

Map Unit Composition
Pits: 100 percent

Description of Pits

Setting
Landform: Flood plains, terraces

Interpretive groups
Land capability (nonirrigated): 8

170—Puget silt loam

Map Unit Setting
Elevation: 10 to 650 feet
Mean annual precipitation: 35 to 55 inches
Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 180 to 200 days

Map Unit Composition
Puget and similar soils: 100 percent

Description of Puget

Setting
Landform: Flood plains, terraces
Parent material: Recent alluvium

Properties and qualities
Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: Occasional
Frequency of ponding: Frequent
Available water capacity: High (about 12.0 inches)

Interpretive groups
Land capability (nonirrigated): 5w

Typical profile
0 to 4 inches: Silt loam
4 to 60 inches: Silt loam

Minor Components

Newberg
Percent of map unit:

180—Riverwash

Map Unit Composition
Riverwash: 100 percent

Description of Riverwash

Setting
Landform: Flood plains, terraces

Properties and qualities
Slope: 0 to 3 percent
Depth to water table: About 0 to 24 inches
Frequency of flooding: Frequent

Interpretive groups
Land capability (nonirrigated): 8

Typical profile
0 to 60 inches: Error

198—Schneider very gravelly silt loam, 65 to 90 percent slopes

Map Unit Setting
Elevation: 50 to 1,800 feet
Mean annual precipitation: 60 to 75 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 150 to 200 days

Map Unit Composition
Schneider and similar soils: 100 percent

Description of Schneider

Setting
Landform: Mountain slopes
Parent material: Colluvium from basic igneous rocks and volcanic ash

Properties and qualities
Slope: 65 to 90 percent
Depth to restrictive feature: 40 to 60 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.9 inches)

Interpretive groups
Land capability (nonirrigated): 7e

Typical profile
0 to 6 inches: Very gravelly silt loam
6 to 30 inches: Very cobbly silt loam
30 to 45 inches: Extremely cobbly silt loam
45 to 49 inches: Unweathered bedrock

203—Schneider-Rock outcrop complex, 65 to 90 percent slopes

Map Unit Setting

Elevation: 50 to 1,800 feet
Mean annual precipitation: 60 to 75 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 150 to 200 days

Map Unit Composition

Schneider and similar soils: 65 percent
Rock outcrop: 25 percent

Description of Schneider

Setting

Landform: Mountain slopes
Parent material: Colluvium from basic igneous rocks and volcanic ash

Properties and qualities

Slope: 65 to 90 percent
Depth to restrictive feature: 40 to 60 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.9 inches)

Interpretive groups

Land capability (nonirrigated): 7e

Typical profile

0 to 6 inches: Very gravelly silt loam
6 to 30 inches: Very cobbly silt loam
30 to 45 inches: Extremely cobbly silt loam
45 to 49 inches: Unweathered bedrock

Description of Rock Outcrop

Setting

Landform: Mountain slopes

Properties and qualities

Slope: 65 to 90 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups

Land capability (nonirrigated): 8s

204—Schooley silt loam

Map Unit Setting
Elevation: 800 to 1,200 feet
Mean annual precipitation: 50 to 70 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 125 to 175 days

Map Unit Composition
Schooley, drained, and similar soils: 100 percent

Description of Schooley, Drained

Setting
Landform: Flood plains, terraces

Properties and qualities
Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water capacity: Very high (about 15.8 inches)

Interpretive groups
Land capability (nonirrigated): 5w

Typical profile
0 to 6 inches: Silt loam
6 to 21 inches: Silt loam
21 to 31 inches: Sand
31 to 40 inches: Silt loam
40 to 60 inches: Muck

Minor Components

Semiahmoo
Percent of map unit:
Landform: Depressions

Newberg
Percent of map unit:

207—Siler silt loam

Map Unit Setting

Mean annual precipitation: 50 to 70 inches
Mean annual air temperature: 50 degrees F
Frost-free period: 125 to 175 days

Map Unit Composition

Siler and similar soils: 90 percent
Minor components: 7 percent

Description of Siler

Setting

Landform: Flood plains, terraces

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Available water capacity: High (about 10.8 inches)

Interpretive groups

Land capability (nonirrigated): 3w

Typical profile

0 to 6 inches: Silt loam
6 to 14 inches: Silt loam
14 to 21 inches: Sand
21 to 60 inches: Stratified loamy sand to silt loam

Minor Components

Riverwash

Percent of map unit: 5 percent
Landform: Flood plains

Puget

Percent of map unit: 2 percent
Landform: Flood plains

247—Xerorthents, spoils

Map Unit Setting
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 degrees F
Frost-free period: 150 to 200 days

Map Unit Composition
Xerorthents and similar soils: 100 percent

Description of Xerorthents

Setting
Landform: Hills

Properties and qualities
Slope: 0 to 20 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: High (about 10.9 inches)

Interpretive groups
Land capability (nonirrigated): 3e

Typical profile
0 to 6 inches: Silty clay loam
6 to 60 inches: Silt loam

W—Water

Map Unit Composition
Water: 100 percent

Description of Water

Setting
Landform: Alluvial cones

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Nitrate and Bacteriological Water Sample Analysis

WATER MANAGEMENT LABORATORIES INC.

1515 80th St. E.
Tacoma, WA 98404
(253) 531-3121

*1,2

INORGANIC CHEMICALS (IOCS) REPORT FOR NITRATES

System ID No: NA	System Name: Morris Well	
Lab/Sample No: 08943382	Date Collected: 06-21-12	DOH Source No: NA
Multiple Source Nos: NA	Sample Type: B	Sample Purpose: I
Date Received: 06-21-12	Date Reported: 06-22-12	Supervisor:
	Date Analyzed: 06-21-12	Analyst: FF
County: Lewis	Group: A B (Other) PWS	
Sample Location: Outside yard hydrant near driveway		
Send Report To: Territorial Landworks, Inc PO Box 3851 Missoula, MT 59806	Bill To:	

DOH#	ANALYTES	RESULTS	UNITS	SRL	TRIGGER	MCL	EXCEEDS		Method/Analyst	
	EPA REGULATED						Trigger?	MCL?		
114	Nitrite - N	<0.1	mg/1	0.5	0.5	1	No	No	4110B	FF
20	Nitrate - N	0.3	mg/1	0.5	5.0	10	No	No	4110B	FF
161	Total Nitrate/Nitrite	NA	mg/1	0.5	5.0	10	—	—	4110B	—

NOTES:

SRL (State Reporting Level): indicates the minimum reporting level required by the Washington Department of Health (DOH).

Trigger Level: DOH Drinking Water response level. Systems with compounds detected at concentrations in excess of this level are required to take additional samples. Contact your regional DOH office for further information.

MCL (maximum contaminent level): If the contaminent amount exceeds the MCL, immediately contact your regional DOH office.

NA (Not Analyzed): in the results column indicates this compound was not included in the current analysis.

ND (Not Detected): in the results column indicates this compound was analyzed and not detected at a level greater than or equal to the SRL.

< (0.001): indicates the compound was not detected in the sample at or above the concentration indicated.

COMMENTS:

Nitrate, Nitrite

SITES 3 & E

1515 80TH STREET E
TACOMA, WA 98404
(253) 531-3121

WATER BACTERIOLOGICAL ANALYSIS

#1,2

SAMPLE COLLECTION: READ INSTRUCTIONS ON BACK OF GOLDENROD COPY
If instructions are not followed, sample will be rejected.

DATE COLLECTED MONTH / DAY / YEAR	TIME COLLECTED	COUNTY NAME
6 / 21 / 12	9 : 20 ☒ AM ☐ PM	LEWIS

TYPE OF SYSTEM: ☐ PUBLIC ☒ INDIVIDUAL (serves only 1 residence)

IF PUBLIC SYSTEM, COMPLETE: I.D. No.

CIRCLE GROUP: A B

NAME OF SYSTEM: Morris Well

SPECIFIC LOCATION WHERE SAMPLE COLLECTED (ie, kitchen tap @ school, fire station, fountain): Yard Hydrant Near Drive

TELEPHONE NO. DAY (406) 240-4265 EVENING ( ) SAME

SAMPLE COLLECTED BY: (Name): JASON RICE

SYSTEM OWNER/ MGR.: (Name): Morris

SOURCE TYPE ☐ GROUND WATER UNDER SURFACE INFLUENCE
☐ SURFACE ☒ WELL or WELL FIELD ☐ SPRING ☐ PURCHASED or INTERTIE ☐ COMBINATION or OTHER

SEND REPORT TO: (Print Full Name, Address and Zip Code)
TERRITORIAL-LAND WORKS INC
Missoula, MT 59806
PO Box 3851 WASHINGTON

TYPE OF SAMPLE (check only one in this column)
☐ ROUTINE DRINKING WATER check treatment → ☐ Chlorinated (Residual ____ Total ____ Free) ☐ Filtered ☐ Untreated or Other
☐ REPEAT SAMPLE Previous coliform presence Lab # ____ Previous coliform presence Date ____
☒ RAW SOURCE WATER Source # S ☒ Total Coliform
☐ NEW CONSTRUCTION or REPAIRS ☒ Fecal Coliform
☒ OTHER (Specify) Investigation - Ecoli

REMARKS: Humics

LABORATORY RESULTS (FOR LAB USE ONLY)

METHOD USED: QT

MF 2410	MPN 2600	PA 2610	MMO 2720	CPRG 2730

TOTAL COLIFORM <1 /100 ml E. COLI <1 /100 ml
FECAL COLIFORM ____ /100 ml HETEROTROPHIC 1340 /per ml

ANOTHER SAMPLE REQUIRED

SAMPLE NOT TESTED BECAUSE:
☐ Sample too old
☐ Wrong container
☐ Incomplete form
☐ ____

TEST UNSUITABLE BECAUSE:
☐ Confluent growth
☐ TNTC
☐ Turbid culture
☐ Excess debris

RAW DRINKING WATER SAMPLE RESULTS

☐ UNSATISFACTORY, Coliforms present
REPEAT SAMPLES REQUIRED: ☐ E. Coli present ☐ E. Coli absent ☐ Fecal present ☐ Fecal absent

☐ SATISFACTORY, Coliforms absent

SEE REVERSE SIDE OF GREEN COPY FOR EXPLANATION OF RESULTS

LAB NO.	DATE, TIME RECEIVED	RECEIVED BY
089 14771	6-21-12 3:50 pm	CG

DATE REPORTED		ROUTE	ACCT. #
6-23-12	CH	✓	Visa

SITES 3 & E

WATER MANAGEMENT LABORATORIES INC.

1515 80th St. E.
Tacoma, WA 98404
(253) 531-3121

#1,2

INORGANIC CHEMICALS (IOCS) REPORT FOR NITRATES

System ID No: NA	System Name: Meyers well		
Lab/Sample No: 08943383	Date Collected: 06-21-12		DOH Source No: NA
Multiple Source Nos: NA	Sample Type: B		Sample Purpose: I
Date Received: 06-21-12	Date Reported: 06-22-12	Supervisor: LMC	
	Date Analyzed: 06-21-12	Analyst: ~~KK~~	
County: Lewis	Group: A B (Other) PVT		
Sample Location: ~~Outside spigot near wellhouse~~ KITCHEN SINK			
Send Report To: Territorial Landworks, Inc PO Box 3851 Missoula, MT 59806	Bill To:		

DOH#	ANALYTES	RESULTS	UNITS	SRL	TRIGGER	MCL	EXCEEDS		Method/Analyst	
EPA REGULATED							Trigger?	MCL?		
114	Nitrite - N	<0.1	mg/1	0.5	0.5	1	No	No	4110B	~~KK~~
20	Nitrate - N	<0.2	mg/1	0.5	5.0	10	No	No	4110B	~~KK~~
161	Total Nitrate/Nitrite	NA	mg/1	0.5	5.0	10	—	—	4110B	—

NOTES:

SRL (State Reporting Level): indicates the minimum reporting level required by the Washington Department of Health (DOH).

Trigger Level: DOH Drinking Water response level. Systems with compounds detected at concentrations in excess of this level are required to take additional samples. Contact your regional DOH office for further information.

MCL (maximum contaminent level): If the contaminent amount exceeds the MCL, immediately contact your regional DOH office.

NA (Not Analyzed): in the results column indicates this compound was not included in the current analysis.

ND (Not Detected): in the results column indicates this compound was analyzed and not detected at a level greater than or equal to the SRL.

< (0.001): indicates the compound was not detected in the sample at or above the concentration indicated.

COMMENTS:

Nitrate, Nitrite

SITE 2

1515 80TH STREET E
TACOMA, WA 98404
(253) 531-3121

WATER BACTERIOLOGICAL ANALYSIS

#1, 2

SAMPLE COLLECTION: READ INSTRUCTIONS ON BACK OF GOLDENROD COPY
If instructions are not followed, sample will be rejected.

DATE COLLECTED MONTH / DAY / YEAR	TIME COLLECTED	COUNTY NAME
6 / 21 / 2012	8 : 50 ☒ AM ☐ PM	LEWIS

TYPE OF SYSTEM: ☐ PUBLIC ☒ INDIVIDUAL (serves only 1 residence)

IF PUBLIC SYSTEM, COMPLETE: I.D. No. [ ] CIRCLE GROUP A B

NAME OF SYSTEM: Meyer's Well

SPECIFIC LOCATION WHERE SAMPLE COLLECTED (ie, kitchen tap @ school, fire station, fountain): Kitchen Sink ~~Outside Spigot~~

TELEPHONE NO. DAY (466) 240-4265 EVENING ( ) SAME ↑

SAMPLE COLLECTED BY: (Name) JASON RICE

SYSTEM OWNER/ MGR.: (Name)

SOURCE TYPE ☐ GROUND WATER UNDER SURFACE INFLUENCE
☐ SURFACE ☒ WELL or WELL FIELD ☐ SPRING ☐ PURCHASED or INTERTIE ☐ COMBINATION or OTHER

SEND REPORT TO: (Print Full Name, Address and Zip Code)
Territorial-Landworks, Inc
PO Box 3851; Missoula, MT 59806

WASHINGTON

TYPE OF SAMPLE (check only one in this column)

☐ ROUTINE DRINKING WATER check treatment → ☐ Chlorinated (Residual ___ Total ___ Free) ☐ Filtered ☐ Untreated or Other ___

☐ REPEAT SAMPLE
Previous coliform presence Lab # ___
Previous coliform presence Date ___

☒ RAW SOURCE WATER Source # S [ ] [ ]
☐ NEW CONSTRUCTION or REPAIRS
☒ OTHER (Specify) Investigation

☒ Total Coliform
☒ ~~Fecal Coliform~~ Ecoli

REMARKS

LABORATORY RESULTS (FOR LAB USE ONLY)

METHOD USED 6X

MF 2410	MPN 2600	PA 2610	MMO 2720	CPRG 2730

TOTAL COLIFORM <1 /100 ml E. COLI <1 /100 ml
FECAL COLIFORM ___ /100 ml HETEROTROPHIC 1340 /per ml

ANOTHER SAMPLE REQUIRED

SAMPLE NOT TESTED BECAUSE:
☐ Sample too old
☑ Wrong container
☑ Incomplete form
☐ ___

TEST UNSUITABLE BECAUSE:
☐ Confluent growth
☐ TNTC
☐ Turbid culture
☐ Excess debris

RAW DRINKING WATER SAMPLE RESULTS

☐ UNSATISFACTORY, Coliforms present
REPEAT SAMPLES REQUIRED: ☐ E. Coli present ☐ E. Coli absent ☐ Fecal present ☐ Fecal absent

☐ SATISFACTORY, Coliforms absent

SEE REVERSE SIDE OF GREEN COPY FOR EXPLANATION OF RESULTS

LAB NO.	DATE, TIME RECEIVED	RECEIVED BY
089 14772	6-21-12 3:50 pm	CG

DATE REPORTED		ROUTE	ACCT. #
6-23-12	CD	✓	Visa

SITE 2