APPENDIX J

WELLHEAD PROTECTION REPORT

ROBINSON
NOBLE

CITY OF AUBURN
WELLHEAD PROTECTION PLAN
HAZARD INVENTORY UPDATE

NOVEMBER 2014

by

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City of Auburn
Wellhead Protection Plan Update
November 2014

Introduction

Under the Washington Administrative Code (WAC), public water systems have primary responsibility for developing and implementing local wellhead protection programs. Due to the limited jurisdictional and regulatory authority afforded most purveyors, it is essential they work with other local, state, and federal agencies possessing the appropriate authority. The Washington State Department of Health (Health) oversees the wellhead protection program.

The City of Auburn (City) developed a Wellhead Protection Plan to identify and protect the groundwater resources which supply the Well 1, 2, 3A, 3B, 4, 5, 5A, 5B, 6, and 7 wellfields; West Hill Springs; and Coal Creek Springs. The initial plan was created in 2000 by Pacific Groundwater Group (PGG). Robinson Noble provided a plan update in 2008 (Robinson, Noble & Saltbush, 2008). This report largely replaces that work. The study area, physiographic setting, and wellhead protection zones were defined in several works by PGG (1996, 1999 and 2000). Those reports remain valid for use in this project.

The plan meets the requirements of the Federal Safe Drinking Water Act and conforms to the wellhead protection measures directed by Washington State Department of Health. The study is divided into three primary areas of interest: 1) Wellhead Protection Area Delineation, 2) Existing and Potential Contamination Hazard Identification, and 3) Protection Strategies and Implementation Tasks.

The City is located in the Green River Valley between the City of Kent and the southern boundary of King County. Figure 1 shows the location of the City's wells and the approximate study area. The majority of the City is located in the valley, separated from the City of Kent to the north by the Green River. To the west is the Federal Way upland; to the east are the outlets of the upper Green and White River valleys. The City of Pacific resides to the south of the City along with the neighboring Lake Tapps upland. Ten production wells and two spring collection facilities are currently used to supply the City's needs. At the present time and into the near future, the use of groundwater constitutes the City's primary and most economical source of water.

Wellhead Protection Area Definition

A wellhead protection area (WHPA) defines the area surrounding a public water supply well where the well may be at risk from contaminants. It is based upon capture zones, which describe the area of the well's source aquifer (and all overlying material) that can contribute water to the well in a given period of time. Capture zones are typically defined for time-of-travel periods of one-half, one, five, and ten years. These four zones are defined by regulation as a management tool; actual contaminants reaching the source aquifer may move faster or slower than the calculated times-of-travel.

Typically, a "zone of contribution" is determined for the study area. The zone of contribution is the aquifer area which contributes groundwater to the wellfields independent of travel time. However, a zone of contribution was not determined in previous models. Therefore, for this

WHPA, we have defined a fifth zone which we label as the area of investigation. The area of investigation includes areas where potential surface water and stormwater runoff and surface water bodies may contribute to the groundwater in the WHPAs. However, the area of investigation we have delineated is likely much smaller than the actual zone of contribution would be. Based upon the existing WHPA zones and the generalized water flow directions of the shallow aquifer system, we delineated an area of investigation, which covers approximately 42 square miles, inside the zone of contribution. Stormwater runoff is considered in our area of investigation because it runs over the surface of the ground, picking up and dissolving potential contaminants, and may eventually discharge these contaminants to groundwater via infiltration through ditches or ponds designed to percolate water or from surface-water bodies which receive the runoff.

Travel-time boundaries can be determined by either technical or non-technical methods, although technical methods are preferred so that the Wellhead Protection Plan (WHPP) better protects the actual capture zones of protected wells. In general, there are four delineation methods available. They are, from generally least to generally most accurate: the calculated fixed-radius method, analytical modeling, hydrogeologic mapping, and numerical modeling. The particular method employed (and the accuracy of that method) depends largely on the availability of hydrogeologic data. Numerical modeling, for example, can be highly accurate but also typically requires a relatively large amount of data. For areas with typical data availability, time-travel boundaries are often delineated using a combination of analytical modeling and hydrogeologic mapping, which provides a reasonably technical level of delineation.

Pacific Groundwater Group initially delineated the City's wellhead protection areas in 1997 by using a two-dimensional analytical model. Later, in 2000, PGG re-delineated capture zones for the City utilizing MODPATH Version 2, a three-dimensional particle-tracking program that utilizes steady-state head distribution created by a numerical model to calculate time-related capture zones. Numerical models are typically highly detailed, three-dimensional representations of water flow through identified hydrogeologic layers and are considered the most accurate approach for delineating wellhead protection areas by the Washington State Department of Health.

In 2008, Robinson, Noble, & Saltbush, Inc. used the modeled capture zones from 2000 to perform a hazard assessment within the wellhead protection area. The wellhead protection area includes ten wellfields and two springs that are related by overlapping geographical areas and represent three aquifer systems. We then provided the City with implementation tasks and strategies to help effectively implement the WHP plan. This current report is intended to provide a single effort that will suffice to update WHPAs for all ten wellfields and both springs, and the WHPAs have been mapped together for this updated wellhead protection plan.

The US Geological Survey is currently completing groundwater flow modeling of the Puyallup River Watershed, and the model area will cover the WHPP study area. The resulting numerical computer model will likely refine aquifer characteristics, groundwater flow patterns, and the location of aquitard-deposits. During the next update of the WHP plan, we recommend using the USGS model to re-define the WHPAs as the new model will represent an expansion of and improvement over the older PGG work.

Of particular interest to the WHPAs is the Osceola Mudflow (Qom), which originated on Mt. Rainier approximately 5,700 years ago, and consists of poorly sorted clay, silt, sand, gravel, boulders, and wood debris. It functions as an important aquitard in the valley. However, a 1999 hydrogeologic characterization report by PGG states that the mudflow does not occur beneath the confluence of the White River and Auburn-Kent valleys or near Auburn's Production Well 1, Wells T-4S/D, CW-2S/D, WR-2, and TW-9S/D. The USGS reports the thickness of the mudflow

ranges from approximately 0 to 60 feet in the study area (Dragovich and others, 1994). In the area defined by PGG where the mudflow is missing, it was likely not deposited or removed by erosional processes. The area where Osceola Mudflow aquitard is not present in the study area is shown on Figure 1.

Existing and Potential Contamination Hazard Identification

The inventory of potential contamination sources within the WHPA was performed according to the Washington State Department of Health 1993 publication "Inventory of Potential Contaminant Sources in Washington's Wellhead Protection Areas." As part of this inventory, a search of contamination-related databases was made by EDR Inc., an environmental database research company. They reviewed 27 federal and state databases for any known or potential contaminant sites within a 5-mile radius of the center of the City's service area. The sites in this radial search were narrowed further by Robinson Noble based on the sites' locations in relation to WHPAs.

We also performed an evaluation of various land-use categories in the study area and ranked them according to the likely activities occurring within those zones. Each land use zone was included as a specific entry (representing all of the area covered by that zone) in the contamination source inventory. The land-use zones, in order of relative risk, include: 1) rural areas, 2) commercial sites, 3) industrial, 4) mixed-use areas, 5) medium-density urban residential, 6) high-density urban residential, 7) mining and transportation corridors, 8) pipeline corridors, 9) and low-density urban residential. The ranking and types of potential risks for each zone are discussed below.

The results of the contamination source inventory include a list of potential and known environmental hazards in proximity to the City's water system. From this process, 513 sites or categories of land-use activities were identified as known or potential hazards to the City's groundwater sources. These sites and land-use activities were prioritized and ranked such that the wellhead protection implementation process can address each site or land use in a systematic manner. Each site was ranked according to three factors: proximity of potential hazard to the WHPA, type of contamination, and distance from the groundwater source to the potential hazard.

Protection Strategies and Implementation Tasks

The completion of wellhead protection planning provides no safeguards unless effective management strategies are implemented to prevent potential contamination of groundwater sources. With the hazards identified, the Wellhead Protection Plan provides for six strategies and 12 specific tasks for the City to undertake to complete the process. Also included is a detailed review of the State spill-response plan and a contingency plan to address the possible loss of one or more water sources. The plan is based a great deal upon monitoring of the existing system, active data collection and management by the City, and cooperation with those state and local agencies which regulate potential contaminants.

Contaminant Source Inventory Methodology

A summary of potential contaminant sources presented in the Health 1993 guidance is reproduced in Table 1. These sources were considered when performing the contaminant inventory for the City.

Table 1: Potential Contaminant Source Listed by Type

Category I

Sources Designed to Discharge Substances

Subsurface Percolation (e.g. septic systems and cesspools)
Injection Wells
- Hazardous waste
- Non-hazardous waste (e.g. brine disposal and drainage)
- Non-waste (e.g. enhanced recovery, artificial recharge solution mining, and *in-situ* mining)

Land Application
- Wastewater (e.g. spray irrigation)
- Wastewater by-products (e.g. sludge)
- Hazardous waste
- Non-hazardous waste

Category II

Sources Designed to Store, Treat, and/or Dispose of Substances; Discharge through Unplanned Release

Landfills
- Industrial hazardous waste
- Industrial non-hazardous waste
- Municipal sanitary

Open Dumps, Including Illegal Dumping (Waste)
Residential (or Local) Disposal (Waste)
Surface Impoundments
- Hazardous waste
- Non-hazardous waste

Waste Tailings
Waste Piles
- Hazardous waste
- Non-hazardous waste

Materials Stockpiles (Non-waste)
Graveyards or Animal Burial
Above-ground Storage Tanks
- Hazardous waste
- Non-hazardous waste
- Non-waste

Underground Storage Tanks
- Hazardous waste
- Non-hazardous waste
- Non-waste

Containers
- Hazardous waste
- Non-hazardous waste
- Non-waste

Open Burning Sites
Detonation Sites

Category III

Sources Designed to Retain Substances during Transport or Transmission

Pipelines
- Hazardous waste
- Non-hazardous waste
- Non-waste

Materials Transport and Transfer Operations
- Hazardous waste
- Non-hazardous waste
- Non-waste

Category IV

Sources Discharging Substances as a Consequence of Other Planned Activities

Irrigation Practices (e.g. return flow)
Pesticide Applications
Fertilizer Applications
Animal Feeding Operations
De-icing Salt Applications
Urban Runoff
Percolation of Atmospheric Pollutants
Mining and Mine Drainage
- Surface mine-related
- Underground mine-related

Category V

Sources Providing Conduit or Inducing Discharge through Altered Flow Patterns

Production Wells
- Oil (and gas) wells
- Geothermal and heat recovery wells
- Water supply wells

Other Wells (non-waste)
- Monitoring wells
- Exploration wells

Construction Excavation

Category VI

Naturally Occurring Sources whose Discharge is Created and/or Exacerbated by Human Activity

Ground Water - Surface Water Interactions
Natural Leaching
Saltwater Intrusion/Brackish Water
- Upconing (or intrusion of other poor-quality natural water)

Radioactive Disposal Sites

The initial part of the contaminant inventory was a search of contaminant-related databases completed by EDR, Inc. EDR is a third-party environmental database research company that

reviews federal and state environmental databases for known or potential contaminated sites within a designated area. Table 2 lists the primary federal and state databases (in alphabetical order according to the database abbreviations used by EDR) reviewed by EDR in order to locate sites of known or potential soil and groundwater contamination.

Table 2: Federal and State Databases

- Washington Emissions Data System (AIRS)
- Ecology Facility/Site Identification System (ALLSITES)
- Clandestine Drug Lab (CDL, Hist CDL, and US CDL)
- Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS)
- CERCLIS No Further Remedial Action Planned (CERL NFRAP)
- Confirmed and Suspected Contaminate Sites (CSCSL)
- Confirmed and Suspected Contaminants Sites List No Further Action (CSCSL NFA)
- Department of Transportation, Office of Pipeline Safety (DOT OPS)
- Department of Defense sites (DOD)
- Drycleaners and Inactive Drycleaners (DRYCLEANERS and INACTIVE DRYCLEANERS)
- Emergency Response Notification Systems (ERNS)
- Financial Assurance Information listing (FINANCIAL ASSURANCE)
- Facility Index System (FINDS)
- FIFRA/TSCA Tracking System (FTTS and Hist FTTS)
- Formerly-used DOD sites (FUDS)
- Hazardous Waste Information System – CA Dept. of Toxic Substances (HAZNET)
- Hazardous Materials Information Reporting System (HMIRS)
- Hazardous Site List (HSL)
- Integrated Compliance Information System (ICIS)
- Independent Clean-up Report (ICR)
- Indian Leaking Underground Storage Tank (Indian LUST)
- Indian Underground Storage Tank (Indian UST)
- Institutional and Engineering Controls (INST CONTROL, US ENG CONTROLS, and US INST CONTROL)
- Leaking Underground Storage Tank (LUST)
- Hazardous waste manifest data (MANIFEST)
- Mines master index file (MINES)
- National Pollutant Discharge Elimination System permits (NDPES)
- National Priority List (NPL)
- PCB Activity Database System (PADS)
- RCRA Conditionally Exempt Small Quantity Generator (RCRA CESQG)
- RCRA Large Quantity Generator (RCRA LQG)
- RCRA non-Generator (RCRA NonGen)
- RCRA Small Quantity Generator (RCRA SQG)
- Records of Decision (ROD)
- Reported spills (SPILLS)
- Solid Waste Facilities Database (SWF/LF)
- Recycling Facility List (SWRCY)
- Solid Waste Tire Facilities (SWTIRE)
- Toxic Chemical Release Inventory (TRIS)
- US Aerometric Information Retrieval System (AIRS)
- Underground Injection Controls (UIC)
- Brownfields Grant Sites (US Brownfields)
- Underground Storage Tank (UST)
- US Mines Master Index File (MINES)
- Voluntary Cleanup Program (VCP)

EDR also searches additional non-federal and state databases, including some that are proprietary. The full list of databases researched is included in the EDR report, an electronic copy of which is included as Appendix A on the attached CD.

When EDR identifies a site during the database search, it lists the site with a unique site identification data key. However, since many sites are included on multiple databases and may have

different identifying information on the separate databases, some individual sites end up with more than one listing and identification key. In cases where there are several apparent sites in close proximity or at the same location, EDR attempts to group such listings in "clusters" having related data keys that allow for easy identification of all the listings for that general location.

We have condensed the initial listings from EDR into a final list of sites, attempting to combine all related listings for each site into a single entry on the potential hazard list. For those sites with multiple EDR listings, one of the unique data keys for each listing is retained as the combined site ID on the final hazard list (Table 10 in Appendix B). This should allow for identification of associated listings in the EDR report. Figures 3 through 7 show the locations of each site with their final ranking as an identifier.

Field Survey

A field verification or "windshield survey" was performed by City staff based on guidance provided by Robinson Noble. The purpose of the windshield survey was to verify that listed sites are appropriately located and to identify and describe any additional sites of concern that were not included from the database search. The sites provided by the EDR report were organized and plotted onto maps by their respective database listings. A windshield survey checklist was also designed based on the Health publication, "Wellhead Protection Program Guidance Document – Sample Inventory Form." Once the survey checklist, EDR database list, and map of database sites were produced, they were given to the City to allow field staff to confirm the presence/condition of the sites. City employees performed this task because they are familiar with the businesses and land uses within the service area and because field staff are routinely deployed in the field on other tasks. The findings of the field survey were incorporated into the potential hazards listing and ranking discussed below.

New sites beyond the EDR listings were not identified through the field survey, though the field verification process identified the current uses of each property visited. This allowed us to cross-check the database listings and then add current uses or business names that EDR did not identify.

Methodology for Establishing Risk Priority

The methodology for prioritizing risks in the WHPA was partially based on the EPA guidance document entitled "Managing Ground Water Contamination Sources in Wellhead Protection Areas: a Priority Setting Approach" (EPA, 1991). The ranking effort was also based on the level of confidence in data and information that is currently available for known and potential contamination sites.

Each site was ranked according to three decision levels. The decision levels are listed below in Table 3 (Level I represents the highest hazard risk criteria; Level III is the lowest).

Table 3: Overall Risk Prioritization

Decision Level	Available Data and Information
I	Proximity of potential hazard to the WHPA
II	Type of contamination
III	Straight-line distance from the wells to the potential hazard

Each known or potential hazard was first scored and then ranked using decision level one. Sites with equal level one rankings were then further scored and ranked using decision level two. If sites were still equal in priority, they were further sub-prioritized under decision level three. Once sites were all differentiated in priority (i.e., no ties in scoring), no further ranking was nec-

essary. For this project, ranking beyond decision level III was unnecessary. The criteria for scoring sites within each level are discussed below.

Decision Level I – Proximity to WHPA

For the first decision level, the sub-prioritization of contaminated sites was based on their location in the WHPA zones; the shorter the travel time, the higher the priority. Scores for each site and hazard category are summarized in Table 4.

Table 4: Proximity to Source

Sub-Priority Score	Proximity to Source
1	½-year time-of-travel to the source (Zone 1)
2	1-year time-of-travel to the source (Zone 2)
3	5-year time-of-travel to the source (Zone 3)
4	10-year time-of-travel to the source (Zone 4)
5	Area of investigation outside Zone 4 (Zone 5)

Decision Level II – Type of Contamination

For the second decision level, the sites were ranked as either known or potential sites of contamination. Known contamination sites were defined as those with known releases of contaminants according to the environmental database survey results. Sites of potential contamination are areas or locations that are used in ways that could pose a risk to the groundwater. This category's scoring is summarized in Table 5.

Table 5: Type of Contamination

Sub-Priority Score	Known or Suspected Contamination	Type of Site	Assumptions
1	Known	CSCSL, HSL, ICR, RGA HWS, RGA LUST, Indian LUST, SPILLS, SPILLS 90, US BROWNFIELDS	As a worst case scenario, contamination is assumed to be comprised of the most toxic chemical identified for the site based on information contained in the Ecology and EPA databases.
2	Known or Suspected	Inactive Drycleaners, Drycleaners, RGA LF, SWF/LF, US Hist Cleaners [1],	Contamination is known or suspected to exist at the site, but may be partially controlled.
3	Known	VCP sites; CDL, historic CDL	Voluntary cleanup sites (VCP) are sites where contamination has occurred, but the contamination has been at least partially controlled or cleaned up. Clandestine drug labs (CDL) can cause toxic fumes, spills, explosions, fires, and can create large amounts of toxic waste.
4	Potential	Financial Assurance; Indian UST, UST; , rural zoned areas; pipeline corridors	It is assumed that petroleum products are stored in USTs, but contamination is not imminent. Rural areas use septic systems. Nitrates and bacterial contamination from septic systems are assumed to be health risks, along with potential chemical hazards, but it is not known what the likelihood is for systems to contaminate the wells.
5	Potential	ERNS, Haznet, Hist Auto, Manifest, RCRA-CESQG, RCRA-NonGen, RCRA-NLR, TRIS; commercial or industrial zoned areas	Hazardous chemicals may be stored on RCRA sites, but contamination has not necessarily occurred. Commercial/industrial uses at this level assume that they are served by sewer systems.
6	Potential	FINDS, US MINES, mining land uses and transportation corridors	This category also includes highways and railroad tracks where accidental spills can occur (with the risk based on the possibility of hazardous material spill; for example, gasoline).

Sub-Priority Score	Known or Suspected Contamination	Type of Site	Assumptions
7	Potential	ALLSITES, urban residential zoned areas	Urban residential uses within areas served by sewer systems are generally lower risk than those served by septic systems.
8	Potential	FTTS, HIST FTTS, open space/recreational/forest zoned areas	Non-residential insecticide, fungicide, and rodenticide uses. Herbicide and pesticide use along transportation corridors, power lines, and in open spaces/recreational uses,
9	Potential	CERC NFRAP, NPDES	This category includes the potential release of lead, petroleum products, and/or solvents via a stormwater system.
10	Potential	CSCSL NFA	Sites achieving a NFA ranking are presumed to have been cleaned up sufficiently to no longer pose a threat. Therefore, this ranking will take precedence over other categories listed for the same site.

[1] Existing and historic drycleaners, landfills (LF), and solid waste facilities (SWF) all have, or had, contaminants present, but the contaminants were not necessarily released to the environment. However, particularly for older sites, the chances of release due to use practices and facility designs is particularly high for these sites. Therefore, contamination is suspected. Additionally, the types of contamination typically found at these sites are particularly mobile in groundwater. These factors combine to rank these sites high although contamination is not known for certain.

Decision Level III – Distance from Wells

For potentially hazardous sites with similar characteristics for prioritization decision levels I and II, the direct distance from the site to the well was used to further rank the sites. In some cases, the nearest wellfield to a hazard site is not a reasonable path (i.e., groundwater moving up gradient). Therefore, we determined the most direct distance based on pathways that are reasonably achievable. Those sites closest to the wells or springs were given a higher priority.

As noted above, a portion of the valley was defined by PGG as lacking deposits of the Osceola mudflow. If correct, the absence of this aquitard will allow for water and/or contaminants to travel vertically through the substrate and into the aquifer faster than it would otherwise.[1] This translates into a shorter travel time to the wellfield. Travel-time calculations were performed based on porosity of the material, averaged thickness of the mudflow deposits, hydraulic conductivity, and difference groundwater elevation above and below the unit. Using average values, we determined that water and/or contaminants could travel vertically through the mudflow unit in an estimated 135 days. Therefore, where the mudflow unit is not present, flow toward the well can be assumed to be 135 days faster. Over a similar period, water and/or contaminants already in the source aquifer would travel approximately 520 feet horizontally toward the wellfield. To account for this quicker time of travel, we subtracted 520 feet from the calculated straight-line distance measured between the nearest source well and the site in question for areas where the mudflow deposit is not present. Where a site had a distance that is less than 520 feet from a source well, we assumed a minimum travel time of one month or 245 feet and used this value for the distance.

Land Use

Land use zones are added to the hazard ranking process in order to include the more general, non-point-source activities that each zone represents. Since the land use activities vary with the zoning, it is reasonable to use the zone classifications as a proxy for trying to identify individual activities within a zone. So rather than call out each commercial business as a possible handler of hazardous materials (a paint store for example), the commercial zone can be given a suitable

[1] The USGS Puyallup River Watershed model will likely refine the areas where mudflow deposits are present. The assumptions used here should be revisited during the next WHPP update using the USGS model as a guide to better define the vertical relationships, flow directions, and times of travel.

ranking level and the nearest instance of that zone to a source well is ranked in the hazard inventory process.

Land use and zoning within the study area include (in general order of prevalence) medium density urban residential industrial, mixed use, commercial, rural area (large lots, 2.5 acres or larger), low density urban residential, mining, and high density urban residential. These land-use categories are discussed below in relation to the potential hazards they represent. Figure 8 shows the locations of zoning categories within the Auburn City limits.

Residential Land Uses

Residential zoning generally falls into four categories across the study area: rural; low density, medium density, and high density urban residential. Table 6 lists the residential land categories.

Table 6: Residential-use Designations

Land Use/Zoning	Description	Hazard Ranking
Rural (2.5, 5, and 10 acre)	Large lot residential (includes non-residential rural uses such as churches and some schools) 1 dwelling unit per 4 acres	7
Urban residential, low	Small lot single- and multi-family residential mixed. Low – 1- 3 dwelling units per acre	274
Urban residential, medium	medium – 4 - 10 dwelling units per acre	18
Urban residential, high	High – 11 or more dwelling units per acre	19

Three rural-zoning categories are present representing allowed minimum lot sizes of 2.5, 5, and 10 acres. As each of these variations on rural zoning present essentially the same basic risk to the City's sources; they are combined into a single category for this ranking process. Contaminant sources related to rural land use include chemical fertilizer, herbicide, and pesticide application; petroleum hydrocarbons; household chemicals; and household sewage. Petroleum hydrocarbons from home heating-oil tanks and farm equipment fuel tanks, as both aboveground and underground storage tanks (USTs), are a potential threat with this land use.

The risk is higher from rural zones for two reasons. First, rural zones in general, because of the potential for agricultural uses, have a larger potential for high, more concentrated use of fertilizers, pesticides, and herbicides. Second, because rural zones are not sewered, risk is elevated due to the use of septic systems, which have the potential to deposit contaminants directly into the subsurface. So, while urban area densities are greater than rural zones, the potential pathways for contamination are often better controlled (sewers, stormwater handling systems, more impervious cover, etc.). However, it is worth remembering that typically risk from septic systems is dominated by the gradual loading of contaminants (i.e., nitrates) from many systems together over a large area rather than inputs of a hazardous material to a specific septic system. In general, single-source contamination is not only uncommon but also rarely travels significant distances beyond the septic drain field because most household chemicals are not highly mobile nor are used in significant enough volumes to cause extended contamination.

Commercial Land Uses

Commercial land use makes up approximately 2,353 acres of the study area and is ranked as the seventh highest risk to the WHPA because of its proximity and subsurface pathways for contamination.

The most likely potential contaminants related to commercial land uses are, but are not limited to, petroleum hydrocarbons and metals. These potential contaminants are generally due to the presence of fuel in USTs, parking lots, and listings of businesses potentially as RCRA small-quantity generators of hazardous materials.

Industrial Land Uses

Like commercial zones, industrial areas can host a range of activities with potential to cause contamination. The most likely contaminants related to industrial uses are petroleum hydrocarbons and metals. Contaminants are generally due to the potential for large spills, presence of aboveground and underground storage tanks, parking lots, and potentially small or large quantity generators of hazardous materials.

Mining & Transportation

Major transportation routes are included as potential hazards due to the transport of potential contaminants by road or rail and the potential use of herbicides and pesticides along the routes. Two Burlington Northern Santa Fe (BNSF) and one Union Pacific railroad corridors extend through WHPA and study area. Heavily trafficked roads determined to be significant transportation corridors through the WHPA and study area include Highway 18, A Street East, and Auburn Way.

The main consideration for transportation corridors is for large spills, typically involving petroleum hydrocarbons or hazardous materials. Smaller streets and roads are not listed separately in the potential hazards list because there is less chance for large spills and small spills (i.e., leaks, over application of de-icing salt, etc.) that might occur only on non-highways are less of a concern. Hazards related to smaller streets and roads are included within the other land-use categories (specifically the rural and urban planning development categories).

Multiple sand and gravel mining operations are located in the study area. Openwork mining allows a direct route for potential contaminants to enter the groundwater system. While it is assumed that the mines operate under best-management practices and conform to all appropriate state regulations, the lack of vegetated cover and continued disturbance of mining pits when in operation makes mines potential sites for contamination. Contaminants of particular concern associated with mining are petroleum based fuels and hydraulic fluid.

Mixed Uses

The final category of land-use categories is mixed use. This category includes a mixture of residential, commercial, and public land uses. Public land use includes hospitals, public swimming pools and athletic facilities, libraries, parks, etc. Potential contaminants include the use of herbicides and pesticides, as well as other chemicals for public swimming pools and hospitals, etc.

Pipeline Corridors

The Olympic Pipeline, owned by BP, is located in the study area and is within the West Hill Springs WHPA 5- and 10-year zones. The pipeline transports gasoline, diesel, and jet fuel from refineries at Cherry Point and Anacortes, Washington to as far south as Portland, Oregon. Hazards associated with the pipeline corridor include potential for leaking and spills of petroleum products from the pipeline, as well as the potential use of herbicides and pesticides along the routes.

Table 7, below, shows the relative ranking for the non-residential land use categories.

Table 7: Other Land-use Zoning Designations

Land Use/Zoning	Description	Hazard Ranking
Mixed Use	Mix of residential, public properties including swimming pools and athletic facilities, libraries, and parks, hospitals, and some commercial uses.	10
Mining &Transportation Corridors	Highway 18, Auburn Way, and A Street. Active and abandoned sand and gravel mines.	54
Industrial	Safeway Distribution Center, Oldcastle Precast Concrete Manufacturing, Northwest Aviation Service Group, and many others	16
Commercial	neighborhood business, shopping malls, and strip malls, etc.	11
Pipeline Corridors	BP's Olympic petroleum pipeline	125

Identified Contaminant Sources

In the federal and state databases reviewed by EDR, 992 sites are identified within the WHPP study area. These sites are scattered among all four of the WHPA zones and the area of investigation, as well as outside the WHPAs. However, based on the locations, types of listings, the field verification effort, and review of additional on-line database information where available, we reduced the final list of sites to be ranked to 504. Adding in the nine land-use categories discussed above brings the total number of ranked hazards to 513. The five highest ranked sites are shown below in Table 8. The City should do additional due diligence on the highest ranked sites to evaluate to risk to the WHPAs. The hazard sites are mapped on Figures 2 through Figure 7 and shown in Table 10, attached as Appendix B.

Table 8: EDR Identified Contaminant and Potential Sources

Hazard Ranking	EDR ID Numbers	EDR Site Name	Address	Database
1	CU 950, CU 949, CU 953, CU 952, CU 951	The Church of Jesus Christ of Latter Day Saints	331 4th St. NE	ICS, RGA HWS, FINDS, ALLSITES, CSCL
2	DP1003	No Name Provided	634 M Street NE	SPILLS
3	DP 975	No Name Provided	1207 6th St NE	SPILLS
4	CW 849	No Name Provided (residence-duplex)	1208 4th St NE	EDR US Historic Cleaners
5	DN 962, DN 969, DN 968	B and G One Hour Cleaners	420 N Auburn Way	ALLSITES, Inactive Cleaners, RCRA NLR, FINDS, Historic Cleaners

Potential Groundwater Concerns

For wellhead protection planning, it is important to understand the potential sources and types of contamination that threaten the City's WHPAs. It is also important to understand the potential pathways for contaminant migration since these contaminant pathways can increase the vulnerability of an aquifer by decreasing travel time from a source to a wellhead or spring. The following section briefly summarizes the main mechanisms for transport of contaminants to the subsurface.

Discharge onto the Ground Surface

Direct discharge to the ground surface occurs when products or waste materials are spilled onto the ground. With the help of rainfall infiltration, the materials percolate into the subsurface, and if a sufficient volume of material is released, they eventually reach the water table and migrate down gradient within the shallow aquifer. In large enough quantities, spills can impact deeper aquifers where water supply wells are completed.

Direct Discharge to the Subsurface

Discharge to the subsurface occurs from septic systems and dry wells (UICs). Discharge into the subsurface is a more direct mechanism for transport because contaminants are discharged closer to the water table and because subsurface discharge bypasses the upper layers of soil, which have the ability to absorb and disperse many types of contaminants.

Abandoned Wells

Old, improperly constructed or improperly abandoned wells[2] can act as direct conduits for contaminant transport to an aquifer. In such wells, transport can occur between the ground surface and aquifer zones because of a lack of a well seal or an inadequately constructed seal.

Stormwater Runoff

Rainfall onto the ground either induces infiltration into the subsurface or becomes runoff. The quality of the water which infiltrates or runs off is dependent on the type of land use and the potential presence of contaminants which may be located on the ground surface. Stormwater infiltration issues are similar to those of discharge to the ground surface. Stormwater runoff is considered differently because it runs over the surface of the ground, picking up and dissolving potential contaminants, and may eventually discharge these contaminants to groundwater via infiltration through ditches or ponds designed to percolate water or from surface-water bodies which receive the runoff.

The potential concerns due to water infiltration or runoff are diverse and reflect the land-use activities in the area of interest. Paved roadways, parking areas, and residential developments can contribute heavy metals and petroleum hydrocarbons which originate primarily from vehicle-related emissions. Industrial and commercial operations commonly process and release a variety of organic pollutants (e.g., solvents, paints, and dry cleaning solutions) as well as petroleum products.

Management Strategies

This WHP program is designed to be an on-going management activity to meet the City's future planning needs and to adapt to changes in the City's use of the aquifer system. As such, the management strategies and practices outlined within this study provide a general direction but will periodically need to be refined to fit specific conditions. Additional adaptations may be needed to address future activities and regulations or changes in current regulations that may affect the WHPAs. The following sections detail proposed strategies to protect the integrity of the City's water sources.

Land Management Activities

The City should encourage owners or agencies responsible for large land parcels and developments to use and monitor best management practices (BMP) for control, reduction, and restriction of potential contaminants into the WHPAs.

[2] Washington State has standards for construction and abandonment of wells, WAC 173-160.

WHP Land-use Strategies

The City of Auburn has no authority to directly control land use for those areas of the WHPAs that are outside the city limits. Therefore, the City must develop a cooperative relationship with those state and local agencies that administer land use programs. At the present time, the best strategy for the City is to seek special designations for the WHPAs from pertinent agencies. The City should evaluate and seek the different designations that may be most beneficial.

Possible Special Protection Area Designations

- A Special Protection Area designation under the state groundwater quality standards (WAC-173-200)
- A Special Use Area by the Department of Agriculture
- An Environmentally Sensitive Area under various County-level programs

WHP Regulatory Strategies

This WHPP is designed to use the existing statutory rules and regulations to protect groundwater quality. The City, in coordination with state and local agencies having statutory authority in the area, could monitor regulated activities within the WHPA. The following regulatory strategies are recommended.

Well Drilling Inspections inside the WHPA

The City should support continuation of the delegation by the Department of Ecology (Ecology) of well construction inspection authority to the King and Pierce County Health Departments. Regardless of the responsible agency, the City should encourage more frequent well construction inspection than currently occurs.

Washington State Environmental Policy Act/Hydrogeologic Evaluations

The City should request that the King County Department of Development and Environmental Services (DDES) and the Pierce County Planning and Land Services (PALS) to require hydrogeologic evaluations that specifically address impacts to groundwater quality and quantity parameters for any development within the WHPAs which requires SEPA action or seeks a Determination of Non-Significance (DNS) designation. Additionally, the City should enter into a Memorandum of Understanding (MOU) with DDES and PALS seeking City comment on the effects such developments will have on the groundwater system. Designation of the area as a Special Protection Area will be the first step toward gaining such an agreement.

Septic Tanks

The City should request King County and Pierce County to require as-builts drafted by septic design professionals be recorded with property deeds for new septic systems. Additionally, the City should support the implementation of laws and regulations requiring proper inspection and maintenance of septic systems. The City currently has an active sewer system throughout the majority of the City; however, septic systems still exist in many areas. In areas that are sewered, septic tanks are not allowed for new construction as everything must be connected to the sewer.

Planning Strategies

A substantial degree of future protection for the WHPAs will be achieved through present-day planning and coordination. In order to accomplish the required level of future protection, the following strategies are recommended.

Sewers

The City, in coordination with the managers of neighboring local sewer systems, should develop emergency plans to be implemented in the advent of sewage leaks or spills. The City could encourage the County to require all industrial and commercial facilities within the WHPAs to connect to sanitary sewers if such services are reasonably available.

Stormwater Management

The City should conduct or promote research on the impact of stormwater discharge on water quantity and quality. Additionally, the City, in coordination with the responsible agencies, should evaluate the adequacy of stormwater facilities including proper routing, retention, and detention. In the upland areas, a balance should be found that allows optimum recharge of stormwater to groundwater systems while adequately protecting the water quality of the aquifers. Generally in the valley areas, aquifer recharge of stormwater is less of a concern and stormwater management should focus more solely on water quality protection.

Petroleum Pipelines

The City should document the location and use of petroleum pipelines and establish emergency response plans for pipeline failure. These efforts should be coordinated with the pipeline companies and the federal, state, and county agencies responsible for emergency, petroleum-product spill response.

Hazardous Material Transport

The City should investigate the feasibility of re-routing the transport of hazardous materials away from the half-year and one-year WHPA zones and the area where the Osceola mudflow aquitard is not present. However, it may be necessary for this option to exclude Highway 18 and SR 164 (Auburn Way South) since they represent major regional transportation routes. While Highway 18 does not travel directly through the 6-month or 1-year zones, it does pass through Zone 1A, an area with no confining layer above the main aquifer utilized by the City. A stronger emphasis on emergency response for this area could be an alternative to the rerouting of hazardous material transportation.

Spill Response

The City has established formal communication protocols with first-response emergency units of the Valley Regional Fire Authority. Notification of the location of the WHPAs should also be given to emergency response organizations outside of the City boundaries as appropriate. The City also has an Emergency Response procedure (600-02) to help it respond to minor spill events within City limits. However, creation of a formal Spill Response Plan that brings together City and first-responder agencies under the incident command system is recommended. Such a plan describes the proper response procedures to a major spill event that might threaten City water supplies and can prove valuable in cases where a first responder's perspective differs from the City's desire for protection of water resources by pre-establishing command and control roles and identifying proper contacts to ensure good decision making in the field.

Data Management Strategies

One of the principal goals of the WHPP is the development of a data collection network and analysis plan capable of providing the City with advance warning of contamination to the City's water supply. The following data management strategies seek to establish and maintain scientific data upon which future WHPP actions can be based.

Groundwater Monitoring Plan

The City should actively participate in the collection and analysis of regional and local groundwater information. The development of a proper groundwater-monitoring plan will be crucial to the City's capability to protect their water sources. This can be accomplished in cooperation with Health, the Regional Water Associations of South King County, Seattle-King County Health Department, the Department of Natural Resources (DNR), Ecology, and other entities seeking to monitor the groundwater resources of the region.

Abandoned Well Inventory

The City should locate and inventory decommissioned, abandoned, and unused wells. Owners of these wells could be notified of the potential liability such wells cause and be educated on the benefits of well decommissioning.

Herbicide and Pesticide Survey

The City should inventory and monitor major herbicide and pesticide use within the WHPAs. This inventory may be used to guide future groundwater monitoring and WHP-related education programs. In addition, the City could encourage county, state, and private land managers to use vegetation-management practices that protect groundwater quality.

Underground Storage Tanks Inventory

The City should inventory and locate underground storage tanks. Besides those presently identified by the current hazard inventory, this inventory should include new tanks placed after the hazard inventory was finished, residential home heating-oil USTs, and other tanks that have not been previously identified.

Drywell Monitoring

The City should encourage stormwater management agencies to develop an evaluation and monitoring plan for drywells within the WHPAs.

Education Strategies

Education of the public and industrial/commercial occupants of the WHPAs concerning groundwater protection is a critical portion of the WHPP. Through proper education, the degree and potential for future contamination can be greatly reduced; therefore, the following recommendations are made.

- If not already begun, the City should begin groundwater educational programs to educate WHPA residents, particularly on groundwater quality issues. The WHPAs could be targeted for distribution of literature regarding septic tank maintenance; fuel-oil storage tank maintenance and abandonment; residential use of herbicides and pesticides; and hazardous material use, disposal, and storage
- In addition to City-run programs, the City should participate in and support small-quantity waste disposal programs and actively work with state and local government in developing and creating public education programs concerning groundwater.

Wellhead Protection Implementation Tasks

In order to accomplish the protection of the WHPA, we recommend that the City adopt the WHP Implementation Tasks listed below. Twenty-six tasks were initially proposed during the 2008 WHPP update (Robinson, Noble, & Saltbush 2008). Two tasks have been completed, four have been removed as redundant, and eight tasks are currently being completed by the City as shown in the Table 9 below.

Table 9: 2008 Implementation Tasks Currently in Progress

2008 Task Number	Task goal
3	Notify county health and planning departments
11	Participate in a regional groundwater data development and management program
13	Ensure SEPA evaluations include WHP considerations
14	Document the type and amount of herbicide and pesticide application
17	Promote and coordinate public education programs on WHP concerns
20	Encourage development and use of best management practices in developments covering groundwater protection
22	Encourage thorough analysis of groundwater impacts for siting, operation, and reclamation of gravel quarries and mines
26	Work with responsible parties to assess adequacy of stormwater systems

The remaining tasks are listed in their recommended priority of implementation. Task numbers from the 2008 update have been retained. The City may institute all or a portion of these tasks, depending upon available funding, time, or other concerns.

Task 2

The City should establish formal communication with first responders and educate them about the needs for wellhead protection. As an example, Tacoma-Pierce County Health Department collected the WHPAs defined by each Group A water purveyor in Pierce County and created a GIS-based map. This map layer was then shared with all Pierce County fire departments to help inform their responses to fires or hazardous material spills in proximity to vulnerable water supplies.

Task 4

Consideration should be given to seeking designation of the WHPAs as a special protection area. As mentioned previously, there are numerous special designations the City may wish to seek in order to protect the WHPAs. The City should evaluate the protection offered by these designations and seek those most appropriate for the WHPAs.

Task 5

The City should create awareness of the wellhead protection area by posting metal "WATER SUPPLY PROTECTION AREA" signs along major arterial roads at the borders of the WHPAs.

Task 7

Increasing public awareness of homeowners who are connected to the City's water system through notification letters to customers within the WHPAs should be accomplished by the City. This notification letter should be given to homeowners either at the time of service hook up or as part of property escrow.

The City should deliver a copy of the WHPP to the King County and Pierce County library systems. This will allow interested residents to learn more about the wellhead protection program of the water system.

In addition, the City should inform local residents of the WHPA through a press release sent to Auburn Reporter, Tacoma News Tribune, and the Seattle Times for publication in the local or "Your Town" sections of each paper.

Task 8

The City should coordinate with King and Pierce Counties to require engineering as-builts of new septic systems be recorded with property deeds. These as-builts should be drawn and

submitted by septic-tank designers who are registered professional designers licensed by Washington State. The City should support the implementation of state laws and regulations regarding septic system inspection and maintenance programs and promote and coordinate public education programs concerning proper septic tank maintenance and proper hazardous waste disposal.

Task 9 and Task 24 (combined)

City public works staff should review routine leak detection procedures for sewer lines, request the use of "leak-proof" piping for new sewer construction, and replace older lines. There are currently multiple sewer force mains located throughout the City. The City currently has contingency plans in place for pump and line failure; however, the City should develop an emergency response procedure for sewer force main breaks within the half-year and 1-year WHPA zones. The City could seek to have appropriate agencies require sewer hook-up for all industrial-commercial facilities within the WHPAs if sewer service is reasonably available.

Task 12

The City could encourage King and Pierce Counties to maintain their delegated authority of well-drilling inspection and should coordinate with this program to gain advance notice of drilling in or near the City's WHPAs. The contacts for the appropriate programs are Tacoma-Pierce County Health Department's Drinking Water and Wells program at 253-798-6470 and Public Health – Seattle & King County Department's Drinking Water program at 206-296-4932. For information on the delegated authority, contact the Department of Ecology's Well Construction and Licensing program at 360-407-6650 (see also: http://www.ecy.wa.gov/programs/wr/wells/wellhome.html).

Task 15 and 16 (combined)

The City should annually review the CSCSL, LUST, and other significant environmental database listings within the WHPAs. Also, the City could monitor Ecology's progress in the cleanup of contaminated sites within the WHPAs and encourage Ecology and county inspection of RCRA hazardous waste generator facilities.

Additionally, review of annual Superfund Amendments and Re-authorization Act (SARA) Title III reports, in order to document and inventory the chemicals used in the WHPAs, is recommended. This review could be used to guide groundwater monitoring and WHP-related education programs.

Task 18

The City should develop data on the number and size of exempt underground tanks within the half-year and one-year WHPA zones. Also, the City should promote and coordinate public education programs concerning underground tank hazards, leak detection methods, and proper removal and closure procedures. These programs should target owners of exempt underground tanks. Such owners should be encouraged to contact the Pollution Liability insurance Agency (PLIA) to receive no-cost coverage of up to $60,000 at http://www.plia.wa.gov/.

Task 19

The City could seek to have Ecology prioritize the investigation of contaminated and potentially-contaminated sites within the WHPAs. This could assure that those areas with existing contamination and any subsequent contamination events within the WHPAs are given highest priority in relation to the amount and type of contamination in clean-up activities and budgets.

Task 23

An inventory of abandoned or unused wells in the six-month, one-, and five- year zones should be made. The owners of these wells should be informed about proper well decommissioning procedures.

Task 25

The City should investigate the need and feasibility for re-routing transport of hazardous materials through the WHPAs. Also, the City should create a formal Spill Response Plan to describe the City's responsibilities and responses to a major spill event under the State's Incident Command System.

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U.S. Environmental Protection Agency, Office of Water, 1991, managing ground water contamination sources in wellhead areas a priority setting approach, Washington D.C. EPA 570/9-91-023, 252 p.

The statements, conclusions, and recommendations provided in this report are to be exclusively used within the context of this document. They are based upon generally accepted hydrogeologic practices and are the result of analysis by Robinson Noble staff. This report, and any attachments to it, is for the exclusive use of the City of Auburn. Unless specifically stated in the document, no warranty, expressed or implied, is made.

FIGURES

WEST HILL SPRINGS

WELL 6

WELL 7

WELL 2

WELL 1

WELL 4

WELL 3A

WELL 3B

COAL CREEK SPRINGS

WELL 5A

WELL 5

WELL 5B

0’ 4200’

Legend

- Springs
- Well
- Area of Investigation
- 6 Month WHPA
- 1 Year WHPA
- 5 Year WHPA
- 10 Year WHPA
- Area where Osceola mudflow (Qom) aquitard is not present
- Water Service Boundary
- Auburn City Limits
- Active Railroad

ROBINSON NOBLE

Note:
Image from ESRI ArcGIS

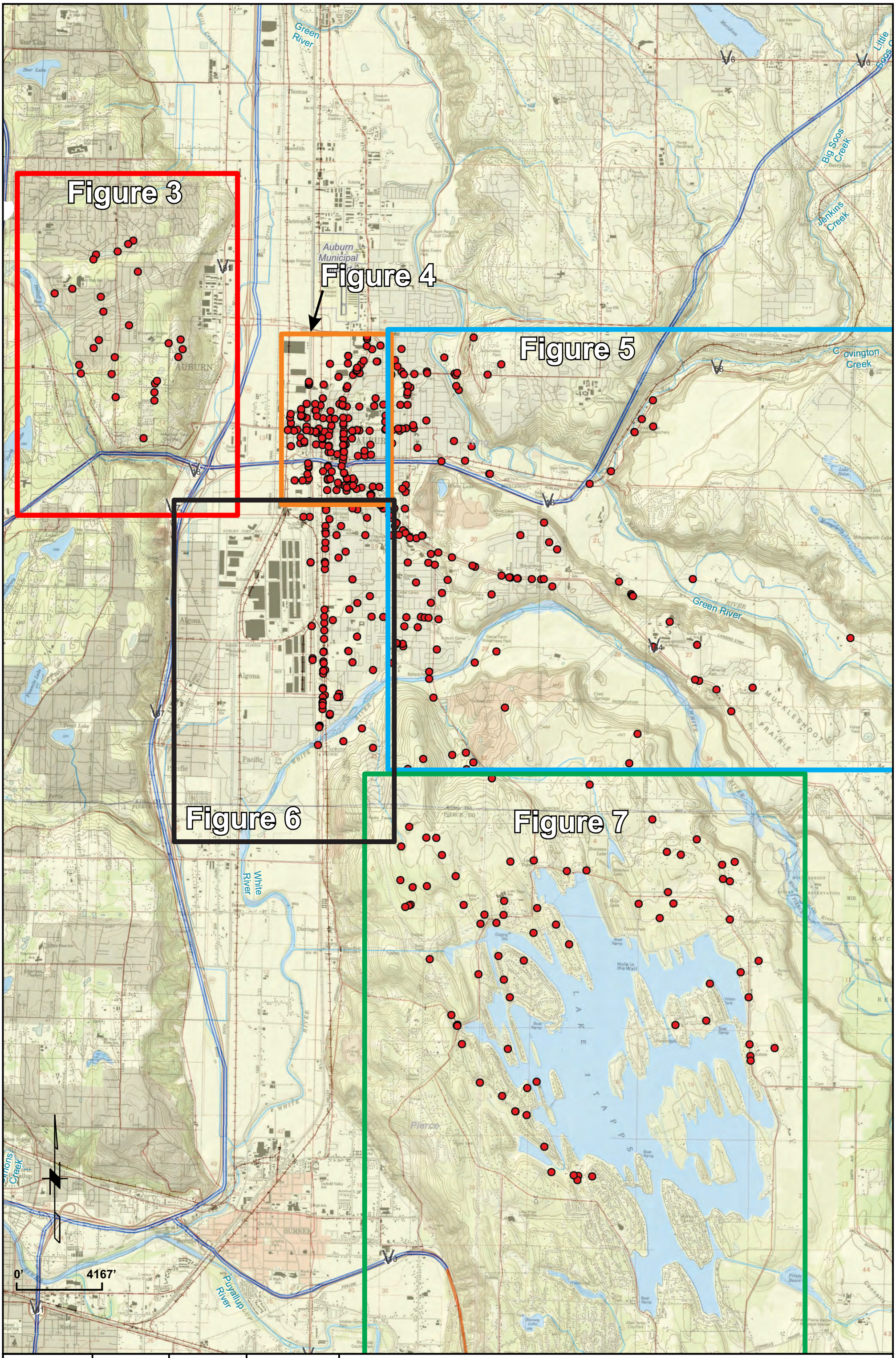
PM: BGC
November 2014
1051-005B

King County
T 21 N/R 04 E
Scale 1” = 4200’

Figure 1

Wellhead Protection Location Map

City of Auburn: Water Comprehensive Plan Update

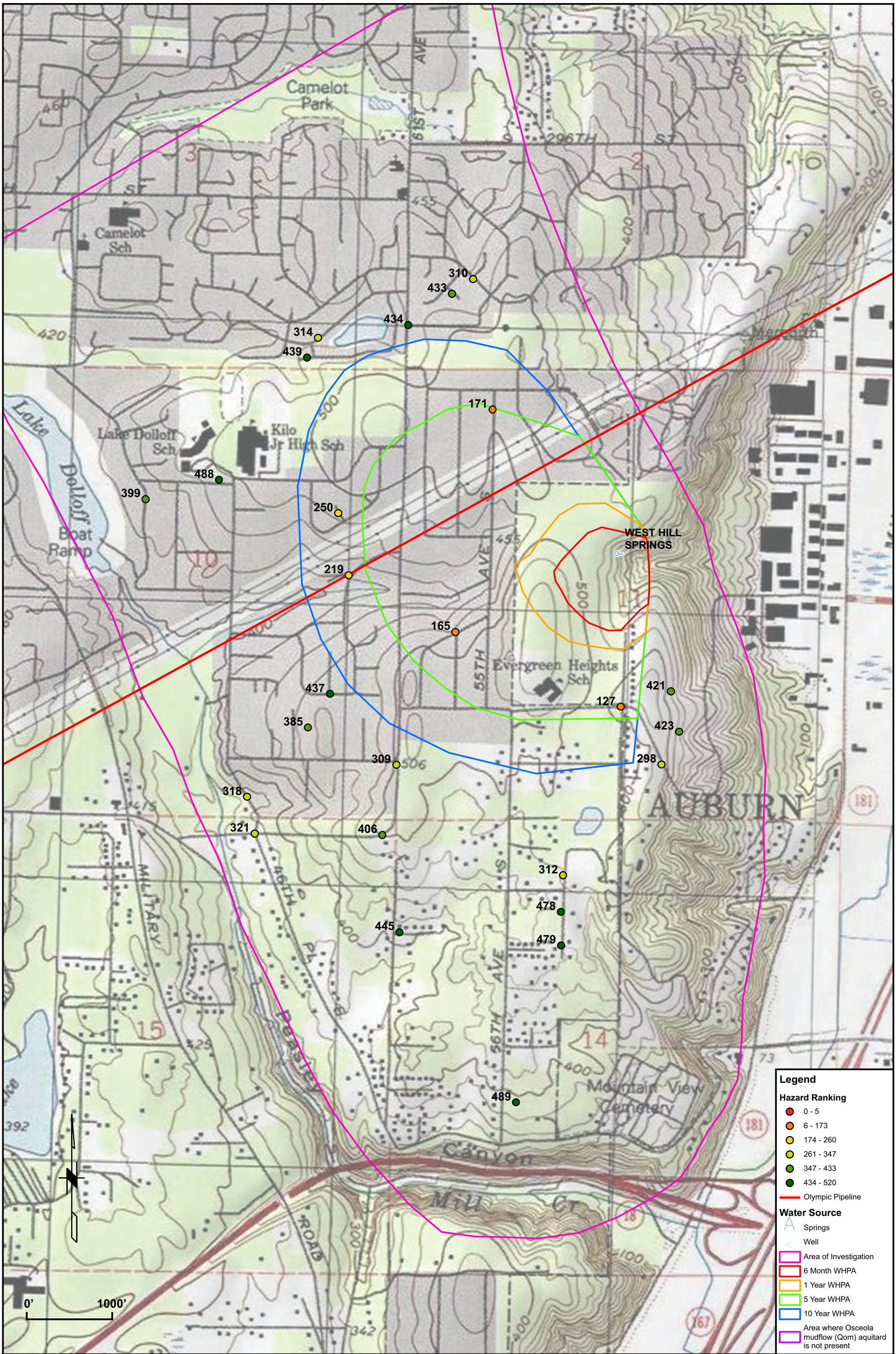


ROBINSON NOBLE	Note: Image from ESRI ArcGIS	PM: BGC November 2014 1051-005B	King County T 21 N/R 04 E Scale 1" = 4167'

Figure 2

Hazard Site Location Map

City of Auburn: Water Comprehensive Plan Update



ROBINSON NOBLE	Note: Image from ESRI ArcGIS	PM: BGC November 2014 1051-005B	King County T 21 N/R 04 E Scale 1" = 1000'	Figure 3 Hazard Site Location Map City of Auburn: Water Comprehensive Plan Update

Legend

Hazard Ranking

- 0 - 5
- 6 - 173
- 174 - 260
- 261 - 347
- 347 - 433
- 434 - 520

Water Source

- Springs
- Well
- Area of Investigation
- 6 Month WHPA
- 1 Year WHPA
- 5 Year WHPA
- 10 Year WHPA
- Area where Osceola mudflow (Qom) aquitard is not present

WELL 7

WELL 6

Cem

Park

Hosp

Washington Sch

AUBURN

BM 74

BM 87

BM 96

BM 90

PO

0’ 500’

ROBINSON NOBLE	Note: Image from ESRI ArcGIS	PM: BGC November 2014 1051-005B	King County T 21 N/R 04 E Scale 1” = 500’	Figure 4 Hazard Site Location Map City of Auburn: Water Comprehensive Plan Update

Figure 5

Hazard Site Location Map

City of Auburn: Water Comprehensive Plan Update

King County
T 21 N/R 05 E
Scale 1" = 2000'

PM: BGC
November 2014
1051-005B

Note: Image from ESRI ArcGIS

ROBINSON NOBLE

Legend

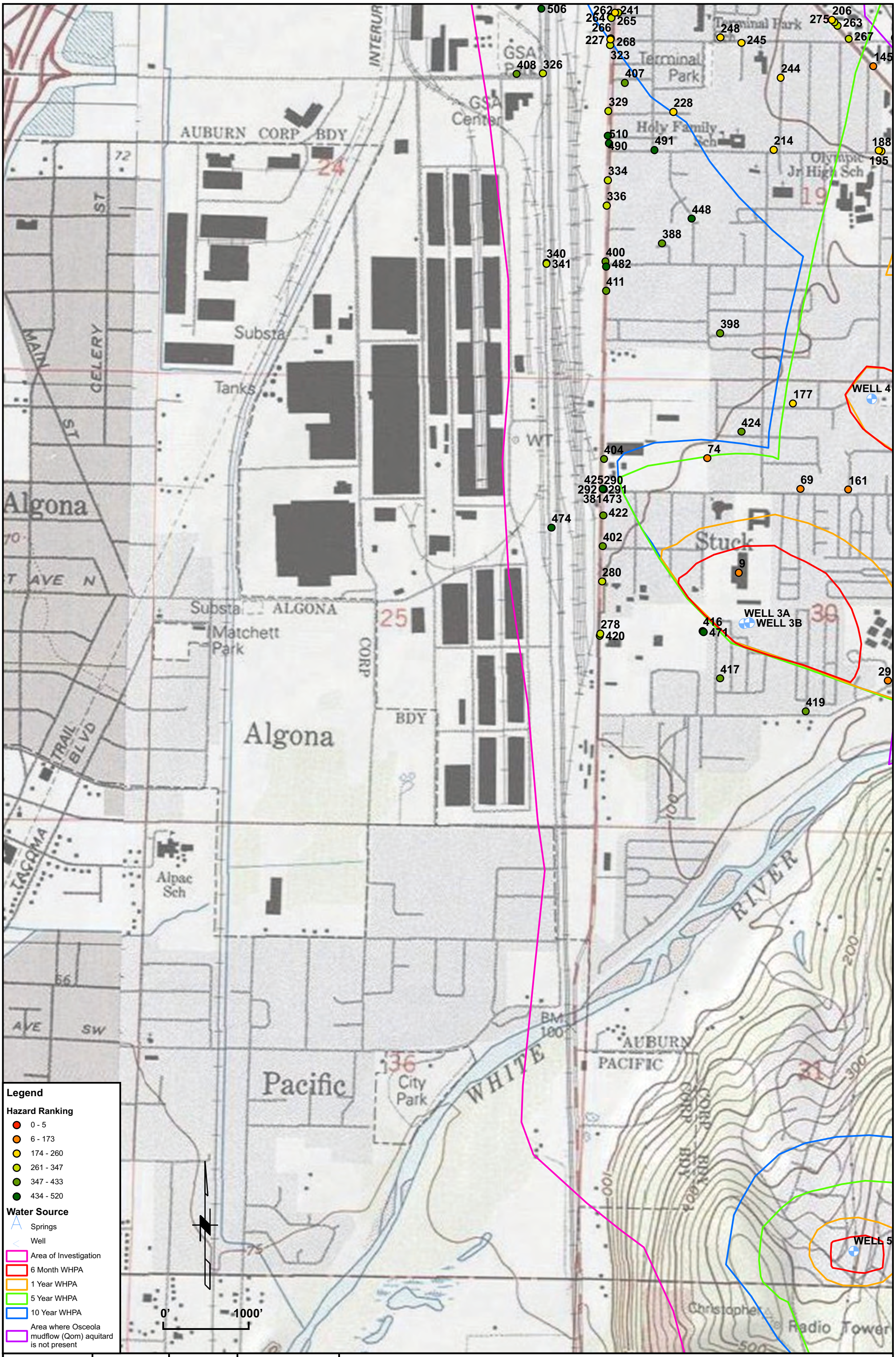
Hazard Ranking

- 0 - 5
- 6 - 173
- 174 - 260
- 261 - 347
- 347 - 433
- 434 - 520

Water Source

- Springs
- Well
- Area of Investigation
- 6 Month WHPA
- 1 Year WHPA
- 5 Year WHPA
- 10 Year WHPA
- Area where Osceola mudflow (Qom) aquitard is not present

0’ 2000’



Legend

Hazard Ranking

- 0 - 5
- 6 - 173
- 174 - 260
- 261 - 347
- 347 - 433
- 434 - 520

Water Source

- Springs
- Well
- Area of Investigation
- 6 Month WHPA
- 1 Year WHPA
- 5 Year WHPA
- 10 Year WHPA
- Area where Osceola mudflow (Qom) aquitard is not present

ROBINSON NOBLE

Note: Image from ESRI ArcGIS

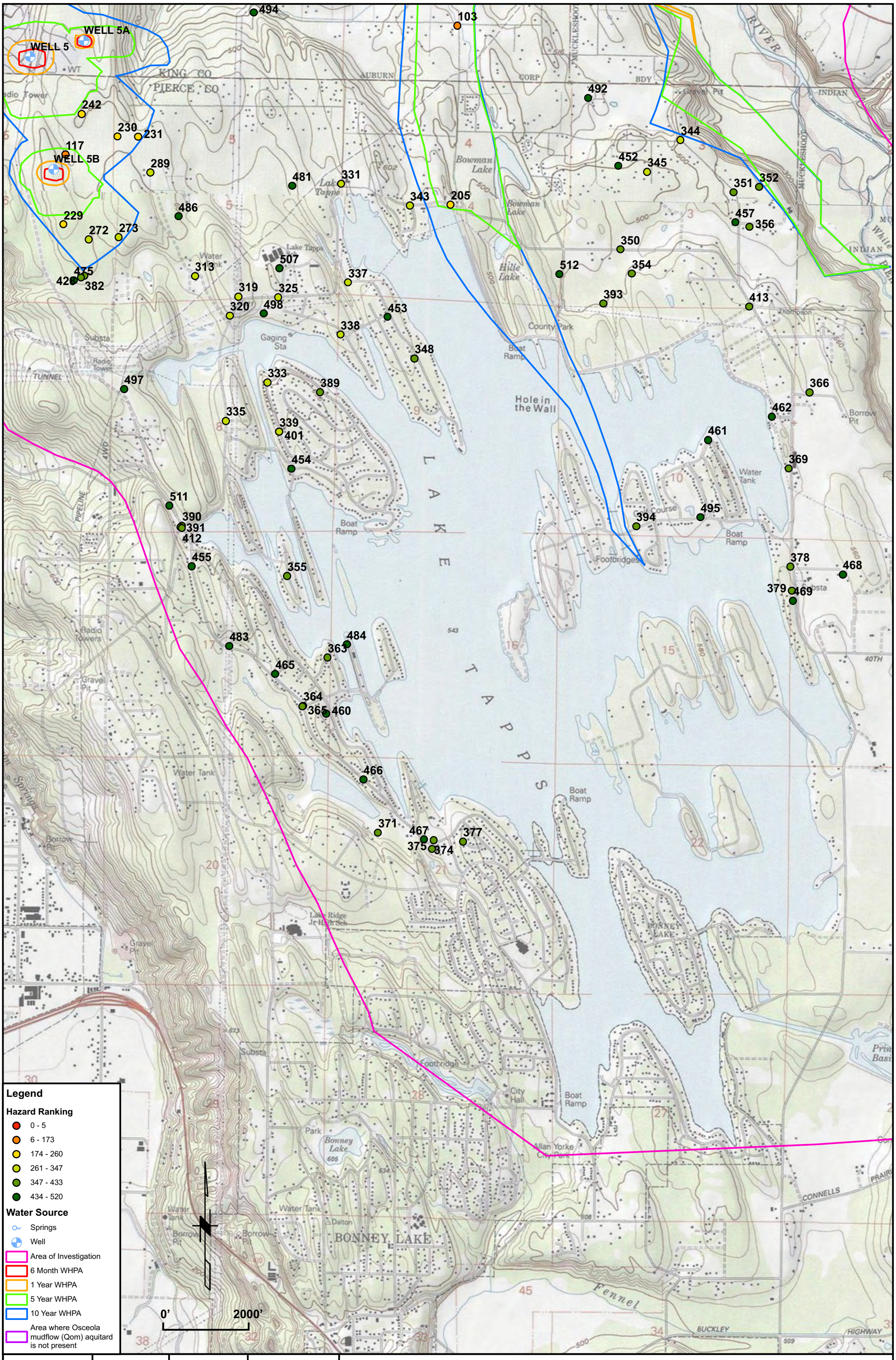
PM: BGC
October 2014
1051-005B

King County
T 21 N/R 04 E
Scale 1” = 1000’

Figure 6

Hazard Site Location Map

City of Auburn: Water Comprehensive Plan Update



Legend

Hazard Ranking

- 0 - 5
- 6 - 173
- 174 - 260
- 261 - 347
- 347 - 433
- 434 - 520

Water Source

- Springs
- Well
- Area of Investigation
- 6 Month WHPA
- 1 Year WHPA
- 5 Year WHPA
- 10 Year WHPA
- Area where Osceola mudflow (Qom) aquitard is not present

ROBINSON NOBLE

Note: Image from ESRI ArcGIS

PM: BGC
November 2014
1051-005B

King County
T 21 N/R 04 E
Scale 1” = 2000’

Figure 7

Hazard Site Location Map

City of Auburn: Water Comprehensive Plan Update

WEST HILL SPRINGS

WELL 6

WELL 7

WELL 2

WELL 1

WELL 4

WELL 3A

WELL 3B

COAL CREEK SPRINGS

WELL 5

WELL 5A

WELL 5B

0’ 4200’

Legend

Water Service Boundary

Auburn City Limits

Water Source

	Hazard Ranking
Springs	
Well	
Olympic Pipeline	*125*

Zoning

Industrial	*16*
Commercial	*11*
Mixed Use	*10*
Residential Low (1 DU/ACRE)	*274*
Residential Medium (4-10 DU/ACRE)	*18*
Residential High (11+ DU/ACRE)	*19*
Rural (1 DU/4 ACRES)	*7*
Mining	*54*

ROBINSON NOBLE

Note: Image from ESRI ArcGIS

PM: BGC
November 2014
1051-005B

King County
T 21 N/R 04 E
Scale 1” = 4200’

Figure 8

Zoning Map

City of Auburn: Water Comprehensive Plan Update