WELLHEAD PROTECTION PLAN

City of Yelm, Washington

REPORT

DRAFT

Submitted To: Stephanie Ray
City of Yelm
105 Yelm Ave. West
Yelm, WA 98597

Submitted By: Golder Associates Inc.
9 Monroe Parkway, Suite 270
Lake Oswego, OR 97035 USA

Distribution: City of Yelm, WA – Two hardcopies and one electronic
Golder Associates Inc., Lake Oswego, OR – One hardcopy

July 2012 **113-99719**

A world of capabilities delivered locally

Golder Associates

EXECUTIVE SUMMARY

This report updates the 2010 Wellhead Protection Plan for the City of Yelm. The report documents the delineation of the wellhead protection areas for the City of Yelm (City). The City currently obtains its drinking water supply from two existing wells (Wells 1A and 2), and is planning to expand their source capacity and seek approval to include a new additional groundwater supply source (SW Well 1A). The two existing wells are completed in the glacial advance outwash aquifer (Qva), while the new well is completed in a deeper unconsolidated aquifer (TQu). Both aquifers are confined by overlying low-permeability sediments.

A Wellhead Protection Plan for the existing wells was last updated in 2010 as part of the City's Water System Plan Update. Since that time, the City has planned upgrades to their water system, which have necessitated the following updates to their existing WHPP:

- Expanded knowledge of the hydrogeologic characteristics of the area now that a deeper supply source aquifer (TQu) has been identified;
- Revised wellhead protection area (WHPA) delineations for existing Wells 1A and 2 using a numerical groundwater flow model and planned pumping capacity expansions;
- New WHPA delineation for the planned SW Well 1A supply source using the numerical groundwater flow model;
- A new contaminant source inventory generated within the updated and newly defined WHPAs; and
- Susceptibility assessment for the planned SW Well 1A source supply.

Contaminant sources having the potential to adversely impact groundwater quality were identified within the WHPAs through an environmental database search of potential contaminant source sites and an evaluation of typical land use practices. A total of 120 known or suspected soil and groundwater contamination sites were identified within a 2.5 mile search radius encompassing the WHPAs. Of the 120 potential contaminant source sites identified, 23 sites coincide with the six-month and one-year capture zones for Wells 1A and 2. No known or potential contaminant sites were identified in the five- or ten-year capture zones for Wells 1A and 2, and none were identified within any of the WHPA capture zones delineated for SW Well 1A.

To prevent and protect against contamination of the City's drinking water supply sources, the City currently employs the following management strategies:

- Controlling future development in WHPA capture zones through land use regulations;
- Enforcement and regulation of activities within the WHPAs through the City's Municipal Codes;

- Notification to owners and operators of potential sources of contamination, and the agencies or jurisdictions that regulate them, that they reside within the City's WHPA boundaries;
- Spill prevention measures to prevent the accidental release of pollutants, and spill treatment and response actions to be taken to minimize potential damages in case a spill does occur; and
- Contingency measures to implement in the event that a natural disaster or contamination event results in the temporary or permanent loss of the City's water supply source.

The following pollution prevention and risk reduction measures are recommended to compliment the City's current commitment to protect its groundwater sources and maintain a safe and reliable community water supply:

- Adopt new WHPAs – To continue to protect the valuable groundwater resource, the City should adopt the newly-defined WHPAs to enforce land use restrictions on certain high-risk activities;
- Public Outreach/Education – Increase public awareness and ownership of the wellhead protection program through outreach efforts focused on groundwater protection;
- Water Quality Monitoring – Install groundwater monitoring wells designed to improve the coverage for groundwater quality from known or suspected contaminant sites, and evaluate groundwater quality test results;
- Spill Response Plan Update – The Spill Response Plan should be reevaluated and updated as needed to address any site specific conditions pertaining to SW Well 1A after the wellhouse facility is constructed.

Table of Contents

List of Tables

List of Figures

List of Appendices

List of Attachments

Compact Disc: Environmental Data Resources Full Report (*enclosed at the back of the document*)

1.0 INTRODUCTION

The potable water supply for the City of Yelm (City) is from groundwater sources. The City currently relies on two approved groundwater supply wells (Wells 1A and 2), and is currently expanding their source capacity and seeking approval to include an additional supply well (SW Well 1A). The City is committed to protecting its groundwater sources through a proactive wellhead protection program to help prevent groundwater contamination and maintain a safe and reliable community water supply.

Robinson and Noble (2001) prepared a Wellhead Protection Plan (WHPP) for existing Wells 1A and 2 in 2001. The City last updated its WHPP in 2010 as part of the City's Water System Plan update (Brown and Caldwell, 2010). Since 2010, a few upgrades by the City have necessitated a subsequent WHPP update (this report), including: (1) an increase in pumping capacity at Wells 1A and 2, (2) a planned new supply source (SW Well 1A), and (3) the ability to improve the previously mapped wellhead protection areas (WHPAs) using a numerical groundwater flow model (a more complex delineation method than used for past updates). This report updates the City's existing WHPP in the following ways:

- An updated discussion of the hydrogeologic characteristics of the area now that a deeper supply source aquifer (TQu) has been identified;
- Updated WHPA delineations for Wells 1A and 2 using a numerical groundwater flow model and the planned pumping capacities;
- New WHPA delineations for the planned SW Well 1A supply source using the numerical groundwater flow model and planned pumping capacity;
- Susceptibility assessment for the planned SW Well 1A source supply; and
- A contaminant source inventory within the updated and newly defined WHPAs.

1.1 Regulatory Background and Purpose

The 1986 amendments to the Safe Drinking Water Act (SDWA) authorized two provisions for groundwater protection, one of which was the Wellhead Protection (WHP) program. The WHP program was developed to protect and prevent potential groundwater contamination of public drinking water supplies.

The SDWA allows each state to design its own WHP program in order to maximize effectiveness at the local level. The State of Washington requires that all Group A water systems develop WHP plans as stated in Washington Administrative Code (WAC 246-290). The Washington State Department of Health (WDOH) has established requirements, guidelines, and materials to assist water systems in developing WHP plans. For a groundwater supplied system, the following elements are required:

- Discussion of the hydrogeologic characteristics of the area;
- Susceptibility assessment of the source supplies;
- Delineation of the wellhead protection areas (WHPAs);
- Contaminant source inventory within the defined WHPAs;

- Contingency plan;
- Notification to owners/operators of potential contamination sources;
- Notification to regulatory agencies and local governments of WHPA boundaries and contaminant source inventory findings; and
- Notification to local emergency responders of WHPA boundaries, results of the susceptibility assessment and contaminant source inventory, and contingency plan.

1.2 City Production Wells

Wells 1A and 2 are the City's sole drinking water supply sources. The wells are located on Second Avenue SE between Washington and McKenzie Streets in SW¼, SW¼, Section 19, T17N, R2E W.M. in Thurston County (Figure 1). Well 1A was drilled in 2005 as a replacement for Well 1, which was installed in the 1950s and currently functions as a monitoring well. Well 2 was constructed in 1958 and was equipped with new pumping equipment in 2002. Well 1A is located approximately 65 feet southwest of Well 2. Table 1 summarizes the construction details for Wells 1A and 2. Water well reports and borehole logs for the existing water supply wells are provided in Appendix A. Both Wells 1A and 2 were recently inspected, cleaned, and upgraded with new pumping equipment to increase their capacities.

At the time the 2001 WHPP (Robinson and Noble, 2001) was prepared, Wells 1A and 2 were in operation and two additional wells were identified as potential future sources (Wells 3 and 3A). Since 2001, Wells 3 and 3A have both been completely decommissioned.

In 2010, the City commenced a deep groundwater resource exploration project in the Tahoma Terra area west of downtown. The project was designed to explore the potential of developing a new groundwater source from a portion of the aquifer system that would lessen the effects of pumping on local surface water features and existing groundwater users. Based on the findings from this exploration project, the City has constructed a new groundwater supply well (SW Well 1A). The well is located in Thurston County in SE¼, SE¼, Section 23, T17N, R1E W.M. (Figure 1). Construction details of SW Well 1A are provided in Table 1. A water well report and borehole log is provided in Appendix A. The City has applied for a water right for this well and further development will occur once water rights are obtained.

1.3 Plan Overview

This WHPP update includes the following elements:

- Section 2.0: Hydrogeologic Conditions – Presents the current understanding and characterization of hydrogeologic conditions in the Yelm area;
- Section 3.0: Wellhead Protection Area Delineation – Identifies the six-month and one-, five-, and ten-year WHPAs for City's existing (Wells 1A and 2) and planned future well (SW Well 1A);
- Section 4.0: Susceptibility and Contaminant Source Inventory – Presents an inventory of known and potential contaminant sources, identifies and discusses land use activities in

the Yelm area and within the WHPAs, and assesses the potential risk these land use activities and associated contaminants may have to the supply sources;

- Section 5.0: Management Strategy – Presents an overview of the City's efforts to manage groundwater protection and coordinate activities among state agencies, local governments, emergency responders, and owner/operators of potential contaminant sources, and others. This section also provides general considerations for new monitoring wells.
- Section 6.0: Summary – Summarizes key aspects of the wellhead protection plan; and
- Section 7.0: Recommendations – Provides a list of recommendations for further consideration based on findings from this WHPP update.

2.0 HYDROGEOLOGIC CONDITIONS

This section provides background information on the physical setting and hydrogeology of the Yelm area based on previous investigations and findings from the 2010 deep groundwater exploration project. The primary sources of data for the characterization of the local hydrogeologic system include:

- Conceptual Model and Numerical Simulation of the Groundwater Flow System in the Unconsolidated Sediments of Thurston County (Drost et. al, 1999);
- City of Yelm Wellhead Protection Plan (Robinson and Noble, 2001);
- Thompson Creek Conceptual Hydrogeologic Model (Golder, 2009);
- City of Yelm 2010 Water System Plan update (Brown and Caldwell, 2010); and
- The City of Yelm Southwest Well 1A Development Report (Golder, 2010).

2.1 General Physical Setting

The City of Yelm is located along the western margin of Yelm Prairie approximately 15 miles southeast of the City of Olympia in northeastern Thurston County, Washington.

2.2 Climate and Precipitation

The Yelm area has a climate characterized by dry, warm summers and wet, cool winters (WRCC, 2009). Average annual rainfall totals 50.8 inches, nearly 85 percent of which falls during the months of October through April. Total rainfall is generally greatest during the month of November (8.1 inches) and lowest during July (0.8 inches). Air temperatures average 38.9 °F during the three coldest months of the year (December through February) and 61.5 °F during the three warmest months (July through September).

2.3 Surface Hydrology

Yelm is located within the Nisqually River drainage and is bordered to the east by Yelm Creek and to the west by Thompson Creek (Figure 1). Both creeks drain northward and discharge to the Nisqually River north of Yelm. Thompson Creek flows along the western margin of Yelm Prairie along the base of the Thurston Highlands west of Yelm. Thompson Creek originates from a wetland complex southwest of Yelm near the base of the highlands. Yelm Creek originates approximately 4.6 miles southwest of Yelm and receives flow from Goodwin Lake and other kettle depression lakes and minor tributary streams before discharging to the Nisqually River.

2.4 Hydrogeologic Setting

The Yelm area is situated in the south-central portion of the Puget Sound Lowland. The Puget Sound Lowland is a north-south-oriented basin that has experienced repeated deposition, erosion and reworking of geologic sediments during glacial and interglacial periods. The repeated glacial advances and retreats covered the area with layered, unconsolidated glacial and non-glacial deposits. The most recent glacial

advance into the Yelm area took place approximately 13,500 to 15,000 years ago and is known as the Vashon Stade of the Fraser Glaciation.

The groundwater system in the study area has been described as being composed of seven major hydrogeologic units (Drost, et al., 1999). The hydrogeologic nomenclature of Drost, et al. (1999) is used for this study to remain consistent with previous work. A summary of the lithologic and hydrologic characteristics of each unit is presented in Table 2 (adapted from Drost et al., 1999). The hydrogeologic units known to exist within this area of Thurston County from the surface downward include:

- Recessional Outwash (Qvr);
- Till (Qvt);
- Advance Outwash (Qva);
- Kitsap Formation (Qf);
- Salmon Springs(?) Drift (Qc);
- Unconsolidated and undifferentiated deposits (TQu); and
- Bedrock (Tb).

The primary water-bearing units include the Qva, Qc, and TQu. The till (Qvt) and Kitsap Formation (Qf) units are typically composed of low-permeability, fine-grained sediments and act as confining layers for deeper groundwater flow systems. The hydrostratigraphic units (as interpreted from area well logs) are illustrated on geologic cross-sections adapted from Robinson and Noble (2001) and Golder (2010), and are provided in Appendix B. A brief description of each unit is provided in the subsections below.

2.4.1 Recessional Outwash (Qvr)

The recessional outwash deposits (Qvr) blanket most of Yelm east of the Thurston Highlands. The sediments were deposited by meltwater streams discharging from the glacier as it retreated from the Yelm area. With the exception of alluvial sands and gravels found along many of the local streams, the recessional outwash is the youngest geologic deposit in the area. The Qvr sediments are composed primarily of sand and gravel. Area well logs indicate the thickness to range between 10 and 50 feet. The Qvr unit is generally too thin to support groundwater supply wells; most wells in the area are completed in the deeper, more transmissive Qva aquifer.

2.4.2 Till (Qvt)

An unsorted mixture of rock debris known as glacial till (Qvt) underlies the Qvr unit and confines groundwater in the deeper Qva. The till was transported by the glacier as it advanced into the area and was deposited over the Qva. The Qvt deposits are generally composed of a mixture of sands, gravels, cobbles, and boulders within a compacted matrix of silt and clay. Drillers commonly refer to these deposits as “hardpan”, “cemented”, or “boulder clay”. The Qvt unit is found at depth throughout the Yelm

area and is exposed at the surface west of Yelm forming the eastern portion of the Thurston Highlands. The thickness generally ranges between 35 and 80 feet, and is known to exceed 100 feet in areas west and southwest of Yelm (Drost et al., 1999). The Qvt unit at SW Well 1A is approximately 145 ft thick (25 to 170 ft bgs) and consisted predominately of cemented, fine-to-coarse sand and gravel with silt and cobbles. The Qvt unit is considered a confining bed (i.e., aquitard) and its cemented conditions limit its permeability.

2.4.3 Advance Outwash (Qva)

The advance outwash deposits (Qva) lie beneath and are confined by the overlying Qvt till. The Qva sediments were carried and deposited by meltwater streams discharging from the glacier as it advanced into the Yelm area. The Qva is a relatively permeable aquifer unit consisting generally of gravel in a matrix of sand with some sand lenses. The Qva is widespread throughout the subsurface ranging in thickness between 15 and 85 ft, and is the primary source for domestic and municipal water supplies in the Yelm area. Wells 1A and 2 are completed in and obtain groundwater from this unit.

2.4.4 Kitsap Formation (Qf)

The Kitsap Formation is a low-permeability, fine-grained confining layer that separates the overlying Qva unit from the deeper Qc and TQu units. The Qf unit is composed predominately of clay and silt, with some layers of sand and gravel, and may include some till or till-like deposits and minor amounts of peat and wood. The Qf unit is extensive throughout the Yelm area and its thickness generally ranges between approximately 25 and 80 feet. The Qf unit at SW Well 1A is approximately 21 ft thick (219 and 240 ft bgs) and consisted of both silt and clay with organics and fine-to-coarse sand with silt, gravel and cobbles.

2.4.5 Salmon Springs(?) Drift

Below the Qf is the Salmon Springs(?) Drift unit (Qc). The Qc unit consists mainly of coarse-grained sand and gravel and is characterized by its oxidized red or brown staining (i.e., iron-oxides). This unit is referred to as the Salmon Springs(?) Drift by Noble and Wallace (1966) because its stratigraphic relationships mapped in Thurston County are similar to the Salmon Springs Drift type-section mapped in Pierce County and north of Tacoma, WA. The Qc unit is extensive throughout the Yelm area and its thickness typically ranges between 15 and 50 feet. The Qc unit is roughly 60 ft thick at SW Well 1A (240 and 300 ft bgs) and consists predominately of sand with gravel (stained reddish brown) and silt. Groundwater in the Qc is confined by the overlying Qf unit and is a supply source for some wells.

2.4.6 Unconsolidated and Undifferentiated Deposits (TQu)

Unconsolidated and undifferentiated deposits of the TQu underlie the Qc unit. The TQu consists of glacial and non-glacial sediments of clay, silt, sand, and gravel, and is known to consist of layers of fine-grained deposits and coarse-grained water-bearing units (Drost et al., 1999). The TQu is widespread throughout the region, but its thickness is not well known.

SW Well 1A is completed within the coarse-grained, water-bearing layers of the TQu. The coarse-grained layers consist predominately of fine-to-coarse sand with some gravel, while the fine-grained layers generally consist of silt and clay with some fine sand. The TQu unit at SW Well 1A is at least 500 ft thick (from 300 ft bgs to the total explored drilling depth of 800 ft bgs). The total thickness however, remains unknown because bedrock was not encountered within the exploratory drilling depth.

2.4.7 Bedrock (Tb)

The deepest geohydrologic unit in the Yelm area is consolidated bedrock (Tb). The bedrock unit consists of sedimentary claystone, siltstone and sandstone and igneous bodies of andesite and basalt. The Tb unit is known to contain some water in fractures and joints, but is considered an unreliable source due to low yields and poor water quality (Drost et al., 1998).

2.5 Groundwater Movement

Groundwater in the Yelm area is derived from two different flow systems: shallow and deep. The shallow groundwater system consists primarily of the advance outwash (Qva) deposits, whereas the deeper, regional groundwater system consists of the older glacial deposits identified as the Salmon Springs(?) Drift (Qc) and unconsolidated and undifferentiated deposits of the TQu. Studies conducted by Robinson and Noble (1995 and 2001) indicate that the groundwater elevation and flow direction of the deeper system are different from those in the shallow system beneath Yelm. Groundwater within the shallow system generally flows in a northerly direction across Yelm Prairie toward the Nisqually River, whereas groundwater in the deeper system moves more northwesterly away from the Nisqually River toward Olympia, WA.

3.0 WELLHEAD PROTECTION AREA DELINEATION

This section discusses the modeling approach used to delineate time-of-travel based wellhead protection areas (WHPAs) and identifies the six-month and one-, five-, and ten-year WHPA capture zones for the City's existing supply wells (Wells 1A and 2) and planned future well (SW Well 1A).

3.1 Previous WHPAs

WHPAs were originally delineated by Robinson and Noble (2001) for the City's active source wells using a combination of delineation methods: the near-well capture zones were delineated using an analytical approach, while hydrogeologic analyses and mapping techniques were used at distant locations from the wells. Planned capacity expansions and a new groundwater flow modeling tool capable of evaluating groundwater protection and development projects in the Thurston County area have prompted revisions to the previously mapped WHPA capture zones.

3.2 Modeling Approach

The WHPAs for the City's current and planned supply wells were delineated using the most up-to-date version of the McAllister Groundwater Model, which encompasses a broad area of Thurston County and was utilized to support the City's water right applications and mitigation program (City of Yelm, 2011). Details of the model construction and calibration are provided by CDM (2002a and 2002b), Golder (2008a and 2008b), and City of Yelm (2011). This most up-to-date version of the McAllister Groundwater Model is hereafter referred to as the "existing model".

The existing model was modified in order to delineate updated WHPAs for the City's current and planned supply sources. Adaptations and modifications to the existing model for this use (including model refinements and updates), as well as a more detailed discussion of modeling approach and capture zone analysis, are presented in a Technical Memorandum provided in Appendix C. The adaptation resulted in a separate Yelm-specific tool that is hereafter referred to as the Yelm 2011 WHPA Model.

The WHPAs were delineated for the following City wells:

- SW Well 1A (recently drilled; planned new source); and
- Wells 1A and 2 (current, approved sources).

3.3 WHPA Modeling Results

Figure 2 displays the predicted six-month and one-, five-, and ten-year time-of-travel capture zones for the City supply sources. Figures TM-2 and TM-3 of Appendix C show the model-predicted groundwater elevations in feet above mean sea level (amsl) and flow directions in the Yelm area for the Qva and TQu aquifers, respectively. The WHPA capture zones are summarized for each of the supply/aquifer sources in the following two subsections.

3.3.1 SW Well 1A – TQu Aquifer

The shape of the six-month and one-, five-, and ten-year time-of-travel WHPA capture zones (using an annual average pumping rate of 584 gallons per minute based on the maximum annual water right volume of 942 acre-feet) has a regular, elongated pattern and does not display any apparent sign of flow disruption from other wells or potential aquifer boundaries. No evidence of vertical flow was observed in the capture zones delineated for SW Well 1A. The capture zones exhibit a narrow and elongated pattern due to the highly transmissive nature of the TQu. The six-month and one-, five-, and ten-year time-of-travel capture zones respectively extend roughly 460, 800, 3,300, and 6,400 feet upgradient from SW Well 1A. The capture zone is approximately 815 feet wide at its maximum width.

3.3.2 Wells 1A and 2 – Qva Aquifer

The capture zones delineated for Wells 1A and 2 (using a combined annual average pumping rate of 555 gpm based on the combined maximum annual water right volume of 894.92 acre-feet) are irregularly shaped and noticeably different than the capture zone for SW Well 1A. In particular, there is a bend in the mid part of the five-year capture zone, which results from a combination of factors, including the presence of several domestic wells, the close proximity of model boundaries to the capture zone, and a decrease in aquifer hydraulic conductivity (from 640 ft/d to 70 ft/d). The width of the capture zone for Wells 1A and 2 is wider than the SW Well 1A, which results from differences in aquifer thickness. The model thickness of the Qva is considerably less than the thickness of the TQu (Appendix C).

Vertical flow from the underlying Qf to the Qva is predicted by the model in close proximity of Wells 1A and 2 (west side of capture zone), and also from the model's river boundary downwards to the Qva in the south-western part of the capture zone where groundwater movement is predicted to travel west-east for a short distance. Because the WHPA model analyses were performed using steady-state simulations (i.e., worst-case scenario because the duration of pumping is assumed to be very long, long enough to reach equilibrium, and does not incorporate seasonal variability in pumping demand), vertical migration of groundwater is expected to be less than predicted by the model.

The new capture zones for Wells 1A and 2 vary from the previous delineations by Robinson and Noble (2001). Several changes account for the differences:

- Pumping rates were revised to incorporate increased capacity at these wells;
- A more realistic regional hydraulic gradient (consistent with the existing model) elongate the capture zones; and
- The 2012 Yelm WHPA model represents an improved distribution of transmissivity and appropriate geological (model) layering to reflect observed hydrostratigraphic conditions.

Consequently, the revised capture zones should be viewed as more representative of actual conditions, despite being different than those delineated previously.

4.0 SUSCEPTIBILITY AND CONTAMINANT SOURCE INVENTORY

Aquifer susceptibility is the relative ability with which a contaminant can migrate from the land surface to a water supply source aquifer. Susceptibility is based primarily on local hydrogeologic factors and well construction. Aquifer vulnerability considers both the physical susceptibility to contaminant infiltration and the risk of exposure to contaminants. Exposure risk is primarily associated with land use in relation to the water supply area and the associated activities or types of chemicals used and/or stored.

4.1 Susceptibility Assessment

The primary factors influencing aquifer susceptibility include:

- Well construction, integrity, and usage;
- Aquifer type (confined or unconfined); and
- Characteristics of the hydrogeologic system.

For example, with all else being equal, a relatively deep confined aquifer is less susceptible to contamination than a shallow, unconfined aquifer. In addition, wells that have been poorly constructed or improperly sealed and cased can potentially serve as a pathway for contaminants despite whether the well is deep and completed in a confined aquifer. The main mechanisms for transport of contaminants to the subsurface include:

- Discharge to the ground surface – Discharge of chemical products or waste materials through spills, stormwater runoff and/or intentional disposal. Such materials could infiltrate the surface sediments and potentially reach a drinking water source aquifer;
- Discharge to surface water bodies – Depending on its connection and interaction with groundwater, surface water bodies could transport contaminants to an aquifer system through natural recharge; and
- Improperly abandoned or poorly constructed wells – Wells that have been improperly decommissioned or constructed with inadequate surface seals could act as direct conduits for transport of potential contaminants to an aquifer.

Based on the DOH guidelines, the susceptibility of a well is rated as high, moderate or low. Wells 1A and 2 are considered by the State Department of Health to have high susceptibility due to their relatively shallow depths and the highly transmissive nature of the Qva aquifer in this area. Despite both wells being completed in and obtaining water from the confined Qva aquifer, Well 2 is considered more susceptible due to its age. SW Well 1A, completed in the deep and confined TQu aquifer and sealed to approximately 328 feet below ground surface, is considered to have the lowest level of susceptibility. A Susceptibility Assessment Form for the City's planned additional supply well (SW Well 1A) is provided in Appendix D.

4.2 Contaminant Source Inventory

An essential component of wellhead protection is generating an inventory of potential sources of groundwater contamination that may threaten a source of supply. An inventory of potential contaminant sources within and around the WHPAs for SW Well 1A and Wells 1A and 2 was generated and their potential risk prioritized based on the following steps:

- Environmental database searches to identify known or suspected soil and groundwater contaminant sources;
- Conducting a field survey of the WHPAs to verify sites identified by the database search and identify any additional potential contamination sources;
- Identifying potential groundwater quality concerns associated with land use practices within the WHPAs; and
- Prioritizing exposure risks to the WHPAs.

4.2.1 Database Search

An inventory of known or suspected soil and groundwater contamination sites within a 2.5-mile radius encompassing the WHPAs was generated by compiling information from the following sources:

- Washington Department of Ecology's Facilities/Sites and Water Well databases;
- EPA's Facility Registration System database; and
- Environmental records compiled by Environmental Data Resources, Inc. (EDR). An Executive Summary of the EDR report is included in Appendix E. Complete results of the report are included in a CD-ROM attached to the inside back cover of this report.

The findings of known or suspected sites of contamination based on results from these sources are summarized in a later section.

4.2.2 Field Survey

City of Yelm personnel conducted windshield surveys of the WHPAs in April, 2012. These surveys included drive-by reconnaissance to verify sites identified by the database search and identify any additional potential contamination sources. Mail and telephone surveys, door-to-door surveys, and personal interviews were not performed.

4.3 Land Use

Land zoning within Yelm and the surrounding area generally consists of residential, rural residential, agriculture, commercial, industrial, institutional, and open-space districts. Figure 3 shows current land-use zoning categorized into four general land-use types: residential, rural residential, commercial/industrial, and institutional/open space. Land uses types making up these general classifications are listed in Table 3.

Information contained in the following subsections was largely adapted from the City's Water System Plan (Brown and Caldwell, 2010) and modified as needed to address any land use types identified in association with the newly delineated WHPAs.

4.3.1 Residential and Rural Residential

The City of Yelm is predominantly made up of residential districts. Potential contaminant issues related to residential land use include: fertilizer and pesticide applications, use of petroleum hydrocarbons, small livestock operations, and nitrate loading and disposal of household chemicals through septic systems.

A primary concern for residential areas, particularly residential areas within the City's urban growth boundary (UGB), is the impact of nitrogen. Properly maintained and used septic systems convert organic nitrogen to nitrate. Most septic drain fields discharge effluent to the unsaturated zone above unconfined aquifers, and contaminants can percolate to the saturated zone and contaminate groundwater. Livestock operations and other hobby farming can also result in nitrate entering groundwater.

The City maintains a STEP (Septic Tank Effluent Pump) sewer system and is nearly all sewered. There are however, some septic systems that remain within the City limits. From the City's general sewer plan work, this represents approximately 157 septic systems. The City's UGB is almost all on septic systems. The City's goal is to connect septic systems to their STEP sewer system as they develop or as existing systems fail.

Hobby farms, lawns and flowerbeds represent potential hazards because they typically receive application of fertilizers, herbicides, and pesticides. The presence of multiple sources of pesticides can result in the potential for additive loading to the groundwater system, resulting in a possible progressive decline in water quality.

Agricultural land uses also present risk concerns. Agricultural activities can cause several types of water quality problems, mostly resulting from fertilizers, pesticides or manure/wastes. Agricultural activities were grouped within rural residential areas.

4.3.2 Commercial/Industrial

The most likely potential contaminants related to commercial/industrial sites include, but are not limited to, petroleum hydrocarbons and metals. These potential contaminants are generally due to the historical or current presence of heating oil and fuel in underground storage tanks (USTs). Additional potential contaminants could also be associated with auto repair and metal fabricator facilities.

Petroleum hydrocarbons can become a serious concern for wellhead protection in commercial and industrial areas, as well as residential areas. There are numerous potential sources for petroleum hydrocarbons within the WHPA. They include gasoline stations, industrial and commercial operations that

fuel and maintain equipment and vehicles, home/commercial heating oil tanks and bulk transport of such fuels. Petroleum hydrocarbons are typically stored in USTs in volumes ranging from 300 gallons per tank (residential use) to up to 10,000 gallons per tank (gasoline service stations). Large spills involving petroleum hydrocarbons are a greater risk than small spills (leaks, etc.).

Groundwater contamination from metals is a potential threat at commercial and industrial sites, which typically handle or use materials with significant metallic constituents (paints, waste oil, etc.), historical pesticides (historical pesticides were typically metal-based compounds), and metal plating shops (cyanides and heavy metals).

Hazardous material storage is a common activity associated with industrial and commercial land uses. Spilled or inappropriate disposal of chemicals poses a significant threat to groundwater quality. Solvents that leak downwards from the surface or subsurface are a major threat to water supplies, as a small quantity can affect a large portion of an aquifer or surface water body. Risk from spilled chemicals can be mitigated by implementing proper handling methods and spill prevention measures.

4.3.3 Institutional/Open Space

Land use activities associated with institutional and open space types include designated forestland and timberland, parks, and undeveloped land (Table 3). These land use types are expected to have the lowest potential for contamination because of the nature and low impact of activities occurring there and because none coincide with any of the delineated WHPAs (Figure 3).

4.4 Potential Groundwater Quality Concerns

The following discussion briefly summarizes the potential groundwater quality concerns associated with the land use types identified within the WHPAs. These concerns can generally be grouped into five categories: nitrates, pesticides, petroleum hydrocarbons, metals and corrosive materials. The types of concerns in relation to land use are summarized in Table 4 and are discussed in more detail below.

Information contained in the following subsections was largely taken from the City's Water System Plan (Brown and Caldwell, 2010) and previous WHPP (Robinson and Noble, 2001), and modified as needed to address any new land uses identified in association with the modified WHPAs.

4.4.1 Nitrates in Groundwater

There are multiple potential sources of nitrate that could be released to groundwater in the WHPAs. These potential sources include septic systems, livestock operations, and fertilizer applications to lawns, golf courses, timber growing sites, and sewer systems.

Septic systems are used in areas that are not served by sewer systems. Although the City of Yelm is nearly all sewered, areas outside the city boundary and within the UGB are on septic. Wastewater

released from septic systems or leaking sewer systems contains bacteria, nutrients, and may contain household chemicals. However, the principal concern from poorly maintained and used septic systems is the impact of nitrogen, which is converted and transported as nitrate in the groundwater system. Nitrate is the primary constituent of concern because of its relatively high mobility in groundwater systems and its potential harmful health effects to humans at high concentration levels. Regional studies have shown that groundwater quality impacts from septic systems used in residential developments vary widely based on hydrogeologic setting, housing density, and system ages, types, and maintenance.

Though nitrate loading from adequately designed, maintained and operated septic systems is generally small, an improperly used system in highly porous soils can allow pathogens to reach groundwater unimpeded. Evidence of this type of septic system failure is not readily visible since drainage from these systems does not cause ponding or odor problems. As previously mentioned, the City's goal is to connect septic systems to their STEP sewer system as they develop or as existing systems fail. In cases where sewer connection is not possible, there are ways to protect against septic nitrate loading:

- Ensure that all new septic systems going into areas of excessively draining soils in the WHPAs are carefully designed and properly installed; and
- Ensure that all water supply wells withdraw water from beneath a protective confining (low permeability) layer such as till.

Agriculture is an additional land use practice within the WHPAs that could result in the release of nitrate into the groundwater system. Properly designed and operated livestock facilities can mitigate the potential for nitrate releases by implementing best management practices defined by the Natural Resources Conservation Service. Poorly managed facilities can release nitrate via surficial runoff and infiltration to the underlying groundwater system.

An additional practice that can leach nitrate to the groundwater is fertilization, especially if applied above recommended rates. Fertilizers usually contain nitrogen in the form of ammonia or nitrate. Though nitrate is the form most readily taken up by plants, ammonia is usually converted to nitrite, and then nitrate, by bacteria in soils. Nitrate is highly mobile in groundwater, so fertilizer application in excess of plant uptake can result in surplus nitrate being transported to groundwater. Fertilizers typically contain other chemicals that could migrate to groundwater, including potassium, sulfate and phosphorus, but their impact to water quality is generally not at the same magnitude as the impact from nitrate.

The presence of multiple sources of nitrate in the wellhead protection management areas, primarily in land use areas designated as rural residential, results in the potential for additive nitrate loading to the groundwater system and the potential for decline in water quality. Nitrate levels have been below 5 mg/L in samples collected from Wells 1A and 2 since 2005. Nitrate was below the method detection limit of

0.0076 mg/L in the initial groundwater quality characterization sample collected at SW Well 1A on October 13, 2010.

4.4.2 Pesticides

Pesticide use typically ranges from larger-scale treatment by certified applicators to smaller-scale homeowner use for yard maintenance and pest control. Pesticides are typically used in residential areas, along transportation corridors, at golf courses, and in farming and forestry operations. For these locations and land uses, the heaviest use of pesticides may be at farming or forest operations or along transportation corridors to prevent unwanted plant growth and damage caused by insects. Pesticides discussed herein include a suite of related products:

- Insecticides – The most widely used insecticides available today are of the organophosphate type. Organophosphates are used in agriculture, in homes and gardens, and in veterinary practice;
- Herbicides – Herbicides are used in transportation corridors, typically by State and County transportation departments. Herbicides are used mainly to keep highway shoulders free from unwanted plant growth; and
- Fungicides – Fungicides are used extensively in industry, agriculture, and residential uses for seed grain and crop protection, and control and suppression of molds, mildews, and yeasts. Typically, fungicides are applied throughout the growing season, whereas most herbicides and insecticides are applied only once.

There are numerous pesticides that are restricted to permitted use and a wide variety of unpermitted, commercially available products. When applied in accordance with manufacturer specifications, pesticides are relatively immobile because they are consumed by the pests or become adsorbed to soil. Most of the products are toxic to humans and animals in small quantities, with specific risk-bases toxicity data available for active ingredients in the commonly used products. Not all pesticides are mobile in groundwater, and not all pesticides are stable or persistent in the environment. Consequently, the potential for pesticides to migrate to groundwater, degrade or transform into other chemical compounds, or persist long enough to contaminate groundwater, varies by usage and between individual pesticides and classes of pesticides.

The likelihood of pesticide use in land use types that coincide with the WHPAs creates the potential for additive loading to the groundwater system resulting in a possible decline in water quality. To date, pesticides have not been a detectable problem in the samples collected from Wells 1A and 2. No synthetic organic compounds (SOCs) or herbicides were detected in the groundwater quality characterization sample collected at SW Well 1A on October 13, 2010.

4.4.3 Petroleum Hydrocarbons

There are numerous potential sources for petroleum hydrocarbons within and near the WHPAs. These include gasoline stations, industrial and commercial operations that fuel and maintain equipment and vehicles, and home and commercial heating oil tanks. Petroleum hydrocarbons are typically stored in USTs in volumes ranging from 300 gallons (residential use) to up to 10,000 gallons per tank (gasoline service stations). Larger storage volume requirements, greater than 10,000 gallons, are typically stored above ground.

Petroleum hydrocarbons are not highly soluble in water. Their solubility is related to the length of the hydrocarbon chains that comprise the material. Short chain hydrocarbons, the types which are found in gasoline, are typically more soluble than longer chain hydrocarbons, which are found in diesel fuel and heating oil. The greatest potential threat to a wellhead is from sources of petroleum hydrocarbons close to the wellhead because of the limited potential for natural attenuation in the subsurface. Petroleum hydrocarbon releases may also be more of a threat at sites where other types of solvent have been spilled. The materials can sometimes act as co-solvents and increase the solubility of petroleum product, and, therefore, increase the likelihood of transport of the petroleum hydrocarbons to a wellhead.

Volatile organic compounds (VOCs) have not been detected in Well 2 since 1990 or Well 1A since 2005, and have never exceeded state drinking water maximum contaminant levels (MCLs). SOCs have never been detected in Wells 1A or 2. No VOCs or SOCs were detected in the groundwater quality characterization sample collected at SW Well 1A on October 13, 2010.

4.4.4 Metals

Groundwater contamination from metals is a potential threat at commercial and industrial sites, which handle, store, or use materials with significant metallic constituents (paints, waste oil, etc.), historical pesticide use areas (historical pesticides were typically metal-based compounds), and metal plating and auto repair shops (cyanides and heavy metals). Metals are not highly soluble in water. Their solubility is generally related to pH and oxidation-reduction potential (Eh) in the aquifer. High concentrations of metals typically do not migrate far from their source areas because of their low solubility, tendency to adsorb to clay particles or organic matter, tendency to precipitate (depending on Eh/pH relationships), and/or tendency to substitute for other minerals in the aquifer. State regulated inorganic contaminants, including primary and secondary metals, have never exceeded their established contaminant levels at Wells 1A or 2. The only inorganic constituent having a concentration above its regulatory criteria in the initial groundwater quality characterization sample collected at SW Well 1A on October 13, 2010 was manganese. Total manganese was detected at 0.15 mg/L. Manganese above the secondary MCL (SMCL) does not pose a risk to human health or the environment. Meeting the SMCL for manganese is not a mandatory requirement, and is only provided as a recommendation for aesthetic quality.

4.4.5 Corrosive Materials

Corrosive materials (acidic and basic compounds) may be present in some products used, or contained in waste materials generated from or stored at commercial/industrial facilities within the WHPAs. Materials such as these can change the pH of shallow ground water and induce corrosion problems in structures that are in contact with the groundwater (foundations, pipelines, etc.). Changing pH of groundwater could result in mobilizing and/or immobilizing other constituents, like metals, as described above. Extreme changes in pH may make groundwater unsuitable for human consumption or for use in industrial processes. However, the buffering capacity of native soils and rock may minimize the migration of corrosive groundwater. Groundwater pH at Wells 1A and 2 and at SW Well 1A from an initial groundwater quality characterization sample collected on October 13, 2010, are within the secondary maximum contaminant level (SMCL) range (6.5-8.5), and no monitored constituents have indicated an apparent concern regarding corrosive substances.

4.5 Risk Priority Rankings for Potential Contaminant Source Sites

A total of 120 known or suspected soil and groundwater contamination sites were identified by the database searches (Figure 4). Each site was ranked according to three factors, or decision levels, to define risk priority. The decision levels were, in decreasing order of importance:

- Level I – Proximity of the potential hazard to the WHPA;
- Level II – Type of contamination at the site; and
- Level III – Straight-line distance to the closest wellhead in feet.

To determine the risk priority rankings, each known and potential contamination site was prioritized using decision Level I. Sites having equal Level I priority rankings were then further sub-prioritized using decision Level II. If sites were still equal in priority, they were further sub-prioritized under decision Level III. The methodology for prioritizing contaminant risk was based on the methodology of the previous contaminant source inventories (Brown and Caldwell, 2010; Robinson and Noble, 2001). This methodology is described in the following sections.

4.5.1 Decision Level I – Potential Contaminant Source Site Location Relative to Wellhead Protection Area

For the first decision level, the prioritization of the known or suspected contaminant source sites was based on the particular time-of-travel capture zone the site was located within. The Decision Level I sub-priority rankings are listed in Table 5. Sites located within the 6-month capture zone were assigned a sub-priority level ranking of one, while sites within the ten-year capture zone were assigned a sub-priority level ranking of four. In summary, the shorter the travel time, the higher the position in the priority level, with a level of one being the highest. Sites identified outside of the WHPAs were given a sub-priority level ranking of five if their location was hydraulically upgradient (i.e., groundwater flow toward the well; similar

to “upstream” for surface water) and assigned a six if hydraulically downgradient (i.e., groundwater flow away from the well; or “downstream”).

4.5.2 Decision Level II – Type of Contamination

For the second decision level, the sites were sub-prioritized based on the type of contamination identified in the state or federal environmental database search results and whether site contamination is known or suspected. The Decision Level II sub-priority rankings and their associated contaminated site types are listed in Table 6. Known contaminant sites were assigned sub-priority levels between one and three depending upon the contaminated site type: confirmed or State cleanup sites were assigned a sub-priority level of one, whereas voluntary cleanup sites for example were assigned a level of three. Sites with Leaking Underground Storage Tanks were assigned a level of two. Potential contaminant sites were assigned sub-priority levels between four and ten. Examples of level four sites include recycling facilities and hazardous waste generators, whereas facilities and sites of interest for example were assigned a level of ten. In summary, known contaminant source sites were assigned higher sub-priority levels (depending upon contaminated site type) than potential contaminant source sites.

4.5.3 Decision Level III – Straight Line Distance from Wells

For known contamination sites, or potential contamination sites having the same sub-priority level ranking for both Decision Levels I and II, the straight-line distance (in feet) from the site to the closest wellhead was used to sub-prioritize further. Sites closer to a supply source were given a higher priority level position than sites further away.

4.6 Contaminant Source Inventory Results

The following discussion presents sites identified by the contaminant source inventory and their associated risk priority rankings. A total of 120 potential contaminant source sites were identified by the database searches and windshield survey, and ranked according to the scheme outlined above. A complete list of rankings is provided in Table 7 and their locations shown on Figure 4. Potential contaminant sources identified within the 100-ft Sanitary Control Area (SCA) for Wells 1A and 2 and SW Well 1A are also discussed.

4.6.1 Wells 1A and 2

Of the 120 potential contaminant source sites identified, 23 coincide with the WHPAs delineated for Wells 1A and 2. Ten sites are located in the six-month capture zone and the remaining thirteen are within the one-year capture zone. The potential contaminant source locations coinciding with each WHPA zone for Wells 1A and 2 are shown in Figure 5 and briefly discussed below. Each site is further described in Table 7.

- Sanitary Control Area (SCA) – Wells 1, 1A and 2 are each located in separate secured well houses and the site surrounded by security fencing. Small amounts of oils, lubricants, cleaning fluid, and paint are stored within the buildings. The building for Well 1 includes a separate space for storage of caustic soda. A 200kW generator with 300 gallon capacity diesel fuel tank is located adjacent to the Well 2 pump house on a concrete pad with a 6-inch curb. The wells are located within 100 feet of a public roadway or parking lot. Spill prevention, containment, and response/treatment measures to address these potential contaminant concerns and minimize potential impacts in the event of an accidental release are described in Chapter 5 and Appendix 5 of the City's WSP (Brown and Caldwell, 2010). To date, there have been no known spills at the well site;
- Six-Month Capture Zone – The six-month capture zone extends approximately 3,500 feet upgradient (to the southeast) of Wells 1A and 2. A total of 10 sites (Sites 1 through 10) were identified within this zone, two of which are identified as known contaminated sources (Sites 1 and 2 on Figure 5). Site 1, the highest ranked site, is a gas station that was identified on the Confirmed and Suspected Contaminated Site List and has received a No Further Action determination. Site 2 is a drugstore identified as a small quantity hazardous waste generator. The remaining sites are primarily businesses that store or handle hazardous chemicals, have underground storage tanks onsite, or that have been identified as having a 5D2-class Underground Injection Control well for stormwater purposes.
- One-Year Capture Zone – The one-year capture zone extends approximately 6,300 feet upgradient of Wells 1A and 2. A total of 13 sites (Sites 11 through 23) were identified within this zone, one of which was identified as a known contaminated source (Site 11 on Figure 5). Site 11 is gas station/convenient store identified on the Emergency Response Notification and Hazardous Materials Incident Report Systems lists for an accidental spill of 20 gallons of unleaded gasoline. The remaining sites are primarily businesses that store or handle hazardous chemicals or that have underground storage tanks onsite.
- Five- and Ten-Year Capture Zones – No known or potential contaminant sites were identified in the five- or ten-year capture zones. Land use type in these zones is designated as rural residential. Potential groundwater quality concerns associated with these land use types were discussed in previous sections of this report.

4.6.2 SW Well 1A

SW Well 1A is located in an undeveloped area zoned for residential land use held in full legal control by the City of Yelm (see Appendix F for Declaration of Covenant). A facility to enclose and protect SW Well 1A is currently in the design phase, but has not been constructed. Currently, the well casing terminates approximately three feet above the ground surface and is capped and secured. The facility will include a secured well house and flow monitoring components with a separate area to store and handle disinfection/treatment chemicals, and may also include a backup power generator for emergency use. The well site/facility will be controlled by security fencing. When developed, the area will likely include grass cover, sidewalks and a paved driveway. The Spill Response Plan (discussed in Section 5.4) will need to be updated to include this well before it is put into service.

No known or suspected soil or groundwater contamination sites were identified within the 100-ft SCA of SW Well 1A (Appendix F). When the facility is constructed and the site fully developed, potential contaminant sources within the SCA may include those associated with water treatment chemicals

handled or stored at the well site or stormwater runoff. A stormwater retention pond currently exists east of SW Well 1A, but is planned for relocation before the well is put into service. At full site/area development, the SCA will partially overlap a public roadway, but because the well is sealed to a depth approximately 328 feet below ground surface and obtains water from a deep aquifer overlain by two confining layers (Qt and Qf), SW Well 1A is considered to have the lowest level of susceptibility and infiltration of surface contaminants is unlikely. Infiltration of surface contaminants from stormwater is further mitigated by the City by routinely sweeping roadways and cleaning stormwater catch basins.

No known or suspected soil or groundwater contamination sites were identified within the six-month or one-, five-, and ten-year WHPA capture zones (Figure 4).

Land use type within the SCA, six-month and one-year capture zones is designated as residential with some areas in future transition to commercial and institutional space, whereas types within the five- and ten-year capture zones are designated as both residential and rural residential. Potential groundwater quality concerns associated with these land use types were discussed in previous sections of this report.

5.0 MANAGEMENT STRATEGY

The key elements of a wellhead protection program include a management strategy, a spill response plan, a contingency plan and recommended improvements. The key management strategies include monitoring and data management, land use, regional coordination, and public education and notification programs. This chapter presents the management strategies the City currently employs, and identifies recommended improvements.

5.1 Land Use and Regulatory Control

Controlling future development in WHPA capture zones through land use regulations is an important tool used by the City and Thurston County to reduce the risk of groundwater contamination. The Yelm Municipal Code (YMC) is the City's primary mode of enforcement and regulation of activities within the WHPAs.

5.1.1 City of Yelm

YMC 14.08 identifies general and specific-use performance standards for areas designated as critical aquifer recharge areas (CARA). The general performance standards [YMC 14.08.110(C)] address proposed activities and development as follows:

- Proposed activities will not cause contaminants to enter the aquifer and will not adversely affect recharging of the aquifer;
- The proposed activity must comply with the water source protection requirements and recommendations of the U.S. Environmental Protection Agency, Washington State Department of Health, and the Thurston County Environmental Health Division; and
- All new development, redevelopment, and small parcel development shall meet the water quality requirements of the stormwater manual as adopted by the city of Yelm.

Special use performance standards [YMC 14.08.110(D)] address:

- Storage Tanks – All storage tanks proposed to be located in a CARA must comply with local building code requirements and must conform to requirements for underground [YMC 14.08.110(D)(1)(a)] and aboveground [YMC 14.08.110(D)(1)(b)] storage tanks;
- Vehicle Repair and Servicing – Such activities must be conducted over impermeable pads and within a covered structure. Chemicals used must be stored in a manner that protects them from weather and provides containment should leaks occur. No dry wells shall be allowed in CARAs on sites used for vehicle repair and servicing; and
- Use of Reclaimed Water for Surface Percolation or Direct Recharge – Water reuse projects for reclaimed water must be in accordance with the adopted water or sewer comprehensive plans that have been approved by the state Departments of Ecology and Health.

5.1.2 Thurston County

Thurston County assumes leadership of determining land use activities within WHPAs located outside city limits. Thurston County has adopted a Nonpoint Source Pollution Ordinance, which in part targets small quantity generators within WHPAs within Thurston County. The purpose of this ordinance is to minimize environmental impacts from hazardous materials. The County also implements a Business Pollution Prevention Program to provide education and technical assistance inspections for small quantity generators. This program is sponsored by the Thurston County Hazardous Waste Program and addresses activities such as proper storage, use, floor washing activities, incidental dumping, abandoned materials, and intentional ground disposal of hazardous wastes.

The County's primary mechanism for controlling land use within WHPAs is the Critical Areas Ordinance (CAO). Functions of the CAO include controlling types of land use and residential densities within hydrogeologically-sensitive areas. The County also requires:

- Turf Management Plans and Integrated Pest Management Plans to identify potential sources of groundwater contamination; and
- Farm Plans for agriculture located within one-year capture zones.

Improvements to County land use can be encouraged by the City, but are ultimately the County's authority. In 2005, Thurston County updated its CARA section of the Critical Areas Ordinance. However, these changes have not been adopted at this time.

5.2 Public Education

Public education and voluntary action are critical to protecting public and private drinking water supplies. Public participation in the groundwater protection planning and management strategies increases awareness and ownership of the program. Public education is also an important component of non-regulatory wellhead protection strategies which rely on homeowners and residents to properly maintain private wells and correctly dispose of household hazardous wastes. Public education can be accomplished in a number of ways, including brochures, mailers, utility bill inserts, press releases, booths at special events, meetings and workshops. Public education programs focused on wellhead/groundwater protection can emphasize the following issues:

- Proper use of household chemicals, especially lawn chemicals such as fertilizers and pesticides. Many homeowners fail to use lawn chemicals in accordance with the label, and chemical over-use, especially when combined with over-watering, can lead to impacts to groundwater supplies. Educate homeowners about the importance of following the manufacturer's instructions when using lawn and household chemicals;
- Correct disposal of household hazardous wastes including waste oils, paint, lawn chemicals, and other household hazardous materials. Inappropriate disposal of these substances, including pouring chemicals on the ground or down the drain into a septic

system, can create a threat to groundwater quality. The implementation of periodic no-cost hazardous waste collection days can be an effective tool for encouraging proper disposal, especially when paired with public education efforts;

- Appropriate maintenance of private wells and septic systems. Public education efforts to encourage correct maintenance of septic systems and private wells can include making resources available on a website, flyers, or brochures; and
- Increase awareness of residents and business owners/operators located in wellhead protection areas. Hands-on learning and technical assistance opportunities for households, business owners, teachers, and students can help develop knowledge, teach new skills, and ultimately change the attitudes, practices, and behaviors of those living or working in wellhead protection areas.

5.3 Notifications

This section includes notification lists and example letters to both the identified potential contaminant sources and to the regulatory agencies, local governments, and emergency responders notifying them of the City's WHPAs.

5.3.1 Notification to Owners of Potential Sources of Contamination

Separate letters of notification will be delivered to those owners/operators located within the WHPAs and identified as potential sources of contamination. These letters will include a map of the WHPAs and the locations of potential and known sources of ground water contamination. The list of owners/operators to be contacted are those identified in Table 7 as having prioritizations of 1 and 2 under the Decision Level I risk priority ranking (Sites 1 through 23). An example letter is included in Appendix G.

5.3.2 Notification to Regulatory Agencies and Local Governments

Regulatory agencies and local governments will be provided separate letters of notification. These letters will include information of the water-supply system, WHPA boundaries, and locations of potential and known sources of ground water contamination within the wellhead protection area boundaries. An example letter and list of appropriate regulatory agencies that should be notified after any changes are made to WHPAs are included in Appendix G.

5.3.3 Notification to Local Emergency Responders

Separate letters of notification will be delivered to the appropriate emergency responders. These letters will include results of the susceptibility assessment and the findings of the wellhead protection inventory so that local emergency responders can evaluate whether changes in emergency response procedures (e.g., incident/spill response) are needed to better protect groundwater within the wellhead protection areas. The list of incident responders to be contacted and provided with information regarding the City's WHPAs is included in Appendix G.

5.4 Spill Response Plan

Spill response planning is an important aspect of both an emergency management plan and a wellhead protection program. Chapter 5 of the City's WSP (Brown and Caldwell, 2010) describes spill prevention measures currently in place to prevent the accidental release of pollutants in the area of Wells 1A and 2, and describes spill treatment and response actions to be taken to minimize potential damages in case a spill does occur. This plan remains valid as no significant changes that would impact the emergency response measures identified have occurred since the WSP was last updated in 2010. The Spill Response Plan should be reevaluated and updated as needed to address any site specific conditions after the SW Well 1A facility is constructed.

5.5 Contingency Plan

A contingency plan is required as part of the WHPP in the event that a natural disaster or contamination event results in the temporary or permanent loss of the City's water supply source. Chapter 5 of the City's WSP (Brown and Caldwell, 2010) presents an initial evaluation of the feasibility of developing alternative sources of supply, including interconnects with other neighboring water systems or distribution of purchased water. Based on this initial evaluation, neighboring systems have little extra capacity and would provide little benefit in terms of contingency planning of the loss of an existing source. The most effective contingency effort is the development of SW Well 1A.

SW Well 1A was drilled and tested in 2010 to explore the potential of developing a new groundwater source from a deeper portion of the regional aquifer system (the TQu unit). Aquifer and water quality testing has shown that the well is capable of producing high quality water at a yield of 2,100 gpm and is planned to be in operation in late 2014 or early 2015.

Because SW Well 1A withdraws water from a deep well-confined portion of the regional aquifer system, its hydraulic connection to shallower aquifer units is limited. Results from a pumping test conducted to assess the deep aquifer system did not result in observable response in nearby observation wells completed in overlying units suggesting little-to-no hydraulic connection between the shallow aquifer source for Wells 1A and 2 and the deeper TQu (Golder, 2010). Consequently, SW Well 1A is much less vulnerable to surface contamination and could function as an emergency supply source in the event of the temporary or permanent loss of Wells 1A and 2, depending upon the magnitude and characteristics of the contamination.

5.6 General Considerations for New Monitoring Wells

Groundwater quality monitoring can provide early notification to allow for sufficient time to implement emergency response or contingency planning measures in the event that a drinking water source becomes threatened. Figure 6 shows the general locations recommended for groundwater quality monitoring in the WHPA for Wells 1A and 2. The general locations targeted are within the model predicted

six-month and one-year capture zones and downgradient of known or suspected soil or groundwater contamination sites. Factors associated with selecting an actual location, such as land ownership and access, have not been considered at this time. The recommended general locations are discussed below and listed in decreasing priority:

- MW 1 – Located within the six-month capture zone downgradient of one known (Site 1) and four potential (Sites 6-9) contaminant sources;
- MW 2 – Located in the six-month capture zone downgradient of one known (Site 2) and four suspected (Sites 3-5 and 10) contaminant sources;
- MW 3 – Located with the one-year capture zone downgradient of several potential contaminant source sites; and
- MW 4 – Located within the one-year capture zone southwest and cross-gradient of MW-3. This location is recommended to monitor for potential contaminants associated with rural residential land use activities, including agricultural.

The monitoring wells should be completed within the Qva aquifer to depths between approximately 50 and 70 feet bgs.

Because no known or suspected contamination sites were identified within any of the WHPAs for SW Well 1A and because the well is sealed into a deep aquifer overlain by two confining layers, no monitoring wells are recommended at this time. Groundwater quality monitoring in the SW Well 1A WHPAs should be reconsidered if subsequent contaminant inventory updates identify known or suspected soil or groundwater contamination sites that have the potential to threaten this source of supply.

5.6.1 Monitoring and Data Management

Recommended monitoring at these wells should include both water quality and water level monitoring. Analytes recommended for water quality monitoring include nitrate, total coliform bacteria, VOCs, and select metals and herbicides. For MWs 1 through 3, the recommended sampling frequency should be biannually for select herbicides and quarterly for the remaining analytes. MW 4 should be sampled for all of these same analytes, but on a biannual basis. Groundwater levels are recommended to be measured at each well during each water quality sampling event. The proposed sampling schedules should be reviewed after the first complete year of monitoring based on the initial results.

Data collected from the network of monitoring wells should be maintained in a database. Laboratory water quality test results should be reviewed for quality control and assurance, compared to state drinking water quality criteria and water quality data collected at Well 1, and evaluated for declining water quality trends.

6.0 SUMMARY

Golder has prepared this report to update the City of Yelm's Wellhead Protection Plan in order to prevent contamination of groundwater used as the City's source of drinking water supply. The following WHPP updates have been made:

- An updated discussion of the hydrogeologic characteristics of the area now that a deeper supply source aquifer (TQu) has been identified;
- Revised WHPAs for Wells 1A and 2 using a numerical groundwater flow model and the planned pumping capacities;
- Newly delineated WHPAs for the planned SW Well 1A supply source using the numerical groundwater flow model and planned pumping capacity;
- Susceptibility assessment for the planned SW Well 1A source supply; and
- A contaminant source inventory within the updated and newly defined WHPAs.

6.1 City Production Wells

Wells 1A and 2 are the City's sole drinking water supply sources. These two wells are completed in and obtain water from the confined Qva aquifer. Based on the findings from a deep groundwater resource exploration project in the Tahoma Terra area west of downtown, the City has constructed a new groundwater supply well (SW Well 1A). SW Well 1A is completed in and obtains water from the confined TQu aquifer. Further development of this well as a drinking water supply source is currently underway.

6.2 Wellhead Protection Area Delineations

The WHPAs for the City's current and planned supply wells were delineated using the most up-to-date version of the McAllister Groundwater Model utilized to support the City's water right applications and mitigation program. This model was adapted to delineate updated WHPAs for the City's current supply sources (Wells 1A and 2) and new WHPAs for the City's planned source (SW Well 1A). The adaptation resulted in a separate Yelm-specific tool that is referred to as the Yelm 2011 WHPA Model.

6.3 Known Potential Contaminant Sources

A total of 120 known or suspected soil and groundwater contamination sites were identified by a field survey within the WHPA boundaries and environmental database searches within a 2.5-mile radius encompassing the WHPAs. Of the 120 potential contaminant source sites identified, 23 coincide with the WHPAs delineated for Wells 1A and 2. Ten of 23 sites identified are located within the six-month capture zone, two of which were identified as known contaminated sources (Sites 1 and 2 on Figure 5). The remaining thirteen sites are within the one-year capture zone, one of which was identified as a known contaminated source (Site 11 on Figure 5). No known or potential contaminant sites were identified in the five- or ten-year capture zones for Wells 1A and 2. No known or suspected soil or groundwater contamination sites were identified within any of the WHPA capture zones delineated for SW Well 1A.

6.4 Management Strategy

The City currently employs the following management strategies to prevent and protect against contamination of the City's drinking water supply sources:

- Controlling future development in WHPA capture zones through land use regulations;
- Enforcement and regulation of activities within the WHPAs through the City's Municipal Codes;
- Notification to owners and operators of potential sources of contamination, and the agencies or jurisdictions that regulate them, that they reside within the City's WHPA boundaries;
- Spill prevention measures to prevent the accidental release of pollutants, and spill treatment and response actions to be taken to minimize potential damages in case a spill does occur; and
- Contingency measures to implement in the event that a natural disaster or contamination event results in the temporary or permanent loss of the City's water supply source.

7.0 RECOMMENDATIONS

The following pollution prevention and risk reduction measures are recommended to compliment the City's current commitment to protect its groundwater sources and maintain a safe and reliable community water supply:

- Adopt new WHPAs – To continue to protect the valuable groundwater resource, the City should use the newly-defined WHPAs to enforce land use restrictions on certain high-risk activities. The City should also engage in discussions with the operators of potential non-point source contaminants, such as golf courses and farmers, to establish and apply best management practices to reduce the risk of impacting the source waters.
- Public Outreach/Education – Increase public awareness and ownership of the wellhead protection program through outreach efforts focused on groundwater protection, such as brochures, utility bill inserts, press releases, booths at special events, meetings and workshops, and/or posting public signage throughout the parts of the community that are located within the WHPAs.
- Groundwater Protection Monitoring Wells – We recommend installation of new monitoring wells dedicated to determine the groundwater quality from known or suspected contaminated sites and improve the understanding of the local groundwater conditions. These wells are as follows:
  - MW 1 – Located within the six-month capture zone downgradient of one known (Site 1) and four potential (Sites 6-9) contaminant sources;
  - MW 2 – Located in the six-month capture zone downgradient of one known (Site 2) and four suspected (Sites 3-5 and 10) contaminant sources;
  - MW 3 – Located with the one-year capture zone downgradient of several potential contaminant source sites; and
  - MW 4 – Located within the one-year capture zone southwest and cross-gradient of MW-3. This location is recommended to monitor for potential contaminants associated with rural residential land use activities, including agricultural.
- Water Quality Monitoring Data – Water quality data collected from the network of monitoring wells should be maintained in a database. Laboratory water quality test results should be reviewed for quality control and assurance, compared to state drinking water quality criteria and water quality data collected at Well 1, and evaluated for declining water quality trends.
- Spill Response Plan Update – The Spill Response Plan should be reevaluated and updated as needed to address any site specific conditions pertaining to SW Well 1A after the facility is constructed.

With these actions, it is our opinion that the City of Yelm will both comply with State regulations, and continue to ensure that the long-term supply of high-quality drinking water remains available to its residents.

8.0 SIGNATURE PAGE

GOLDER ASSOCIATES INC.

David Banton, RG, LHG
Principal Hydrogeologist

Kenneth Janssen
Senior Project Hydrogeologist

9.0 REFERENCES

Brown and Caldwell, 2010, City of Yelm Water System Plan, July 2101.

City of Yelm, 2011, Water Right Mitigation Plan, Mitigation for City of Yelm Water Right Application: G2-29085 – Priority Date January 10, 1994. February 2011.

CDM, 2002a. Model Construction and Steady-State Calibration – McAllister Wellfield Numerical Model. Prepared for the City of Olympia Public Works Dept. April 2002.

CDM, 2002b. Final Report – McAllister Wellfield Numerical Model. Prepared for the City of Olympia Public Works Dept. July 2002.

Drost, B.W., G.L. Turney, N.P. Dion, and M.A. Jones, 1999. Conceptual Model and Numerical Simulation of the Ground-Water Flow System in the Unconsolidated Sediments of Thurston County, Washington. U.S. Geological Survey Water Resources Investigation Report 99-4165. Prepared in cooperation with Thurston County Department of Health.

Environmental Data Resources Inc. 2012, Wellhead Protection Contaminant Source Inventory, Inquiry Number: 3269533.1s, March 2012

EPA Facility Registry System. 2012. Geography Search on City Name: = “Yelm” and State: = “WA”. Obtained 03/16/202 from http://www.epa.gov/enviro/html/fii/fii_query_java.html

Golder Associates, Inc., 2008a. Groundwater Modeling of Water Right Applications and Transfers. Prepared for Yelm of Yelm. January 29, 2008.

Golder Associates, Inc., 2008b. Future Demand/Supply Forecast and Groundwater Modeling for Mitigation Planning. October 10, 2008.

Golder Associates, Inc., 2009, Technical Memorandum, Thompson Creek Conceptual Hydrogeologic Model, Portland, Oregon, December 2009.

Golder Associates, Inc., 2010, The City of Yelm Southwest Well 1A Development Report: Drilling, Well Construction and Testing, Portland, Oregon, March 2010.

Noble, J. B.; Wallace, E. F., 1966, Geology and Ground-Water Resources of Thurston County, Washington; Volume 2: Washington Division of Water Resources Water-Supply Bulletin 10, v. 2, 141 p., 5 plates.

Pollock, D.W, 1994, User’s guide for MODPATH/MODPATH-PLOT, Version 3: A particle tracking post-processing package for MODFLOW, the U.S. Geological Survey finite-difference ground-water flow model. U.S. Geological Survey Open-File Report 94-464. September 1994.

Robinson and Noble, Inc., 1995, Preliminary Ground Water Exploration for the Thurston Highlands Associates. January, 1995.

Robinson and Noble, Inc., 2001, City of Yelm Wellhead Protection Plan. May, 2001.

United States Geological Survey (USGS), 1990a, 7.5-minute McKenna Quadrangle, Washington, 1:24,000.

United States Geological Survey (USGS), 1990b, 7.5-minute Tenalquot Prairie Quadrangle, Washington, 1:24,000.

Washington State Department of Ecology. 2010. Land Use: Washington State 2010. Obtained 03/16/2012 from http://www.ecy.wa.gov/services/gis/data/data.htm#l

Washington State Department of Ecology. 2011. Facility/Site. Obtained 03/16/2012 from http://www.ecy.wa.gov/services/gis/data/data.htm#f

Western Regional Climate Center (WRCC), 2010, Historical Climate Information. http://www.wrcc.dri.edu/. Accessed July 1, 2010.

Tables

TABLE 1
CITY OF YELM WELLS

DOH Source No.	Alternative Name	Well Tag ID	Status/Usage	Well Diameter (in)	Well Depth (ft bgs)	Screened Interval (ft bgs)	SWL (ft bgs)	Capacity (gpm)	TRS Location	(1)Aquifer Unit
01	Well 1	AAA-943	Active/Emergency	12	63	53-63	30	275	T17N R2E S19	Qva
02	Well 2	AAA-944	Active/Permanent	12	61	50-61	30	1,700		
03	Well 3	AAA-945	Decommissioned	12	40	n/a	n/a	500	T17N R2E S20	Qvr?
04	Well 4 3A	AGP-800	Not Active/Emergency	12	55	24-34	16	400		
05	Well 1A	ALG-255	Active/Permanent	12	67	57-67	30	1,700	T17N R2E S19	Qva
n/a	SW Well 1A	ALM-113	New active/permanent source pending DOH approval	12	633	369-437 487-547 611-625	103	2,100	T17N R1E S23	TQu

Notes: (1) Qvr - Recessional Outwash; Qvt - Glacial Till; Qva - Advance Outwash; Qf - Kitsap Formation; Qc - Salmon Springs(?) Drift; Tqu - Unconsolidated and Undifferentiated Deposits; and Tb - Bedrock.
Further descriptions of each unit are provided in Table 2.

TABLE 2
LITHOLOGIC AND HYDROLOGIC CHARACTERISTICS OF GEOHYDROLOGIC UNITS (Drost et al., 1999)

System	Series	Geologic unit		Geohydrologic unit, in this report[1]	Typical thickness (feet)	Lithologic characteristics	Hydrologic characteristics
Quaternary	Holocene		Alluvium	Qvr Qvrm	10-40	Alluvial and deltaic sand and gravel along major water courses. Moderately to well-sorted glacial sand and gravel, including kettled end moraine	An aquifer where saturated. Groundwater is mostly unconfined. Perched conditions occur locally.
	Pleistocene	Vashon Drift	Recessional outwash and end moraine				
			Till	Qvt[2]	20-55	Unsorted sand, gravel, and boulders in a matrix of silt and clay.	Confining bed, but can yield usable amounts of water. Some thin lenses of clean sand and gravel.
			Advance outwash	Qva	10-45	Poorly to moderately well-sorted, well-rounded gravel in a matrix of sand with some sand lenses.	Ground water, mostly confined. Used extensively for public supplies near Tumwater.
		Kitsap Formation		Qf[3]	20-70	Predominantly clay and silt, with some layers of sand and gravel. Minor amounts of peat and wood.	Confining bed, but in places yields usable amounts of water.
		Salmon Springs(?) Drift (Noble and Wallace, 1966) / Deposits of "penultimate" glaciation (Lea, 1984)		Qc	15-70	Coarse sand and gravel, deeply stained with red or brown iron oxides.	Water is confined. Used extensively for industrial purposes near Tumwater.
		Unconsolidated and undifferentiated deposits		TQu	Not known	Various layers of clay, silt, sand, and gravel of both glacial and nonglacial origin.	Contains both aquifers and confining beds. Water probably confined.
Tertiary	Miocene and Eocene	Bedrock		Tb	Not known	Sedimentary rocks consisting of claystone, siltstone, sandstone, and minor beds of coal. Igneous bodies of andesite and basalt.	Poorly permeable base of unconsolidated sediments. Locally an aquifer, but generally unreliable. Water contained in fractures and joints. Well yields relatively small. Numerous abandoned wells.

[1]The identification of geohydrologic units in this report is a "best estimate" based on drillers' logs and existing surficial geology maps.
[2]Includes "late Vashon lake deposits" (Washington State Department of Ecology, 1980). May include till of "penultimate" glaciation (Lea, 1984).
[3]Includes alluvium younger than Kitsap Formation in Nisqually River delta. May include some Vashon till (where multiple tills are present). May include till of "penultimate" glaciation (Lea, 1984).

SOURCE: Drost et al., 1999

TABLE 3
LAND USE TYPES

Residential	Rural Residential	Commercial and Industrial	Institutional and Open Space
All other residential not elsewhere coded	Agriculture classified under current use chapter 84.34 RCW	Arterial commercial	Educational services
High density residential 14	Long term agriculture	Automobile parking	Designated forest land under chapter 84.33 RCW
Household, 2-4 units	Rural	Central business district	Institutional
Household, multiunits (5 or more)	Rural 1/10	Commercial	Institutional district
Household, single family units	Rural residential 1/5	Contract construction services	Military reservation
Low density residential	Rural residential resource 1/5	Governmental services	Open space
Master planned community	Urban reserve 1/5	Heavy commercial	Open space land classified under chapter 84.34 RCW
Moderate density residential		Industrial	Open space park
Residential		Large lot commercial	Parks
Residential lamird 1/1		Light industrial	Timberland classified under chapter 84.34 RCW
Residential lamird 1/2		Mining activities and related services	Undeveloped land
Residential lamird 2/1		Miscellaneous services	
		Neighborhood commercial	
		Other retail trade	
		Professional services	
		Retail trade - automotive, marine craft, aircraft, and accessories	
		Retail trade - eating and drinking	
		Retail trade - general merchandise	
		Utilities	

TABLE 4
LAND USE RISK CONCERNS

Land Use Category	Nitrates	Pesticides and Fertilizers	Petroleum Hydrocarbons	Metals	Corrosive Materials
Residential and Rural Residential	Yes	Yes	Yes	Limited	No
Commercial/Industrial	No	Yes	Yes	Yes	Yes
Institutional/Open Space	Yes	Yes	Limited	Limited	No

TABLE 5
LEVEL I SUB-PRIORITIZATION: POTENTIAL CONTAMINANT SOURCE SITE LOCATION RELATIVE TO WELLHEAD PROTECTION AREA

Sub-Priority Level	Description
1	WHPA Zone 1 (6 month time of travel capture zone)
2	WHPA Zone 2 (1 year time of travel capture zone)
3	WHPA Zone 3 (5 year time of travel capture zone)
4	WHPA Zone 4 (10 year time of travel capture zone)
5	Outside the WHPAs - Hydraulically Upgradient of the WHPA(1)
6	Outside the WHPAs - Hydraulically Downgradient of the WHPA(1)

NOTES: (1) Determined based on the Potentiometric Surface Map Presented in Appendix C.

TABLE 6
LEVEL II SUB-PRIORITIZATION: TYPE OF CONTAMINATION

Sub-Priority Level	Known or Suspected Contamination	Type of Contaminated Site	Code
1	Known	Confirmed and Suspected Contaminated Sites State Clean-up Sites	CSCSL NFA SCS
2	Known	Leaking Underground Storage Tanks	LUST
3	Known	Washington Independent Clean-up Report Emergency Response Notification System Hazardous Materials Incident Report System Voluntary Clean-up Site DOE Enforcement Action Final	ICR ERNS HMRIS VCP ENF F
4	Potential	Resource Conservation Recovery Act Sites Toxic Chemical Release System Facility Index System Emergency/Hazard Chemical RPT Tier 2 Recycling Facility Hazardous Waste Generators, Managers, or Planners Hazardous Waste Manifest Information	RCRA TRIS FINDS EHCR2 RECYCLING HAZ WASTE MANIFEST
5	Potential	Operational Underground Storage Tanks Financial Assurance for a UST	UST FA
6	Potential	Active or Inactive Facilities that fail to meet RCRA Solid Waste Facility or Landfill site	SPILLS SFW/LF
7	Potential	FIDRA/TSCAL Tracking System (Pesticide Use)	FTTS
8	Potential	Clandestine Drug Labs	CDL
9	Potential	National Pollution Discharge Permit	NPDES
10	Potential	Underground Injection Wells Facilities and Sites of Interest to WA DOE	UIC All SITES

TABLE 7
CONTAMINANT SOURCE INVENTORY AND RISK PRIORITY RANKING

Rank #	Ref #	Name	Address	List Source Type	Decision		
					I	II	III (ft)
1	EDR 24	YELM SHELL	706 YELM AVE E, YELM, WA 98597	UST, FINANCIAL ASSURANCE, RCRA-NONGEN, VCP, ICR, FINDS, MANIFEST, LUST FACILITY, CSCSL NFA	1	1	1,814
2	DOE 19	YELM RITE AIDE	VANCIL RD & SR507 , YELM, WA 98597	VCP	1	3	2,849
3	EDR 13	RITE AID 5286 YELM AVE	909 YELM AVE E, YELM, WA 98597	RCRA, ALL SITES, FINDS, MANIFEST, HAZARDOUS WASTE GENERATOR, HAZARDOUS WASTE PLANNER	1	5	2,508
4	EDR 11	JIFFY LUBE STORE 2812	1002 E YELM AVE, YELM, WA 98597	ALL SITES, FINDS, EMERGENCY/HAZ CHEM RPT TIER2	1	5	2,895
5	WSS 16	SAFEWAY GAS STATION	1109 YELM AVE E, YELM, WA 98597	UST	1	5	3,180
6	WSS 20	WALT'S TIRE SERVICE	509B YELM AVE E, YELM, WA 98597	ALL SITES	1	10	1,225
7	WSS 21	NAPA AUTO PARTS	509A YELM AVE E, YELM, WA 98597	ALL SITES	1	10	1,225
8	EDR 5	CHURCH OF JESUS CHRIST OF LDS	10423 CLARK ROAD SE, YELM, WA 98597	UIC	1	10	1,726
9	WSS 23	EAGLE CAR WASH	403 YELM AVE, YELM, WA 98597	ALL SITES	1	10	2,023
10	WSS 22	LES SCHWAB TIRE	811 YELM AVE E, YELM, WA 98597	ALL SITES	1	10	2,734
11	EDR 7	16507 STATE ROUTE 507 SE	16507 STATE ROUTE 507 SE, YELM, YELM, WA	HMRIS, ERNS	2	3	4,521
12	EDR 17	RAINIER CHEVRON	16518 YELM AVE SE, YELM, WA 98597	FINDS, UST	2	5	4,472
13	EDR 9	HASSAN CORPORATION	16507 SR 507, YELM, WA 98597	FINANCIAL ASSURANCE, RCRA, UST, HAZARDOUS WASTE GENERATOR	2	5	4,545
14	DOE 24	YCOM NETWORKS CONST YARD	10812 BALD HILL RD SE , YELM, WA 98597	EMERGENCY/HAZ CHEM RPT TIER2, ALL SITES, FINDS	2	5	5,826
15	EDR 4	PUGET SOUND ENERGY- PSE	10730 MORRIS ROAD, YELM, WA	SPILLS	2	7	4,943
16	WSS 19	O'REILLY'S AUTO PARTS	902 ALGIERS DR NE, YELM, WA 98597	ALL SITES	2	10	2,433
17	WSS 18	YELM FAMILY DENTISTRY	106 PLAZA DRIVE, YELM, WA 98597	ALL SITES	2	10	3,716
18	WSS 13	QT SPA NAILS	B102 CREEK ST, YELM, WA 98597	ALL SITES	2	10	4,208
19	WSS 14	DESERT TANING	B104 CREEK ST, YELM, WA 98597	ALL SITES	2	10	4,208
20	WSS 17	AUTO ZONE	1210 YELM AVE E, YELM, WA 98597	ALL SITES	2	10	4,208
21	WSS 12	J & I POWER EQUIPMENT	10615 BALD HILL RD, YELM, WA 98597	ALL SITES	2	10	4,762
22	WSS 15	YELM AUTO MALL	16150106TH AVE, YELM, WA 98597	ALL SITES	2	10	4,774
23	WSS 11	DEL'S FARM SUPPLY	10616 BALD HILL RD, YELM, WA 98597	ALL SITES	2	10	4,925
24	EDR 70	LIVINGSTON BOATS INC	406 RAILROAD ST, YELM, WA 98597	RCRA, FTTS, FINDS, MANIFEST, TRIS, HAZARDOUS WASTE GENERATOR, CSCSL NFA	5	1	1,737

TABLE 7
CONTAMINANT SOURCE INVENTORY AND RISK PRIORITY RANKING

Rank #	Ref #	Name	Address	List Source Type	Decision		
					I	II	III (ft)
25	EDR 137	BILLS TOWING	801 W YELM AVE, YELM, WA	ALL SITES, CSCSL NFA, FINDS, STATE CLEAN-UP SITE	5	1	3,697
26	EDR 151	WOOD FABRICATORS	1001 NE RHOTON RD, YELM, WA 98597	RCRA-NONGEN, ICR, ALL SITES, CSCL NFA, FINDS, LUST FACILITY, HAZARDOUS WASTE GENERATOR	5	1	4,425
27	EDR 191	FLYING M	35618 HWY 507 S, MCKENNA, WA 98558	UST, LUST FACILITY	5	2	12,312
28	DOE 20	NISQUALLY PINES PROPERTY	8903 PEPPERIDGE LN SE , YELM, WA 98597	VCP	5	3	7,848
29	EDR 182	13431 SOLBERG RD.	13431 SOLBERG RD., YELM, WA	ERNS	5	3	17,407
30	DOE 46	US DEA NEAT RD YELM	20104 NEAT RD, YELM, WA 98597	HAZARDOUS WASTE GENERATOR	5	5	340
31	DOE 13	YCOM NETWORKS PLANT OPS	105 2ND ST, YELM, WA 98597	EMERGENCY/HAZ CHEM RPT TIER2, HAZWASTE	5	5	668
32	EDR 48	MICHAEL J MCCASLIN	107 S 1ST ST, YELM, WA 98597	UST, ALL SITES, FINDS	5	5	894
33	EDR 51	GORDERS AUTO REBUILD	103 1ST ST N, YELM, WA 98597	RCRA, FINDS, UST, ALL SITES, HAZARDOUS WASTE GENERATOR	5	5	919
34	EDR 55	YELM EXTENSION SCHOOL	107 FIRST ST NORTH, YELM, WA 98597	FINDS	5	5	925
35	EDR 40	FRONTIER VILLAGE PROF DRYCLEAN	404 1ST ST SE & MOSMAN, YELM, WA 98597	RCRA, ALL SITES, FINDS, HAZARDOUS WASTE GENERATOR, INACTIVE DRYCLEANER	5	5	1,011
36	EDR 37	MOUNT RAINIER CLINIC INC	503 1ST ST S, YELM, WA 98597	ALL SITES, FINDS, EMERGENCY/HAZ CHEM RPT TIER2	5	5	1,057
37	EDR 59	YELM EXTENSION SCHOOL	203 N FIRST ST, YELM, WA 98597	FINDS	5	5	1,111
38	EDR 67	HARTS LAKE ASSOCIATES	402 NW RAILROAD, YELM, WA 98597	UST, ALL SITES, FINDS	5	5	1,732
39	EDR 6	MILL POND INTERMEDIATE SCHOOL	909 MILL RD SE, YELM, WA 98597	FINDS	5	5	1,874
40	EDR 60	YELM MIDDLE SCHOOL	402 YELM AVE. W, YELM, WA 98597	FINDS	5	5	1,895
41	EDR 64	LACKAMAS ELEMENTARY	16240 BALD HILL RD, YELM, WA 98597	FINDS	5	5	1,904
42	EDR 91	SAMANTHA RIDGE	502 CRYSTAL SPRINGS ST, YELM, WA 98597	ALL SITES, CONSTRUCTION SW GP	5	5	2,410
43	DOE 32	HERTERS INC	MAIN ST , YELM, WA 98597	RCRA, HAZARDOUS WASTE GENERATOR	5	5	2,463
44	EDR 92	LASCO BATHWARE	801 NORTHERN PACIFIC, YELM, WA 98597	RCRA, ALL SITES, TRIS, FINDS, MANIFEST, AIRS, FINANCIAL ASSURANCE, UST	5	5	2,703
45	EDR 94	CENEX HARVEST STATES YELM	509 RHOTON RD, YELM, WA 98597	ALL SITES, FINDS, EMERGENCY/HAZ CHEM RPT TIER2	5	5	2,742

TABLE 7
CONTAMINANT SOURCE INVENTORY AND RISK PRIORITY RANKING

Rank #	Ref #	Name	Address	List Source Type	Decision		
					I	II	III (ft)
46	EDR 98	PENSKE TRUCK LEASING CO LP	801 NORTHERN PACIFIC RD BLDG 2, YELM, WA 98597	RCRA, ALL SITES, FINDS, MANIFEST, HAZARDOUS WASTE GENERATOR	5	5	2,786
47	EDR 112	NORTHWEST DELI MART 46	608 YELM HWY, YELM, WA 98597	FINDS, UST, EMERGENCY/HAZ CHEM RPT TIER2	5	5	2,899
48	EDR 125	CENTRAL REDDIMIX INC	705 RHOTON RD, YELM, WA 98597	FINDS	5	5	3,374
49	EDR 126	GLACIER NORTHWEST	705 NORTHWEST RHOTON ROAD, YELM, WA	ALL SITES, SPILLS, NPDES, UST, FINDS, TRIS	5	5	3,374
50	FRS 41	YELM COMMUNITY SCHOOLS TRANS DEPT	401 COATS ST NW, YELM, WA 98597	RCRA, UST, HAZARDOUS WASTE GENERATOR	5	5	3,663
51	EDR 81	JOHNS MEADOWS	16440 MIDDLE RD SE, YELM, WA	ALL SITES, CONSTRUCTION SW GP	5	5	3,734
52	EDR 80	FORT STEVENS ELEMENTARY	16525 100TH WAY SE, YELM, WA 98597	FINDS	5	5	4,137
53	EDR 159	HOFFMAN PLAT	9405 CULLENS ROAD, YELM, WA 98597	FINDS, ALL SITES, CONSTRUCTION SW GP	5	5	4,572
54	EDR 164	CULLENS ROAD PLAT	9329 CULLENS RD, YELM, WA 98597	ALL SITES, NPDES, FINDS, MUNICIPAL IP	5	5	4,842
55	EDR 148	T AUTOMOTIVE SERVICE	16713 CANAL RD SE, YELM, WA 98597	RCRA-NONGEN, ALL SITES, FINDS, HAZARDOUS WASTE GENERATOR	5	5	5,456
56	EDR 170	YELM WWTP AND WATER RECLAMATION FACILITY	931 NORTHERN PACIFIC ROAD, YELM, WA 98597	ALL SITES, FINDS	5	5	5,706
57	EDR 1	CITY OF YELM	105 W YELM AVE, YELM, WA 98597	ALL SITES, NON ENFORCEMENT FINAL	5	5	5,828
58	EDR 3	YELM PRAIRIE ELEMENTARY	16535 110TH AVE. SE, YELM, WA 98597	FINDS	5	5	6,011
59	EDR 166	YELM DRUG CHEMICAL DU	NW COR OF FLUME RD & BRIDGE RD, YELM, WA 98597	RCRA-NONGEN, ALL SITES, FINDS, HAZARDOUS WASTE GENERATOR	5	5	6,974
60	DOE 26	WAL MART SUPERCENTER 3705	17100 SR 507 SE , YELM, WA 98597	HAZ WASTE MANAGEMENT ACTIVITY, HAZARDOUS WASTE GENERATOR, RCRA, FINDS, ALL SITES, SPILLS, MANIFEST	5	5	7,721
61	EDR 145	YELM MAINTENANCE SITE	17526 HWY 507 SE, YELM, WA 98597	UST, ALL SITES, FINDS	5	5	9,696
62	EDR 122	BNH AUTO WRECKING	17505 110TH AVE SE, YELM, WA 98597	RCRA, FINDS, ALL SITES, HAZARDOUS WASTE GENERATOR	5	5	10,291
63	DOE 17	WE & B LIMITED	15708 123RD AVE , YELM, WA 98597	SWF/LF, RCRA, FINDS, ALL SITES, SPILLS, MANIFEST, RECYCLING	5	5	10,466
64	EDR 132	VAIL RD DRUG LAB	11515 VAIL RD SE, YELM, WA 98597	RCRA-NONGEN, ALL SITES, FINDS, HAZARDOUS WASTE GENERATOR	5	5	11,770
65	EDR 183	NISQUALLY VALLEY CARE CENTER	9414 357TH ST S, MCKENNA, WA 98558	FINDS, ALL SITES, NPDES, MUNICIPAL IP	5	5	11,790

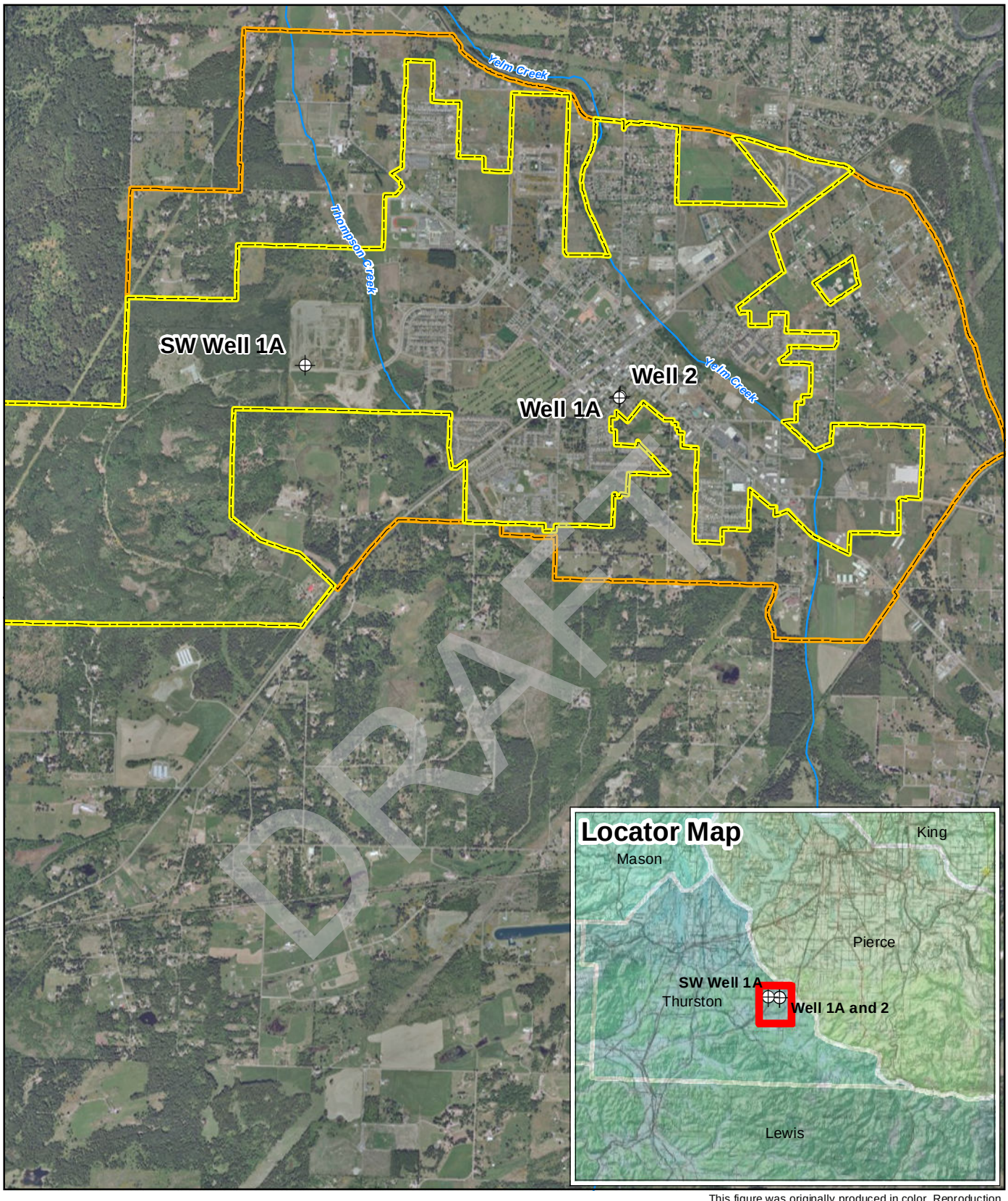
TABLE 7
CONTAMINANT SOURCE INVENTORY AND RISK PRIORITY RANKING

Rank #	Ref #	Name	Address	List Source Type	Decision		
					I	II	III (ft)
66	EDR 139	FOUR CORNER GROCERY	11500 BALD HILLS RD, YELM, WA 98597	FINANCIAL ASSURANCE, UST, ALL SITES, FINDS, ENFORCEMENT FINAL	5	5	11,891
67	EDR 199	WEST AIR AVIATION	18324 COOK RD 6, YELM, WA 98597	RCRA, ALL SITES, FINDS	5	5	14,719
68	DOE 52	CENTURYTEL ROYAL CITY	101 CATALPA AVE NE, ROYAL CITY, WA 99357	EMERGENCY/HAZ CHEM RPT TIER2	5	5	15,526
69	FRS 32	WA DOT YELM	SR 507 MP 29.6 NORTHSIDE, YELM, WA 98597	HAZWASTE, EMERGENCY/HAZ CHEM RPT TIER2	5	5	17,036
70	FRS 8	DESCHUTES DRUG LAB	VAIL RD & DESCHUTES T16N R2E S, YELM, WA 98597	RCRA	5	5	17,530
71	FRS 44	YELM GARAGE	112 SE YELM AVE, YELM, WA 98597	UST	5	6	882
72	EDR 57	NISQUALLY VALLEY GOLF COURSE	MOSSMAN & EDWARDS, YELM, WA 98597	UST, ALL SITES	5	6	1,524
73	EDR 65	SAFEWAY FUEL CENTER YELM AVE	1109 A YELM AVE E, YELM, WA 98597	UST, ALL SITES	5	6	1,947
74	EDR 114	PARKS PLACE	608 W YELM AVE, YELM, WA 98597	FINANCIAL ASSURANCE	5	6	2,899
75	DOE 37	CENTRALIA CITY LIGHT YELM HYDRO	14024 YELM HWY SE , YELM, WA 98597	UST, ENFORCEMENT FINAL	5	6	3,622
76	DOE 41	VALLEY TRADING POST VALLEY GROCERY	15547 VAIL RD SE , YELM, WA 98597	UST	5	6	11,624
77	DOE 58	WALTS PLACE STORE	POST OFFICE HWY 500 FT S, MCKENNA, WA	UST	5	6	12,418
78	DOE 27	DYLANS CORNER	15201 VAIL RD , YELM, WA 98597	UST	5	6	13,143
79	EDR 118	CREAMERY TRANSPORT CO INC	17025 HANNUS RD SE, YELM, WA 98597	UST, ALL SITES	5	6	13,641
80	EDR 44	NA	222 YELM AVENUE EAST, YELM, WA	SPILLS	5	7	632
81	EDR 36	NA	118 MOSSMAN AVENUE SOUTHEAST, YELM, WA	SPILLS	5	7	872
82	EDR 61	AMTEK	406 RAILROAD STREET, YELM, WA	SPILLS	5	7	1,724
83	EDR 90	NA	16145 RAILWAY RD, YELM, WA	SPILLS	5	7	2,640
84	EDR 109	CHIROPRACTIC OFFICE	604 YELM HWY SE, SUITE A, YELM, WA	SPILLS	5	7	2,881
85	EDR 116	WESTSTAR INC	608 YELM AVENUE, YELM, WA	ALL SITES, SPILLS	5	7	2,899
86	EDR 46	PUGET SOUND ENERGY	15235 105TH AVENUE SOUTHEAST, YELM,WA	SPILLS	5	7	3,608
87	EDR 2	UNKNOWN	10826 VANCIL ROAD, YELM, WA	SPILLS	5	7	3,840
88	EDR 143	NA	909 YELM AVENUE WEST, YELM, WA	SPILLS	5	7	4,215
89	EDR 56	UNKNOWN	10405 GROVE ROAD SE, YELM, YELM, WA	SPILLS	5	7	5,435
90	EDR 147	NA	16747 CANAL ROAD SE, YELM, WA	SPILLS	5	7	5,478
91	EDR 178	PREVIOUS OWNER	119 VIEW DRIVE NORTHWEST, YELM, YELM, WA	SPILLS	5	7	5,815
92	EDR 47	NA	10535 GROVE ROAD, YELM, WA	SPILLS	5	7	6,014
93	EDR 174	NA	9543 BRIDGE ROAD SOUTHEAST, YELM, WA	SPILLS, CDL	5	7	7,332
94	EDR 169	GERBER & SONS	9801 BRIDGE RD SE, YELM, WA	SPILLS	5	7	7,706
95	EDR 188	RESIDENCE	9132 BRIDGE RD, YELM, WA	SPILLS	5	7	7,808

TABLE 7
CONTAMINANT SOURCE INVENTORY AND RISK PRIORITY RANKING

Rank #	Ref #	Name	Address	List Source Type	Decision		
					I	II	III (ft)
96	EDR 195	NA	9110 PEPPERIDGE LANE SOUTHEAST, YELM, WA	SPILLS, CDL	5	7	7,810
97	EDR 89	UNKNOWN	11610 HOBIE STREET SOUTHEAST, YELM, WA	SPILLS	5	7	8,221
98	EDR 87	NA	17246 110 TH AVENUE SOUTH EAST, YELM, WA	SPILLS	5	7	9,329
99	EDR 20	UNKNOWN	15011 119TH WAY SE YELM., YELM, WA	SPILLS	5	7	9,721
100	EDR 162	NA	HWY 507/ VAIL RD SE, YELM, WA	SPILLS	5	7	10,792
101	EDR 19	NA	15836 123 AVENUE, YELM, WA	SPILLS	5	7	11,066
102	EDR 158	NA	110TH AND VAIL ROAD SOUTHEAST, YELM, WA	SPILLS	5	7	11,428
103	EDR 39	NA	15218 123RD AVENUE SOUTHEAST, YELM, WA	SPILLS	5	7	11,504
104	EDR 124	NA	11647 VAIL ROAD SOUTHEAST, YELM, WA	SPILLS	5	7	12,113
105	EDR 45	PUGET SOUND ENERGY	12520 MORRIS ROAD SE, YELM, WA	SPILLS	5	7	12,304
106	EDR 190	UNKNOWN	35807 94TH AVENUE SOUTH, MCKENNA, WA.	SPILLS	5	7	12,558
107	EDR 177	NA	11234 AERO LANE SE, YELM, WA	SPILLS	5	7	13,182
108	EDR 138	NA	14945 129TH LANE SE, YELM, WA	SPILLS	5	7	14,012
109	EDR 196	NA	12635 WAGON WHEEL ROAD SOUTHEAST, YELM, WA	SPILLS	5	7	14,140
110	EDR 197	NA	13103 ZELLER ROAD SE, RAINIER, WA	SPILLS	5	7	16,150
111	EDR 62	YELM SD 2	404 YELM AVE W, YELM, WA 98597	FTTS	5	8	1,901
112	EDR 187	15913 SE 90TH AVE	15913 SE 90TH AVE, ROCHESTER, WA	SPILLS, CDL	5	9	6,327
113	EDR 97	NA	11822 HOBBY ST SE, YELM, WA 98597	CDL	5	9	9,292
114	EDR 161	NA	12220 HILLCREST, YELM, WA 0	CDL	5	9	11,346
115	EDR 88	TODAY'S DENTAL	502 WEST YELM AVENUE, YELM, WA 98597	UIC	5	10	2,446
116	EDR 117	TAHOMA TERRA INFILTRATION GALLERIES	14848 LONGMIRE ST SE, YELM, WA 98579	UIC	5	10	3,063
117	EDR 111	YELM AREA RELIABILITY	16302 RAILWAY RD SE, YELM, WA 98597	ALL SITES, NPDES	5	10	3,461
118	EDR 173	YELM HIGH SCHOOL 12	1315 YELM AVE. W, YELM, WA 98597	FINDS	6	5	4,900
119	EDR 179	YELM COMMUNITY SCHOOLS	14901 YELM HWY SE, YELM, WA 98597	RCRA, ALL SITES, FINDS, HAZARDOUS WASTE GENERATOR	6	5	4,910
120	EDR 172	NA	14504-C SE BERRY VALLEY RD, YELM, WA	CDL	6	9	2,579

Figures



LEGEND

- Well
- Yelm City Limits
- Yelm Urban Growth Area
- Creek

0 4,000

Scale in Feet

Map Projection:
NAD83 State Plane WA
South FIPS 4602 Feet

Source:
ESRI (Imagery), Washington DOE (Counties),
City of Yelm (City Limits, Urban Growth Area), NHD (Creek),
USGS (Topo map), Golder Associates, Inc.(Wells)

N

This figure was originally produced in color. Reproduction in black and white may result in a loss of information.

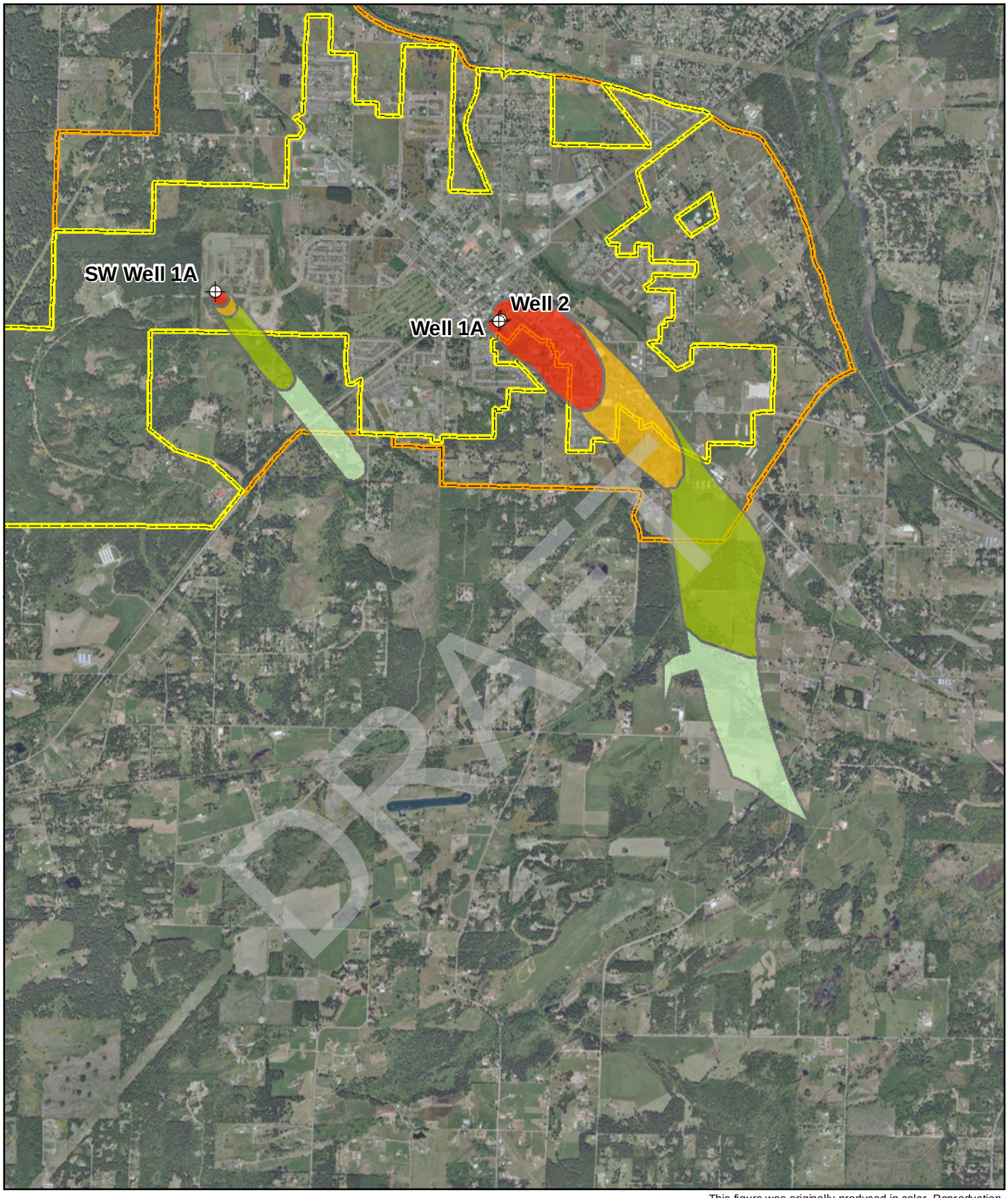
FIGURE **1**

WELL LOCATION

YELM WELL HEAD PROTECTION PLAN

Path: S:\Projects\2011\2011 Water Group Projects\113-99719 Yelm WHPP\Task 4 - Wellhead Protection Plan\mxds\11399719F01_Well_Locations.mxd

Golder Associates



LEGEND

- Well
- Yelm City Limits
- Yelm Urban Growth Area

Wellhead Capture Zone

- 6 month
- 1 year
- 5 year
- 10 year

0 4,500

Scale in Feet

Map Projection:
NAD83 State Plane WA
South FIPS 4602 Feet

Source:
ESRI (Imagery), City of Yelm (City Limits, Urban Growth Area), Golder Associates, Inc.(Wells, Wellhead Capture Zone)

DRAFT

N

This figure was originally produced in color. Reproduction in black and white may result in a loss of information.

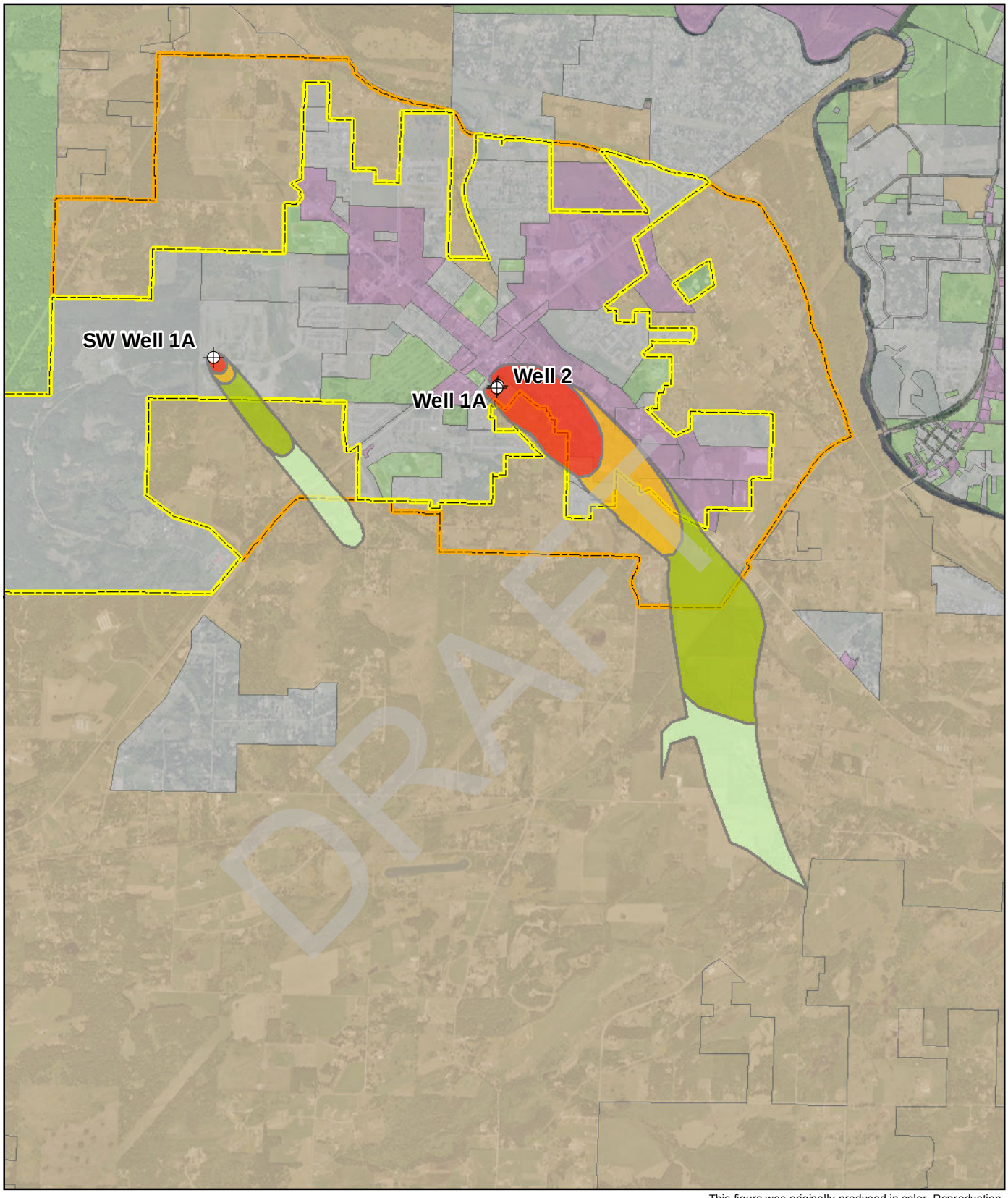
FIGURE **2**

WELLHEAD PROTECTION AREAS

YELM WELL HEAD PROTECTION PLAN

Path: S:\Projects\2011\2011 Water Group Projects\113-99719 Yelm WHPP\Task 4 - Wellhead Protection Plan\mxds\11399719F02_Wellhead_Protection_Areas.mxd

Golder Associates



LEGEND

- Well
- Yelm City Limits
- Yelm Urban Growth Area

Wellhead Capture Zone

- 6 month
- 1 year
- 5 year
- 10 year

Land Use

- Commercial/ Industrial
- Institutional/ Open Space
- Residential
- Rural Residential

0 4,500

Scale in Feet

Map Projection:
NAD83 State Plane WA South
FIPS 4602 Feet

Source:
ESRI (Imagery), City of Yelm (City Limits, Urban Growth Area), Thurston County and WA DOE (Land Use), Golder Associates, Inc.(Wells, Wellhead Capture Zone)

This figure was originally produced in color. Reproduction in black and white may result in a loss of information.

N

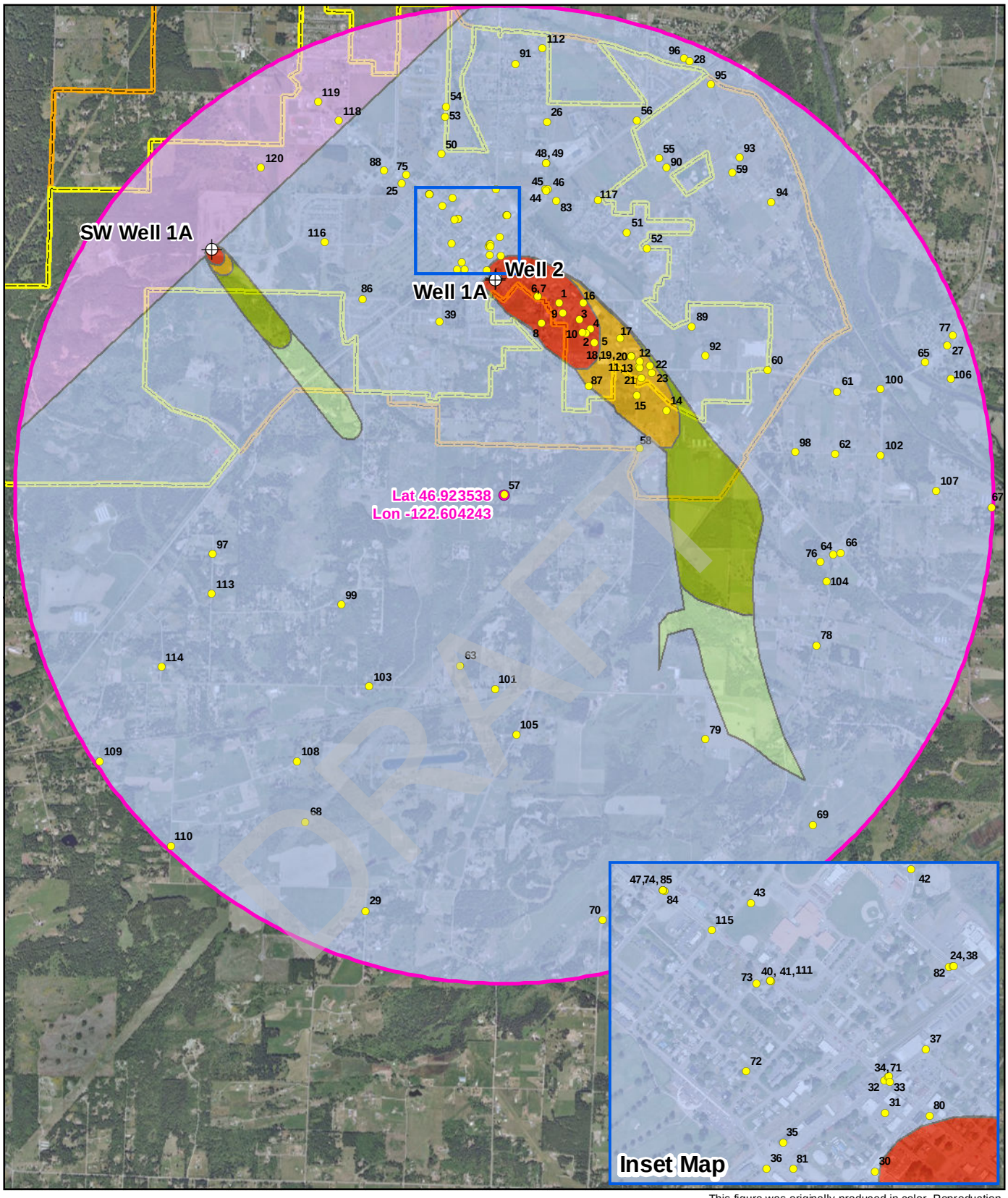
FIGURE **3**

LAND USE

YELM WELL HEAD PROTECTION PLAN

Path: S:\Projects\2011\2011 Water Group Projects\113-99719 Yelm WHPP\Task 4 - Wellhead Protection Plan\mxds\11399719F03_Zoning.mxd

Golder Associates



LEGEND

- Well
- Yelm City Limits
- Yelm Urban Growth Area
- 2.5 Mile Radius Vertex
- 2.5 Mile Radius Boundary
- Facilities (Rank #)
- (See Table 7)

Decision Level I Areas

- 1 (6 month)
- 2 (1 year)
- 3 (5 year)
- 4 (10 year)
- 5 Upgradient
- Downgradient

0 4,500

Scale in Feet

Map Projection:
NAD83 State Plane WA South FIPS 4602 Feet

Source:
ESRI (Imagery), City of Yelm (City Limits, Urban Growth Area), Golder Associates, Inc.(Wells, Decision Level 1 Areas, 2.5 mile Boundary and Center)

N

This figure was originally produced in color. Reproduction in black and white may result in a loss of information.

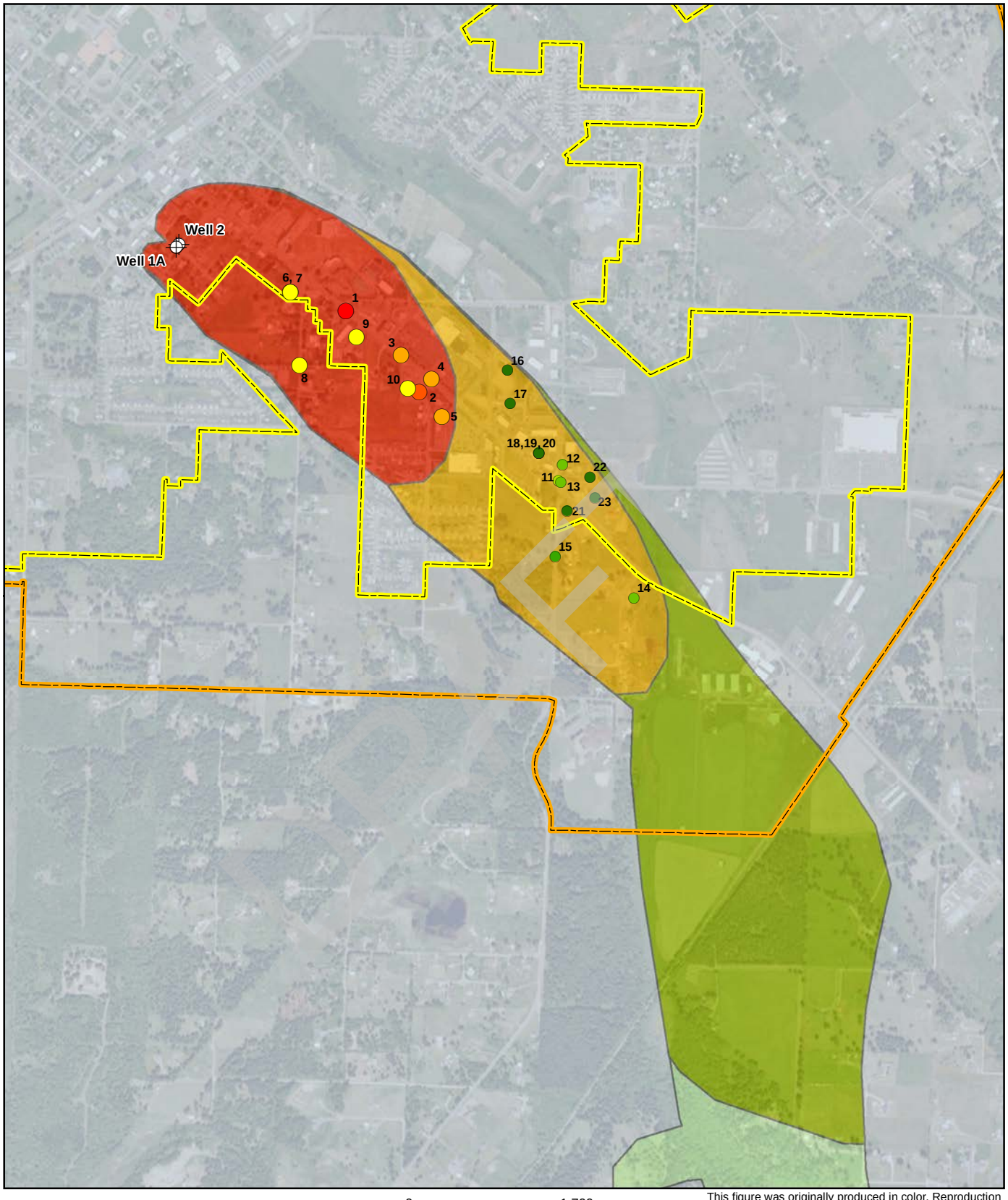
FIGURE 4

DECISION LEVEL I HAZARD AREAS AND FACILITIES

YELM WELL HEAD PROTECTION PLAN

Golder Associates

Path: S:\Projects\2011\2011 Water Group Projects\113-99719 Yelm WHPP\Task 4 - Wellhead Protection Plan\mxds\11399719F04_Decision_Level_1 w Haz Rank.mxd



LEGEND

Well

Yelm City Limits

Yelm Urban Growth Area

Decision Level 1 Areas

1 (6 month)

2 (1 year)

3 (5 year)

4 (10 year)

5 Upgradient

Decision Level I and II Ratings Hazard Rank #

1, 1 | 2, 3

1, 3 | 2, 5

1, 5 | 2, 7

1, 10 | 2, 10

(See Table 7)

0 1,700

Scale in Feet

Map Projection:
NAD83 State Plane WA South FIPS 4602 Feet
Source:
ESRI (Imagery), City of Yelm (City Limits, Urban Growth Area), Golder Associates, Inc.(Wells, Decision Level 1 Areas, Facilities)

N

This figure was originally produced in color. Reproduction in black and white may result in a loss of information.

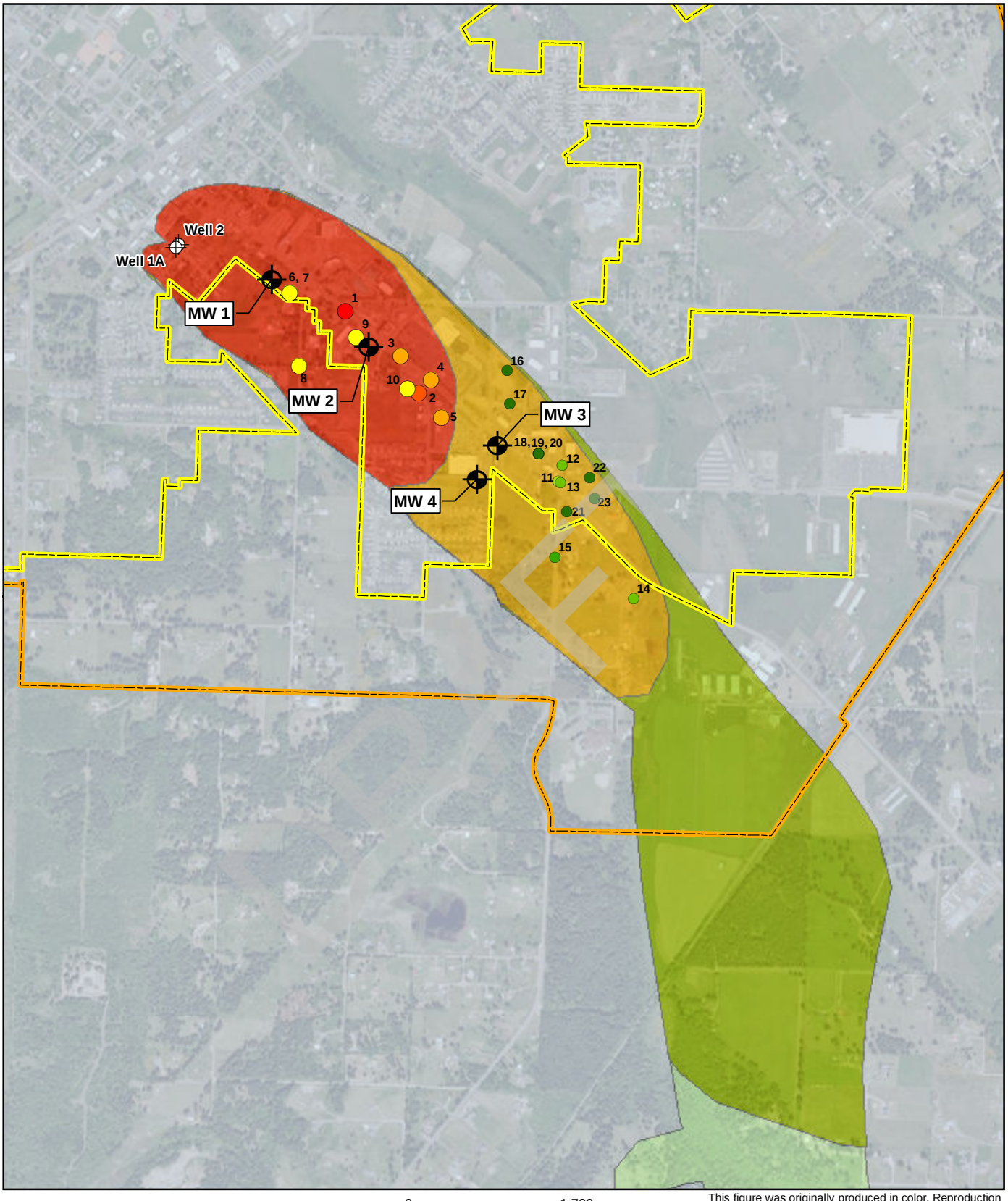
FIGURE **5**

DECISION LEVEL I (PRIORITIZATION 1 AND 2) WITH DECISION LEVEL II SUB-PRIORITIZATION

YELM WELL HEAD PROTECTION PLAN

Path: S:\Projects\2011\2011 Water Group Projects\113-99719 Yelm WHPP\Task 4 - Wellhead Protection Plan\mxds\11399719F05_Decision_Level_1_Haz1_and2.mxd

Golder Associates



LEGEND

- Well
- Recommended Monitoring Well Locations
- Yelm City Limits
- Yelm Urban Growth Area

Decision Level 1 Areas

- 1 (6 month)
- 2 (1 year)
- 3 (5 year)
- 4 (10 year)
- 5 Upgradient

Decision Level I and II Ratings Hazard Rank #

- 1, 1
- 1, 3
- 1, 5
- 1, 10
- 2, 3
- 2, 5
- 2, 7
- 2, 10

(See Table 7)

0 1,700

Scale in Feet

Map Projection:
NAD83 State Plane WA South FIPS 4602 Feet
Source:
ESRI (Imagery), City of Yelm (City Limits, Urban Growth Area), Golder Associates, Inc.(Wells, Decision Level 1 Areas, Facilities)

N

This figure was originally produced in color. Reproduction in black and white may result in a loss of information.

FIGURE **6**

RECOMMENDED MONITORING WELL LOCATIONS

YELM WELL HEAD PROTECTION PLAN

Path: S:\Projects\2011\2011 Water Group Projects\113-99719 Yelm WHPP\Task 4 - Wellhead Protection Plan\mxds\11399719F06_RecommendedMonitoringWells.mxd

Golder Associates

Appendix A

City Production Wells – Well Reports and Borehole Logs

Well 1A

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* 178313

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

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

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

DIMENSIONS: Diameter of well 12 inches, drilled 69 ft.

Depth of completed well 67 ft.

CONSTRUCTION DETAILS

Casing Installed: ☑ Welded 12 " Diam. from +2 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 perfs in. by in. and no. of perfs from ft. to ft.

Screens: ☑ Yes ☐ No ☑ K-Pac Location 55

Manufacturer's Name JOHNSON

Type SLOTTED Model No.

Diam. 9" Slot size .050 from 57 ft. to 67 ft.

Diam. Slot size from ft. to ft.

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

Materials placed from ft. to ft.

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

Material used in seal BENTONITE 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 29 ft. below top of well Date 4/22/05

Artesian pressure lbs. per square inch Date

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

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

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

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

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

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

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

Time	Water Level	Time	Water Level	Time	Water Level

Date of test

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

Airtest 500 gal./min. with stem set at 50 ft. for 4 hrs.

Artesian flow g.p.m. Date

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

CURRENT

Notice of Intent No. W186586

Unique Ecology Well ID Tag No. ALG255

Water Right Permit No. 4630 /Certificate #3561

Property Owner Name CITY OF YELM

Well Street Address 204 2nd STREET SE

City YELM County THURSTON

Location SW 1/4-1/4 SW 1/4 Sec 19 Twn 17N R 2E 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. 64420500100

CONSTRUCTION OR DECOMMISSION PROCEDURE

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

MATERIAL	FROM	TO
BROWN SANDY LOAM, COBBLES, LOOSE,DRY	0	2
BROWN MEDIUM SANDY GRAVEL, TIGHT,	2	
DRY, BOULDERS		32
BROWN MEDIUM TO COARSE SANDY	32	
GRAVEL WITH BOULDERS, LOOSE, WET		46
BROWN MEDIUM SANDY GRAVEL, TIGHT,	46	
BOULDERS, DRY		54
BROWN MEDIUM TO COARSE SANDY	54	
GRAVEL WITH COBBLES, LOOSE, WATER		67
BROWN MEDIUM SANDY GRAVEL TO	67	
BOULDERS, TIGHT, WET		69

RECEIVED

JUN 0 1 2005

DEPARTMENT OF ECOLOGY

Start Date 4/18/05 Completed Date 4/22/05

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

☐ Driller ☐ Engineer ☐ Trainee Name (Print) ROGERAY PHYTHIAN

Driller/Engineer/Trainee Signature

Driller or trainee License No. 2053

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

Drilling Company ARCADIA DRILLING INC.

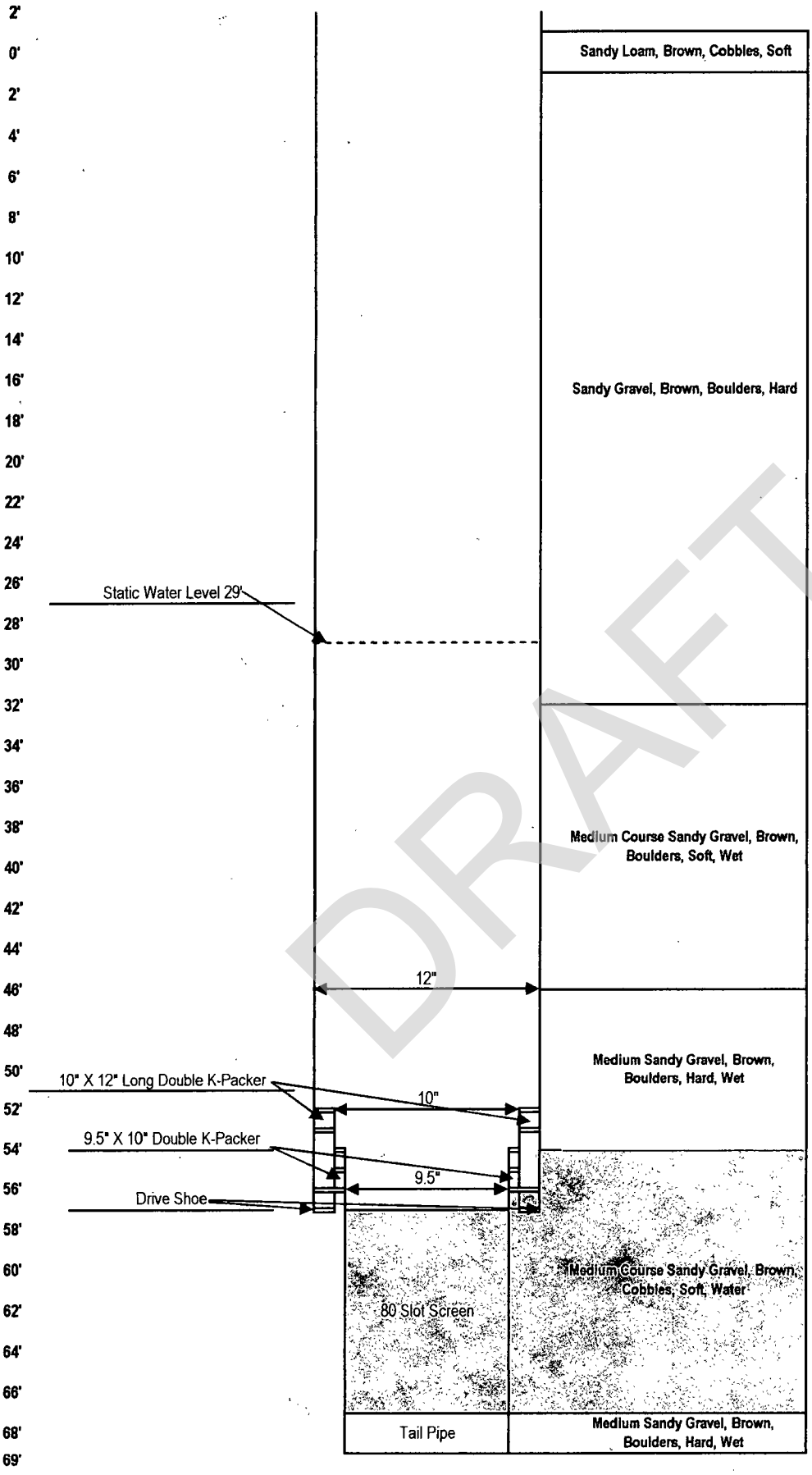
Address PO BOX 1790

City, State, Zip SHELTON WA 98584

Contractor's Registration No. ARCADDI098K1 Date 4/27/05

Ecology is an Equal Opportunity Employer.

City Of Yelm Well Number 1A



Well Address:
204 2nd St. SE
Yelm WA
Thurston County

Owner:
City of Yelm

SW 1/4 of the SW 1/4 Sec. 19 Twn. 17N Ran. 2E

Tax Parcel Number:
64420500100

Water Right Information:
Application No. 4924
Permit No. 4630
Certificate No. 3561

Notice of Intent Number:
W186586

Well Identification Number:
ALG255

Drilled By:
Arcadia Drilling, Inc.
PO Box 1790
Shelton WA 98584
Rogeray Phythian LI # 2053

Design By:
William Neal LI# 2625

Date Drilled
May 14 to May 22, 2005

Arcadia Drilling, Inc.
PO Box 1790 Shelton, WA 98584
(360) 426-3395 voice (360) 426-1455 fax

YELM WELL NO. 2

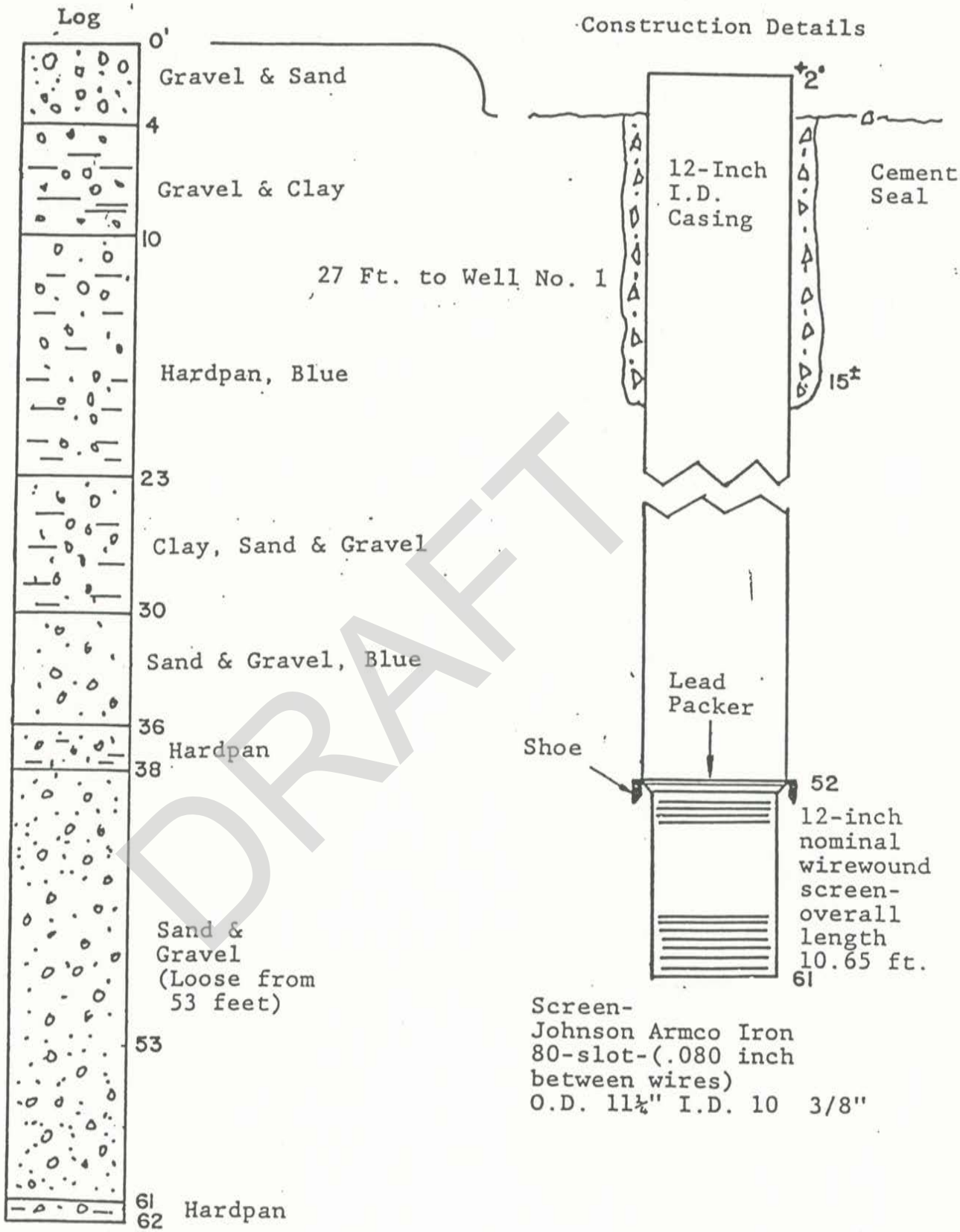


PLATE NO. III-2

SW Well 1A

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 WE11324

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

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

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

DIMENSIONS: Diameter of well 12" inches, drilled 800 ft. Depth of completed well 633 ft.

CONSTRUCTION DETAILS

Casing Installed: ☒ Welded 12" Diam. from +2 ft. to 367.5 ft.

☐ Liner installed _____" Diam. from _____ ft. to _____ ft.

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

Perforations: ☐ Yes ☒ No

Type of perforator used _____

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

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

Manufacturer's Name Johnson Screen

Type Wire-wrapped Model No. _____

Diam. 8" Slot size 0.035 from 352 ft. to 357 ft.

Diam. 8" Slot size 0.035 from 369 ft. to 437 ft.

Gravel/Filter packed: ☒ Yes ☐ No Size of gravel/sand 10x20

Materials placed from 353 ft. to 633 ft.

Surface Seal: ☒ Yes ☐ No To what depth? 327.7 ft.

Material used in seal Neat cement

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name Goulds

Type: Lineshaft turbine H.P. _____

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

Static level 102.5 ft. below top of well Date 10/6/10

Artesian pressure N/A 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? Boart Longyear

Yield: 2100 gal./min. with 82.2 ft. drawdown after 73 hrs.

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

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

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

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

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

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

Artesian flow _____ g.p.m. Date _____

Temperature of water 54 Was a chemical analysis made? ☐ Yes ☐ No

CURRENT

Notice of Intent No. WE11324

Unique Ecology Well ID Tag No. ALM113

Water Right Permit No. Application G2-29804, G2-29805 and G2-29806

Property Owner Name City of Yelm

Well Street Address Tahoma Blvd SE & Dotson St. SE

City Yelm County Thurston

Location SE 1/4-1/4 SE 1/4 Sec 23 Twn 17 R 1E **(s, t, r Still REQUIRED)** EWM ☒ Or WWM ☐

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

Tax Parcel No. (Required) 78640000024

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
Fine sand w/ some silt	0	25
Med/fine sand, gravel, cobble	25	170
Med/fine sand with grave/silt	170	219
Silty with fine sand and wood	219	240
Silty sand/iron oxide stainin	240	300
Silty sand with wood	300	370
Silty sand	370	400
Silt and clay	400	453
Fine sand and silt	453	470
Silt and clay, some wood	470	485
Silty fine sand	485	525
Med to coarse sand	525	552
Silt with fine sand	552	610
Fine to med sand/gravel	610	630
Silt/clay with wood	630	665
Fine to coarse sand/gravel	665	675
Silt/clay	675	800

Start Date 4/27/10 Completed Date 10/8/10

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

☒ Driller ☐ Engineer ☐ Trainee Name (Print) Duane Stevenson

Driller/Engineer/Trainee Signature

Driller or trainee License No. 2795

IF TRAINEE: Driller's License No:

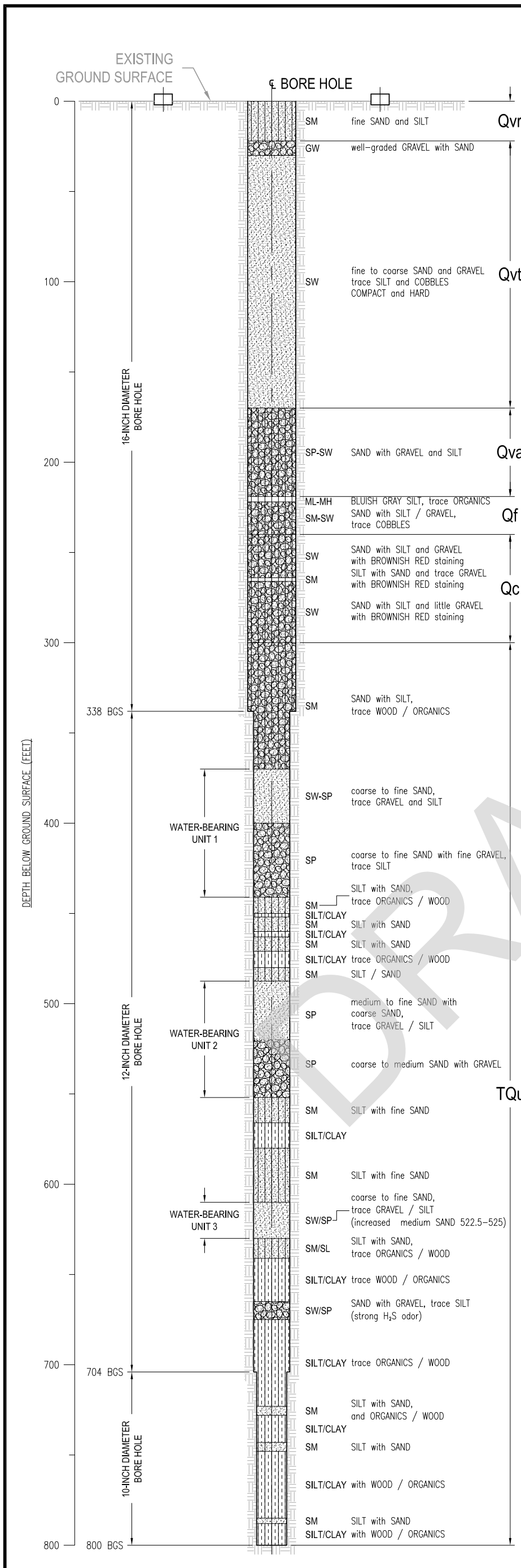
Driller's Signature:

Drilling Company Boart Longyear

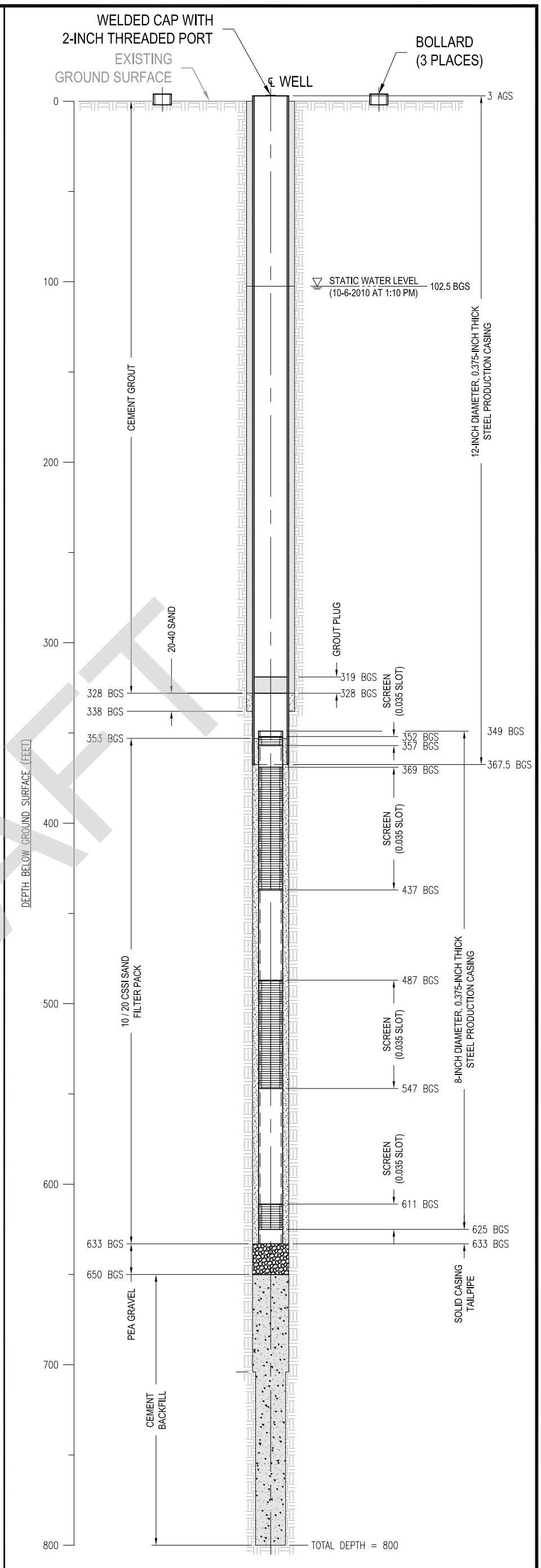
Address 11277 SW Clay St, Suite A

City, State, Zip Sherwood, OR 97140

Contractor's Registration No. _____ Date _____



GEOLOGICAL LOG
(HORIZONTAL EXAGGERATION = 20:1)



WELL ASSEMBLY
(HORIZONTAL EXAGGERATION = 20:1)

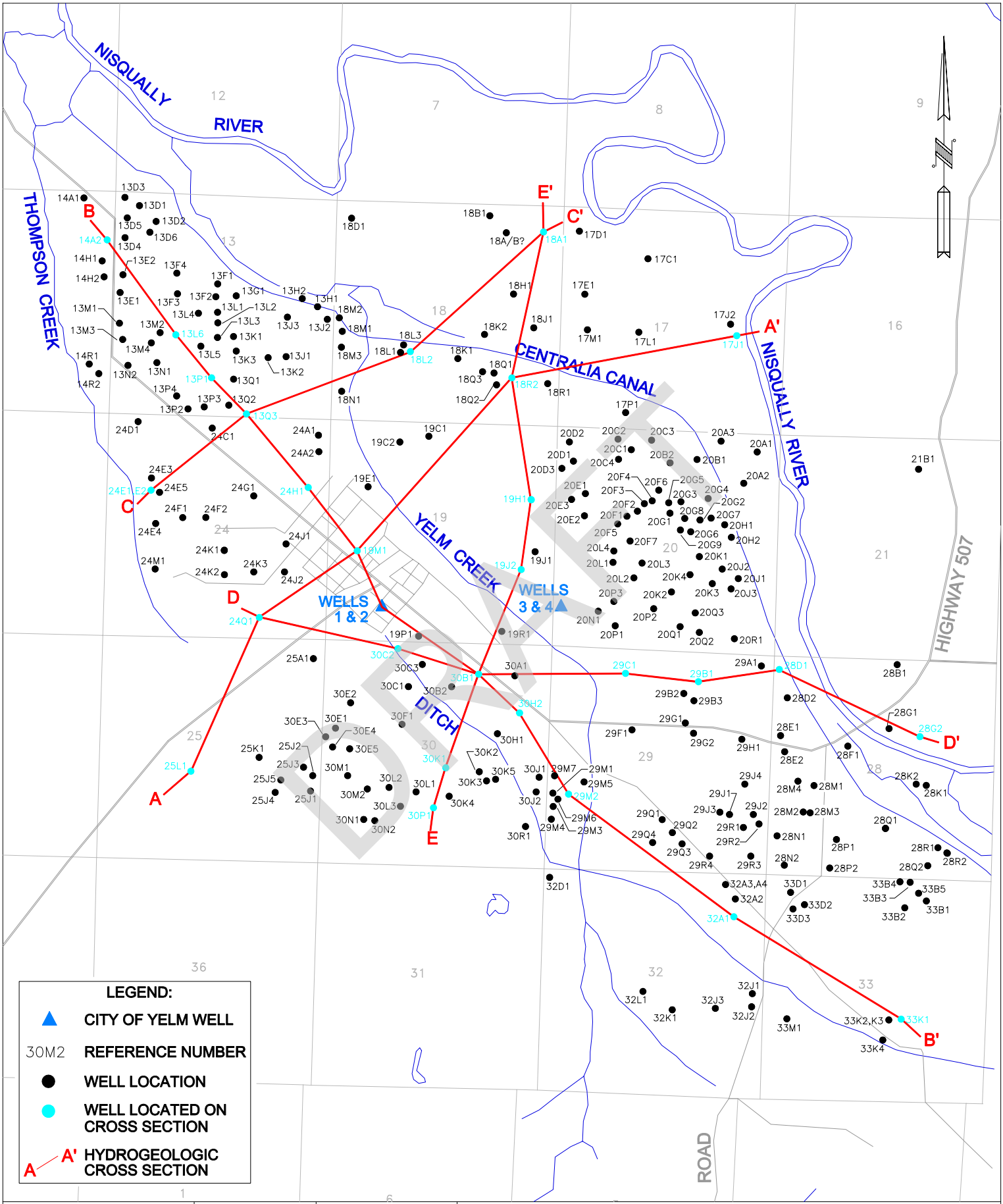
NOTES:
1. ALL DIMENSIONS ARE IN FEET, EXCEPT AS NOTED.

AS-BUILT SCHEMATIC OF SW WELL 1A

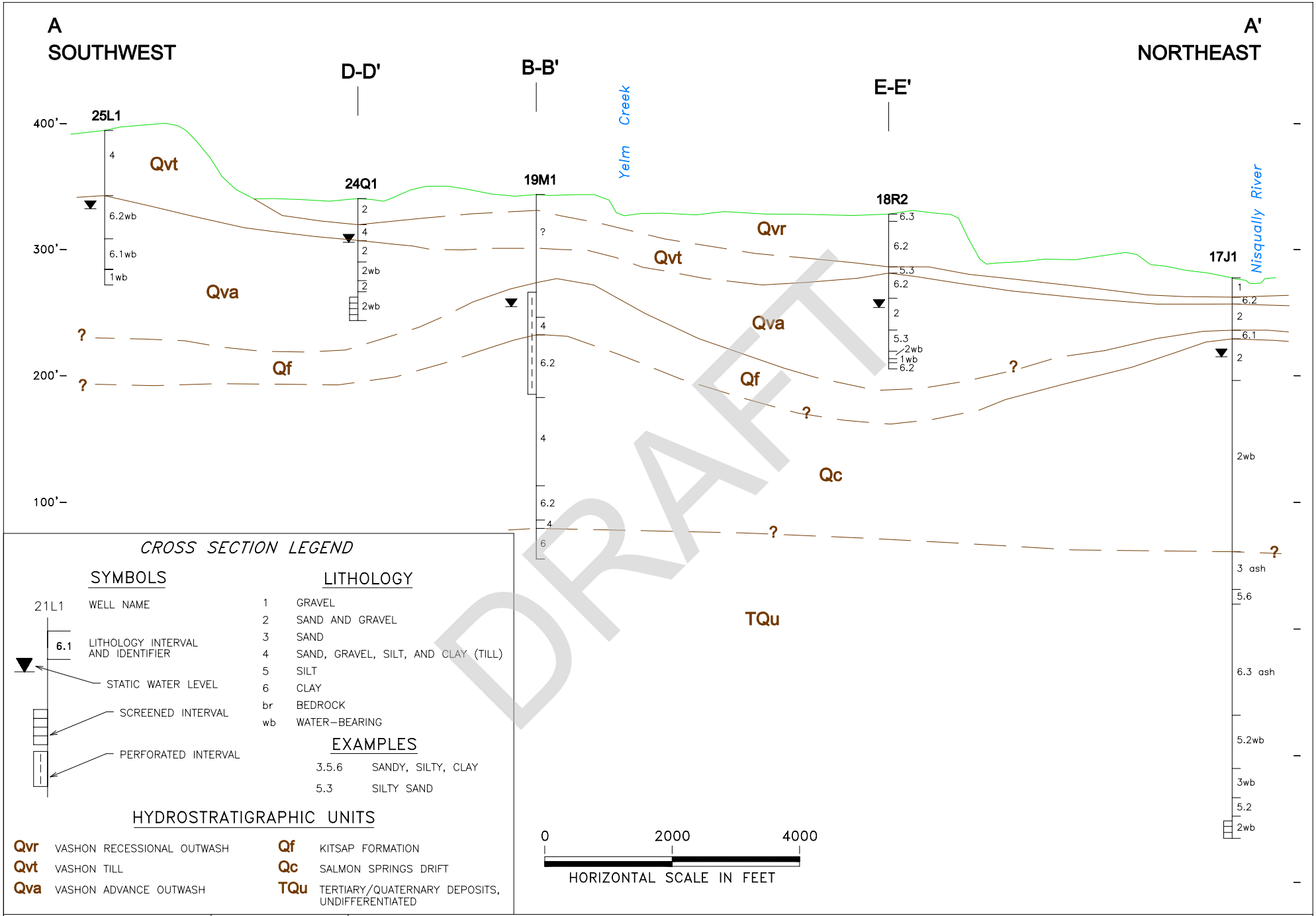
COY/SW Well No. 1A/WA

Golder Associates

Appendix B
Geologic Cross-Sections



ROBINSON & NOBLE, INC.	PM: BGC/KAH MAY 2001 00-211WH	SCALE 1"=3,000'	FIGURE 2 WELL AND CROSS SECTION LOCATION MAP CITY OF YELM WELLHEAD PROTECTION PLAN



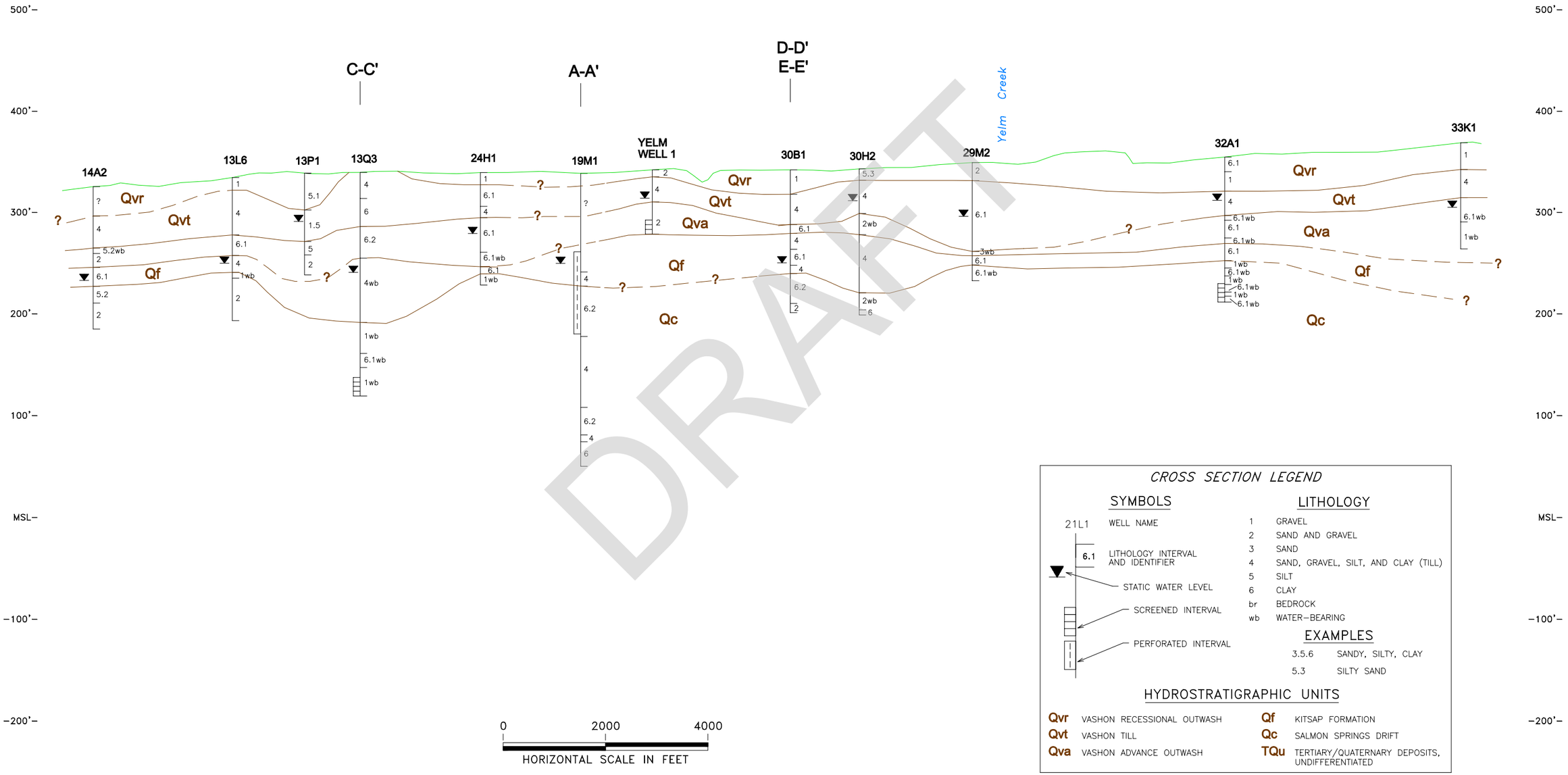
ROBINSON & NOBLE, INC.

PM: BGC/KAH
MAY 2001
00-211WH

FIGURE 5
HYDROGEOLOGIC CROSS SECTION A-A'
CITY OF YELM WELLHEAD PROTECTION PLAN

B
NORTH

B'
SOUTH



CROSS SECTION LEGEND

SYMBOLS

21L1 — WELL NAME

6.1 — LITHOLOGY INTERVAL AND IDENTIFIER

STATIC WATER LEVEL

SCREENED INTERVAL

PERFORATED INTERVAL

LITHOLOGY

1	GRAVEL
2	SAND AND GRAVEL
3	SAND
4	SAND, GRAVEL, SILT, AND CLAY (TILL)
5	SILT
6	CLAY
br	BEDROCK
wb	WATER–BEARING

EXAMPLES

3.5.6	SANDY, SILTY, CLAY
5.3	SILTY SAND

HYDROSTRATIGRAPHIC UNITS

Qvr	VASHON RECESSIONAL OUTWASH	Qf	KITSAP FORMATION
Qvt	VASHON TILL	Qc	SALMON SPRINGS DRIFT
Qva	VASHON ADVANCE OUTWASH	TQu	TERTIARY/QUATERNARY DEPOSITS, UNDIFFERENTIATED

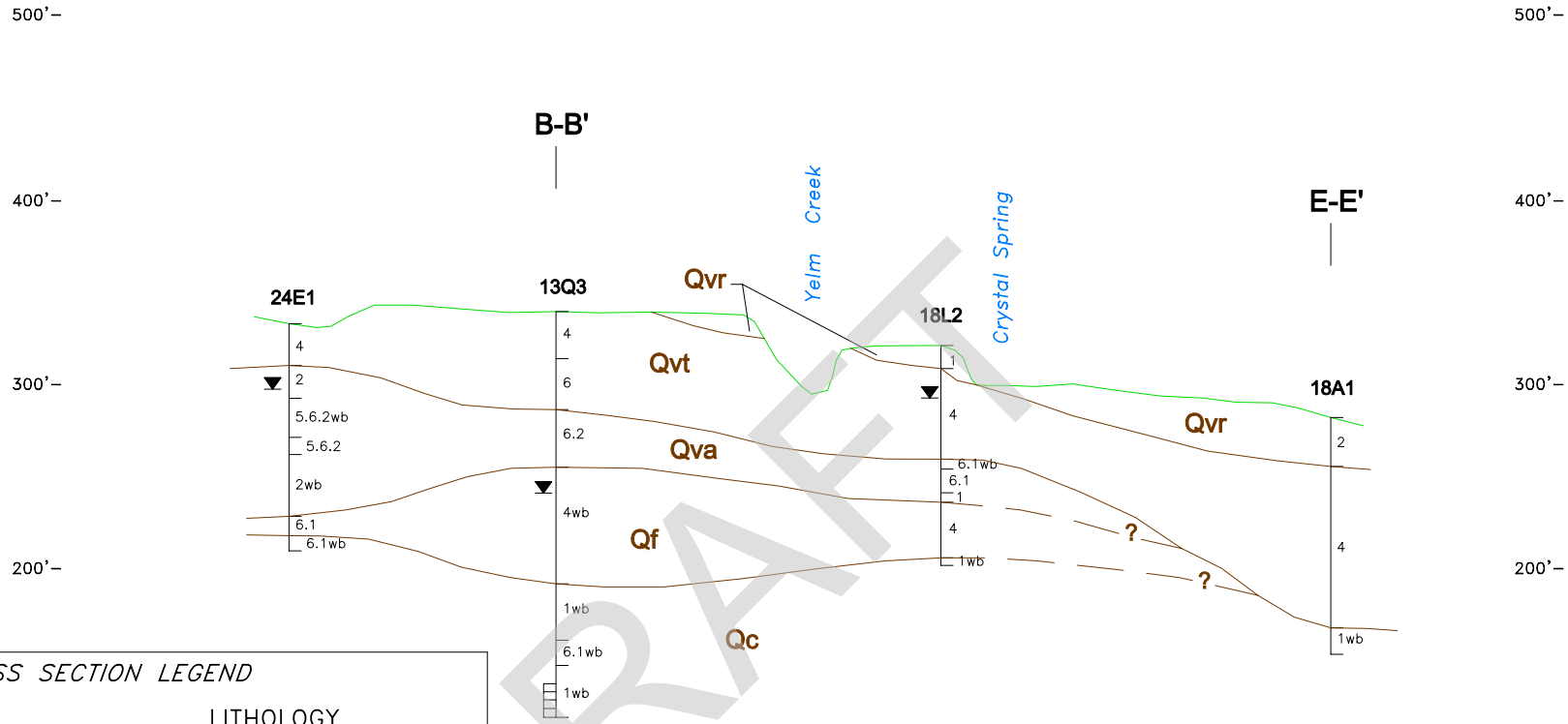
ROBINSON & NOBLE, INC.

PM: BGC/KAH
MAY 2001
00-211WH

FIGURE 6
HYDROGEOLOGIC CROSS SECTION B-B'
CITY OF YELM WELLHEAD PROTECTION PLAN

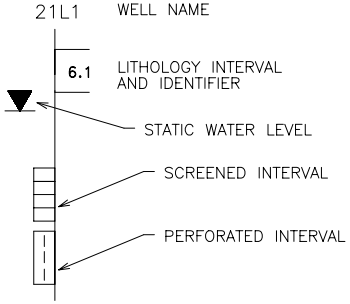
C
SOUTHWEST

C'
NORTHEAST



CROSS SECTION LEGEND

SYMBOLS



LITHOLOGY

1	GRAVEL
2	SAND AND GRAVEL
3	SAND
4	SAND, GRAVEL, SILT, AND CLAY (TILL)
5	SILT
6	CLAY
br	BEDROCK
wb	WATER–BEARING

EXAMPLES

3.5.6	SANDY, SILTY, CLAY
5.3	SILTY SAND

HYDROSTRATIGRAPHIC UNITS

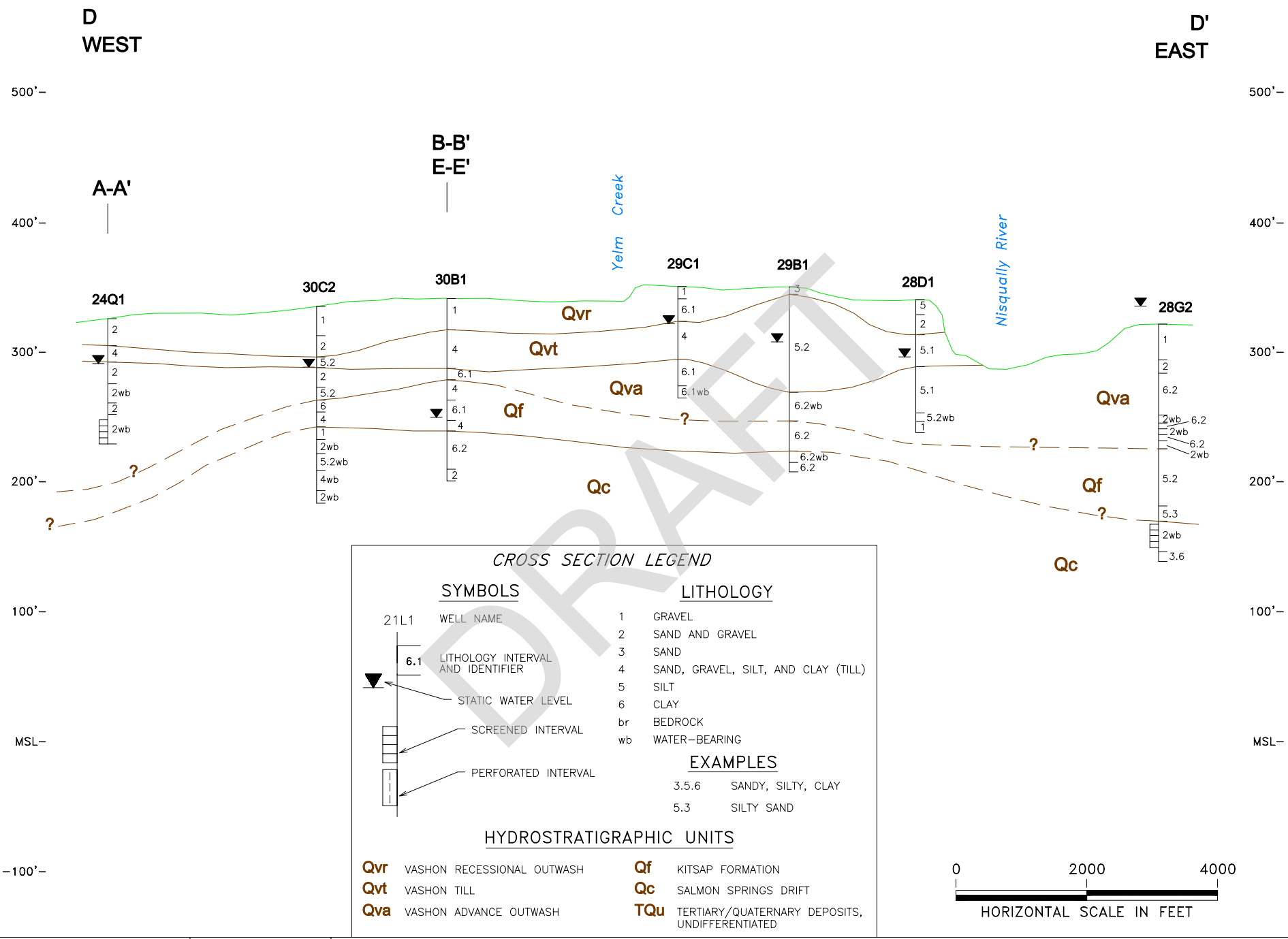
Qvr	VASHON RECESSIONAL OUTWASH
Qvt	VASHON TILL
Qva	VASHON ADVANCE OUTWASH
Qf	KITSAP FORMATION
Qc	SALMON SPRINGS DRIFT
TQu	TERTIARY/QUATERNARY DEPOSITS, UNDIFFERENTIATED

0 2000 4000
HORIZONTAL SCALE IN FEET

ROBINSON & NOBLE, INC.

PM: BGC/KAH
MAY 2001
00-211WH

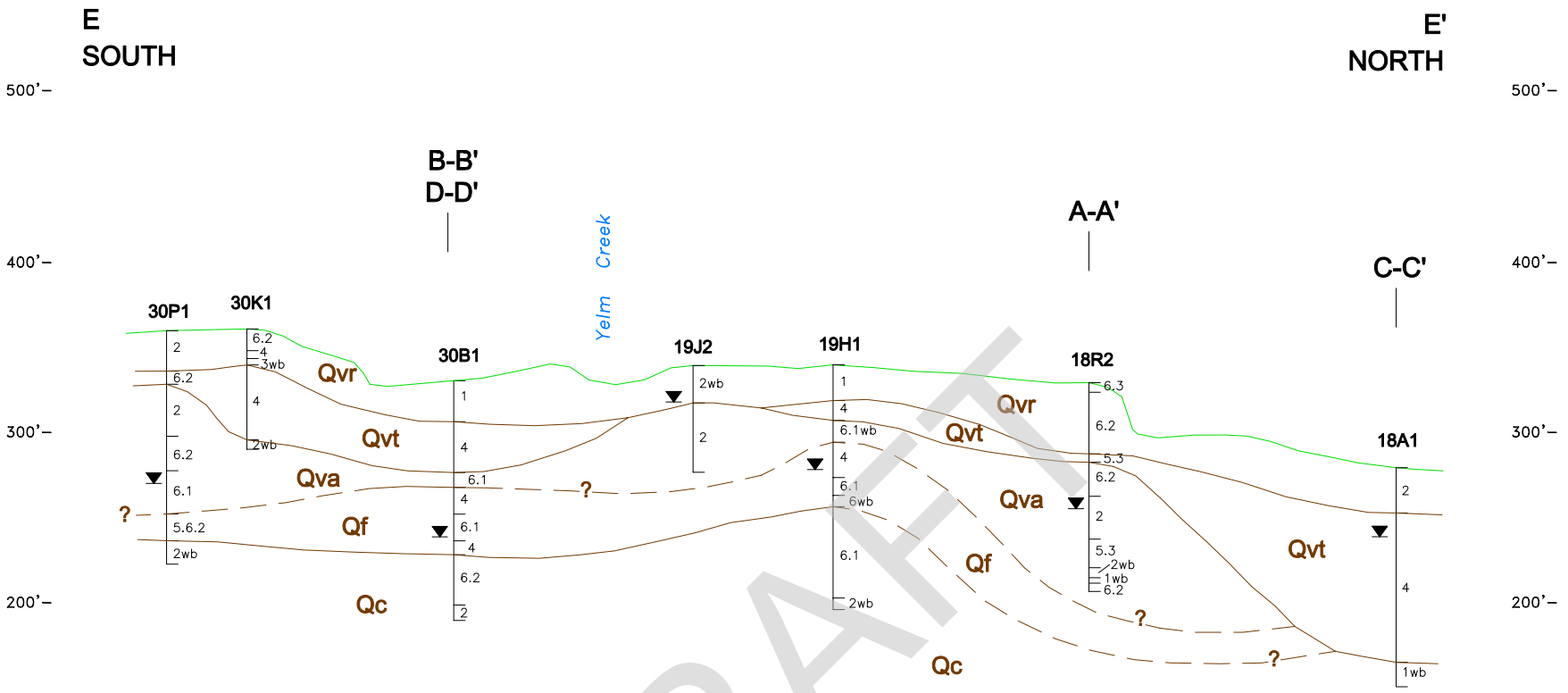
FIGURE 7
HYDROGEOLOGIC CROSS SECTION C-C'
CITY OF YELM WELLHEAD PROTECTION PLAN



ROBINSON & NOBLE, INC.

PM: BGC/KAH
MAY 2001
00-211WH

FIGURE 8
HYDROGEOLOGIC CROSS SECTION D-D'
CITY OF YELM WELLHEAD PROTECTION PLAN



CROSS SECTION LEGEND

SYMBOLS

21L1 — WELL NAME

6.1 — LITHOLOGY INTERVAL AND IDENTIFIER

STATIC WATER LEVEL

SCREENED INTERVAL

PERFORATED INTERVAL

LITHOLOGY

1	GRAVEL
2	SAND AND GRAVEL
3	SAND
4	SAND, GRAVEL, SILT, AND CLAY (TILL)
5	SILT
6	CLAY
br	BEDROCK
wb	WATER–BEARING

EXAMPLES

3.5.6	SANDY, SILTY, CLAY
5.3	SILTY SAND

HYDROSTRATIGRAPHIC UNITS

Qvr	VASHON RECESSIONAL OUTWASH
Qvt	VASHON TILL
Qva	VASHON ADVANCE OUTWASH
Qf	KITSAP FORMATION
Qc	SALMON SPRINGS DRIFT
TQu	TERTIARY/QUATERNARY DEPOSITS, UNDIFFERENTIATED

0 2000 4000

HORIZONTAL SCALE IN FEET

ROBINSON & NOBLE, INC.

PM: BGC/KAH

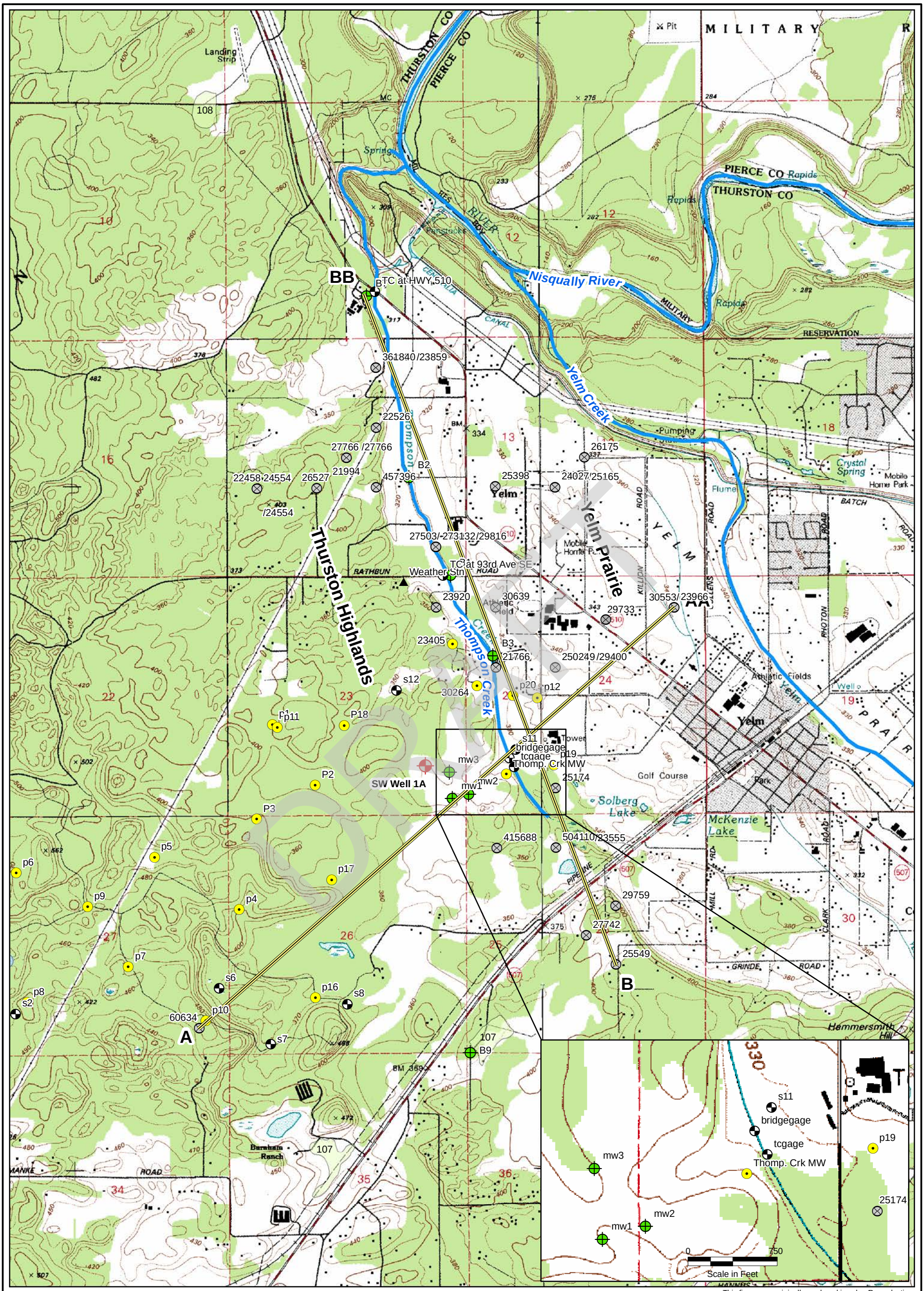
MAY 2001

00-211WH

FIGURE 9

HYDROGEOLOGIC CROSS SECTION E-E'

CITY OF YELM WELLHEAD PROTECTION PLAN



LEGEND

- Ecology Well Logs
- Monitoring Wells
- Piezometers
- SW Well 1A
- Staff Gagues
- Weather Station
- Streams

Map Projection:
UTM NAD27, Zone 10 North

Source:
Washington State Geospatial Data Archive;
Washington Department of Ecology

This figure was originally produced in color. Reproduction in black and white may result in a loss of information.

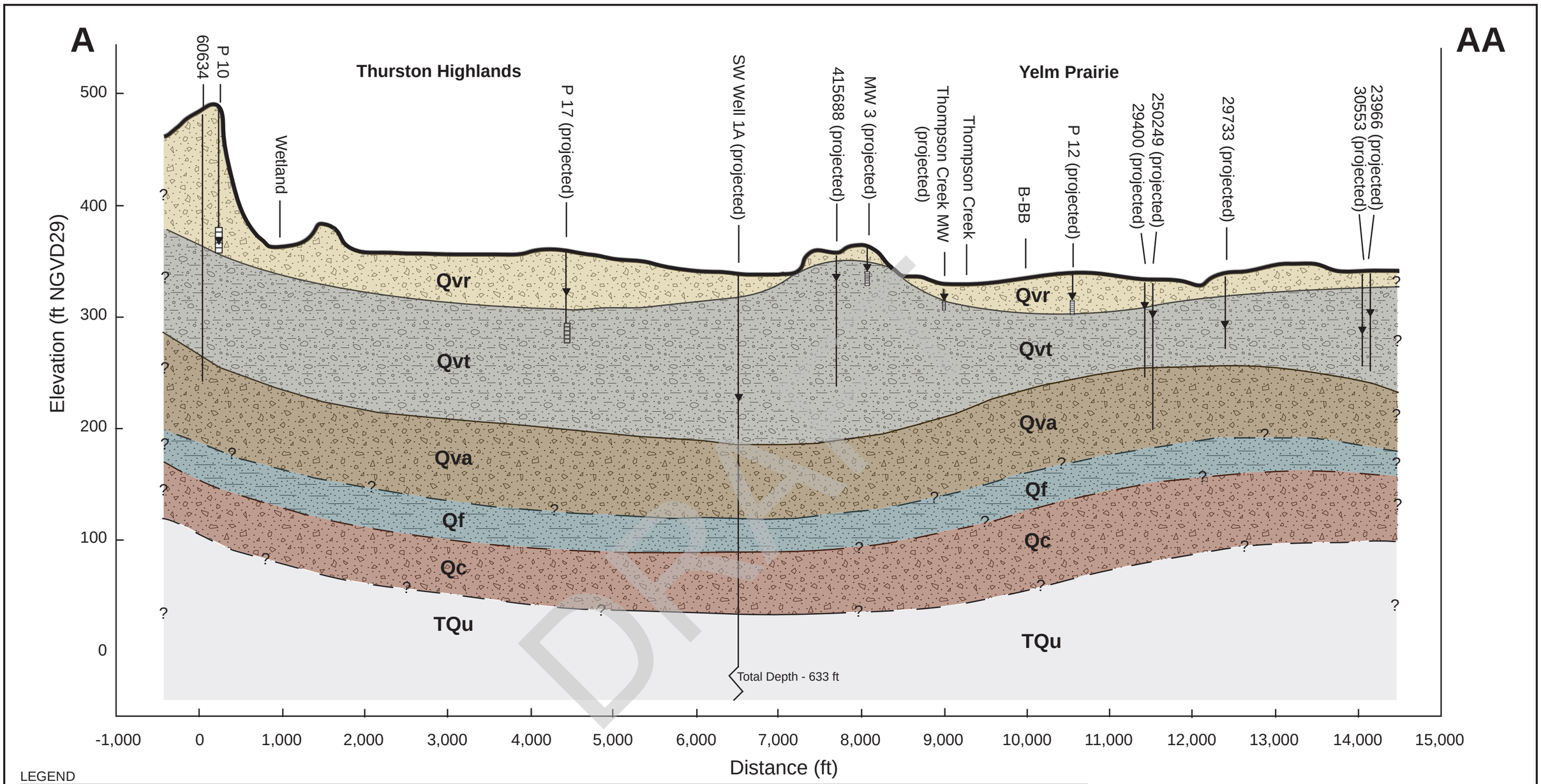
FIGURE **A-1**

GEOLOGIC CROSS-SECTION AND WELL LOCATIONS

CITY OF YELM SW WELL 1A DEVELOPMENT PROJECT

10399709 SWWell1ACross-SectionsWellLocations.mxd | 1/17/2011 | KJANSSEN

Golder Associates



LEGEND

Recessional Outwash (Qvr) - Sand and gravel, locally including low-permeability moraine deposits (Qvrm) of unsorted and unlayered rock debris known as till; groundwater is mostly unconfined, but perched water conditions occur in areas of Qvrm deposits.

Till (Qvt) - Unsorted and unlayered deposits of sand, gravel, cobbles, and boulders in a compacted and indurated matrix of silt and clay with some lenses of clean sand and gravel; confining unit.

Advanced Outwash (Qva) - Gravel in a matrix of sand with some sand lenses; groundwater is confined.

Kitsap Formation (Qf) - Predominately clay and silt, with some layers of sand and gravel, and may include some till or till-like deposits; confining unit.

Salmon Springs (?) Drift (Qc) - Pre-Vashon glacial deposits of sand and gravel typically stained red or brown; groundwater is confined.

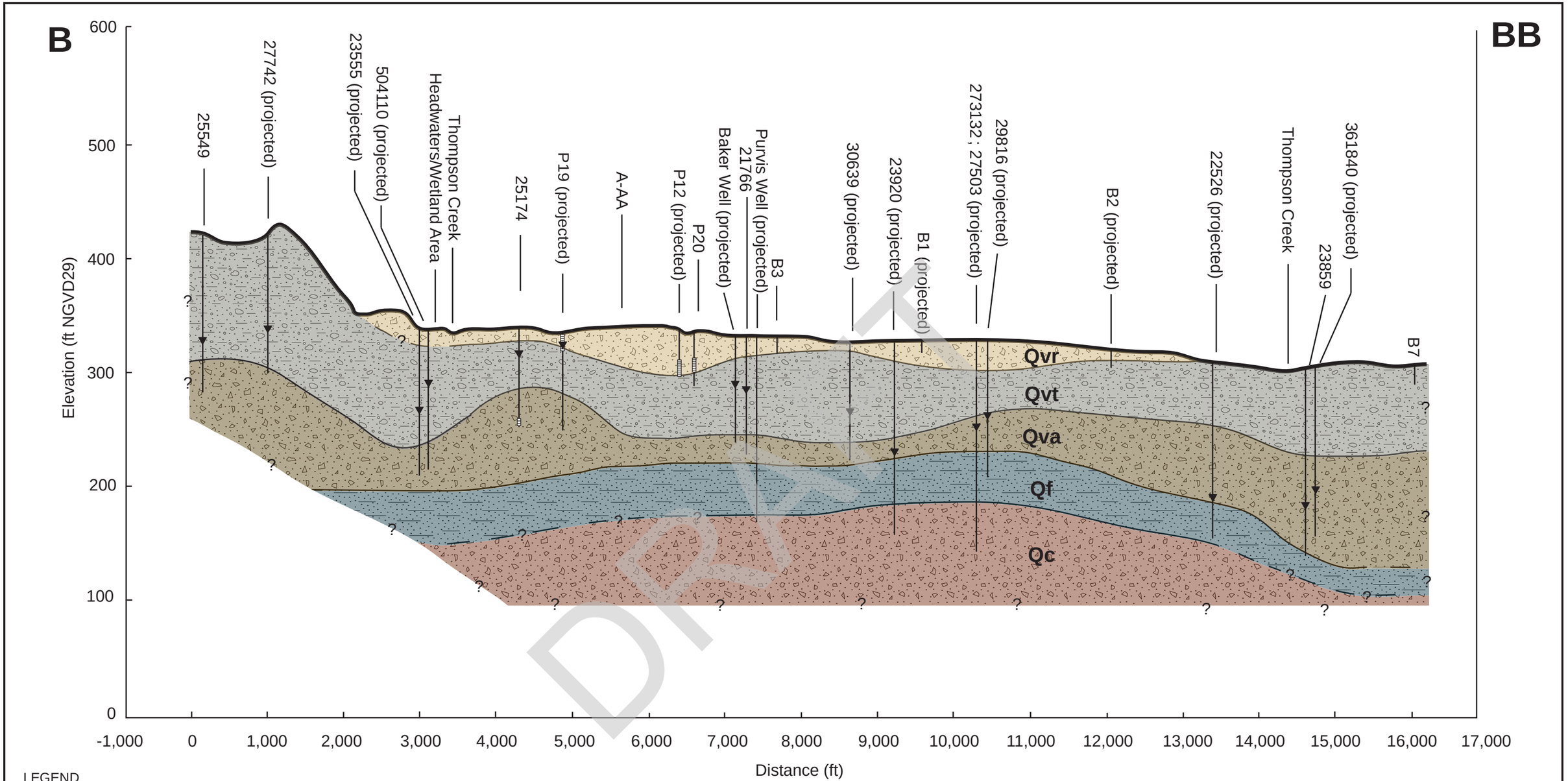
(TQu) - Layers of clay, silt, sand and gravel of glacial and nonglacial origin.

Water Level

Screened Interval

Note: See Figure A-1 in Appendix A for cross section location.

FIGURE **2**
GEOLOGIC CROSS-SECTION A-AA
CITY OF YELM SW WELL 1A DEVELOPMENT PROJECT



LEGEND

Recessional Outwash (Qvr) - Sand and gravel, locally including low-permeability moraine deposits (Qvrm) of unsorted and unlayered rock debris known as till; groundwater is mostly unconfined, but perched water conditions occur in areas of Qvrm deposits.

Till (Qvt) - Unsorted and unlayered deposits of sand, gravel, cobbles, and boulders in a compacted and indurated matrix of silt and clay with some lenses of clean sand and gravel; confining unit.

Advanced Outwash (Qva) - Gravel in a matrix of sand with some sand lenses; groundwater is confined.

Kitsap Formation (Qf) - Predominately clay and silt, with some layers of sand and gravel, and may include some till or till-like deposits; confining unit.

Salmon Springs (?) Drift (Qc) - Pre-Vashon glacial deposits of sand and gravel typically stained red or brown; groundwater is confined.

▼ **Water Level**

Screened Interval

Note: See Figure A-1 in Appendix A for cross section location.

FIGURE **3**
GEOLOGIC CROSS-SECTION B-BB
CITY OF YELM SW WELL 1A DEVELOPMENT PROJECT

Appendix C
Yelm 2012 WHPA Model Technical Memorandum

TECHNICAL MEMORANDUM

Date: January 19, 2012 **Project No.:** 113-99719
To: Stephanie Ray, Project Manager; City of Yelm, WA
From: Michael Klisch, LHG, and Emanuele Pellichero; Golder Associates Inc.

RE: CITY OF YELM WHPA MODELING RESULTS

1.0 WHPA MODELING APPROACH

The most up-to-date version of the McAllister Groundwater Model, which encompasses a broad area of Thurston County and used to support the City's water right applications and mitigation program; herein referred to as the "existing model" was modified in order to delineate updated Wellhead Protection Areas (WHPA) for the City's drinking water supply wells. Details of the existing model construction and calibration are provided by CDM (2002a and 2002b), Golder (2008a and 2008b), and City of Yelm (2011).

The wellhead protection areas were delineated for the following wells:

- Water supply well SW Well 1A (recently drilled); and
- The City's downtown wells, Well 1A and Well 2.

The existing model used for the delineations is a steady-state model built in Groundwater Vistas (GWV) 6.11 (ESI, 2011). The existing steady-state model modified for the WHPA delineations was originally named "base_30a". The steps involved in adapting and modifying the base model (base_30a) into the new WHPA model are explained in the sections below, and is hereafter referred to as the Yelm 2012 WHPA Model, or the "revised model". Note that for the purpose of this analysis, model simulations were run only under steady-state conditions.

1.1 Refinements To Existing Model

In order to improve model resolution and more accurately define the WHPA capture zones, the model grid spacing was adjusted in the vicinity of the City's three drinking water supply wells. The size of the cells was refined from 250 feet by 250 feet to approximately 35 feet by 35 feet for an area about 500 feet wide centered around each well location (note that Wells 1A and 2 are located in close proximity, approximately 65 feet apart). The entire model grid was then smoothed using an automated grid smoothing routine incorporated into GWV. A maximum grid change ratio of 1.5 was used in order to gradually adjust the size of the grid cells away from the cells containing the wells. The revised model grid is shown on Figure TM-1.

Golder Associates Inc.
9 Monroe Parkway, Suite 270
Lake Oswego, OR
Tel: 503-607-1820 Fax: 503-607-1825 www.golder.com

1.1.1 Changes in Model Boundaries and Mass Balance

Because the grid refinements will cause changes in the conductance of boundary conditions such as drains, rivers, or constant heads, the revised model boundary conductances were checked for consistency against the existing model. Where cells were split during grid refinement, the sum of the conductances of the split cells were equivalent to the conductances of the original cells in the existing model.

The model was then run to evaluate the mass balance differences between the existing and revised model. For this comparison, SW Well 1A, which was not included in the existing base model, was switched off.

The mass balance components for the two models and the net-flow comparison are summarized in Table TM-1. The net-flow comparison in Table TM-1 shows that there are negligible differences (< 2.1%) in mass balance between the two models. The primary reason for the differences in mass balance is because a different set of starting heads were used for each model. The existing model starting heads could not be used in the revised model because of a different number of grid cells resulting from the refinement of the grid around the three Yelm wells. Therefore, the starting heads in the revised model were set to the top of layer 1.

1.1.2 Changes in Groundwater Heads and Flow Direction

The model-predicted groundwater heads and groundwater flow directions from the revised model were visually compared to the heads and groundwater flow directions in the existing model. No significant changes in groundwater elevations and flow directions were observed. In addition, modeled groundwater heads were compared between the two models at 11 target locations used in the existing model for calibration. Results are summarized in Table TM-2. Differences in hydraulic heads at all target locations are relatively small (< 1.3%), always falling below 0.4 ft. Also in this case, no significant changes in groundwater elevations were depicted. The interpreted groundwater contours from the model-predicted hydraulic heads for the Qva and TQu are shown in Figures TM-2 and TM-3, respectively.

1.2 Model Updates

New City water supply well SW Well 1A was completed in October 2010 (Golder, 2011). SW Well 1A is located in the Tahoma Terra area west of downtown Yelm in Thurston County, Washington. The well is located in SE¼, SE¼, Section 23, T17N, R1E W.M. (1,106,790 ft northing and 593,521 ft easting, Washington State Plane South). The pumping rate for SW Well 1A was set to 942 acre-feet per year (112,421 ft^3/d, or an annual average pumping rate of 584 gallons per minute; gpm) based on the annual water right quantity. As the well screen is located both in model layers 8 and 9, GWV split its pumping rate between these two layers proportional to the thickness of each layer as:

- Layer 8 – 51,990.5 ft^3/d

- Layer 9 – 60,430.2 ft^3/d

The pumping rate was revised for Wells 1A and 2 based on their annual water right quantities. The new pumping rate was set to a combined rate of 894.92 acre-feet per year (106,802 ft^3/d, or an annual average pumping rate of 555 gpm) for the two wells, or a pumping rate of 53,401.3 ft^3/d (277.5 gpm) for each well.

1.3 Capture Zone Analysis Approach

Capture zones for the three City wells were delineated using the particle tracking software MODPATH (Pollock, 1994) in GWV 6.11 (ESI, 2011). MODPATH uses a particle tracking scheme that allows an analytical expression of the particle's flow to be obtained within each grid cell. Particle paths are computed by tracking from one cell to the next until the particles reaches a boundary, an internal sink/source, or satisfies some other termination criterion (Pollock, 1994). In order to define groundwater flow paths in proximity of the City's wells, a total of 150 particles were placed in the revised model in concentric circles around SW Well 1A, and Wells 1A and 2. For SW Well 1A, as the well is screened in two layers, 50 particles were placed both in layer 8 and layer 9. For Wells 1A and 2, as they fall in neighboring cells and both wells are screened only in layer 3, only one circle of 50 particles was placed around both wells in layer 3.

The MODPATH simulation was run for 10,000 days. Reverse particle tracking was used to delineate the capture zones for each well. Time-of-travel markers were placed along the particle paths indicating the six-month, and one-, five-, and ten- time-of-travel zones defining the WHPAs.

2.0 YELM 2012 WHPA DELINEATION RESULTS

The results of the analysis to delineate the WHAP capture zones are shown in Figure TM-4. This figure indicates that:

- The particle pathlines are generally consistent with the groundwater flow direction;
- The particles' velocity changes in relationship with the magnitude of the hydraulic conductivity and the hydraulic gradient present along the particle paths in the revised model;
- The presence of wells or boundary conditions can influence groundwater flow and consequently disrupt particles pathlines; and
- Upward or downward vertical flow is occasionally seen in the revised model, particularly with regard to Wells 1A and 2. Vertical flow causes a noticeable decrease in the particles' velocity. The vertical hydraulic conductivities (*Ky*) defined in all layers are lower than the corresponding horizontal hydraulic conductivities (*Kh*), particularly in lower permeability layers such as, layer 2, 4 and 7, where *Ky* values range between 2.5×10^{-3} ft/d and 5×10^{-3} ft/d.

2.1 SW Well 1A – TQu Aquifer

As mentioned in Section 1.2, SW Well 1A is screened both in layer 8 and layer 9. For this reason, two different capture zones were delineated for this well in each layer. As hydraulic properties for layers 8 and 9 are very homogenous in the Yelm area and no other wells or boundary conditions are present in the vicinity of SW Well 1A, the two capture zones delineated in MODPATH present a very regular shape and do not display any apparent sign of flow disruption. Moreover, with the hydraulic properties being identical in layers 8 and 9, the shape of the two capture zones tend to coincide. However, the capture zone in layer 9 appears slightly more elongated than in layer 8. This is the result of particles travelling faster in layer 9 as the pumping rate for SW Well 1A is slightly higher than in layer 8, as explained in Section 1.2. No evidence of vertical flow was observed in the capture zones delineated for SW Well 1A.

2.2 Downtown Wells 1A and 2 – Qva Aquifer

The capture zones delineated in layer 3 for Wells 1A and 2 are irregularly shaped and noticeably different than the capture zone for SW Well 1A. In particular, there is a bend in the mid part of the five-year capture zone for Wells 1A and 2, which results from a combination of factors, including the presence of several wells located along the particle paths in layer 3, the close proximity of drain boundaries to the capture zone, and a significant decrease in hydraulic conductivity (from 640 ft/d to 70 ft/d) present along the particle pathlines at distance.

The shape of the capture zone for Wells 1A and 2 is more elongated than for the capture zones delineated for SW Well 1A. This is due to the combination of a higher hydraulic gradient present in layer 3, particularly in the southern part of the Yelm area close to the constant head (CH) boundaries, and the presence of a very high hydraulic conductivity area defined in layer 3 (640 ft/d) around Yelm. The downtown wells' capture zone is also wider than the SW Well 1A capture zone, which reflects the fact that in the Yelm area the thickness of layer 3 (about 40 ft) is considerably less than the thickness of layers 8 and 9, respectively approximately 185 ft and 200 ft. Vertical flow from layer 4 to layer 3 is apparent in close proximity of the downtown wells (west side of capture zone). Sporadic vertical flow from a stream boundary in layer 1 downwards to layer 3 is also apparent in the south-western part of the downtown wells capture zone where particles travel west-east for a short distance.

3.0 REFERENCES

City of Yelm, 2011, Water Right Mitigation Plan, Mitigation for City of Yelm Water Right Application: G2-29085 – Priority Date January 10, 1994. Prepared February 2011.

CDM, 2002a. Model Construction and Steady-state Calibration - McAllister Wellfield Numerical Model. Prepared for Yelm of Olympia Public Works Dept. April 2002.

CDM, 2002b. Final Report – McAllister Wellfield Numerical Model. Prepared for Yelm of Olympia Public Works Dept. July 2002.

Environmental Simulations Inc, 2011, Groundwater Vistas, version 6.14, build 2.

Golder Associates, Inc, 2008a. Groundwater Modeling of Water Right Applications and Transfers. Prepared for Yelm of Yelm. January 29, 2008.

Golder Associates, Inc, 2008b. Future Demand/Supply Forecast and Groundwater Modeling for Mitigation Planning. October 10, 2008.

Golder Associates, Inc, 2011, The City of Yelm Southwest Well 1A Development Report; Drilling, Well Construction and Testing. Prepared March 15, 2011.

Pollock, D.W, 1994, User's guide for MODPATH/MODPATH-PLOT, Version 3: A particle tracking post-processing package for MODFLOW, the U.S. Geological Survey finite-difference ground-water flow model. U.S. Geological Survey Open-File Report 94-464. September 1994.

List of Tables

List of Figures

TABLE TM-1
MASS BALANCE FOR THE EXISTING AND REVISED MODELS AND NET FLUX COMPARISON

Boundary	[1]Existing Model (base_30a)			[2]Revised Model (whpp_03)			Difference in Net Flux (Existing minus Revised)	
	Flux IN (ft^3/day)	Flux OUT (ft^3/day)	Net Flux (ft^3/day)	Flux IN (ft^3/day)	Flux OUT (ft^3/day)	Net Flux (ft^3/day)	(ft^3/day)	%
CH	11,415,160	10,142,214	1,272,947	12,254,091	10,968,764	1,285,327	-12,380	1.0
Well	0	1,779,391	-1,779,391	0	1,779,391	-1,779,391	0	0.0
Riv	4,144,095	4,933	4,139,162	4,058,093	4,235	4,053,858	85,304	2.1
Drn	0	4,023,003	-4,023,003	0	3,947,612	-3,947,612	-75,391	-1.9
GHB	0	0	0	0	0	0	0	0.0
Str	0	0	0	0	0	0	0	0.0
Rch	390,300	0	390,300	387,849	0	387,849	2,451	0.6
ET	0	0	0	0	0	0	0	0.0
Lake	0	0	0	0	0	0	0	0.0
Total	15,949,555	15,949,541	15	16,700,033	16,700,002	31	-16	1.8
% Error	0	---	---	0	---	---	---	---

NOTES: (1) Most up-to-date version of the McAllister Groundwater Model used to support the City of Yelm's water right applications and mitigation program (City of Yelm, 2011).
(2) Yelm 2012 WHPA Model

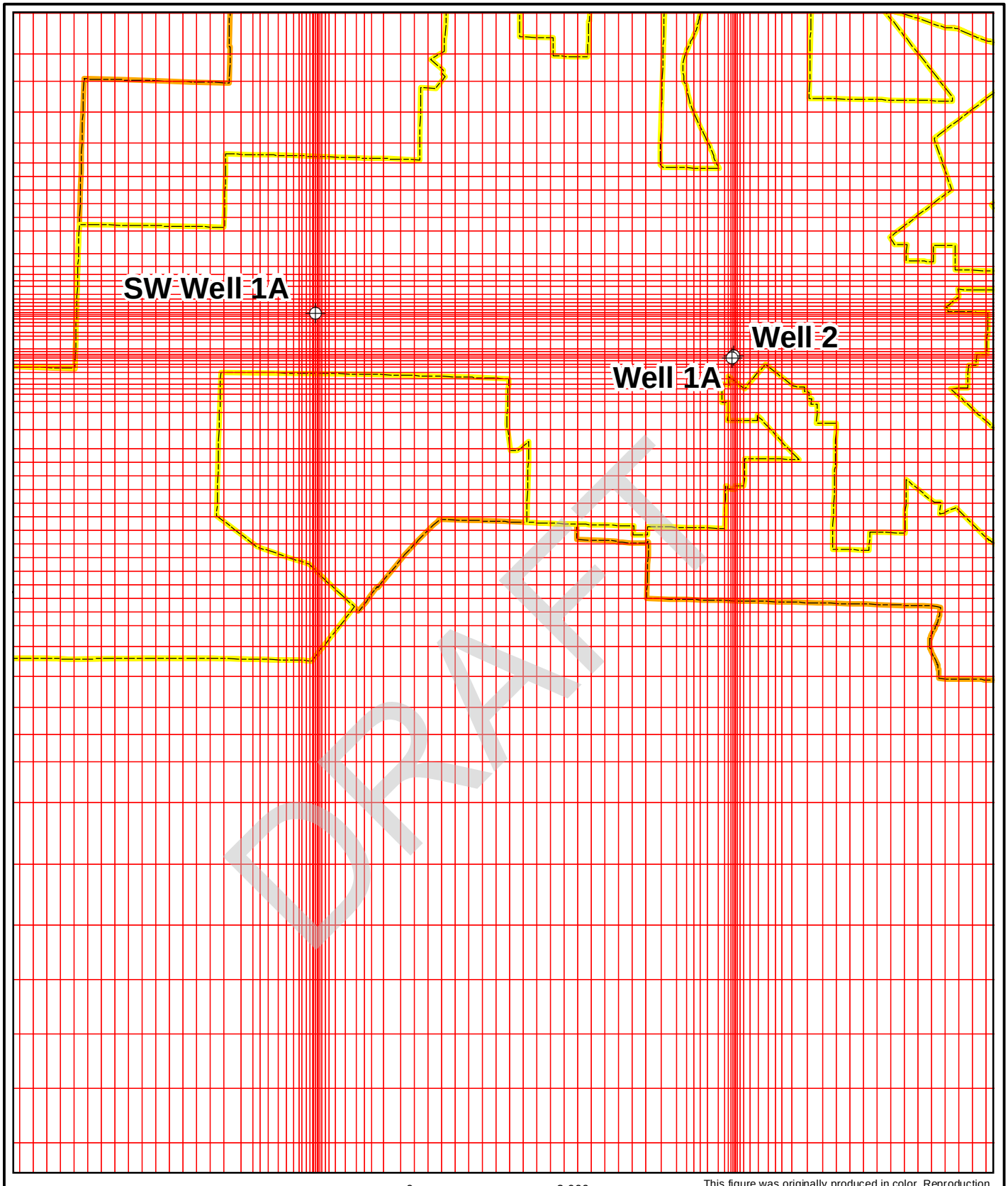
TABLE TM-2
HYDRAULIC HEAD COMPARISON BETWEEN EXISTING AND REVISED MODELS

Target Location	[1]Model Coordinates (ft)		Model Layer No.	Hydraulic Heads (ft)		Difference in Hydraulic Heads (Existing minus Revised)	
	X	Y		[2]Existing Model (base_30a)	[3]Revised Model (whpp_03)	(ft)	%
TW-2	1078513	627081	5	30.3	29.9	0.4	1.3
TW-3	1081651	619218	5	31.9	31.6	0.3	0.9
MW-4	1088419	622867	5	15.3	15.3	0	0.0
MW-3	1090688	623230	5	15.3	15.2	0.1	0.7
MW-17	1093098	624466	5	18.2	18.3	-0.1	0.5
Lakeside	1093415	620077	5	26.2	26.5	-0.3	1.1
17N/01E-08L03	1088410	605088	5	104.5	104.2	0.3	0.3
16N/01E-05F01_(Rainier)	1088244	580257	5	225.9	225.9	0	0.0
Shana_Well1	1057261	615406	3	115	114.6	0.4	0.3
Yelm_1	1118555	592668	3	250.5	250.3	0.2	0.1
SW_Yelm_1	1099413	590228	8	182.4	182.3	0.1	0.1

NOTES: (1) Washington State Plane South

(2) Most up-to-date version of the McAllister Groundwater Model used to support the City of Yelm's water right applications and mitigation program (City of Yelm, 2011).

(3) Yelm 2012 WHPA Model



LEGEND

- Well
- Revised Model Grid Cell
- Yelm City Limits
- Yelm Urban Growth Area

0 3,000

Scale in Feet
Map Projection:
NAD83 State Plane WA South
FIPS 4602 Feet

Source:
City of Yelm (City Limits, Urban Growth Area), Golder Associates, Inc.(Revised Model Grid Cell)

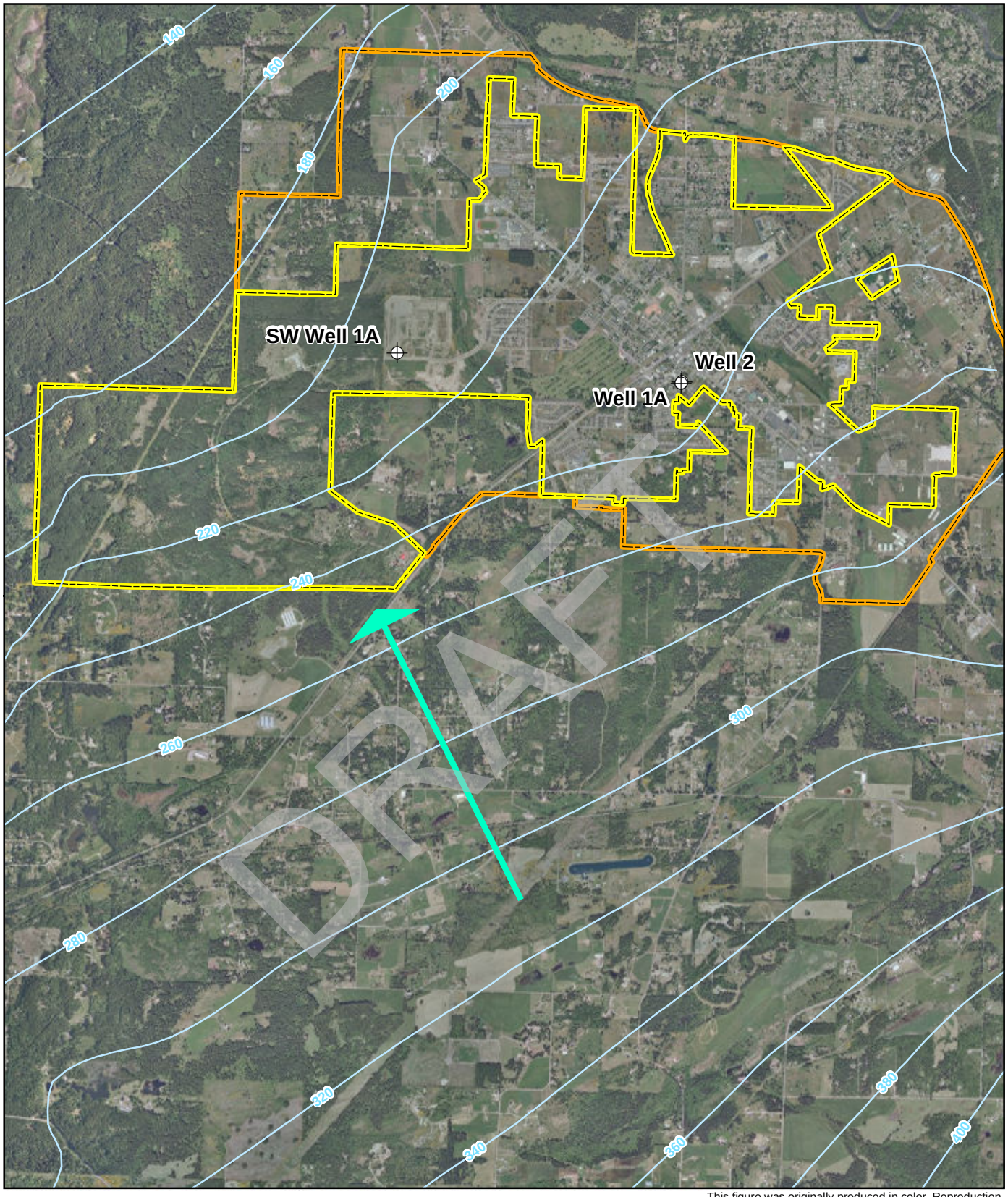
N

This figure was originally produced in color. Reproduction in black and white may result in a loss of information.

FIGURE **TM-1**
REVISED MODEL GRID
YELM WELL HEAD PROTECTION PLAN

Path: S:\Projects\2011\2011 Water Group Projects\113-99719 Yelm WHPP\Task 4 - Wellhead Protection Plan\mxds\11399719FTM_1_Revised Model Grid.mxd

Golder Associates



LEGEND

- Well
- Generalized Qva Groundwater Flow Direction
- Interpreted Groundwater Contour (Qva)
- Yelm City Limits
- Yelm Urban Growth Area

0 4,500

Scale in Feet
Map Projection:
NAD83 State Plane WA South
FIPS 4602 Feet

Source:
ESRI (Imagery), City of Yelm (City Limits, Urban Growth Area), Golder Associates, Inc.(Wells, Groundwater Contours)

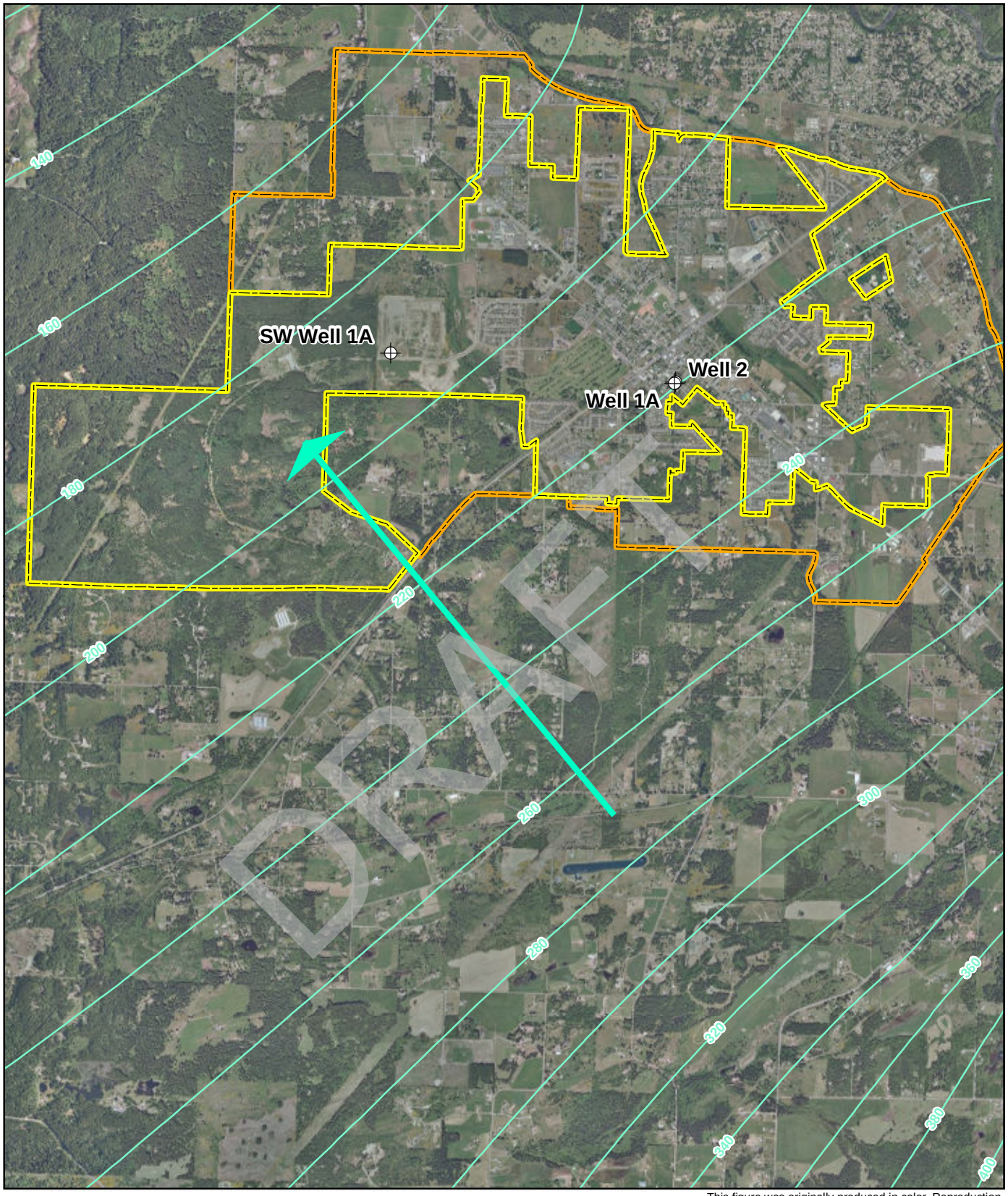
N

This figure was originally produced in color. Reproduction in black and white may result in a loss of information.

FIGURE **TM-2**
INTERPRETED GROUNDWATER CONTOURS FOR THE QVA
YELM WELL HEAD PROTECTION PLAN

Path: S:\Projects\2011\2011 Water Group Projects\113-99719 Yelm WHPP\Task 4 - Wellhead Protection Plan\mxds\11399719FTM_2_Interpreted Groundwater Contours Qva.mxd

Golder Associates



LEGEND

- Well
- Generalized TQu Groundwater Flow Direction
- Interpreted Groundwater Contour (Qva)
- Yelm City Limits
- Yelm Urban Growth Area

0 4,500

Scale in Feet
Map Projection:
NAD83 State Plane WA South
FIPS 4602 Feet

Source:
ESRI (Imagery), City of Yelm (City Limits, Urban Growth Area), Golder Associates, Inc.(Wells, Groundwater Contours)

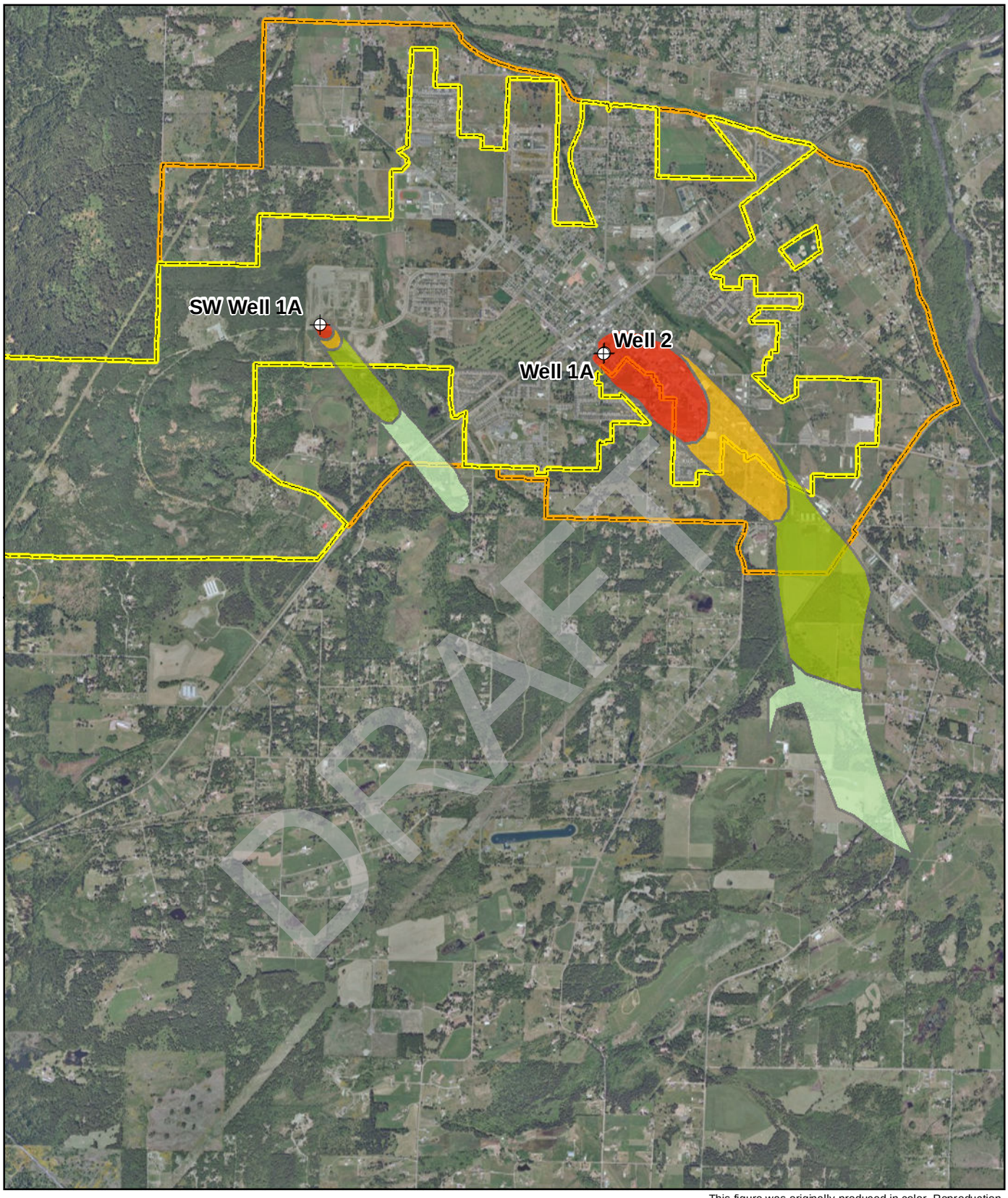
N

This figure was originally produced in color. Reproduction in black and white may result in a loss of information.

FIGURE **TM-3**
INTERPRETED GROUNDWATER CONTOURS FOR THE TQU
YELM WELL HEAD PROTECTION PLAN

Path: S:\Projects\2011\2011 Water Group Projects\113-99719 Yelm WHPP\Task 4 - Wellhead Protection Plan\mxds\11399719FTM_3_Interpreted Groundwater Contours TQu.mxd

Golder Associates



LEGEND

Well

Wellhead Capture Zone

6 month

1 year

5 year

10 year

Yelm City Limits

Yelm Urban Growth Area

0 4,500

Scale in Feet

Map Projection:
NAD83 State Plane WA South FIPS 4602 Feet

Source:
ESRI (Imagery), City of Yelm (City Limits, Urban Growth Area), Golder Associates, Inc.(Wells, Wellhead Capture Zone)

DRAFT

N

This figure was originally produced in color. Reproduction in black and white may result in a loss of information.

FIGURE **TM-4**

WELLHEAD PROTECTION AREAS

YELM WELL HEAD PROTECTION PLAN

Path: S:\Projects\2011\2011 Water Group Projects\113-99719 Yelm WHPP\Task 4 - Wellhead Protection Plan\mxds\11399719FTM_4_Wellhead_Protection_Areas.mxd

Golder Associates

Appendix D

SW Well 1A Groundwater Contamination Susceptibility Assessment Form

Ground Water Contamination
Susceptibility Assessment Survey Form
Version 2.2

IMPORTANT! Please complete one form for each ground water source (well, wellfield, spring) used in your water system. Photocopy as necessary.

PART I: System Information

Well owner/manager : City of Yelm, Washington

Water system name : Yelm, City of

County: Thurston

Water system number: 99350 Source number: planned new source

Well depth: 633 feet (ft.) (*From WFI form*)

Source name: SW Well 1A

WA well identification tag number: ALM - 113 ___-___ ___ ___

_____ well not tagged

Number of connections: 3,217** Population served: 6,215**

Township: 17N Range: 1E

Section: 23 1/4 1/4 Section: SE SE

Latitude/longitude (if available): 46 deg 56' 28.44" N / -122 deg 38' 07.87"

How was lat./long. determined?

____ global positioning device ____ survey X topographic map
____ other: _____

* Please refer to Assistance Packet for details and explanations of all questions in Parts II through V.

PART II: Well Construction and Source Information

1) Date well originally constructed: 10 / 08 / 10 month/day/year

last reconstruction: ___ / ___ /___ month/day/year

_____ information unavailable

**NOTE: SW Well 1A is a planned new source; approval pending; not yet hooked up to water system.

2) Well driller: Duane Stevenson, Boart Longyear, Sherwood, Oregon

___ well driller unknown

3) Type of well:

X **Drilled:** ___ rotary ___ bored ___ cable (percussion) ___ **Dug**

___ **Other:** ___ spring(s) ___ lateral collector (Ranney)

___ driven ___ jetted ___ other: _____

Additional comments: _____

4) Well report available? X YES (attach copy to form) ___ NO

If no well log is available, please attach any other records documenting well construction; e.g. boring logs, "as built" sheets, engineering reports, well reconstruction logs.

5) Average pumping rate: 2,100 gpm (gallons/min)

Source of information: 72-hr constant rate pumping test

If not documented, how was pumping rate determined? _____

___ Pumping rate unknown

6) Is this source treated? ___ YES X NO NOTE: SW Well 1I is planned new supply source; well not yet in use.

If so, what type of treatment:

___ disinfection ___ filtration ___ carbon filter ___ air stripper ___ other

Purpose of treatment (describe materials to be removed or controlled by treatment):

7) If source is chlorinated, is a chlorine residual maintained: ___ YES ___ NO

Residual level: _____ (*At the point closest to the source.*)

PART III: Hydrogeologic Information

1) Depth to top of open interval: [check one]

___ (less than) 20 ft ___ 20–50 ft ___ 50–10 ft ___ 100–200 ft X (greater than) 200 ft

___ information unavailable

2) Depth to ground water (static water level):

___ (less than) 20 ft ___ 20–50 ft ___ 50–100 ft X (greater than) 100 ft

___ flowing well/spring (artesian)

How was water level determined?

___ well log ___ other: measured manually using water-level indicator

___ depth to ground water unknown

3) If source is a flowing well or spring, what is the confining pressure:

_____ psi (pounds per square inch)
or
_____ feet above wellhead

4) If source is a flowing well or spring, is there a surface impoundment, reservoir, or catchment associated with this source: ___ YES ___ NO

5) Wellhead elevation (height above mean sea level): 386 (ft)

How was elevation determined? X topographic map ___ Drilling/Well Log ___ altimeter

___ other: _____

___ information unavailable

6) Confining layers: (This can be completed only for those sources with a drilling log, well log or geologic report describing subsurface conditions. Please refer to assistance package for example.)

X evidence of a confining layer in well log

___ no evidence of a confining layer in well log

If there is evidence of a confining layer, is the depth to ground water more than 20 feet above the **bottom** of the **lowest confining layer**? X YES ___ NO

___ information unavailable

7) Sanitary setback:

___ (less than) 100 ft* X 100–120 ft ___ 120–200 ft ___ (greater than) 200 ft
* if less than 100 ft describe the site conditions:

_____

_____

_____

_____

8) Wellhead construction: NOTE: Wellhouse constructed around pump and wellhead is proposed in design. Final Final design will also include controlled access by security fencing.

X wellhead enclosed in a wellhouse

X controlled access (describe): Currently, the wellhead is capped and secured.

_____

___ other uses for wellhouse (describe): _____

_____

___ no wellhead control

9) Surface seal:

___ 18 ft

___ (less than) 18 ft (no Department of Ecology approval)

___ (less than) 18 ft (Approved by Ecology, include documentation)

X (greater than) 18 ft

___ depth of seal unknown

___ no surface seal

10) Annual rainfall (inches per year):

___ (less than) 10 in/yr ___ 10–25 in/yr X (greater than) 25 in/yr

PART IV: Mapping Your Ground Water Resource

1) Annual volume of water pumped: 306,952,045 (gallons)

How was this determined?

___ meter

___ estimated: ___ pumping rate (_____)

___ pump capacity (_____)

X other: Annual water right quantity

2) "Calculated Fixed Radius" estimate of ground water movement:
(see Instruction Packet)

6 month ground water travel time : 450 (ft)

1 year ground water travel time : 636 (ft)

5 year ground water travel time: 1,421 (ft)

10 year ground water travel time: 2,010 (ft)

NOTE: Groundwater movement was estimated using a numerical groundwater flow model. Please Refer to the City's Wellhead Protection Plan for modeled wellhead protection area capture zones.

Information available on length of screened/open interval?

X YES ___ NO

Length of screened/open interval: 147 (ft)

3) Is there a river, lake, pond, stream, or other obvious surface water body within the 6 month time of travel boundary? X YES ___ NO (mark and identify on map).

4) Is there a stormwater and/or wastewater facility, treatment lagoon, or holding pond located within the 6 month time of travel boundary? X YES ___ NO (mark and identify on map).

Comments: Stormwater retention pond. Pond will be relocated before the well is put into service.

PART V: Assessment of Water Quality

1) Regional sources of risk to ground water:

Please indicate if any of the following are present within a circular area around your water source having a radius up to and including the five year ground water travel time:

	6 month	1 year	5 year	unknown
likely pesticide application				
stormwater injection wells				
other injection wells				
abandoned ground water well				
landfills, dumps, disposal areas				
known hazardous materials clean-up site				
water system(s) with known quality problems				
population density (greater than) 1 house/acre				
residences commonly have septic tanks			X	
Wastewater treatment lagoons				
sites used for land application of waste				

Mark and identify on map any of the risks listed above which are located within the 6 month time of travel boundary? (*Please include a map of the wellhead and time of travel areas with this form. Please locate and mark any of the following.*) NOTE: No known or suspected soil or groundwater contamination sites were identified in the 6-month or 1-, 5-, 10-yr capture zones. Please refer to City's WHPP for more information.

If other recorded or potential sources of ground water contamination exist within the ten year time of travel circular zone around your water supply, please describe:

No known or suspected soil or groundwater contamination sites were identified in the 6-month or 1-, 5-, or 10-yr capture zones. 10-yr capture zone is within rural residential land use and intersects a transportation corridor - herbicide application and septic system use likely.

2) Source specific water quality records:

Please indicate the occurrence of any test results since 1986 that meet the following conditions: (Unless listed on assessment, MCLs are listed in assistance package.)

A. Nitrate: (Nitrate MCL = 10 mg/l)	YES
Results greater than MCL	
(less than) 2 mg/liter nitrate	X
2–5 mg/liter nitrate	
(greater than) 5 mg/liter nitrate	
Nitrate sampling records unavailable	

B. VOCs: (VOC detection level 0.5 ug/l or 0.0005 mg/l.)	YES
Results greater than MCL or SAL	
VOCs detected at least once	
VOC test performed but never detected	X
VOC sampling records unavailable	

C. EDB/DBCP: (EDB MCL = 0.05 ug/l or 0.00005 mg/l. DBCP MCL = 0.2 ug/l or 0.0002 mg/l.)	YES
EDB/DBCP detected below MCL at least once	
EDB/DBCP detected above MCL at least once	
EDB/DBCP never detected	X
EDB/DBCP tests required but not yet completed	
EDB/DBCP tests not required	

D. Other SOCs (pesticides and other synthetic organic chemicals):	YES
Other SOCs detected	
Other SOC tests performed but none detected *	X
Other SOC tests not performed	

*If any SOCs in addition to EDB/DBCP were detected, please identify and date. If other SOC tests were performed, but no SOCs detected, list test methods here: EPA methods 549.2, 531.2, 515.4, 525.2, 548.1, 508.1

E. Bacterial contamination:

YES

Any bacterial detection(s) in the past 3 years in samples taken from the source (not distribution sampling records). Total coliform 2 MPN/100 ml E. Coli <2 MPN/100 ml ____

Has source (in past 3 years) had a bacteriological contamination problem found in distribution samples that was attributed to the source. ____

Source sampling records for bacteria unavailable ____

Part VI: Geographic or Hydrologic Factors Contributing to a Non-Circular Zone of Contribution

The following questions will help identify those ground water systems which may not be accurately represented by the calculated fixed radius (CFR) method described in Part IV. For these sources, the CFR areas should be used as a preliminary delineation of the critical time of travel zones for that source. As a system develops its Wellhead Protection Plan for theses sources, a more detailed delineation method should be considered.

1)Is there evidence of obvious hydrologic boundaries within the 10 year time of travel zone of the CFR? (Does the largest circle extend over a stream, river, lake, up a steep hillside, and/or over a mountain or ridge?)

___ YES X NO

Describe with references to map produced in Part IV:

_____

_____

2) Aquifer Material:

A) Does the drilling log, well log or other geologic/engineering reports identify that the well is located in an area where the underground conditions are identified as fractured rock and/or basalt terrain?

___ YES X NO

B) Does the drilling log, well log or other geologic/engineering reports indicate that the well is located in an area where the underground conditions are primarily identified as coarse sand and gravel?

X YES ___ NO

3) Is the source located in an aquifer with a high horizontal flow rate? (These can include sources located on flood plains of large rivers, artesian wells with high water pressure, and/or shallow flowing wells and springs.)

___ YES X NO

4) Are there other high capacity wells (agricultural, municipal and/or industrial) located within the CFRs?

a) Presence of ground water extraction wells removing more than approximately 500 gal/min within...

	YES	NO	unknown
6 month travel time	___	X	___
6 month–1 year travel time	___	X	___
1–5 year travel time	___	X	___
5–10 year travel time	___	X	___

b) Presence of ground water recharge wells (dry wells) or heavy irrigation within...

	YES	NO	unknown
1 year travel time	___	X	___
1–5 year travel time	___	X	___
5–10 year travel time	___	X	___

Please identify or describe additional hydrologic or geographic conditions that you believe may affect the shape of the zone of contribution for this source. Where possible, reference them to locations on the map produced in Part IV.

Suggestions and Comments

Did you attend one of the susceptibility workshops?	___ YES	X NO
Did you find it useful?	___ YES	___ NO
Did you seek outside assistance to complete the assessment?	X YES	___ NO

- -

This form and instruction packet are still in the process of development. Your comments, suggestions and questions will help us upgrade and improve this assessment form. If you found particular sections confusing or problematic please let us know. How could this susceptibility assessment be improved or made clearer? Did the instruction package help you find the information needed to complete the assessment? How much time did it take you to complete the form? Were you able to complete the assessment without additional/outside expertise? Do you feel the assessment was valuable as a learning experience? Any other comments or constructive criticisms you have would be appreciated.

SW Well 1A

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 WE11324

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

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

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

DIMENSIONS: Diameter of well 12" inches, drilled 800 ft. Depth of completed well 633 ft.

CONSTRUCTION DETAILS

Casing Installed: ☒ Welded 12" Diam. from +2 ft. to 367.5 ft.

☐ Liner installed _____" Diam. from _____ ft. to _____ ft.

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

Perforations: ☐ Yes ☒ No

Type of perforator used _____

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

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

Manufacturer's Name Johnson Screen

Type Wire-wrapped Model No. _____

Diam. 8" Slot size 0.035 from 352 ft. to 357 ft.

Diam. 8" Slot size 0.035 from 369 ft. to 437 ft.

Gravel/Filter packed: ☒ Yes ☐ No Size of gravel/sand 10x20

Materials placed from 353 ft. to 633 ft.

Surface Seal: ☒ Yes ☐ No To what depth? 327.7 ft.

Material used in seal Neat cement

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name Goulds

Type: Lineshaft turbine H.P. _____

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

Static level 102.5 ft. below top of well Date 10/6/10

Artesian pressure N/A 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? Boart Longyear

Yield: 2100 gal./min. with 82.2 ft. drawdown after 73 hrs.

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

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

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

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____

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

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

Artesian flow _____ g.p.m. Date _____

Temperature of water 54 Was a chemical analysis made? ☐ Yes ☐ No

CURRENT

Notice of Intent No. WE11324

Unique Ecology Well ID Tag No. ALM113

Water Right Permit No. Application G2-29804, G2-29805 and G2-29806

Property Owner Name City of Yelm

Well Street Address Tahoma Blvd SE & Dotson St. SE

City Yelm County Thurston

Location SE 1/4-1/4 SE 1/4 Sec 23 Twn 17 R 1E **(s, t, r Still REQUIRED)** EWM ☒ Or WWM ☐

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

Tax Parcel No. (Required) 78640000024

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
Fine sand w/ some silt	0	25
Med/fine sand, gravel, cobble	25	170
Med/fine sand with grave/silt	170	219
Silty with fine sand and wood	219	240
Silty sand/iron oxide stainin	240	300
Silty sand with wood	300	370
Silty sand	370	400
Silt and clay	400	453
Fine sand and silt	453	470
Silt and clay, some wood	470	485
Silty fine sand	485	525
Med to coarse sand	525	552
Silt with fine sand	552	610
Fine to med sand/gravel	610	630
Silt/clay with wood	630	665
Fine to coarse sand/gravel	665	675
Silt/clay	675	800

Start Date 4/27/10 Completed Date 10/8/10

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

☒ Driller ☐ Engineer ☐ Trainee Name (Print) Duane Stevenson

Driller/Engineer/Trainee Signature

Driller or trainee License No. 2795

IF TRAINEE: Driller's License No:

Driller's Signature:

Drilling Company Boart Longyear

Address 11277 SW Clay St, Suite A

City, State, Zip Sherwood, OR 97140

Contractor's Registration No. _____ Date _____

Appendix E

Environmental Data Resources (EDR) Report – Executive Summary

Wellhead Protection Contaminant Source Inventory
105 Yelm Ave. West
Yelm, WA 98597

Inquiry Number: 3269533.1s
March 01, 2012

The EDR Radius Map™ Report with GeoCheck®

EDR® Environmental Data Resources Inc

440 Wheelers Farms Road
Milford, CT 06461
Toll Free: 800.352.0050
www.edrnet.com

TABLE OF CONTENTS

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

EXECUTIVE SUMMARY

A search of available environmental records was conducted by Environmental Data Resources, Inc (EDR). The report was designed to assist parties seeking to meet the search requirements of EPA's Standards and Practices for All Appropriate Inquiries (40 CFR Part 312), the ASTM Standard Practice for Environmental Site Assessments (E 1527-05) or custom requirements developed for the evaluation of environmental risk associated with a parcel of real estate.

TARGET PROPERTY INFORMATION

ADDRESS

105 YELM AVE. WEST
YELM, WA 98597

COORDINATES

Latitude (North):	46.9235000 - 46° 55' 24.60''
Longitude (West):	122.6042000 - 122° 36' 15.12''
Universal Tranverse Mercator:	Zone 10
UTM X (Meters):	530134.8
UTM Y (Meters):	5196520.5
Elevation:	447 ft. above sea level

USGS TOPOGRAPHIC MAP ASSOCIATED WITH TARGET PROPERTY

Target Property Map:	46122-H5 MCKENNA, WA
Most Recent Revision:	1990
West Map:	46122-H6 TENALQUOT PRAIRIE, WA
Most Recent Revision:	1990

AERIAL PHOTOGRAPHY IN THIS REPORT

Photo Year:	2009
Source:	USDA

TARGET PROPERTY SEARCH RESULTS

The target property was identified in the following records. For more information on this property see page 7 of the attached EDR Radius Map report:

Site	Database(s)	EPA ID
CITY OF YELM 105 W YELM AVE YELM, WA 98597	ALLSITES	N/A

EXECUTIVE SUMMARY

DATABASES WITH NO MAPPED SITES

No mapped sites were found in EDR's search of available ("reasonably ascertainable ") government records either on the target property or within the search radius around the target property for the following databases:

STANDARD ENVIRONMENTAL RECORDS

Federal NPL site list

NPL ---------- National Priority List
Proposed NPL ---------- Proposed National Priority List Sites
NPL LIENS ---------- Federal Superfund Liens

Federal Delisted NPL site list

Delisted NPL ---------- National Priority List Deletions

Federal CERCLIS list

CERCLIS ---------- Comprehensive Environmental Response, Compensation, and Liability Information System
FEDERAL FACILITY ---------- Federal Facility Site Information listing

Federal CERCLIS NFRAP site List

CERC-NFRAP ---------- CERCLIS No Further Remedial Action Planned

Federal RCRA CORRACTS facilities list

CORRACTS ---------- Corrective Action Report

Federal RCRA non-CORRACTS TSD facilities list

RCRA-TSDF ---------- RCRA - Treatment, Storage and Disposal

Federal RCRA generators list

RCRA-LQG ---------- RCRA - Large Quantity Generators

Federal institutional controls / engineering controls registries

US ENG CONTROLS ---------- Engineering Controls Sites List
US INST CONTROL ---------- Sites with Institutional Controls

State- and tribal - equivalent NPL

HSL ---------- Hazardous Sites List

State- and tribal - equivalent CERCLIS

CSCSL ---------- Confirmed and Suspected Contaminated Sites List

State and tribal leaking storage tank lists

INDIAN LUST ---------- Leaking Underground Storage Tanks on Indian Land

EXECUTIVE SUMMARY

State and tribal registered storage tank lists

AST ---------- Aboveground Storage Tank Locations
INDIAN UST ---------- Underground Storage Tanks on Indian Land
FEMA UST ---------- Underground Storage Tank Listing

State and tribal institutional control / engineering control registries

INST CONTROL ---------- Institutional Control Site List

State and tribal voluntary cleanup sites

INDIAN VCP ---------- Voluntary Cleanup Priority Listing

State and tribal Brownfields sites

BROWNFIELDS ---------- Brownfields Sites Listing

ADDITIONAL ENVIRONMENTAL RECORDS

Local Brownfield lists

US BROWNFIELDS ---------- A Listing of Brownfields Sites

Local Lists of Landfill / Solid Waste Disposal Sites

DEBRIS REGION 9 ---------- Torres Martinez Reservation Illegal Dump Site Locations
ODI ---------- Open Dump Inventory
SWTIRE ---------- Solid Waste Tire Facilities
INDIAN ODI ---------- Report on the Status of Open Dumps on Indian Lands

Local Lists of Hazardous waste / Contaminated Sites

US CDL ---------- Clandestine Drug Labs

Local Land Records

LIENS 2 ---------- CERCLA Lien Information
LUCIS ---------- Land Use Control Information System

Other Ascertainable Records

DOT OPS ---------- Incident and Accident Data
DOD ---------- Department of Defense Sites
FUDS ---------- Formerly Used Defense Sites
CONSENT ---------- Superfund (CERCLA) Consent Decrees
ROD ---------- Records Of Decision
UMTRA ---------- Uranium Mill Tailings Sites
MINES ---------- Mines Master Index File
TSCA ---------- Toxic Substances Control Act
SSTS ---------- Section 7 Tracking Systems
ICIS ---------- Integrated Compliance Information System
PADS ---------- PCB Activity Database System

MLTS Material Licensing Tracking System
RADINFO Radiation Information Database
RAATS RCRA Administrative Action Tracking System
DRYCLEANERS Drycleaner List
INDIAN RESERV Indian Reservations
SCRD DRYCLEANERS State Coalition for Remediation of Drycleaners Listing
COAL ASH Coal Ash Disposal Site Listing
COAL ASH DOE Sleam-Electric Plan Operation Data
COAL ASH EPA Coal Combustion Residues Surface Impoundments List
PCB TRANSFORMER PCB Transformer Registration Database

EDR PROPRIETARY RECORDS

EDR Proprietary Records

Manufactured Gas Plants EDR Proprietary Manufactured Gas Plants

SURROUNDING SITES: SEARCH RESULTS

Surrounding sites were identified in the following databases.

Elevations have been determined from the USGS Digital Elevation Model and should be evaluated on a relative (not an absolute) basis. Relative elevation information between sites of close proximity should be field verified. Sites with an elevation equal to or higher than the target property have been differentiated below from sites with an elevation lower than the target property.
Page numbers and map identification numbers refer to the EDR Radius Map report where detailed data on individual sites can be reviewed.

Sites listed in ***bold italics*** are in multiple databases.

Unmappable (orphan) sites are not considered in the foregoing analysis.

STANDARD ENVIRONMENTAL RECORDS

Federal RCRA generators list

RCRA-SQG: RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Small quantity generators (SQGs) generate between 100 kg and 1,000 kg of hazardous waste per month.

A review of the RCRA-SQG list, as provided by EDR, and dated 06/15/2011 has revealed that there are 4 RCRA-SQG sites within approximately 2.5 miles of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
RITE AID 5286 YELM AVE	***909 YELM AVE E***	***NNE 1/2 - 1 (0.974 mi.)***	***12***	***10***
LIVINGSTON BOATS INC	***406 RAILROAD ST***	***N 1 - 2 (1.432 mi.)***	***G47***	***74***
WAL MART SUPERCENTER 3705	17100 STATE RT 507 SE	ENE 1 - 2 (1.482 mi.)	H52	98
LASCO BATHWARE	***801 NORTHERN PACIFIC***	***N 1 - 2 (1.580 mi.)***	***I64***	***119***

EXECUTIVE SUMMARY

RCRA-CESQG: RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Conditionally exempt small quantity generators (CESQGs) generate less than 100 kg of hazardous waste, or less than 1 kg of acutely hazardous waste per month.

A review of the RCRA-CESQG list, as provided by EDR, and dated 06/15/2011 has revealed that there are 5 RCRA-CESQG sites within approximately 2.5 miles of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
FRONTIER VILLAGE PROF DRYCLEAN	***404 1ST ST SE & MOSMAN***	***NNW 1 - 2 (1.208 mi.)***	***D26***	***43***
GORDERS AUTO REBUILD	***103 1ST ST N***	***N 1 - 2 (1.281 mi.)***	***E33***	***50***
PENSKE TRUCK LEASING CO LP	***801 NORTHERN PACIFIC RD***	***N 1 - 2 (1.580 mi.)***	***I63***	***108***
BNH AUTO WRECKING	***17505 110TH AVE SE***	***E 1 - 2 (1.701 mi.)***	***K74***	***158***
YELM COMMUNITY SCHOOLS	***14901 YELM HWY SE***	***NNW >2 (2.224 mi.)***	***111***	***185***

Federal ERNS list

ERNS: The Emergency Response Notification System records and stores information on reported releases of oil and hazardous substances. The source of this database is the U.S. EPA.

A review of the ERNS list, as provided by EDR, and dated 10/03/2011 has revealed that there are 2 ERNS sites within approximately 2.5 miles of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
16507 STATE ROUTE 507 SE	16507 STATE ROUTE 507 S	NE 1/2 - 1 (0.949 mi.)	A9	9
13431 SOLBERG RD.	13431 SOLBERG RD.	SSW >2 (2.241 mi.)	112	186

State and tribal landfill and/or solid waste disposal site lists

SWF/LF: The Solid Waste Facilities/Landfill Sites records typically contain an inventory of solid waste disposal facilities or landfills in a particular state. The data come from the Department of Ecology's Solid Waste Facilities Handbook.

A review of the SWF/LF list, as provided by EDR, and dated 10/11/2011 has revealed that there is 1 SWF/LF site within approximately 2.5 miles of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
W.E. & B. LIMITED	15708 123RD AVENUE	S 1 - 2 (1.007 mi.)	B18	24

State and tribal leaking storage tank lists

LUST: The Leaking Underground Storage Tank Incident Reports contain an inventory of reported leaking underground storage tank incidents. The data come from the Department of Ecology's Leaking Underground Storage Tanks Site List.

A review of the LUST list, as provided by EDR, and dated 11/22/2011 has revealed that there is 1 LUST

site within approximately 2.5 miles of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
FLYING M	***35618 HWY 507 S***	***ENE >2 (2.389 mi.)***	***120***	***189***

State and tribal registered storage tank lists

UST: The Underground Storage Tank database contains registered USTs. USTs are regulated under Subtitle I of the Resource Conservation and Recovery Act (RCRA). The data come from the Department of Ecology's Statewide UST Site/Tank Report.

A review of the UST list, as provided by EDR, and dated 11/22/2011 has revealed that there are 15 UST sites within approximately 2.5 miles of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
RAINIER CHEVRON	16518 YELM AVE SE	NE 1/2 - 1 (0.975 mi.)	A13	22
YELM SHELL	***706 YELM AVE E***	***NNE 1 - 2 (1.019 mi.)***	***C21***	***37***
MICHAEL J MCCASLIN	107 S 1ST ST	N 1 - 2 (1.276 mi.)	E31	48
GORDERS AUTO REBUILD	***103 1ST ST N***	***N 1 - 2 (1.281 mi.)***	***E34***	***52***
NISQUALLY VALLEY GOLF COURSE	***MOSSMAN & EDWARDS***	***NNW 1 - 2 (1.315 mi.)***	***37***	***55***
SAFEWAY FUEL CENTER YELM AVE	***1109 A YELM AVE E***	***NNW 1 - 2 (1.431 mi.)***	***F43***	***59***
HARTS LAKE ASSOCIATES	***402 NW RAILROAD***	***N 1 - 2 (1.432 mi.)***	***G44***	***60***
LASCO BATHWARE	801 NORTHERN PACIFIC	N 1 - 2 (1.568 mi.)	I60	105
NORTHWEST DELI MART 46	608 YELM HWY	NNW 1 - 2 (1.584 mi.)	J69	152
CREAMERY TRANSPORT CO INC	***17025 HANNUS RD SE***	***SE 1 - 2 (1.614 mi.)***	***72***	***155***
GLACIER NORTHWEST INC YELM PLA	***705 NW RHOTON RD***	***N 1 - 2 (1.708 mi.)***	***L77***	***160***
FOUR CORNER GROCERY	***11500 BALD HILLS RD***	***E 1 - 2 (1.745 mi.)***	***M84***	***166***
YELM MAINTENANCE SITE	***17526 HWY 507 SE***	***ENE 1 - 2 (1.781 mi.)***	***O88***	***169***
WOOD FABRICATORS	***1001 NE RHOTON RD***	***N 1 - 2 (1.918 mi.)***	***92***	***172***
FLYING M	***35618 HWY 507 S***	***ENE >2 (2.389 mi.)***	***120***	***189***

State and tribal voluntary cleanup sites

VCP: Sites that have entered either the Voluntary Cleanup Program or its predecessor Independent Remedial Action Program.

A review of the VCP list, as provided by EDR, and dated 01/24/2012 has revealed that there are 3 VCP sites within approximately 2.5 miles of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
YELM SHELL	***706 YELM AVE E***	***NNE 1 - 2 (1.019 mi.)***	***C20***	***25***
LIVINGSTON BOATS INC YELM	***406 RAILROAD ST***	***N 1 - 2 (1.432 mi.)***	***G46***	***62***
WOOD FABRICATORS	***1001 NE RHOTON RD***	***N 1 - 2 (1.918 mi.)***	***92***	***172***

EXECUTIVE SUMMARY

ICR: These are remedial action reports Ecology has received from either the owner or operator of the site. These actions have been conducted without department oversight or approval and are not under an order or decree.

A review of the ICR list, as provided by EDR, and dated 12/01/2002 has revealed that there are 2 ICR sites within approximately 2.5 miles of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
YELM SHELL	***706 YELM AVE E***	***NNE 1 - 2 (1.019 mi.)***	***C20***	***25***
WOOD FABRICATORS	***1001 NE RHOTON RD***	***N 1 - 2 (1.918 mi.)***	***92***	***172***

ADDITIONAL ENVIRONMENTAL RECORDS

Local Lists of Hazardous waste / Contaminated Sites

ALLSITES: Information on facilities and sites of interest to the Department of Ecology.

A review of the ALLSITES list, as provided by EDR, and dated 01/31/2012 has revealed that there are 38 ALLSITES sites within approximately 2.5 miles of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
JIFFY LUBE STORE 2812	***1002 E YELM AVE***	***NNE 1/2 - 1 (0.957 mi.)***	***11***	***9***
RITE AID 5286 YELM AVE	***909 YELM AVE E***	***NNE 1/2 - 1 (0.974 mi.)***	***12***	***10***
WE & B LIMITED	15708 123RD AVE	S 1 - 2 (1.007 mi.)	B19	25
YELM SHELL	***706 YELM AVE E***	***NNE 1 - 2 (1.019 mi.)***	***C20***	***25***
YCOM NETWORKS CONST YARD	***10812 BALD HILL RD SE***	***ENE 1 - 2 (1.084 mi.)***	***22***	***41***
MOUNT RAINIER CLINIC INC	***503 1ST ST S***	***NNW 1 - 2 (1.178 mi.)***	***D24***	***42***
FRONTIER VILLAGE PROF DRYCLEAN	***404 1ST ST SE & MOSMAN***	***NNW 1 - 2 (1.208 mi.)***	***D26***	***43***
MICHAEL J MCCASLIN	***107 S 1ST ST***	***N 1 - 2 (1.276 mi.)***	***E32***	***50***
GORDERS AUTO REBUILD	***103 1ST ST N***	***N 1 - 2 (1.281 mi.)***	***E34***	***52***
NISQUALLY VALLEY GOLF COURSE	***MOSSMAN & EDWARDS***	***NNW 1 - 2 (1.315 mi.)***	***37***	***55***
SAFEWAY FUEL CENTER YELM AVE	***1109 A YELM AVE E***	***NNW 1 - 2 (1.431 mi.)***	***F43***	***59***
HARTS LAKE ASSOCIATES	***402 NW RAILROAD***	***N 1 - 2 (1.432 mi.)***	***G44***	***60***
LIVINGSTON BOATS INC YELM	***406 RAILROAD ST***	***N 1 - 2 (1.432 mi.)***	***G46***	***62***
JOHNS MEADOWS	16440 MIDDLE RD SE	NNE 1 - 2 (1.480 mi.)	49	90
WAL MART SUPERCENTER 3705	***17100 SR 507 SE***	***ENE 1 - 2 (1.482 mi.)***	***H50***	***91***
SAMANTHA RIDGE	502 CRYSTAL SPRINGS ST	N 1 - 2 (1.565 mi.)	58	102
CENEX HARVEST STATES YELM	***509 RHOTON RD***	***N 1 - 2 (1.577 mi.)***	***I61***	***107***
PENSKE TRUCK LEASING CO LP	***801 NORTHERN PACIFIC RD***	***N 1 - 2 (1.580 mi.)***	***I63***	***108***
LASCO BATHWARE	***801 NORTHERN PACIFIC***	***N 1 - 2 (1.580 mi.)***	***I64***	***119***
YELM AREA RELIABILITY	***16302 RAILWAY RD SE***	***NNE 1 - 2 (1.583 mi.)***	***66***	***151***
WESTSTAR INC	***608 YELM AVENUE***	***NNW 1 - 2 (1.584 mi.)***	***J67***	***151***
CREAMERY TRANSPORT CO INC	***17025 HANNUS RD SE***	***SE 1 - 2 (1.614 mi.)***	***72***	***155***
BNH AUTO WRECKING	17505 110TH AVE SE	E 1 - 2 (1.701 mi.)	K73	157
GLACIER NORTHWEST	***705 NORTHWEST RHOTON RO***	***N 1 - 2 (1.708 mi.)***	***L78***	***161***
VAIL RD DRUG LAB	***11515 VAIL RD SE***	***E 1 - 2 (1.709 mi.)***	***M80***	***163***
BILLS TOWING	***801 W YELM AVE***	***NNW 1 - 2 (1.710 mi.)***	***N81***	***164***
FOUR CORNER GROCERY	***11500 BALD HILLS RD***	***E 1 - 2 (1.745 mi.)***	***M84***	***166***
YELM MAINTENANCE SITE	***17526 HWY 507 SE***	***ENE 1 - 2 (1.781 mi.)***	***O88***	***169***
T AUTOMOTIVE SERVICE	***16713 CANAL RD SE***	***NNE 1 - 2 (1.893 mi.)***	***P91***	***171***
WOOD FABRICATORS	***1001 NE RHOTON RD***	***N 1 - 2 (1.918 mi.)***	***92***	***172***
HOFFMAN PLAT	9405 CULLENS RD	N 1 - 2 (1.958 mi.)	Q94	177
CULLENS ROAD PLAT	***9329 CULLENS RD***	***N >2 (2.011 mi.)***	***Q98***	***179***
YELM DRUG CHEMICAL DU	***NW COR OF FLUME RD & BR***	***NNE >2 (2.018 mi.)***	***100***	***180***

EXECUTIVE SUMMARY

Lower Elevation	Address	Direction / Distance	Map ID	Page
YELM WWTP	931 NORTHERN PACIFIC RD	NNE >2 (2.032 mi.)	R103	182
YELM COMMUNITY SCHOOLS	***14901 YELM HWY SE***	***NNW >2 (2.224 mi.)***	***111***	***185***
NISQUALLY VALLEY CARE CENTER	***9414 357TH ST S***	***ENE >2 (2.254 mi.)***	***T113***	***187***
FLYING M	***35618 HWY 507 S***	***ENE >2 (2.389 mi.)***	***120***	***189***
WEST AIR AVIATION	***18324 COOK RD 6***	***E >2 (2.488 mi.)***	***126***	***195***

CSCSL NFA: The data set contains information about sites previously on the Confirmed and Suspected Contaminated Sites list that have received a No Further Action (NFA) determination. Because it is necessary to maintain historical records of sites that have been investigated and cleaned up, sites are not deleted from the database when cleanup activities are completed. Instead a No Further Action code is entered based upon the type of NFA determination the site received.

A review of the CSCSL NFA list, as provided by EDR, and dated 01/24/2012 has revealed that there are 4 CSCSL NFA sites within approximately 2.5 miles of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
YELM SHELL	***706 YELM AVE E***	***NNE 1 - 2 (1.019 mi.)***	***C20***	***25***
LIVINGSTON BOATS INC YELM	***406 RAILROAD ST***	***N 1 - 2 (1.432 mi.)***	***G46***	***62***
BILLS TOWING	***801 W YELM AVE***	***NNW 1 - 2 (1.710 mi.)***	***N81***	***164***
WOOD FABRICATORS	***1001 NE RHOTON RD***	***N 1 - 2 (1.918 mi.)***	***92***	***172***

CDL: Illegal methamphetamine labs use hazardous chemicals that create public health hazards. Chemicals and residues can cause burns, respiratory and neurological , damage and death. Biological hazards associated with intravenous needles, associated with intravenous needles, feces, and blood risks.

A review of the CDL list, as provided by EDR, and dated 02/09/2009 has revealed that there is 1 CDL site within approximately 2.5 miles of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
Not reported	***11822 HOBBY ST SE***	***WSW 1 - 2 (1.578 mi.)***	***62***	***107***

HIST CDL: This listing of contaminated sites by Clandestine Drug Labs includes non-remediated properties. The current CDL listing does not. This listing is no longer updated by the state agency.

A review of the HIST CDL list, as provided by EDR, and dated 02/08/2007 has revealed that there are 5 HIST CDL sites within approximately 2.5 miles of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
Not reported	***11822 HOBBY ST SE***	***WSW 1 - 2 (1.578 mi.)***	***62***	***107***
Not reported	12220 HILLCREST	WSW 1 - 2 (1.959 mi.)	96	178
Not reported	14504-C SE BERRY VALLEY	NW >2 (2.085 mi.)	104	183
Not reported	9346 BRIDGE RD	NNE >2 (2.204 mi.)	S107	184
Not reported	9110 PEPPERIDGE LANE	NNE >2 (2.414 mi.)	W122	194

US HIST CDL: A listing of clandestine drug lab locations. The U.S. Department of Justice ("the Department") provides this web site as a public service. It contains addresses of some locations where law enforcement agencies reported they found chemicals or other items that indicated the presence of either clandestine drug laboratories or dumpsites. In most cases, the source of the entries is not the Department, and the Department has not verified the entry and does not guarantee its accuracy. Members of the public must verify the accuracy of all entries by, for example, contacting local law enforcement and local health departments.

A review of the US HIST CDL list, as provided by EDR, and dated 09/01/2007 has revealed that there is 1 US HIST CDL site within approximately 2.5 miles of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
15913 SE 90TH AVE	15913 SE 90TH AVE	N >2 (2.292 mi.)	U116	188

Records of Emergency Release Reports

HMIRS: The Hazardous Materials Incident Report System contains hazardous material spill incidents reported to the Department of Transportation. The source of this database is the U.S. EPA.

A review of the HMIRS list, as provided by EDR, and dated 10/04/2011 has revealed that there are 2 HMIRS sites within approximately 2.5 miles of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
Not reported	16507 STATE ROUTE 507 S	NE 1/2 - 1 (0.948 mi.)	A7	9
Not reported	16507 STATE ROUTE 507 S	NE 1/2 - 1 (0.948 mi.)	A8	9

SPILLS: Depending on the state, these may be active or inactive facilities or open dumps that failed to meet RCRA Subtitle D Section 4004 criteria for solid waste landfills or disposal sites.

A review of the SPILLS list, as provided by EDR, and dated 01/03/2012 has revealed that there are 39 SPILLS sites within approximately 2.5 miles of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
UNKNOWN	10826 VANCIL ROAD	NE 1/2 - 1 (0.701 mi.)	2	7
PUGET SOUND ENERGY- PSE	10730 MORRIS ROAD	NE 1/2 - 1 (0.849 mi.)	4	8
Not reported	15836 123 AVENUE	S 1/2 - 1 (0.994 mi.)	15	23
UNKNOWN	15011 119TH WAY SE YELM	SW 1 - 2 (1.005 mi.)	16	24
YELM SHELL	***706 YELM AVE E***	***NNE 1 - 2 (1.019 mi.)***	***C20***	***25***
Not reported	118 MOSSMAN AVENUE SOUT	NNW 1 - 2 (1.170 mi.)	D23	41
Not reported	15218 123RD AVENUE SOUT	SSW 1 - 2 (1.197 mi.)	25	42
Not reported	222 YELM AVENUE EAST	N 1 - 2 (1.226 mi.)	27	47
PUGET SOUND ENERGY	12520 MORRIS ROAD SE	S 1 - 2 (1.226 mi.)	28	47
PUGET SOUND ENERGY	15235 105TH AVENUE SOUT	NW 1 - 2 (1.235 mi.)	29	47
Not reported	10535 GROVE ROAD	NE 1 - 2 (1.248 mi.)	30	47
UNKNOWN	10405 GROVE ROAD SE, YE	NE 1 - 2 (1.287 mi.)	36	54
AMTEK	406 RAILROAD STREET	N 1 - 2 (1.431 mi.)	G40	57
WAL MART SUPERCENTER 3705	***17100 SR 507 SE***	***ENE 1 - 2 (1.482 mi.)***	***H50***	***91***
Not reported	17246 110 TH AVENUE SOU	E 1 - 2 (1.500 mi.)	54	101
UNKNOWN	11610 HOBIE STREET SOUT	WSW 1 - 2 (1.521 mi.)	56	102
Not reported	16145 RAILWAY RD	N 1 - 2 (1.526 mi.)	57	102
CHIROPRACTIC OFFICE	604 YELM HWY SE, SUITE	NNW 1 - 2 (1.582 mi.)	J65	151
WESTSTAR INC	***608 YELM AVENUE***	***NNW 1 - 2 (1.584 mi.)***	***J67***	***151***
Not reported	11647 VAIL ROAD SOUTHEA	ESE 1 - 2 (1.705 mi.)	75	159

Lower Elevation	Address	Direction / Distance	Map ID	Page
GLACIER NORTHWEST	***705 NORTHWEST RHOTON RO***	***N 1 - 2 (1.708 mi.)***	***L78***	***161***
Not reported	14945 129TH LANE SE	SW 1 - 2 (1.726 mi.)	83	165
Not reported	909 YELM AVENUE WEST	NNW 1 - 2 (1.772 mi.)	87	168
Not reported	16747 CANAL ROAD SE	NNE 1 - 2 (1.868 mi.)	P90	171
Not reported	110TH AND VAIL ROAD SOU	E 1 - 2 (1.934 mi.)	93	177
Not reported	HWY 507/ VAIL RD SE	ENE 1 - 2 (1.997 mi.)	97	179
GERBER & SONS	9801 BRIDGE RD SE	NE >2 (2.026 mi.)	101	182
Not reported	9543 BRIDGE ROAD SOUTHE	NNE >2 (2.103 mi.)	106	183
Not reported	9346 BRIDGE ROAD	NNE >2 (2.204 mi.)	S108	184
Not reported	11234 AERO LANE SE	E >2 (2.205 mi.)	109	184
PREVIOUS OWNER	119 VIEW DRIVE NORTHWES	N >2 (2.206 mi.)	110	184
Not reported	15913 90TH AVE SE	N >2 (2.290 mi.)	U115	188
RESIDENCE	9132 BRIDGE RD	NNE >2 (2.350 mi.)	V117	188
Not reported	9132 BRIDGE ROAD	NNE >2 (2.350 mi.)	V118	189
UNKNOWN	35807 94TH AVENUE SOUTH	ENE >2 (2.357 mi.)	119	189
Not reported	9110 PEPPERIDGE LANE SO	NNE >2 (2.414 mi.)	W121	194
Not reported	12635 WAGON WHEEL ROAD	SW >2 (2.474 mi.)	X123	194
Not reported	13103 ZELLER ROAD SE	SW >2 (2.475 mi.)	124	195
Not reported	12648 WAGONWHEEL ROAD S	SW >2 (2.479 mi.)	X125	195

Other Ascertainable Records

RCRA-NonGen: RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Non-Generators do not presently generate hazardous waste.

A review of the RCRA-NonGen list, as provided by EDR, and dated 06/15/2011 has revealed that there are 6 RCRA-NonGen sites within approximately 2.5 miles of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
YELM SHELL	***706 YELM AVE E***	***NNE 1 - 2 (1.019 mi.)***	***C20***	***25***
VAIL RD DRUG LAB	***11515 VAIL RD SE***	***E 1 - 2 (1.709 mi.)***	***M80***	***163***
T AUTOMOTIVE SERVICE	***16713 CANAL RD SE***	***NNE 1 - 2 (1.893 mi.)***	***P91***	***171***
WOOD FABRICATORS	***1001 NE RHOTON RD***	***N 1 - 2 (1.918 mi.)***	***92***	***172***
YELM DRUG CHEMICAL DU	***NW COR OF FLUME RD & BR***	***NNE >2 (2.018 mi.)***	***100***	***180***
WEST AIR AVIATION	***18324 COOK RD 6***	***E >2 (2.488 mi.)***	***126***	***195***

TRIS: The Toxic Chemical Release Inventory System identifies facilities that release toxic chemicals to the air, water, and land in reportable quantities under SARA Title III, Section 313. The source of this database is the U.S. EPA.

A review of the TRIS list, as provided by EDR, and dated 12/31/2009 has revealed that there are 2 TRIS sites within approximately 2.5 miles of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
LASCO BATHWARE	***801 NORTHERN PACIFIC***	***N 1 - 2 (1.580 mi.)***	***I64***	***119***
GLACIER NORTHWEST INC YELM PLA	705 RHOTON RD	N 1 - 2 (1.708 mi.)	L79	163

FTTS: FTTS tracks administrative cases and pesticide enforcement actions and compliance activities related to FIFRA, TSCA and EPCRA (Emergency Planning and Community Right-to-Know Act) over the previous five years. To maintain currency, EDR contacts the Agency on a quarterly basis.

A review of the FTTS list, as provided by EDR, and dated 04/09/2009 has revealed that there are 2 FTTS sites within approximately 2.5 miles of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
YELM SD 2	***404 YELM AVE W***	***N 1 - 2 (1.431 mi.)***	***F41***	***58***
LIVINGSTON BOATS INC	***406 RAILROAD ST***	***N 1 - 2 (1.432 mi.)***	***G47***	***74***

HIST FTTS: A complete administrative case listing from the FIFRA/TSCA Tracking System (FTTS) for all ten EPA regions. The information was obtained from the National Compliance Database (NCDB). NCDB supports the implementation of FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act) and TSCA (Toxic Substances Control Act). Some EPA regions are now closing out records. Because of that, and the fact that some EPA regions are not providing EPA Headquarters with updated records, it was decided to create a HIST FTTS database. It included records that may not be included in the newer FTTS database updates. This database is no longer updated.

A review of the HIST FTTS list, as provided by EDR, and dated 10/19/2006 has revealed that there are 2 HIST FTTS sites within approximately 2.5 miles of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
YELM SD 2	***404 YELM AVE W***	***N 1 - 2 (1.431 mi.)***	***F41***	***58***
LIVINGSTON BOATS INC	***406 RAILROAD ST***	***N 1 - 2 (1.432 mi.)***	***G47***	***74***

FINDS: The Facility Index System contains both facility information and "pointers" to other sources of information that contain more detail. These include: RCRIS; Permit Compliance System (PCS); Aerometric Information Retrieval System (AIRS); FATES (FIFRA [Federal Insecticide Fungicide Rodenticide Act] and TSCA Enforcement System, FTTS [FIFRA/TSCA Tracking System]; CERCLIS; DOCKET (Enforcement Docket used to manage and track information on civil judicial enforcement cases for all environmental statutes); Federal Underground Injection Control (FURS); Federal Reporting Data System (FRDS); Surface Impoundments (SIA); TSCA Chemicals in Commerce Information System (CICS); PADS; RCRA-J (medical waste transporters/disposers); TRIS; and TSCA. The source of this database is the U.S. EPA/NTIS.

A review of the FINDS list, as provided by EDR, and dated 10/23/2011 has revealed that there are 42 FINDS sites within approximately 2.5 miles of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
YELM PRAIRIE ELEMENTARY	16535 110TH AVE. SE	ENE 1/2 - 1 (0.731 mi.)	3	7
MILL POND INTERMEDIATE SCHOOL	909 MILL RD SE	NNW 1/2 - 1 (0.948 mi.)	6	8
JIFFY LUBE STORE 2812	***1002 E YELM AVE***	***NNE 1/2 - 1 (0.957 mi.)***	***11***	***9***
RITE AID 5286 YELM AVE	***909 YELM AVE E***	***NNE 1/2 - 1 (0.974 mi.)***	***12***	***10***
RAINIER CHEVRON	16518 YELM AVE SE	NE 1/2 - 1 (0.975 mi.)	A14	23
WE & B LIMITED	15708 123RD AVE	S 1 - 2 (1.005 mi.)	B17	24
YELM SHELL	***706 YELM AVE E***	***NNE 1 - 2 (1.019 mi.)***	***C20***	***25***
YCOM NETWORKS CONST YARD	***10812 BALD HILL RD SE***	***ENE 1 - 2 (1.084 mi.)***	***22***	***41***
MOUNT RAINIER CLINIC INC	***503 1ST ST S***	***NNW 1 - 2 (1.178 mi.)***	***D24***	***42***
FRONTIER VILLAGE PROF DRYCLEAN	***404 1ST ST SE & MOSMAN***	***NNW 1 - 2 (1.208 mi.)***	***D26***	***43***
MICHAEL J MCCASLIN	***107 S 1ST ST***	***N 1 - 2 (1.276 mi.)***	***E32***	***50***
GORDERS AUTO REBUILD	***103 1ST ST N***	***N 1 - 2 (1.281 mi.)***	***E33***	***50***
YELM EXTENSION SCHOOL	107 FIRST ST NORTH	N 1 - 2 (1.283 mi.)	E35	54
YELM EXTENSION SCHOOL	203 N FIRST ST	N 1 - 2 (1.318 mi.)	38	57
YELM MIDDLE SCHOOL	402 YELM AVE. W	N 1 - 2 (1.430 mi.)	F39	57

EXECUTIVE SUMMARY

Lower Elevation	Address	Direction / Distance	Map ID	Page
LACKAMAS ELEMENTARY	16240 BALD HILL RD	N 1 - 2 (1.431 mi.)	F42	58
HARTS LAKE ASSOCIATES	402 NW RAILROAD	N 1 - 2 (1.432 mi.)	G45	61
LIVINGSTON BOATS INC	***406 RAILROAD ST***	***N 1 - 2 (1.432 mi.)***	***G47***	***74***
FORT STEVENS ELEMENTARY	16525 100TH WAY SE	NNE 1 - 2 (1.456 mi.)	48	90
WAL MART SUPERCENTER 3705	17100 STATE RT 507 SE	ENE 1 - 2 (1.482 mi.)	H53	100
CENEX HARVEST STATES YELM	***509 RHOTON RD***	***N 1 - 2 (1.577 mi.)***	***I61***	***107***
PENSKE TRUCK LEASING CO LP	***801 NORTHERN PACIFIC RD***	***N 1 - 2 (1.580 mi.)***	***I63***	***108***
LASCO BATHWARE	***801 NORTHERN PACIFIC***	***N 1 - 2 (1.580 mi.)***	***I64***	***119***
NORTHWEST DELI MART 46	608 YELM HWY	NNW 1 - 2 (1.584 mi.)	J70	155
CREAMERY TRANSPORT CO INC	***17025 HANNUS RD SE***	***SE 1 - 2 (1.614 mi.)***	***72***	***155***
BNH AUTO WRECKING	***17505 110TH AVE SE***	***E 1 - 2 (1.701 mi.)***	***K74***	***158***
CENTRAL REDDIMIX INC	705 RHOTON RD	N 1 - 2 (1.708 mi.)	L76	160
GLACIER NORTHWEST INC YELM PLA	***705 NW RHOTON RD***	***N 1 - 2 (1.708 mi.)***	***L77***	***160***
VAIL RD DRUG LAB	***11515 VAIL RD SE***	***E 1 - 2 (1.709 mi.)***	***M80***	***163***
BILLS TOWING	801 W YELM AVE	NNW 1 - 2 (1.710 mi.)	N82	165
FOUR CORNER GROCERY	11500 BALD HILLS RD	E 1 - 2 (1.745 mi.)	M85	168
YELM MAINTENANCE SITE	17526 HWY 507 SE	ENE 1 - 2 (1.808 mi.)	O89	170
T AUTOMOTIVE SERVICE	***16713 CANAL RD SE***	***NNE 1 - 2 (1.893 mi.)***	***P91***	***171***
WOOD FABRICATORS	***1001 NE RHOTON RD***	***N 1 - 2 (1.918 mi.)***	***92***	***172***
HOFFMAN PLAT	9405 CULLENS ROAD	N 1 - 2 (1.958 mi.)	Q95	178
CULLENS ROAD PLAT	9329 CULLENS ROAD	N >2 (2.011 mi.)	Q99	180
YELM DRUG CHEMICAL DU	***NW COR OF FLUME RD & BR***	***NNE >2 (2.018 mi.)***	***100***	***180***
YELM WATER RECLAMATION FACILIT	931 NORTHERN PACIFIC RO	NNE >2 (2.031 mi.)	R102	182
YELM HIGH SCHOOL 12	1315 YELM AVE. W	NNW >2 (2.093 mi.)	105	183
YELM COMMUNITY SCHOOLS	***14901 YELM HWY SE***	***NNW >2 (2.224 mi.)***	***111***	***185***
NISQUALLY VALLEY CARE CENTER	9414 357TH ST S	ENE >2 (2.254 mi.)	T114	187
WEST AIR AVIATION	***18324 COOK RD 6***	***E >2 (2.488 mi.)***	***126***	***195***

UIC: A listing of underground injection wells.

A review of the UIC list, as provided by EDR, and dated 11/22/2011 has revealed that there are 3 UIC sites within approximately 2.5 miles of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
CHURCH OF JESUS CHRIST OF LDS	10423 CLARK ROAD SE	N 1/2 - 1 (0.896 mi.)	5	8
TODAY'S DENTAL	502 WEST YELM AVENUE	NNW 1 - 2 (1.515 mi.)	55	101
TAHOMA TERRA INFILTRATION GALL	14848 LONGMIRE ST SE	NW 1 - 2 (1.587 mi.)	71	155

MANIFEST: Hazardous waste manifest information.

A review of the MANIFEST list, as provided by EDR, and dated 12/31/2010 has revealed that there are 6 MANIFEST sites within approximately 2.5 miles of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
RITE AID 5286 YELM AVE	***909 YELM AVE E***	***NNE 1/2 - 1 (0.974 mi.)***	***12***	***10***
YELM SHELL	***706 YELM AVE E***	***NNE 1 - 2 (1.019 mi.)***	***C20***	***25***
LIVINGSTON BOATS INC	***406 RAILROAD ST***	***N 1 - 2 (1.432 mi.)***	***G47***	***74***
WAL MART SUPERCENTER 3705	17100 STATE RT 507 SE	ENE 1 - 2 (1.482 mi.)	H51	91
PENSKE TRUCK LEASING CO LP	***801 NORTHERN PACIFIC RD***	***N 1 - 2 (1.580 mi.)***	***I63***	***108***
LASCO BATHWARE	***801 NORTHERN PACIFIC***	***N 1 - 2 (1.580 mi.)***	***I64***	***119***

EXECUTIVE SUMMARY

NPDES: A listing of permitted wastewater facilities.

A review of the NPDES list, as provided by EDR, and dated 01/31/2012 has revealed that there are 4 NPDES sites within approximately 2.5 miles of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
YELM AREA RELIABILITY	***16302 RAILWAY RD SE***	***NNE 1 - 2 (1.583 mi.)***	***66***	***151***
GLACIER NORTHWEST	***705 NORTHWEST RHOTON RO***	***N 1 - 2 (1.708 mi.)***	***L78***	***161***
CULLENS ROAD PLAT	***9329 CULLENS RD***	***N >2 (2.011 mi.)***	***Q98***	***179***
NISQUALLY VALLEY CARE CENTER	***9414 357TH ST S***	***ENE >2 (2.254 mi.)***	***T113***	***187***

AIRS: State of Washington, Department of Ecology, Washington Emissions Data System.

A review of the AIRS list, as provided by EDR, and dated 12/31/2010 has revealed that there are 3 AIRS sites within approximately 2.5 miles of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
LIVINGSTON BOATS INC YELM	***406 RAILROAD ST***	***N 1 - 2 (1.432 mi.)***	***G46***	***62***
LASCO BATHWARE	801 NORTHERN PACIFIC	N 1 - 2 (1.568 mi.)	I59	103
LASCO BATHWARE	***801 NORTHERN PACIFIC***	***N 1 - 2 (1.580 mi.)***	***I64***	***119***

Inactive Drycleaners: A listing of inactive drycleaner facility locations.

A review of the Inactive Drycleaners list, as provided by EDR, and dated 12/31/2010 has revealed that there is 1 Inactive Drycleaners site within approximately 2.5 miles of the target property.

Lower Elevation	Address	Direction / Distance	Map ID	Page
FRONTIER VILLAGE PROF DRYCLEAN	***404 1ST ST SE & MOSMAN***	***NNW 1 - 2 (1.208 mi.)***	***D26***	***43***

FINANCIAL ASSURANCE: A listing of financial assurance information for underground storage tank facilities. Financial assurance is intended to ensure that resources are available to pay for the cost of closure, post-closure care, and corrective measures if the owner or operator of a regulated facility is unable or unwilling to pay.

A review of the FINANCIAL ASSURANCE list, as provided by EDR, and dated 11/21/2011 has revealed that there are 5 FINANCIAL ASSURANCE sites within approximately 2.5 miles of the target property.

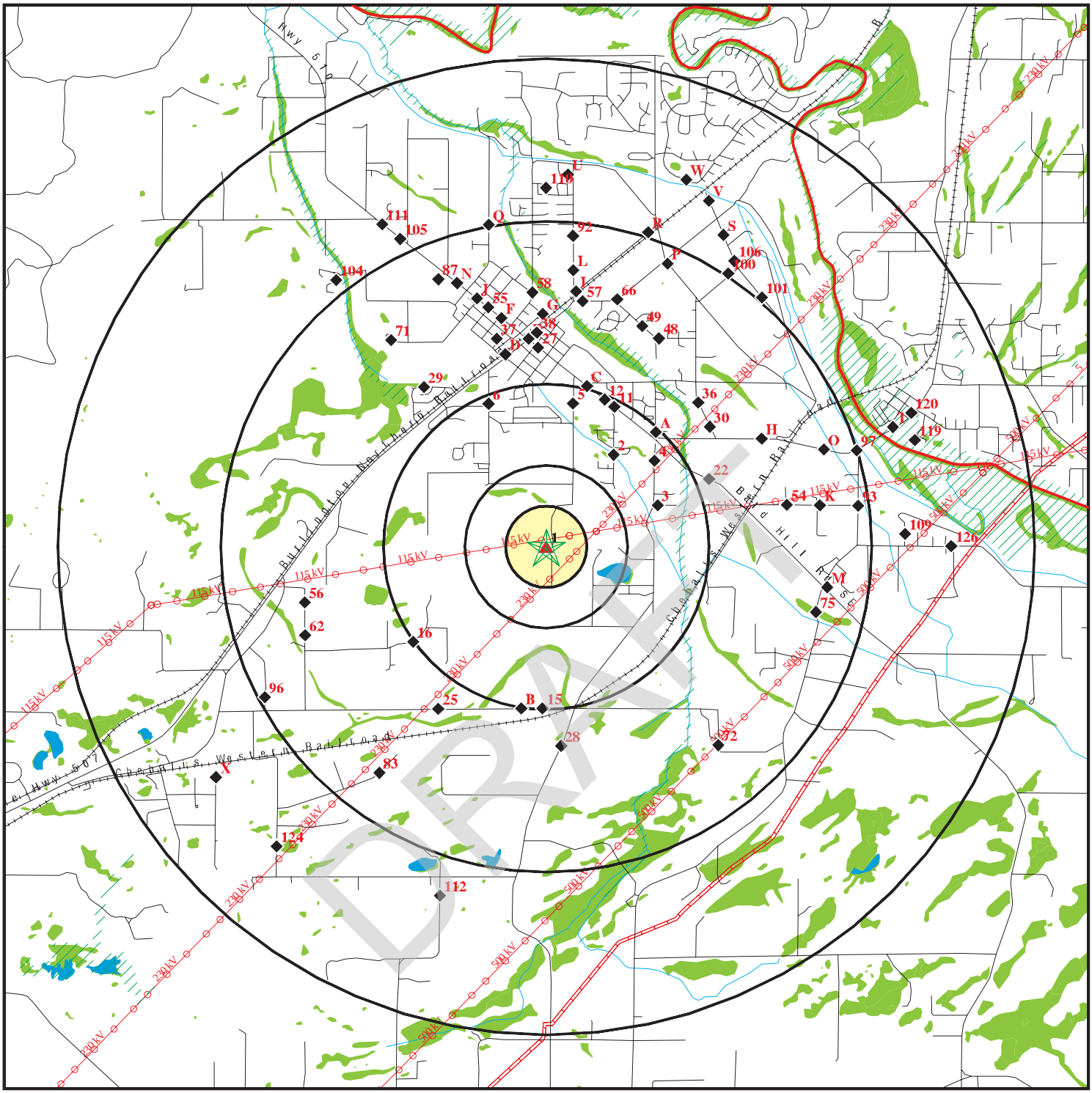
Lower Elevation	Address	Direction / Distance	Map ID	Page
HASSAN CORPORATION	16507 SR 507	NE 1/2 - 1 (0.949 mi.)	A10	9
YELM SHELL	***706 YELM AVE E***	***NNE 1 - 2 (1.019 mi.)***	***C21***	***37***
LASCO BATHWARE	***801 NORTHERN PACIFIC***	***N 1 - 2 (1.580 mi.)***	***I64***	***119***
PARKS PLACE	608 W YELM AVE	NNW 1 - 2 (1.584 mi.)	J68	152
FOUR CORNER GROCERY	11500 BALD HILLS RD	E 1 - 2 (1.745 mi.)	M86	168

EXECUTIVE SUMMARY

Due to poor or inadequate address information, the following sites were not mapped. Count: 30 records.

Site Name	Database(s)
18220 SE BALD HILLS RD	US HIST CDL
MANKE LUMBER CO ROY PIT	ALLSITES
BAYDO CHEVROLET ROY	ALLSITES
HYDRAULIC FLUID SPILL ROW 328TH ST	CSCSL, ALLSITES
GIGLIOTTI PAT CABINET CO	RCRA-NonGen, FINDS, ALLSITES
RITE AID 5286	RCRA-SQG, FINDS, ALLSITES
KEN M SPOONER FARMS INC	ALLSITES, UST
TAHOMA TERRA	ALLSITES
WAL MART STORE 3705-01 SR510 EXT	ALLSITES
DESCHUTES DRUG LAB	ALLSITES
VAIL RD 153RD TO BALD HILL RD	ALLSITES, NPDES
VAIL ROAD	ALLSITES
YELM RITE AIDE	ALLSITES, CSCSL NFA, VCP
HASSAN CORP	RCRA-LQG, FINDS, ALLSITES, UST
YELM GARAGE	FINDS, ALLSITES
RAINIER COMMONS - CHEVRON	ALLSITES, SPILLS
YELM/TRUMP PLAT	UIC
206 3RD ST	HIST CDL
7842 RAINER ROAD	HIST CDL
7843 RAINER ROAD.	HIST CDL
CHEVY STEP VAN	HIST CDL
AMTECH CORP	FTTS, HIST FTTS
YELM WWTP	SWF/LF
YELM GARAGE	UST
DESCHUTES DRUG LAB	RCRA-NonGen, FINDS
15913 90TH SE AVE	US CDL
18220 BALD HILLS SE RD	US CDL
9502 CULLENS RD	US CDL
RAINIER CHEVRON	FINANCIAL ASSURANCE
SAFEWAY #1619	FINANCIAL ASSURANCE

OVERVIEW MAP - 3269533.1s



0 3/4 1 1/2 3 Miles

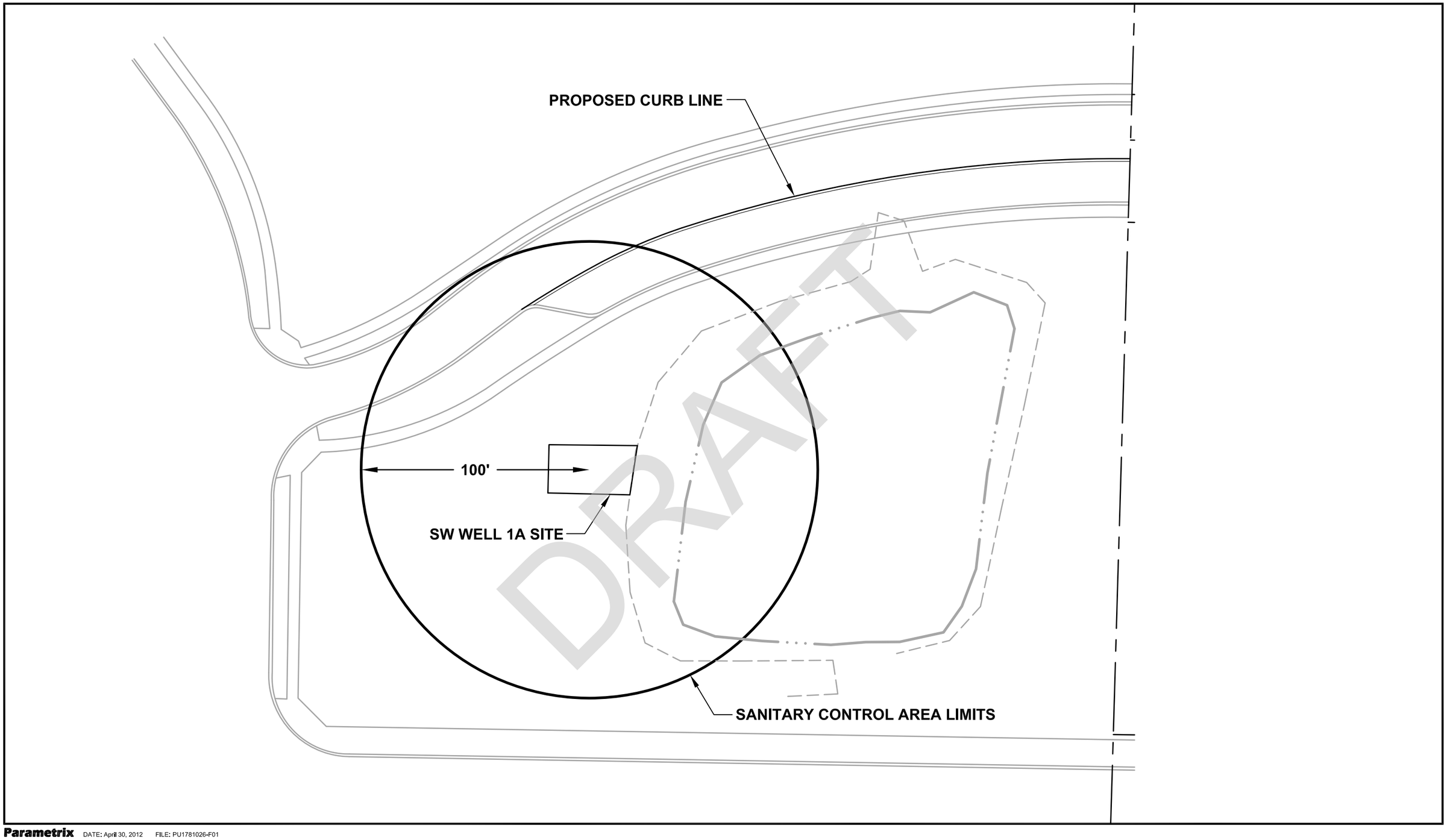
- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Manufactured Gas Plants
- National Priority List Sites
- Dept. Defense Sites
- Indian Reservations BIA
- County Boundary
- Power transmission lines
- Oil & Gas pipelines from USGS
- 100-year flood zone
- 500-year flood zone
- National Wetland Inventory

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME: Wellhead Protection Contaminant Source Inventory ADDRESS: 105 Yelm Ave. West Yelm WA 98597 LAT/LONG: 46.9235 / 122.6042	CLIENT: Golder Associates, Inc. CONTACT: Kenny Janssen INQUIRY #: 3269533.1s DATE: March 01, 2012 6:59 pm

Appendix F

SW Well 1A Sanitary Control Area and Declaration of Covenant



Parametrix DATE: April 30, 2012 FILE: PU1781026-F01

N

0 40

SCALE IN FEET

Figure F-1
SW Well 1A Sanitary Control Area
Wellhead Protection Plan
Yelm, Washington

RETURN ADDRESS

Document Title(s)

DECLARATION OF COVENANT

Reference Numbers(s) of related documents

Additional Reference #=s on page

Grantor(s) (Last, First and Middle Initial)

CITY OF YELM

Additional grantors on page

Grantee(s) (Last, First and Middle Initial)

THE PUBLIC

Additional grantees on page

Legal Description (abbreviated form: i.e. lot, block, plat or section, township, range, quarter/quarter)

TRACT F OF BLA080229YL & TRACT A OF BLA080229YL

Additional legal is on page

Assessor's Property Tax Parcel/Account Number

78640000024 78640000019

Additional parcel #=s on page

The Auditor/Recorder will rely on the information provided on this form. The staff will not read the document to verify the accuracy or completeness of the indexing information provided herein.

4289485 Pages: 3
09/19/2012 04:16 PM Covenant
Thurston County Washington
CITY OF YELM

DECLARATION OF COVENANT

The City of Yelm (City) grantor, being the undersigned, owner in fee simple of the land described herein, hereby declare this covenant and place same on record.

The City, the grantor herein, is the owner in fee simple of the following described real estate situated in Thurston County, State of Washington; to wit:

Section A: SEE ATTACHED LEGAL EXHIBIT 'A'

on which the City owns and operates a municipal potable water well and waterworks, supplying water for public use located on said real estate, at:

Section B: SEE ATTACHED EXHIBIT 'B'

and, grantor is required to keep the water supplied from said well free from impurities which might be injurious to the public health.

It is the purpose of these grants and covenants to prevent certain practices hereinafter enumerated in the use of said grantor's water supply.

NOW, THEREFORE, the grantor agrees and covenants that said grantor's heirs, successors and assigned will not construct, maintain, or suffer to be constructed or maintained upon the said land of the grantor(s) and within 100 (One Hundred) feet of the well herein described, so long as the same is operated to furnish water for public consumption, any potential source of contamination, such as septic tanks and drain fields, sewer lines, underground storage tanks, roads, railroad tracks, vehicles, structures, barns, feed stations, grazing animals, enclosures for maintaining fowl or animal manure, liquid or dry chemical storage, herbicides, insecticides, hazardous waste, or garbage of any kind or description.

These covenants shall run with the land and shall be binding to all parties having or acquiring any right, title, or interest in the land described herein or any part thereof, and shall inure to the benefit of each owner thereof.

WITNESS RON HARDING's hand on this 13th day of Sept., 2012.

(Seal)
Mayor Ron Harding

State of Washington)

County of Thurston)

I, the undersigned, a Notary Public in and for the above named County and State, do hereby certify that on this 13th day of Sept., 2012 personally appeared before me Mayor Ron Harding to me known to be the individual described in and who executed the within instrument, and acknowledge that he signed and sealed the same as free and voluntary act and deed, for the uses and purposes therein mentioned.

GIVEN under my hand and official seal the day and year last above written.

DANA SPIVEY
NOTARY PUBLIC
STATE OF WASHINGTON
COMMISSION EXPIRES
NOVEMBER 1, 2015

Dana Spivey DANA SPIVEY
Notary Public in and for the State of Washington, residing at Rainier WA.
My Commission Expires: 11-1-2015

EXHIBIT "A"

Tract F of Boundary Line Adjustment No. BLA-080229YL, as recorded July 31, 2008 under Auditor's File No. 4027040, together with that portion of Tract A of Boundary Line Adjustment No. BLA-080229YL, as recorded July 31, 2008 under Auditor's File No. 4027040, described as follows:

Commencing at the Northwest corner of the East half of the Southeast quarter of Section 23, Township 17 North, Range 1 East, Willamette Meridian; thence South 01°40'34" West along the West line of said East half, a distance of 1629.94 feet to the Southwest corner of said Tract A; thence South 89°10'49" East along the South line of said Tract, a distance of 558.38 feet to the most Southerly corner common to Tracts A and F of said Boundary Line Adjustment, being a point of cusp on a curve concave to the Northeast having a radius of 28.00 feet, which bears North 00°49'15" East and a central angle of 90°00'01" and being subtended by a chord which bears North 44°10'45" West 39.60 feet; thence along the line common to said Tracts A and F the following courses; Westerly, Northwesterly and Northerly along said curve, a distance of 43.98 feet; thence North 00°49'16" East tangent to said curve, a distance of 32.01 feet to the beginning of a curve tangent to said line; thence Northerly a distance of 28.89 feet along the curve concave to the West, having a radius of 154.50 feet and a central angle of 10°42'56" to a point of reverse curvature; thence Northerly a distance of 5.95 feet along the arc of said curve concave to the East having a radius of 28.00 feet and a central angle of 12°10'59" to the Point of Beginning of this description; thence departing from said common line, North 02°17'19" East tangent to said curve, a distance of 83.43 feet to the beginning of a curve concave to the Northwest having a radius of 130.50 feet, which bears North 16°08'19" West and a central angle of 14°48'23" and being subtended by a chord which bears North 66°38'23" East 33.63 feet; thence Easterly and Northeasterly along said curve, a distance of 33.72 feet to a point of reverse curvature; thence Northeasterly and Easterly a distance of 351.78 feet along the arc of said curve concave to the South having a radius of 642.00 feet and a central angle of 31°23'40" to a point of cusp on the line common to Tracts A and D of said Boundary Line Adjustment; thence South 01°40'08" West along said common line, a distance of 60.01 feet to the East corner common to Tracts A and F of said Boundary Line Adjustment, at the beginning of a curve concave to the South having a radius of 582.00 feet, which bears South 00°31'26" West and a central angle of 31°17'15" and being subtended by a chord which bears South 74°52'48" West 313.88 feet; thence along the line common to said Tracts A and F the following courses; Westerly and Southwesterly along said curve, a distance of 317.81 feet to a point of reverse curvature; thence Southwesterly and Westerly a distance of 48.63 feet along the arc of said curve concave to the Northwest having a radius of 190.50 feet and a central angle of 14°37'30" to a point of cusp on a curve, from which the radius point bears South 15°41'17" East; thence Westerly, Southwesterly and Southerly, a distance of 35.20 feet along the arc of said curve concave to the Southeast having a radius of 28.00 feet and a central angle of 72°01'24" to the Point of Beginning.

Situate in the County of Thurston, State of Washington.

End of Exhibit "A"

SUR 4289486

4289486 09/19/2012 04:16 PM Survey
Thurston County Washington
CITY OF YELM
Pages: 1

RECORD OF SURVEY FOR THE CITY OF YELM WELL No. 1A

EXHIBIT "B"

METHOD OF SURVEY

THIS SURVEY WAS PERFORMED AND ALL MONUMENTS VISITED DURING AUGUST 2012 USING A TOPCON GR-3 GPS RECEIVER FOR ORIENTATION TO HORIZONTAL DATUM, BOUNDARY TIES, ESTABLISHMENT OF PRIMARY CONTROL, USING RTK.

THIS SURVEY MEETS OR EXCEEDS THE MINIMUM STANDARDS OF WASHINGTON ADMINISTRATIVE CODE 332-130-090.

BASIS OF BEARING AND HORIZONTAL DATUM

PURSUANT TO BOUNDARY LINE ADJUSTMENT, BLA-08-0229-YL, AFN 4027040
FROM THE SOUTHEAST SECTION CORNER TO THE EAST QUARTER CORNER = NORTH 01°57'01" EAST

PROPERTY DESCRIPTION

(PURSUANT TO QUIT CLAIM DEED DATED AUGUST 16, 2012; AFN 4283111)

TRACT F OF BOUNDARY LINE ADJUSTMENT No. BLA-08-0229-YL, AS RECORDED JULY 31, 2008 UNDER AUDITOR'S FILE No. 4027040, TOGETHER WITH THAT PORTION OF TRACT A OF SAID BOUNDARY LINE ADJUSTMENT, DESCRIBED AS FOLLOWS:

COMMENCING AT THE NORTHWEST CORNER OF THE EAST HALF OF THE SOUTHEAST QUARTER OF SECTION 23, TOWNSHIP 17 NORTH, RANGE 1 EAST, WILLAMETTE MERIDIAN;
THENCE SOUTH 01°40'34" WEST ALONG THE WEST LINE OF SAID EAST HALF, A DISTANCE OF 1,629.94 FEET TO THE SOUTHWEST CORNER OF TRACT A;
THENCE SOUTH 89°10'49" EAST ALONG THE SOUTH LINE OF SAID TRACT, A DISTANCE OF 558.38 FEET TO THE MOST SOUTHERLY CORNER OF TRACTS A AND F OF SAID BOUNDARY LINE ADJUSTMENT, BEING A POINT OF CUSP ON A CURVE CONCAVE TO THE NORTHEAST HAVING A RADIUS OF 28.00 FEET, WHICH BEARS NORTH 00°49'15" EAST AND A CENTRAL ANGLE OF 90°00'01" AND BEING SUBTENDED BY A CHORD WHICH BEARS NORTH 44°10'45" WEST 39.60 FEET;
THENCE ALONG THE LINE COMMON TO SAID TRACTS A AND F THE FOLLOWING COURSES;
WESTERLY, NORTHWESTERLY, AND NORTHERLY ALONG SAID CURVE, A DISTANCE OF 43.98 FEET;
THENCE NORTH 00°49'16" EAST TANGENT TO SAID CURVE, A DISTANCE OF 32.01 FEET TO THE BEGINNING OF A CURVE TANGENT TO SAID LINE;
THENCE NORTHERLY A DISTANCE OF 28.89 FEET ALONG THE CURVE CONCAVE TO THE WEST, HAVING A RADIUS OF 154.50 FEET AND A CENTRAL ANGLE OF 10°42'56" TO A POINT OF REVERSE CURVATURE;
THENCE NORTHERLY A DISTANCE OF 5.95 FEET ALONG THE ARC OF SAID CURVE CONCAVE TO THE EAST HAVING A RADIUS OF 28.00 FEET AND A CENTRAL ANGLE OF 12°10'59" TO THE POINT OF BEGINNING OF THIS DESCRIPTION;
THENCE DEPARTING FROM SAID COMMON LINE, NORTH 02°17'19" EAST TANGENT TO SAID CURVE, A DISTANCE OF 83.43 FEET TO THE BEGINNING OF A CURVE CONCAVE TO THE NORTHWEST HAVING A RADIUS OF 130.50 FEET, WHICH BEARS NORTH 16°08'19" WEST AND A CENTRAL ANGLE OF 14°48'23" AND BEING SUBTENDED BY A CHORD WHICH BEARS NORTH 65°38'23" EAST 33.63 FEET; THENCE EASTERLY AND NORTHEASTERLY ALONG SAID CURVE, A DISTANCE OF 33.72 FEET TO A POINT OF REVERSE CURVATURE;
THENCE NORTHEASTERLY AND EASTERLY A DISTANCE OF 351.78 FEET ALONG THE ARC OF SAID CURVE CONCAVE TO THE SOUTH HAVING A RADIUS OF 642.00 FEET AND A CENTRAL ANGLE OF 31°23'40" TO A POINT OF CUSP ON THE LINE COMMON TO TRACTS A AND D OF SAID BOUNDARY LINE ADJUSTMENT;
THENCE SOUTH 01°40'08" WEST ALONG SAID COMMON LINE, A DISTANCE OF 60.01 FEET TO THE EAST CORNER COMMON TO TRACTS A AND F OF SAID BOUNDARY LINE ADJUSTMENT, AT THE BEGINNING OF A CURVE CONCAVE TO THE SOUTH HAVING A RADIUS OF 582.00 FEET, WHICH BEARS SOUTH 00°31'26" WEST AND A CENTRAL ANGLE OF 31°17'15" AND BEING SUBTENDED BY A CHORD WHICH BEARS SOUTH 74°52'48" WEST 313.88 FEET;
THENCE ALONG THE LINE COMMON TO SAID TRACTS A AND F THE FOLLOWING COURSES;
WESTERLY AND SOUTHWESTERLY ALONG SAID CURVE, A DISTANCE OF 317.81 FEET TO A POINT OF REVERSE CURVATURE; THENCE SOUTHWESTERLY AND WESTERLY A DISTANCE OF 48.63 FEET ALONG THE ARC OF SAID CURVE CONCAVE TO THE NORTHWEST HAVING A RADIUS OF 190.50 FEET AND A CENTRAL ANGLE OF 14°37'30" TO A POINT OF CUSP ON A CURVE, FROM WHICH THE RADIUS POINT BEARS SOUTH 15°41'17" EAST;
THENCE WESTERLY, SOUTHWESTERLY AND SOUTHERLY, A DISTANCE OF 35.20 FEET ALONG THE ARC OF SAID CURVE CONCAVE TO THE SOUTHEAST HAVING A RADIUS OF 28.00 FEET AND A CENTRAL ANGLE OF 72°01'24" TO THE POINT OF BEGINNING.
SITUATE IN THE COUNTY OF THURSTON, STATE OF WASHINGTON.

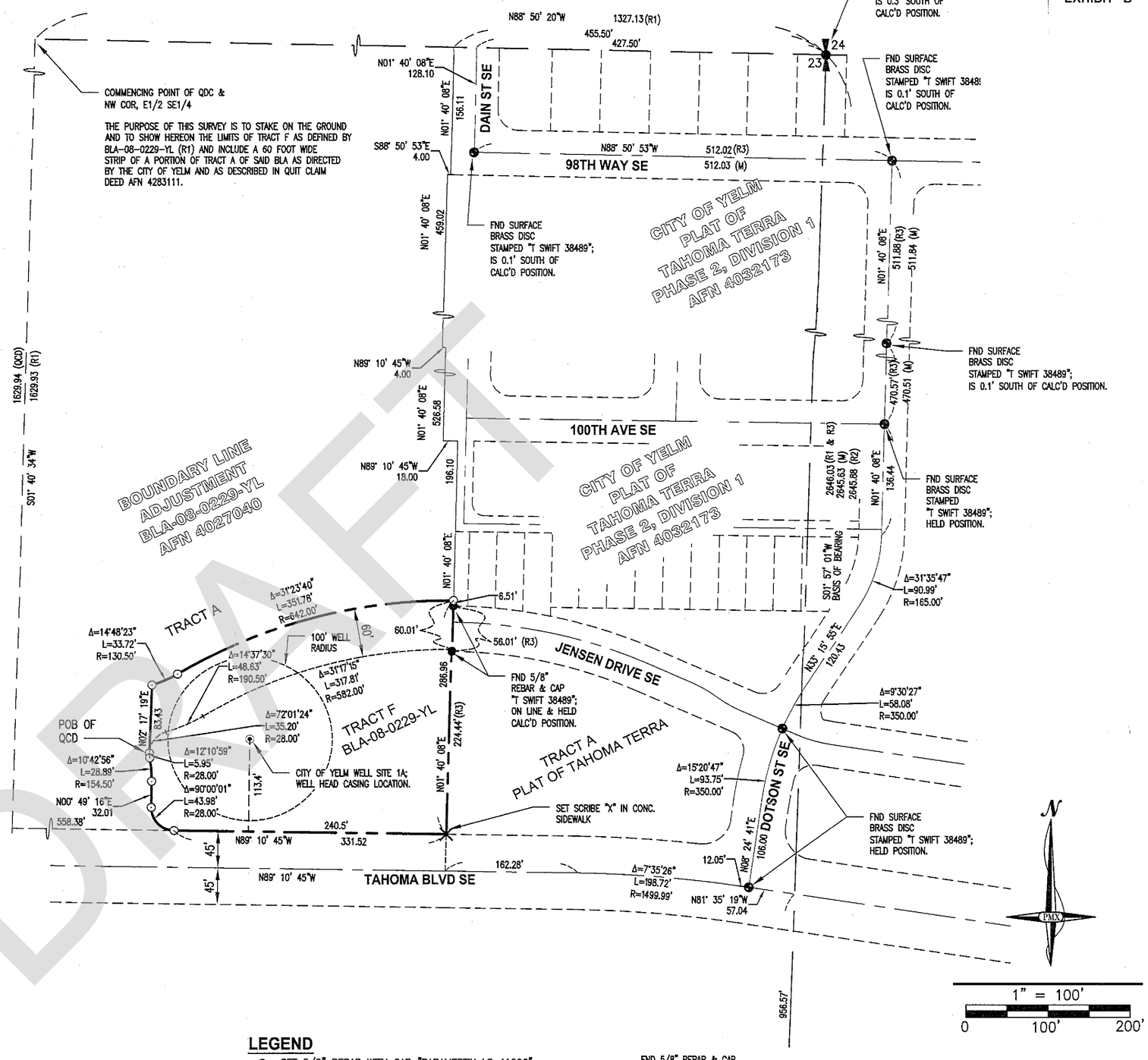
REFERENCE SURVEYS

(R1) BOUNDARY LINE ADJUSTMENT (BLA-08-0229-YL), AFN 4027040; KPFF, JULY 2008.
(R2) PLAT OF TAHOMA TERRA PHASE 1, DIVISION 1, AFN 3830707; BUTLER SURVEYING, MAY 2006.
(R3) PLAT OF TAHOMA TERRA PHASE 2, DIVISION 1, AFN 402173; KPFF, AUGUST 2008.
(R4) AFFIDAVIT OF MINOR CORRECTION OF BLA-080229YL (AFN 4027040), AFN 4032054; AUGUST 2008.

GLOSSARY

FND = FOUND
CALC'D = CALCULATED
(R) = RECORD
(M) = MEASURED
(QCD) = QUIT CLAIM DEED AFN 4283111

AUDITOR OF THURSTON COUNTY WASHINGTON



LEGEND

- ⊙ SET 5/8" REBAR WITH CAP "PARAMERTIX LS 41296"
- ● PROPERTY CORNER FOUND AS NOTED
- ◕ BRASS SURFACE MONUMENT FOUND AS NOTED

AUDITOR'S CERTIFICATE

FILED FOR RECORD THIS 19th DAY OF September 20 12
AT THE REQUEST OF City of Yelm
AUDITOR'S FILE NO. 4289486
DEPUTY
Kim Wyman COUNTY AUDITOR

SURVEYOR'S CERTIFICATE

THIS MAP CORRECTLY REPRESENTS A SURVEY MADE BY ME OR UNDER MY DIRECTION IN CONFORMANCE WITH THE REQUIREMENTS OF THE SURVEY RECORDING ACT AT THE REQUEST OF THE CITY OF YELM AUGUST 10, 2012

Scean A. Ripley 9/11/12
SCEAN A. RIPLEY, PLS NO. 41296

SCEAN A. RIPLEY STATE OF WASHINGTON 41296 REGISTERED PROFESSIONAL LAND SURVEYOR

INDEX DATA

NE 1/4, SE 1/4, OF SECTION 23, TOWNSHIP 17 NORTH, RANGE 1 EAST, W.M.

CITY OF YELM, THURSTON COUNTY, WASHINGTON

Parametrix
ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES
1019 39TH AVENUE SE
SUITE 100
PUYALLUP, WA 98374
T. 253.604.6600
F. 253.604.6799
www.parametrix.com

PMX JOB NO. 216-1781-026

DESIGNED	SAR
DRAWN	SAR
CHECKED	DI
APPROVED	DI & SAR
SCALE	1"=100'
DATE	09/11/2012

ONE INCH AT FULL SCALE. IF NOT, SCALE ACCORDINGLY

SHEET NO. 1 OF 1

Appendix G

Example Letters of Notification and Notification List

Example Letter of Notification – Owners/Operators of Potential Sources of Contamination

Dear (Owner/Operator):

In order to protect the drinking water supply for the customers of the City of Yelm's Water System, we have developed a wellhead protection program in accordance with State requirements. As part of our wellhead protection program, we mapped the area overlying the short-term recharge zone of our drinking water supply wells. This is called our wellhead protection area.

Following identification of the wellhead protection area, we conducted an inventory of potential sources of groundwater contamination within the area. The nature of your business and its location within our wellhead protection area means that your activities have the potential to affect our drinking water supply sources.

We have notified the regulatory agencies that regulates your type of business/facility of your presence within our wellhead protection area. You should contact them to request technical assistance to help manage your business in a way that will best prevent groundwater contamination. We realize you are already careful to protect the environment as you conduct your business. We hope that in forming you of your location in our wellhead protection area will result in an increase in precautions to ensure that your activities will not impact our drinking water quality.

Sincerely,

Example Letter of Notification – Regulatory Agencies/Local Governments

Dear (Agency /Local Government):

As part of the wellhead protection program for the City of Yelm Water System, we are hereby informing you of the findings of our wellhead protection area delineation. This is in accordance with State regulations (WAC 246-290-135).

The City currently has 3,188 service connections, and serves a population of approximately 5,815 people. The State Department of Health has given our system a rating of "highly susceptible." This means that our drinking water supply is very vulnerable to contamination.

The enclosed map shows the 6-month and 1-, 5-, and 10-year time of travel boundaries for our wellhead protection area. Any groundwater contamination that occurs within this wellhead protection area has a high potential to reach our drinking water supply wells. It is therefore of utmost importance to us that all reasonable steps be taken to ensure that land use activities within this area do not contaminate our customers' drinking water supplies.

Thank you for your support in protecting our drinking water.

Sincerely,

Example Letter of Notification – Local Emergency Responders

Dear (Emergency Responder):

The City of Yelm, WA has developed a Wellhead Protection Plan as required by the Washington State Department of Health. As part of this plan, our water system must coordinate with agencies responsible for incident/spill response procedures. Using the results of the susceptibility assessment and the findings of the wellhead protection inventory, local emergency responders are asked to evaluate whether changes in incident/spill response procedures are needed to better protect groundwater within the wellhead protection areas. As stated in Washington State Department of Health's Wellhead Protection Program Guidance Document, "If a public water system's source water is determined to be vulnerable to surface activities, special procedures may need to be incorporated into local emergency response plans". The State Department of Health has given our system a rating of "highly susceptible." This means that our drinking water supply is very vulnerable to contamination.

A map of the wellhead protection areas with potential contaminant sources is enclosed for your review. An acknowledgement of receipt of this information and/or response from your office would be appreciated.

Thank you for your support in protecting our drinking water source. If you have any questions about the plan, please feel free to contact us.

Sincerely,

Regulatory Agencies and Local Governments

Washington State Department of Ecology
Division of Water Resources
PO Box 47775
Olympia, WA 98504-7775
Phone: (360) 407-6300

Washington State Department of Health
Division of Drinking Water
PO Box 47822
Olympia, WA 98504-7822
Phone: (360) 236-3100

Thurston County Department of Public Health
and Social Services
412 Lilly Rd. NE
Olympia, WA 98506-5132
Phone: (360) 867-2500

Local Emergency Incident Responders

Tim Peterson
Emergency Coordinator/Public Works Director
901 Rhoton Road
Yelm, Washington 98597
Day Phone: (360) 458-8499
Evening Phone: (360) 894-2698

Yelm Fire District
PO Box 777
Yelm, WA 98597
Emergency Phone: 911
Business Phone: (360) 458-2799

Yelm Police Department
206 McKenzie Ave SE
Yelm, WA 98597
Emergency Phone: 911
Business Phone: (360) 458-5701

Washington State Department of
Transportation, Emergency Response
2501 112 St. SE
Tacoma, WA 98445-5104
Phone: (253) 536-6089

Thurston County Emergency Management
9521 Tilley Rd. SW
Olympia, WA 98512
Phone: (360) 867-2800

Washington State Department of Ecology
Spill Response Program
PO Box 47775
Olympia, WA 98504-7775
Phone: (360) 407-6300

City of Yelm Public Works Contact List

Tim Peterson
Emergency Coordinator/Public Works Director
901 Rhoton Road
Yelm, Washington 98597
Day Phone: (360) 458-8499
Evening Phone: (360) 894-2698

Kevin Ray
Public Works Field Supervisor
901 Rhoton Road
Yelm, Washington 98597
Day Phone: (360) 458-8406
Evening Phone: (360) 789-2722

Edward "Smitty" Smith
Lead Water System Operator
901 Rhoton Road
Yelm, Washington 98597
Day Phone: (360) 458-8406
Evening Phone: (360) 446-7278

John Ivey
Water System Operator
901 Rhoton Road
Yelm, Washington 98597
Day Phone: (360) 458-8406
Evening Phone: (360) 250-9543

Timothy Rarick
Water System Operator
901 Rhoton Road
Yelm, Washington 98597
Day Phone: (360) 458-8406
Evening Phone: (360) 894-1272

At Golder Associates we strive to be the most respected global group of companies specializing in ground engineering and environmental services. Employee owned since our formation in 1960, we have created a unique culture with pride in ownership, resulting in long-term organizational stability. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees now operating from offices located throughout Africa, Asia, Australasia, Europe, North America and South America.

Africa	+ 27 11 254 4800
Asia	+ 852 2562 3658
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 55 21 3095 9500

solutions@golder.com
www.golder.com

Golder Associates Inc.
9 Monroe Parkway, Suite 270
Lake Oswego, OR
Tel: 503-607-1820
Fax: 503-607-1825

Golder Associates