Exhibit 4-3: Sheet 6 of 6: Surface Waters and Floodplains, SR 520 MP 8.2 to 9.0

Sturtevant Creek ultimately flows into a flat vegetated area along the west side of the I-405 right-of-way between SE 6th Street and SE 8th Street, and then into Mercer Slough.

During the ecosystems survey for this project, WSDOT identified an unnamed tributary to Sturtevant Creek that originates from an area adjacent to I-405 at the northeastern quadrant of the NE 8th Street/I-405 interchange. Stormwater from the interstate and adjacent properties is collected and conveyed via a series of storm drains and roadside ditches located next to I-405. These flow into an underground vault near NE 8th Street. After leaving this vault, water flows into an open channel to become the unnamed tributary to Sturtevant Creek.

What is a talent ditch?

A talent ditch is a man-made feature constructed to convey stormwater. These features function similarly to wetlands and fall under the jurisdiction of the Army Corps of Engineers.

The primary water source for the vault is a sequence of talent ditches that flow south along the east side of I-405. The talent ditches receive runoff from a commercial parking lot located adjacent to the NE 12th Street bridge, as well as roadside stormwater runoff. The talent ditches flow through open and culverted segments north of the unnamed tributary to Sturtevant Creek and then into the underground vault. Storm drains located within the median of I-405 also flow into the underground vault, although they only provide a small amount of water.

The unnamed tributary flows south alongside the I-405 northbound lane for approximately 350 feet before entering an underground culvert. Downstream of the culvert exit, the stream daylights again for a short segment near the northbound NE 8th Street on-ramp. The stream then enters another culvert and flows south to its confluence with Sturtevant Creek just southeast of the I-405 and NE 8th Street interchange.

Yarrow Creek Basin

The north and west portions of the study area along I-405 and SR 520, respectively, are located within the Yarrow Creek basin (see Exhibit 4-1). Yarrow Creek originates northeast of the I-405/SR 520 interchange in Bridle Trails State Park at an elevation of 420 feet above mean sea level, and then flows westerly, eventually discharging in Yarrow Bay on the northeastern shoreline of Lake Washington. Yarrow Creek is approximately 3.5 miles long and drains an area of 1,667 acres. Land use in the basin includes recreational/forested areas,

residential and commercial development, and high-use transportation corridors (I-405, SR 520, and Bellevue Way). The overall impervious land cover is approximately 29 percent.

Much of Yarrow Creek has been piped to accommodate the residential and commercial development, as well as the major roadways in the area. From the headwaters in Bridle Trails Park, the stream flows southwesterly along residential streets in pipes and open channels. The stream crosses beneath I-405 approximately 0.4 miles north of the I-405/SR 520 interchange, north of the northern project limit, via a 36-inch culvert (Exhibit 4-5). From this crossing, the stream flows through the BNSF Railway right-of-way, several culverts, and a wooded ravine before continuing west along Northup Way through mostly commercial areas in a roadside ditch. The creek crosses under SR 520 in a series of culverts and enters a multifamily residential housing area and the Yarrow Bay wetland before discharging to Lake Washington.

The southwestern quadrant of the I-405/SR 520 interchange drains to an unnamed tributary to Yarrow Creek. The project team surveyed this stream and determined that the stream begins in a 24-inch steel culvert that drains a portion of the interchange along SR 520. The stream flows west through a narrow channel along the south side of SR 520 until it enters a culvert and then is conveyed below the highway. On the north side of SR 520, the stream enters a narrow open channel again, and then flows northwest toward the intersection of Northup Way and 108th Avenue NE, where it enters Yarrow Creek.

West Tributary to Kelsey Creek Basin

West Tributary to Kelsey Creek is one of four basins in the Kelsey Creek subwatershed. Kelsey Creek discharges into Mercer Slough near the I-405/SE 8th Street interchange. The West Tributary is approximately 2.8 miles long. The overall land use in the basin is primarily residential, with other major uses including transportation corridors, light industrial/commercial, and open spaces/parks. It has a drainage basin of 1,001 acres and its land cover is 44 percent impervious surfaces.

The headwaters of the West Tributary to Kelsey Creek begin southeast of the I-405 and SR 520 interchange in a large

wetland complex adjacent to the Lowes store property and the BNSF Railway right-of-way (see Exhibit 4-5). A series of storm pipes collects drainage from SR 520 between mileposts 7.2 and 7.5 (see Exhibits 4-5 and 4-6) and from portions of the Northup Way/NE 24th Street intersection (see Exhibit 4-6). The pipes convey surface water south to the headwaters of the creek near the wetland complex along 120th Avenue NE. The open channel of the West Tributary begins in the wetland. From there, the stream flows east under 120th Avenue NE in a culvert, and then continues on the east side of the road. Downstream of the 120th Avenue NE under-crossing, the West Tributary flows through a combination of storm pipes and open ditches/narrow stream channels toward the southeast (see Exhibit 4-7). Here, Goff Creek joins the West Tributary just south of Bel-Red Road. Downstream of the confluence, the stream continues to flow south, crossing under NE 8th Street and flowing through residential and park areas to its confluence with Kelsey Creek just south of SE 8th Street, near Kelsey Creek Park.

Goff Creek Basin

Goff Creek is approximately 7,000 feet long and has a basin area of 679 acres. It is a tributary to the West Tributary to Kelsey Creek. The basin is comprised of mostly residential, commercial, and transportation corridors, but it also has a large wooded area (Bridle Trails State Park). Many of the residential areas are large single-family residences with large yards. Because of the large tracts of undeveloped land, the basin is only 30 percent impervious overall. Goff Creek empties into the West Tributary to Kelsey Creek south of Bel-Red Road.

What are base flows?
The base flow is the volume of flow in a stream or river during dry conditions, as opposed to conditions influenced by storm runoff. Base flows discharge groundwater and water from upstream channels, wetlands, lakes, and ponds.

The headwaters of Goff Creek begin in the southeastern section of Bridle Trails State Park. The stream runs south perpendicular to SR 520, between 127th Avenue NE and 134th Avenue NE (see Exhibits 4-6 and 4-7). The stream crosses beneath NE 24th Street (north of SR 520) in a culvert with a debris barrier on the inlet side. Between NE 24th Street and SR 520, the stream is in a narrowly constricted open channel with v-notched log weirs. The stream crosses under SR 520 via two 36-inch culverts. Storm drainage from SR 520 is conveyed to Goff Creek in several ditches that run along the north and south sides of SR 520. These ditches flow into Goff Creek near the culverts. The stream then daylights south of

SR 520 in a heavily commercialized area between SR 520 and NE 20th Street. Groundwater seeps from the stream banks contribute to the base flows along this stretch of the stream. The stream flows in and out of various culverts as it goes east along NE 20th Street and then south along 132nd Avenue NE. This area is also heavily commercialized and the stream channel has been highly modified due to the urbanized land uses through which it passes.

Valley Creek Basin

Valley Creek is a tributary to the main branch of Kelsey Creek. The stream is approximately 14,000 feet long, flowing from north to south parallel to 140th Avenue NE. The City of Bellevue reports that the Valley Creek drainage basin is 1,391 acres, with an overall impervious cover of 32 percent.[12] The basin extends from the southern border of Kirkland south through Redmond to Bel-Red Road in Bellevue. The primary land use is single-family residential (51 percent) and the secondary land use is open spaces and parks (14 percent).

Valley Creek

The headwaters of Valley Creek begin near 140th Avenue NE at the Bellevue Municipal Golf Course. From there, the stream flows south between 140th Avenue NE and 144th Avenue NE (Exhibit 4-8). At NE 24th Street, a small tributary enters the main branch from the east. This tributary collects surface water runoff from the SR 520/148th Avenue NE interchange. South of NE 24th Street, Valley Creek flows through a heavily commercialized area parallel to 140th Avenue. The stream crosses under SR 520 via two 48-inch-diameter culverts, and is then joined by Sears Creek, a small stream comprised of mostly commercial area runoff. At NE 20th Street, Valley Creek continues to flow south toward Bel-Red Road in a narrow, confined, open channel.

What is the water quality of these surface water bodies?

Ecology has the responsibility of identifying designated uses of all surface waters (including marine waters), and establishing water quality criteria for each designated use. Effective December 21, 2006, Ecology has revised the state's surface water quality standards (Chapter 173-201A WAC) for

[12] *The Watershed Company, 2004.*

water temperature.[13] Ecology's water quality standards set regulatory requirements for maintaining the health of streams, rivers, lakes, estuaries, and marine waters. The standards set the level of pollution that is allowed to enter waters in order to protect human health, aquatic life, and the environment. The numerical standards also cover water quality parameters such as fecal coliform bacteria, dissolved oxygen, temperature, pH, and turbidity. The water quality standards applicable to the streams in the study area are described in Chapter 173-201A WAC.

What are fecal coliform bacteria?

Fecal coliforms are bacteria present in human and animal feces, and enter water bodies either by wildlife using the water or from stormwater runoff. These bacteria can indicate the potential presence of harmful bacteria and viruses. The State sets the standards that levels shall not exceed a geometric mean value of 50 colonies/100 milliliters (ml) and not have more than 10 percent of all samples obtained for calculating the geometric mean value exceeding 100 colonies/100 ml.

Why is dissolved oxygen important?

Healthy streams and lakes provide aquatic animals and plants with high levels of dissolved oxygen, low levels of salt (salinity), and a range of moderate temperatures. The colder the temperature and the lower the salt content, the more dissolved oxygen the water can hold, expressed in units of milligrams per liter (mg/L). The State sets the standard that dissolved oxygen shall exceed 9.5 mg/L.

Ecology completed Washington State's Water Quality Assessment for 2002/2004.[14] The assessment represents an "integrated report" to meet the Clean Water Act requirements of sections 305(b) and 303(d). The report also lists streams that are water quality limited and therefore are placed on the State's 303(d) list. The purpose of the 303(d) list is to allow the State to prioritize certain water bodies for protection and to develop targeted clean-up plans so that the stream can eventually meet the designated uses.

We reviewed the 2004 Statewide Water Quality Assessment and did not find any of the five streams in the study area on the 303(d) list. However, one downstream receiving stream is on the list: Kelsey Creek does not meet the water quality standards for temperature, dissolved oxygen, and fecal coliform downstream of the study area.

There have been no TMDL studies conducted for the streams in the study area. The TMDL is a calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources.

Several agencies have collected surface water quality data for some of the streams in the study area. Water quality data are available for Sturtevant Creek, Yarrow Creek, West Tributary to Kelsey Creek, and Valley Creek. These data are summarized in the following subsections.

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[13] *Ecology, 2005b.*

[14] *Ecology, 2005b.*

Sturtevant Creek

As part of the Nationwide Urban Runoff Program (NURP) study, the City of Bellevue received a grant in the early 1990s to sample and monitor urban runoff and stream water quality.[15] As part of this study published in 1995, the City took water samples from two locations along Sturtevant Creek from 1990 through 1992. The City collected samples for fecal coliform bacteria, pH, nutrients (nitrogen and phosphorous compounds), and heavy metals (such as lead and chromium). The City reported relatively high suspended solids, turbidity, oils, greases, petroleum hydrocarbons, and chemical oxygen demand compared to other Bellevue streams.[16] Fecal coliform samples ranged from a low of 56 colonies per 100 milliliters (/100 ml) (dry weather) to a high of 2,400 colonies/100 ml during wet weather. The City reported that most of these substances may have been high in Sturtevant Creek because a large proportion of this basin is covered by roadway surfaces (49 percent), commercial land use (17 percent), and industrial land use (9 percent).

The project team did not find any water quality data available for the unnamed tributary to Sturtevant Creek.

Yarrow Creek

Since 1976, King County has been conducting monthly water quality monitoring at one site at the mouth of Yarrow Creek, about 1.8 miles downstream of I-405.[17] The County samples for fecal coliform, dissolved oxygen, pH, nitrates, total suspended solids, and total phosphorus. King County reported that overall water quality in Yarrow Creek was characterized as "good" in 1989. The water resources discipline team reviewed the last 3 years of sampling data. Fecal coliform values were relatively high, with an average of 182 colonies/100 ml, and a maximum of 2,500 colonies/100 ml. However, bacteria counts were relatively low in Yarrow Creek compared to other creeks in the monitoring program. Dissolved oxygen concentrations were good overall, and concentrations were consistently higher (better) than the state water quality standards. The average dissolved oxygen concentrations were 10.8 milligrams

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[15] *City of Bellevue, 1995.*

[16] *WSDOT, 2006c.*

[17] *King County, 2004a.*

per liter (mg/L), and the minimum was 9.3 mg/L, which is only slightly lower than the state standard. Average temperature values were consistently lower than state standards, with an average of 11 degrees C, and a maximum of only 14 degrees C.

The project team did not find any water quality data available for the unnamed tributary to Yarrow Creek.

West Tributary to Kelsey Creek

The West Tributary to Kelsey Creek was also sampled as part of the 1995 NURP study, similar to Sturtevant Creek. The City of Bellevue collected samples from two locations on the West Tributary: one site was located just upstream of the Goff Creek confluence, and the other site was located approximately 0.5 mile just downstream of the Goff Creek confluence. The upstream location was selected to represent water quality in the stream downstream of a heavily industrialized and commercialized area.

The City of Bellevue collected samples from 1991 through 1993, during dry weather and wet weather. Dry weather samples were collected to assess the baseline conditions of the stream. Wet weather samples were collected to assess the effects of stormwater runoff on the water quality of the stream. The City reported consistent elevated concentrations of fecal coliform bacteria, lead, nickel, and zinc, and periodic high concentrations of oils, greases, and petroleum hydrocarbons. The City also reported that nearly all the pollutants in the downstream location were reduced by almost 50 percent relative to the upstream location, which is attributed to the dilution effects caused by Goff Creek.[18]

The WSDOT design team collected the individual water quality sample data that was reported in the 1995 study and calculated numerical averages for selected parameters. We assessed the wet weather data separately from the dry weather data. Because both sampling locations are downstream from the study area, the data from both locations were combined to calculate the averages.

Fecal coliform bacteria averaged 2,522 colonies/100 ml during wet weather and 524 colonies/100 ml during dry weather at

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[18] *City of Bellevue, 1995.*

the upstream station. Turbidity (a measure of the particulate matter in the stream) measurements averaged 36 nephelometric turbidity units (NTU) during wet weather, and 3.4 NTU during dry weather. Total suspended solid (TSS) measurements averaged 96 mg/L during wet weather, and 2 mg/L for dry weather. Currently, there is no water quality standard for TSS.

Dissolved oxygen and temperature data were not collected. However, the City did collect several toxic metal compounds as part of its sampling program. Total zinc measurements averaged 0.22 mg/L (wet weather) and 0.047 mg/L (dry weather), while total copper measurements averaged 0.04 mg/L (wet weather) and 0.014 mg/L (dry weather). There are no surface water quality criteria for zinc or copper.

The wet weather samples are more elevated than dry weather samples, indicating that stormwater runoff from the urban, developed areas has an effect on the water quality of the stream.

Goff Creek

The project team did not find any water quality data available for Goff Creek.

Valley Creek

The City of Bellevue Parks Department initiated a monitoring program in 2002 to determine if any park management practices (such as herbicide/pesticide applications) were negatively affecting surface water quality. Valley Creek was selected as one of two streams to be monitored.[19]

Four locations near two parks (one upstream and one downstream each) were sampled. The parks were Bellevue Municipal Golf Course and Highland Park Community Center. The golf course sampling locations are near 140th Avenue NE and NE 48th Place. This intersection is upstream of where Valley Creek crosses the I-405, NE 8th Street to SR 520 Improvement Project study area. The other site is located near of 140th Avenue NE and Northup Way, which is downstream of the project study area.

In winter/spring 2002, wet weather samples were collected at each location for temperature, dissolved oxygen, and

[19] *Parametrix, 2002.*

turbidity, as well as for pollutants such as pesticides and herbicides. The City of Bellevue Parks Department did not analyze the water quality samples for TSS, fecal coliform, or toxic metals. The summary report stated that, in general, most water quality parameters met the state criteria, with the exception of a few low dissolved oxygen measurements in June. Most pesticides and herbicides were undetected in the samples, with two exceptions: the insecticide carbaryl and the herbicide triclopyr were detected both upstream and downstream of Highland Park and the Community Center.

Dissolved oxygen measurements averaged 9.1 mg/L upstream of the study area and 9.6 mg/L downstream of the study area. The state criterion is 9.5 mg/L. Half of the measurements at the upstream location exceeded the criterion. Correspondingly, temperature measurements averaged 11.7 degrees Celsius upstream of the study area, and 12.6 degrees Celsius downstream. Turbidity measurements were low, with an average of 1.5 NTU upstream of the study area and 6.4 NTU downstream. The state criterion is less than 50 NTU.

How does urbanization affect surface water?

What is urbanization?

Urbanization refers to a process in which an increasing proportion of an entire population lives in cities and the suburbs of cities. In regard to watersheds, urbanization is the process of converting vegetated landscapes to impervious areas.

Urbanization increases the overall impervious area in a drainage basin, and that can affect the surface water flow by decreasing the base flows in the summer, increasing maximum or peak flows in the winter, and lowering the groundwater level. Stream flow rates increase and decrease at a faster rate in an urbanized drainage area. There is also an increase in the frequency of flash floods and the extent of flooding during typical rain events.

An increase in the impervious area in a drainage basin can often lead to the following consequences:

- Reduction of streamside vegetation
- Reduction of a stream's base flows
- Increase in water temperatures during summer months
- Increase in peak flow rates and streambank erosion
- Impairment of water quality due to pollutants

These consequences can also have a negative effect on fish and aquatic life in the streams. The sustained peak flows resulting

from increases in impervious surfaces can harm fish or other aquatic organisms when they are unable to seek refuge from high flow areas. High flows can cause streambanks and streambeds to scour and erode, resulting in increased sedimentation, changes in stream bed composition, and decreased habitat complexity. Sediment from the eroding streambanks can deposit on spawning areas and suffocate juvenile fish and the aquatic organisms that live in the stream bed.

Increase in stream temperatures is also a water quality concern because most aquatic organisms (including salmonids) are cold-blooded and are strongly influenced by their surrounding water temperatures. Parking lots, roads, and other hard surfaces tend to absorb solar energy and release it slowly. Rainfall that falls upon these surfaces in the warmer months and then flows directly to surface waters can tend to increase the overall stream temperatures. Several studies, including one local study,[20] have shown that stream temperatures throughout the summer can be increased in urban watersheds, and the degree of warming appears to be directly related to the imperviousness of the contributing watershed.[21] The studies also showed that other factors, such as lack of riparian cover and discharges from stormwater management ponds, also contribute to stream warming. However, the primary factor in stream warming is the amount of impervious cover.

Typically, pollutants found in streams that receive runoff from urbanized and impervious areas include grease, oils, coolants, nutrients, pesticides, road salts, fine sediment, heavy metals, automobile hydraulic fluids, and bacteria or viruses from failing septic systems. Pollutants of concern include heavy metals (copper, zinc), phosphorus, oils and greases, and other petroleum hydrocarbons. Many of these contaminants are regulated by federal and state agencies as to their maximum concentrations allowable in surface water to protect fish and wildlife. Suspended solids consisting of sand, silts, and clays can bond with pollutants and cause environmental problems.

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[20] *Smith, 2006.*

[21] *Center for Watershed Protection, 2003.*

Once in the surface waters, many of these pollutants do not degrade over time.

These pollutants cause numerous problems in surface water systems, such as:

- Algal blooms and a reduction in dissolved oxygen
- Higher turbidity, which reduces the available light, limits plant growth, and harms aquatic life
- Toxic substances (such as metals, pesticides, oil, and grease) in higher concentrations that can build up in the cell tissues of the aquatic species living in the water bodies
- Concentrations of viruses and bacteria that can increase to harmful levels for people, fish, and animals who come in contact with the water

Properly implemented stormwater management systems can help reduce the effective impervious surface of a drainage area by managing the runoff using infiltration or by discharging it to a natural system.

How is stormwater currently managed in the study area?

Precipitation that falls on the roadway and ramps in the study area flows to roadside ditches or storm drains and catch basins located along the edges of the highway. Because the area is highly urbanized, most of the stormwater is eventually conveyed away from the roadway in pipes or culverts. As described earlier in this section, the receiving water bodies are sometimes open channels and sometimes pipe conveyances.

Most stormwater runoff from the roadways enters the streams without receiving any water quality treatment or flow control because these facilities were not required when I-405 and SR 520 were built. However, there are several exceptions where surface water is managed by constructed facilities. Some of these facilities were constructed during the HOV expansion project along SR 520. These are described below.

In the Sturtevant Creek Basin, there is a small constructed pond with retaining walls that is providing some flow control for offsite developments near NE 12th Street. This facility is not connected to the I-405 drainage system. This pond is located north of the unnamed tributary to Sturtevant Creek.

What are stormwater ponds and wetponds?

Stormwater ponds detain and slow down the release of stormwater into the drainage system to reduce flooding and erosion. The use of wetponds within stormwater ponds allows some of the water to be held for extended periods so that sediment can settle out and be removed from the stormwater.

There are also two wetponds at the northeast and southeast quadrants of the I-405/NE 8th Street interchange. These ponds provide water quality treatment and flow control for the improvements to the NE 8th Street overpass and ramps that were constructed in 2003-2004.

In the Yarrow Creek Basin, there are two existing detention ponds. One pond is located along the north side of westbound SR 520, approximately 500 feet west of the I-405 to westbound SR 520 on-ramp. The second pond is located between the eastbound SR 520 lanes and the eastbound SR 520 to I-405 off-ramp.

In the West Tributary to Kelsey Creek basin, there is an existing large water quality and detention vault located under the eastbound 124th Avenue NE shoulder off-ramp. There is also a bioswale in the same area. These two facilities provide water quality treatment and detention for portions of the eastbound lane and the off-ramp at 124th Avenue NE.

What are stormwater vaults?

Stormwater vaults are underground facilities that store and treat stormwater. Dry vaults provide stormwater quantity control by detaining runoff and then releasing reduced flows at established rates. Wet vaults are designed to treat stormwater for both quantity and quality by maintaining a permanent pool of water in a settling basin.

What are bioswales?

Bioswales are long, broad, shallow, grassy channels that are designed so that stormwater flows slowly through the facility. This allows the vegetation and soil matrix to filter and absorb pollutants from the stormwater runoff.

How do environmental regulations affect the stormwater system design for this project?

Water quality regulations mandated by the federal CWA prohibit the discharge of pollutants from non-permitted sources. In Washington, authority for implementing the CWA is delegated to Ecology.

The listing of salmonids under the Endangered Species Act has triggered requirements to protect salmon habitat and water quality. These requirements also focus on more coordination among permit agencies.

WSDOT will need to obtain a variety of permits to construct the project. WSDOT can apply for all of these permits by using the Joint Aquatic Resource Permit Application (JARPA). The JARPA allows an applicant to prepare a single application to apply for multiple water resource related permits issued by various agencies.

The Hydraulic Project Approval (HPA) will contain a list of measures that the project will need to meet for any work within the high water mark of waters of the state. The measures focus on protecting streams from construction-related effects and pollutants. The HPA will include seasonal limits on construction activities, based on fish use, in which any work within a stream must be completed.

What permits does the JARPA cover?

The JARPA application covers several permits including:

- The Hydraulic Project Approval (HPA) from Washington State Department of Fish and Wildlife
- The 401 Water Quality Certification from Ecology
- The Aquatic Resources Use Authorization Notification from the Washington State Department of Natural Resources
- The Section 404 and Section 10 from the Corps
- The Bridge Act Permit and Private Aids to Navigation (PATON – for non-bridge projects) from the U.S. Coast Guard

The 401 certification, included in the JARPA, will verify that this project complies with state water quality standards and other aquatic resource protections.

Ecology has conditionally approved WSDOT's revised HRM for use as an equivalent approach to Ecology's *Stormwater Management Manual for Western Washington;*[22] therefore WSDOT uses the HRM to design stormwater facilities for transportation projects. To meet water quality standards, the manual requires treating stormwater runoff from new pollution-generating impervious surfaces (e.g., roads) before discharge. Stormwater runoff must also receive flow control (detention) in most situations to protect the receiving water from increases in flooding and streambank erosion. WSDOT will construct stormwater facilities based on the HRM to provide treatment and detention for all new impervious surfaces created by the project.

What regulated floodplains are associated with the surface water bodies in the study area?

The project team reviewed the FEMA flood rate insurance maps for the streams in the study area. The team determined that Valley Creek upstream and downstream of the SR 520 crossing has a delineated floodplain. From the FEMA maps, it appears that the NE 24th Street culvert for Valley Creek is causing the floodplain to extend out of the banks.

The City of Bellevue has indicated that there have been recurring flooding issues along Valley Creek, Goff Creek, and Sturtevant Creek. The City of Bellevue also stated that the West Tributary to Kelsey Creek had not had many flooding issues.[23]

How is groundwater used in the study area?

Groundwater in the study area occurs primarily in glacial advance outwash (Qva) and recessional outwash (Qvr) deposits. Exhibit 4-4 shows the different types of glacial deposits in the study area and cross section locations.[24] The

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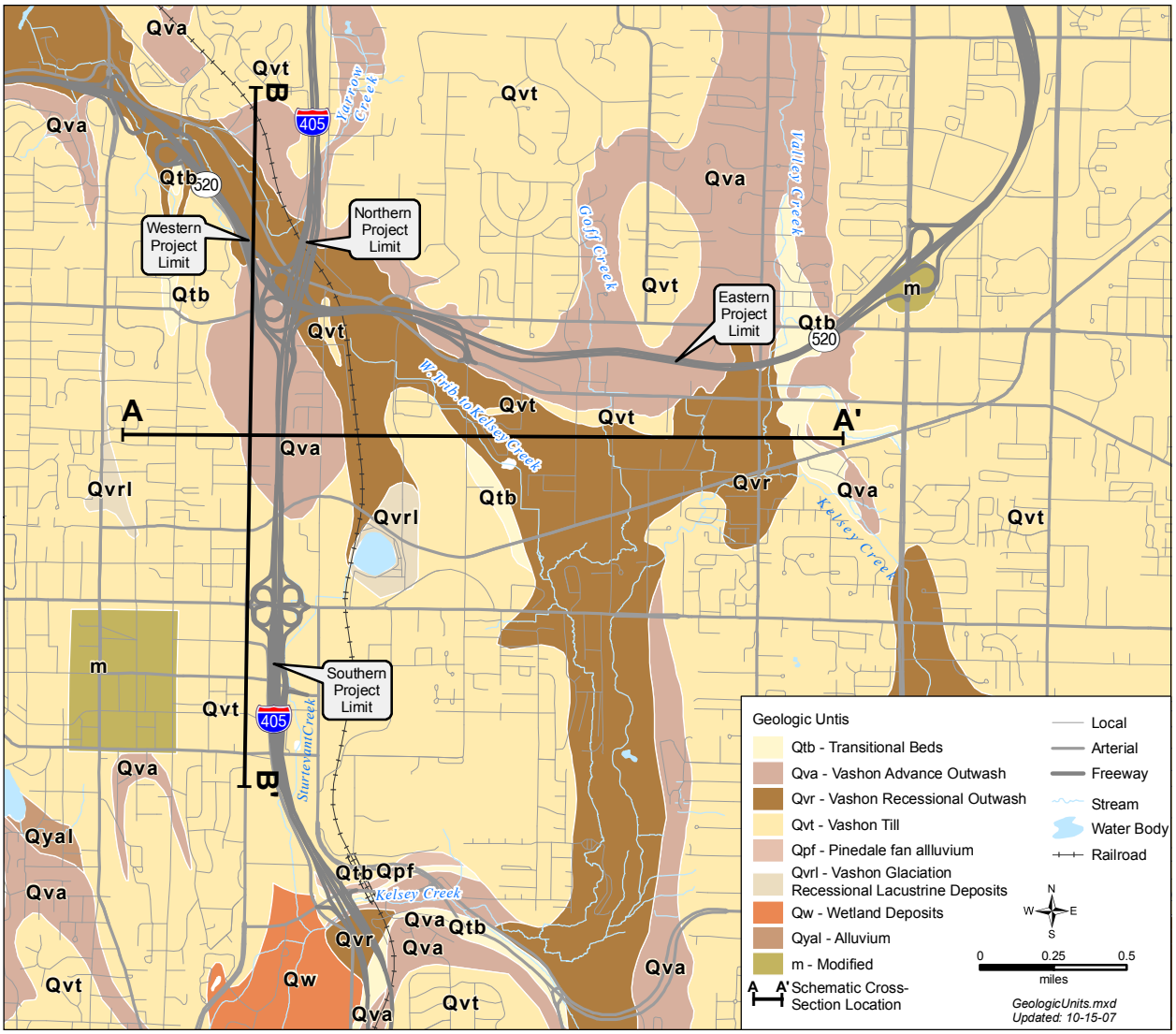
[22] *Ecology, 2007a.*

[23] *LaCombe, 2007.*

[24] *Yount et al., 1993.*

Exhibit 4-4: Geologic Units in the Study Area



outwash deposits consist mostly of sand and gravel with varying amounts of silt. The coarser-grained outwash sediment deposits have higher permeability and regionally are aquifers.[25] Finer-grained sediments are associated with glacial till (Qvt) and glaciolacustrine transitional beds (Qtb). These finer-grained sediments act as aquitards. Underlying the glacial deposits in the study area is the Renton Formation bedrock which is generally deeper than 600 feet below land

What is an aquifer?

An aquifer is a geological stratum of saturated materials with the capability to yield useable quantities of groundwater on a long-term, sustainable basis.

[25] *Vaccaro et al., 1998.*

What is an aquitard?
An aquitard is soil or rock that is less permeable than adjacent aquifers and restricts groundwater flow.

surface.[26] The Renton Formation has low permeability and is not considered to be an aquifer.

Most of the groundwater resources in the study area exist within the near-surface glacial outwash deposits along Kelsey Creek and Yarrow Creek, as described below.

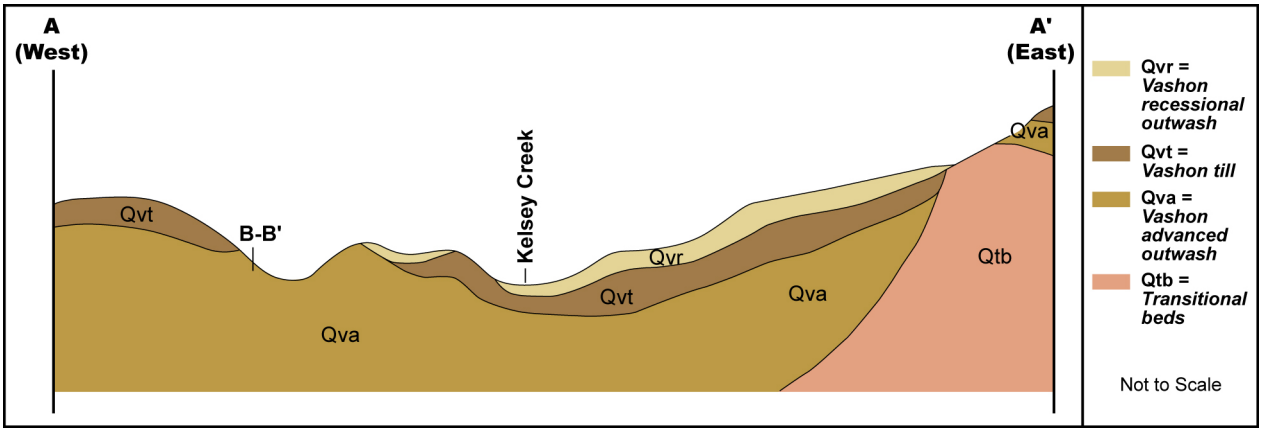
Kelsey Creek Deposits

Glacial recessional outwash deposits (Qvr) are exposed at the land surface along Kelsey Creek, south of SR 520 (Exhibit 4-4).

In general, the outwash is underlain by till, but because of substantial surface water erosion during the glacial retreat, the recessional outwash may be underlain by advanced outwash deposits (Qva) or even in some cases by the older transitional beds (Qtb). Exhibit 4-5 presents a schematic cross-section (A-A') showing the geologic relationships near the center of the study area.

Regional groundwater flow direction is generally westward toward Puget Sound. Shallow groundwater flow direction in the outwash deposits of the Kelsey Creek area is primarily toward the south in the direction of surface water flow. Groundwater ranges in depth from 10 to 40 feet below ground surface. The main discharge of groundwater is to Kelsey Creek. Recharge occurs primarily as a result of direct infiltration from precipitation and from overland flow across till deposits that exist at higher elevations in the Kelsey Creek area.

Exhibit 4-5: Schematic West to East Cross-Section of General Geology in the Study Area (not to scale)



[26] *WSDOT, 2006d.*

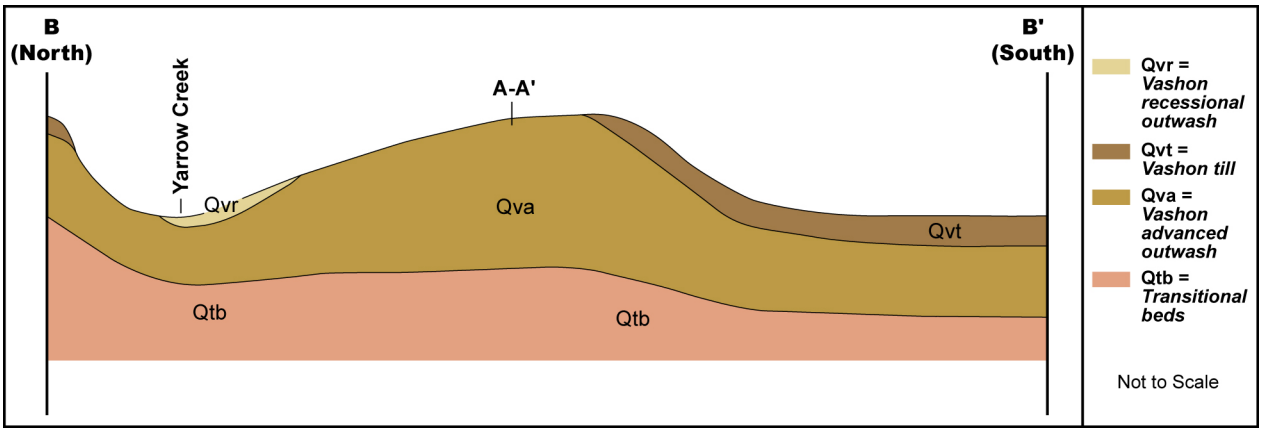
Yarrow Creek Deposits

Glacial advance outwash (Qva) and recessional outwash deposits (Qvr) comprise the shallow deposits underlying the study area along Yarrow Creek north of SR 520 and west of Interstate 405 (see Exhibit 4-4).

The recessional outwash deposits are underlain by advance outwash deposits in the study area because the till was eroded during the glacial retreat (see Exhibit 4-6).

Groundwater depths range from 10 to 40 feet below ground surface in these deposits. Shallow groundwater flow direction in the Yarrow Creek area is primarily toward the northwest in the direction of surface water flow. Discharge of groundwater flows mainly to Yarrow Creek. Groundwater recharge in the Yarrow Creek area occurs primarily as a result of direct infiltration from precipitation and from overland flow across till deposits at higher elevations in the Yarrow Creek area.

Exhibit 4-6: Schematic North to South Cross-Section of General Geology in the Study Area (not to scale)



How is groundwater used in the study area?

Groundwater Wells

Ecology maintains a database of wells in Washington State. All of the wells listed in the database, within approximately 0.5 miles of the study area, are monitoring wells.[27] No water

[27] *Ecology, 2007a.*

supply wells within approximately 0.5 miles of the study area were listed in the database.[28]

Group A water systems are public water systems that serve 15 or more connections, usually residential or municipal. Group B water systems are public water systems conducted to serve less than 15 residential connections. No Group A or Group B water supply systems are within 0.5 miles of the study area.[29]

Groundwater Rights

One hundred ten groundwater certificates and permits are recorded in Ecology's database that have withdrawal locations within approximately 1.0 mile of the I-405, NE 8th Street to SR 520 Improvement Project and are listed in Appendix A. Each certified or permitted withdrawal location is identified for use as irrigation, stock, and/or general domestic supply. Ecology can confirm the existence of a withdrawal certificate or permit as recorded in their database, but not whether groundwater is currently being withdrawn. However, no domestic water supply wells were listed in Ecology's database of wells that have been drilled and installed. For this reason, and because the City of Bellevue supplies potable water to its residents, it is unlikely that any domestic groundwater wells are currently being used within the study area.

What is the quality of these groundwaters?

Little information exists on groundwater in the project vicinity and no water quality testing data or groundwater characterizations have been reported.[30] Because the groundwater locally discharges to Kelsey Creek and Yarrow Creek, any contaminants found to be of concern in these surface water bodies may also affect the groundwater quality.

How is groundwater quality protected?

Certain aquifer areas are designated by King County as critical aquifer recharge areas (CARAs). These areas are more susceptible to groundwater contamination because:

- The depth to groundwater in these areas is shallow,

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[28] *Ecology, 2007b.*

[29] *King County, 2006, and Washington State Department of Health, 2006.*

[30] *Johnson, 2007.*

- There is no protective surface layer of low-permeability soil, and
- The aquifers are essential for use as potable water.

King County's database identifies no CARAs within the study area.[31]

Although King County does not currently designate the shallow deposits of the Kelsey Creek and Yarrow Creek areas as CARAs, the deposits are susceptible to contamination due to the shallow depth to groundwater and the lack of a low-permeability surface layer.

[31] *King County, 2006.*

SECTION 5 PROJECT EFFECTS

How will project construction affect water resources?

Surface Waters

Construction of the Build Alternative will require the use of best management practices that comply with both WSDOT and Ecology requirements. WSDOT will use standard construction BMPs to control runoff and minimize the potential for sediment and other pollutants to be discharged to surface waters.

In-stream work is expected to be minimal. There will be no stream-crossing culvert replacements or extensions with this project. The only place where in-stream construction will occur is within the unnamed tributary to Sturtevant Creek to allow for widening the on-ramp from NE 8th Street to northbound I-405. This widening will encroach into the ordinary high water mark of the unnamed tributary and its buffer. At the unnamed tributary approximately 200 linear feet of stream channel and 6,640 square feet of stream buffer will be permanently affected. The affected portion of the stream will be placed in a pipe to convey the water.

Because there have been persistent flooding problems associated with Sturtevant Creek, Goff Creek, and Valley Creek, measures to prevent temporary increases in flow rates during construction will have to be implemented. Measures could include early construction of stormwater ponds for flow control/sediment removal, staging certain construction activities during dry weather, limiting the exposure of new impervious surfaces, and other measures.

The seven streams within the study area (Sturtevant Creek and its unnamed tributary, Yarrow Creek and its unnamed tributary, West Tributary to Kelsey Creek, Goff Creek, and Valley Creek) drain to Lake Washington. Construction is not expected to occur simultaneously within the five stream basins, and with proper staging of the project, the five proposed permanent detention ponds can be constructed early so they can act as temporary sediment ponds to control sediment and flow rates. Increases in flow rates, even temporary, will not be allowed within the Sturtevant, Goff, and Valley Creek basins.

Surface Water Quality

The project will involve clearing, grading, excavation, and stockpiling activities. Erosion-control and sediment-control BMPs will minimize turbidity effects in surface waters downstream of the project. The potential for sediment and pollutant discharges to surface waters is highest during construction in streams and their buffers. The only stream for which there will be construction within the stream and its buffer is the unnamed tributary to Sturtevant Creek, as described above. Approximately 200 linear feet of stream channel will be permanently affected for widening of the on-ramp from NE 8th Avenue to northbound I-405. The affected portion of the stream will be placed in a pipe to convey the water. Approximately 6,640 square feet of stream buffer will be permanently affected and an additional 2,000 square feet of stream buffer will be temporarily affected by vegetation clearing and equipment staging.

For this project, water quality effects are expected to be minimal because WSDOT will require standard BMPs to be used. There are two categories of BMPs that will be used for construction of the project: sediment control and erosion control.

Sediment-control BMPs physically trap and contain stormwater and separate the suspended solids from the stormwater prior to releasing the water to the environment. The primary mechanisms of separation are filtration and sedimentation processes.

Erosion-control BMPs are techniques that reduce the potential for sediment and other contaminants to enter stormwater. These BMPs are typically referred to as "good housekeeping" or "source control" BMPs, and include practices such as street sweeping, vegetation preservation, segregation of clean versus contaminated stormwater, and timing and staging of construction activities to be limited to dry weather when near sensitive areas. Erosion-control BMPs can also include stabilizing slopes using temporary seeding, erosion control blankets, and plastic sheeting to provide a barrier between the rainfall and the bare earth of a newly graded slope. Some of the measures that will likely be employed on the project are described in Section 6.

Floodplains

The only floodplains within the project limits are located along Valley Creek. The project will not affect these floodplains directly. The existing SR 520 crossing of Valley Creek is approximately 1,500 feet east of the project limits. The project will widen SR 520 at the eastern project limit, and portions of this area are located in the Valley Creek drainage basin. To accommodate increased runoff from the added impervious area, WSDOT will construct a stormwater detention facility.

If the proposed detention facility is constructed prior to the roadway widening, then this extra detention could also help reduce the temporary effects of erosion and sedimentation.

Groundwater

The deepest construction excavation for the project will be near NE 12th Street for construction of the ramps. Excavation is anticipated to be at approximately elevation 144 feet. Six groundwater monitoring wells have been installed by WSDOT in this area to better determine groundwater elevations in the vicinity of NE 12th Street and the potential need for construction dewatering (and permanent dewatering; see the following section). One of the monitoring wells has recorded groundwater levels at approximately elevation 168 feet. This is in an area where the anticipated construction elevation will be approximately 150 feet. Thus, lowering of the water table to a depth of about 18 feet might be required. No known domestic wells were identified in the study area that could be affected by groundwater dewatering. Groundwater from construction dewatering will likely be discharged to the unnamed tributary to Sturtevant Creek.

Other construction effects may be groundwater contamination from contaminated fill brought to the site and groundwater contamination from construction vehicle fuel spills and potential spills of greases and oils commonly used in construction equipment.

How will project operation affect water resources?

Surface Waters

When roadways or other developments create new impervious surfaces as they are constructed or expanded, the natural hydrologic cycle is altered. Less rainwater infiltrates

into the ground as the vegetated pervious surfaces (grassy areas, forests, meadows, etc.) are converted to impervious surfaces (pavement, buildings, bridges). The rainfall rapidly runs off the impervious surfaces and enters either surface water bodies or stormwater collection systems. The volume of stormwater runoff as well as the peak flow rates and velocities increase due to the conversion of pervious to impervious surfaces. The increase in flow rates and velocities in surface water bodies can erode streambanks, cause flooding, and degrade habitat for fish and other aquatic life.

An increase in impervious area generally causes a decrease in vegetated areas. In many cases, this includes the loss of trees. These land cover changes could increase stream temperatures due to more stormwater flowing across the warmer pavement, reduction of the shading potential from vegetation, and stormwater discharges from unshaded, constructed ponds.

The Build Alternative will result in approximately 11.4 acres of new impervious surface. This increase represents approximately 13 percent more impervious surface than the existing conditions in the project limits; the existing impervious area is approximately 86 acres. If left unmitigated, this expected increase in impervious area could result in degradation of the downstream surface waters or an increase in flooding risks. However, WSDOT will provide stormwater flow control for the new impervious area using seven stormwater detention facilities to prevent the potential increases in peak flows and durations of flows. These facilities will be designed in accordance with the WSDOT HRM.

WSDOT is designing the stormwater management facilities to provide water quality treatment for the stormwater runoff from all of the new impervious surfaces (as required) and a portion of the existing impervious surfaces. The additional treatment above that which is required by the WSDOT HRM will provide a benefit for the environment.

The stormwater facilities for the project have been designed in accordance with the WSDOT HRM. Generally, infiltration ponds are the preferred flow control measure, but soil conditions need to be suitable for proper infiltration. Within the project limits, WSDOT has not been able to identify areas with favorable infiltration conditions. Therefore, seven new flow control facilities will be used to provide a combined detention volume of approximately 6.6 acre-feet. The

proposed locations of these facilities are shown in Exhibits 2-1 through 2-6 in Section 2. These facilities include the following:

- Five combined stormwater detention and treatment wetlands will be constructed (four new facilities and one reconstructed facility) within the Sturtevant Creek, Yarrow Creek, and West Tributary to Kelsey Creek basins.
- One detention tank will be constructed within the Goff Creek basin.
- One detention ditch will be constructed within the Valley Creek basin.
- The existing I-405 and SR 520 stormwater collection and conveyance system will be modified to route drainage to the new stormwater management facilities.
- Discharges from the stormwater facilities and the modified drainage system will continue to flow to the existing outfalls to the streams and eventually to Lake Washington.

WSDOT engineers will use local climate records and hydrologic computer models to determine the volume of stormwater runoff from the project for the design the flow control facilities. In Bellevue, approximately 80 percent of the annual precipitation falls during October through May. The average annual precipitation is approximately 38 inches per year. For stormwater facilities, WSDOT requires that the duration of stormwater discharges from the post-construction project limits must match durations for the predeveloped condition for storm events ranging from 50 percent of the 2-year storm up to the 50-year storm event. Also, the 100-year storm event should be analyzed for flooding and property damage. The Bellevue area has a 2-year storm event that contains approximately 2 inches of precipitation over a 24-hour period, while the 100-year storm event contains approximately 4 inches in a 24-hour period.

WSDOT proposes to retain as many of the existing drainage structures and systems within the project limits as possible. This will minimize the size of the project footprint, thereby reducing the effects on the environment. Closed conveyance systems will be used where open ditches are not possible, such as where the right-of-way is narrow. Roadside ditches will be used where conditions allow along I-405. The roadway widening will require new collection structures to be added

adjacent to the new edge of the shoulder. These new structures will be connected to the existing drainage systems. Existing conveyance will be modified as required to satisfy water quality treatment and flow control measures noted above, while maintaining existing flow patterns to each of the receiving water bodies.

Surface Water Quality

As described previously in the section *How does urbanization affect surface water?* stormwater runoff from impervious surfaces such as roadways can potentially have adverse effects on the water quality of the receiving surface waters if mitigation measures are not implemented. The proposed project will cause a net increase in impervious surface. However, once construction is completed there is expected to be a decrease overall in the amount of pollutant loadings to surface waters from the project. This is because the water quality treatment facilities proposed for the project will treat stormwater from both the new impervious surfaces and some of the existing impervious surfaces that currently discharge to streams without treatment. These proposed stormwater facilities will provide water quality treatment for approximately 28 acres of new and existing pavement, or about 240 percent of the new impervious surfaces. WSDOT will provide this projected level of treatment using over 700 linear feet of ecology embankments and five stormwater treatment wetlands. The existing and proposed stormwater treatment facilities are summarized in Exhibit 5-1. These facilities will be designed in accordance with the WSDOT HRM.

What is pollutant loading?

Pollutant loading is a term used to refer to the amount of a pollutant that enters a water body in a specified amount of time. Estimates of pollutant loads are usually given in pounds per year.

Exhibit 5-1: Summary of Existing and Proposed Stormwater Treatment Facilities

Water Body	Existing Stormwater Treatment Facilities	Build Alternative Stormwater Treatment Facilities
Sturtevant Creek	An existing pond in the northeast quadrant of the NE 8th Street interchange treats approximately 1.6 acres of roadway	• Retrofit of existing pond with larger stormwater treatment wetland that will treat about 10.7 acres of roadway • New stormwater treatment wetland at NE 10th Street that will treat about 5.2 acres of roadway
Yarrow Creek	No existing treatment facilities	• New stormwater treatment wetland in the northwest quadrant of the I-405/SR 520 interchange that will treat about 1.6 acres of roadway • New ecology embankment along the southwest quadrant of the I-405/SR 520 interchange that will treat about 0.3 acres of roadway
West Tributary to Kelsey Creek	Existing buried vault on the south side of SR 520 near the 124th Avenue NE off-ramp that provides some treatment (the amount is unknown)	• Existing vault will be abandoned, and a new stormwater treatment wetland will be constructed near NE 24th Street that will treat about 4.7 acres of roadway • A new stormwater treatment wetland will be constructed near Northup Way that will treat about 5.8 acres of roadway
Goff Creek	No existing treatment facilities	• New ecology embankment just west of 130th Avenue NE that will treat about 0.3 acres of roadway.
Valley Creek	No existing treatment facilities	• New ecology embankment that will treat about 0.01 acres of roadway

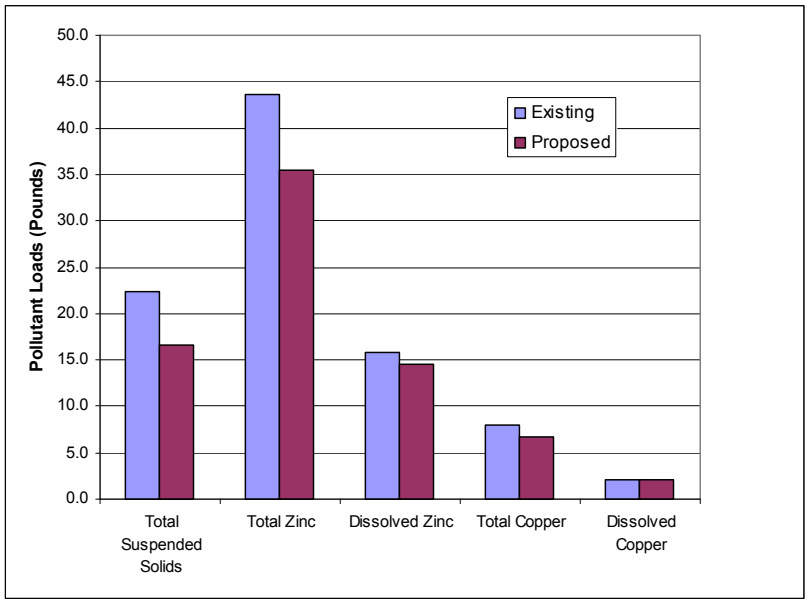
In order to determine the size of the facilities that will be needed to provide the appropriate level of treatment, the WSDOT design team performed a pollutant loading analysis for the existing project limits (without treatment) and the proposed project with treatment. The water quality pollutants that were analyzed include:

- Total suspended solids
- Total and dissolved copper
- Total and dissolved zinc

Pollutant loading charts for both the existing condition and the proposed project are shown in Exhibits 5-2 through 5-6, for Sturtevant Creek, Yarrow Creek, West Tributary to Kelsey Creek, Goff Creek, and Valley Creek, respectively. Values shown are pounds of pollutant per year that are expected to be washed off from the roadway and into the receiving water bodies. This information is tabulated in Exhibit 5-7, which shows that there will be a potential reduction of annual pollutant loadings to the five stream basins for every pollutant

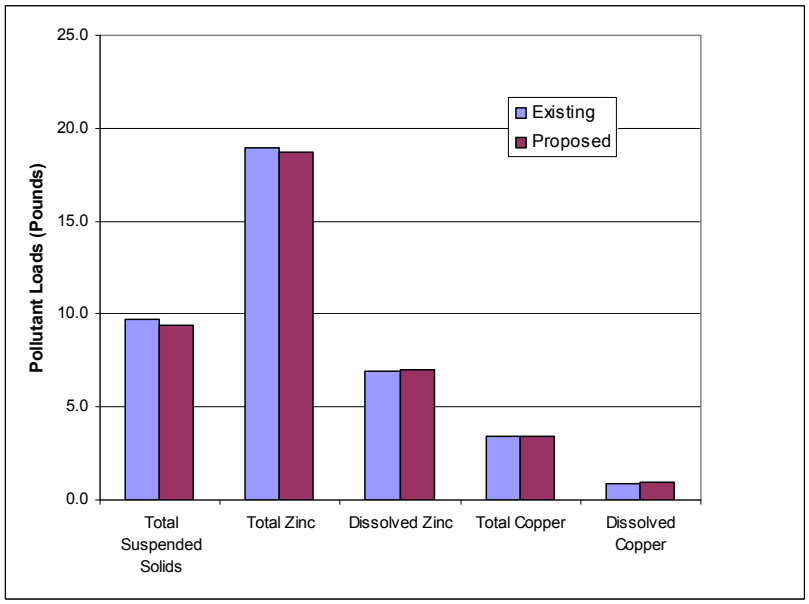
analyzed except dissolved copper. Total project reductions range from almost 18 percent for total suspended solids to 4 percent for dissolved zinc. The slight increase in dissolved copper (2 percent) is negligible.

Exhibit 5-2: Existing and Project Annual Pollutant Loads in Pounds per Year for the Sturtevant Creek Basin



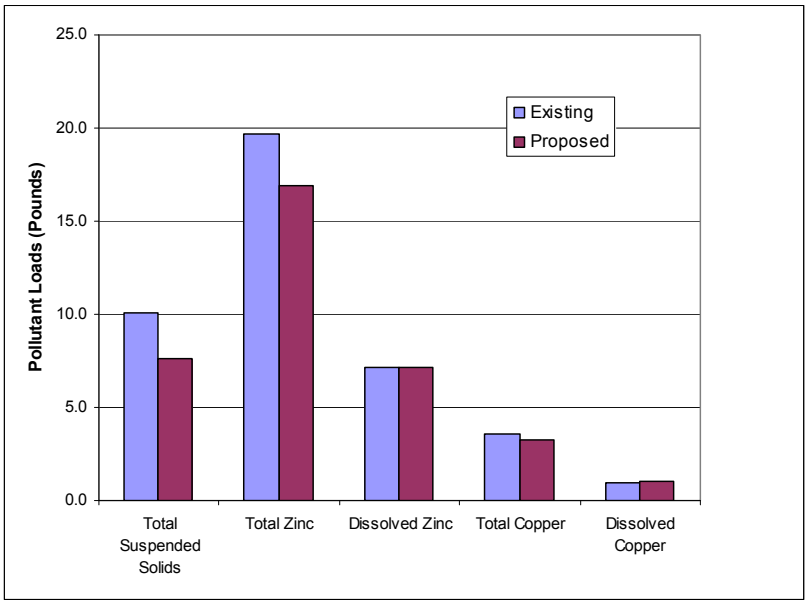
Note: TSS values are reported in 1,000 pounds per year.

Exhibit 5-3: Existing and Project Annual Pollutant Loads in Pounds per Year for the Yarrow Creek Basin



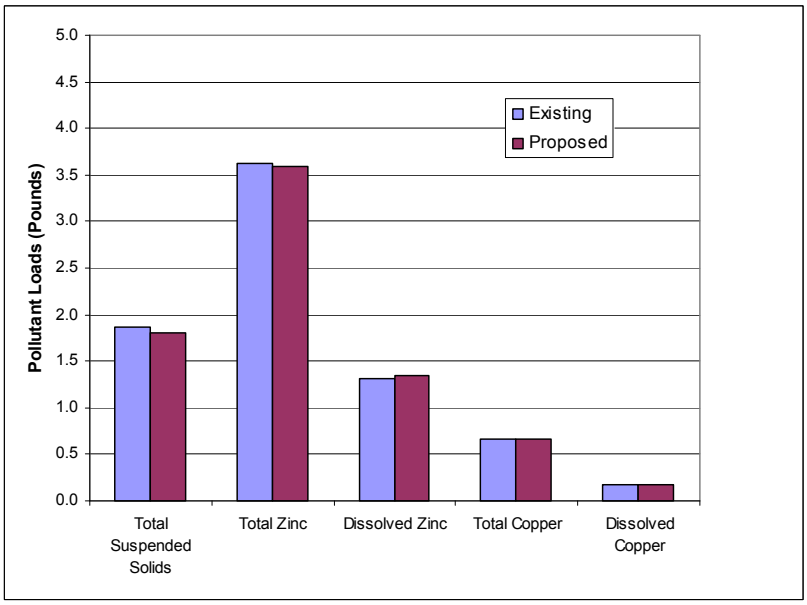
Note: TSS values are reported in 1,000 pounds per year.

Exhibit 5-4: Existing and Project Annual Pollutant Loads in Pounds per Year for the West Tributary to Kelsey Creek Basin



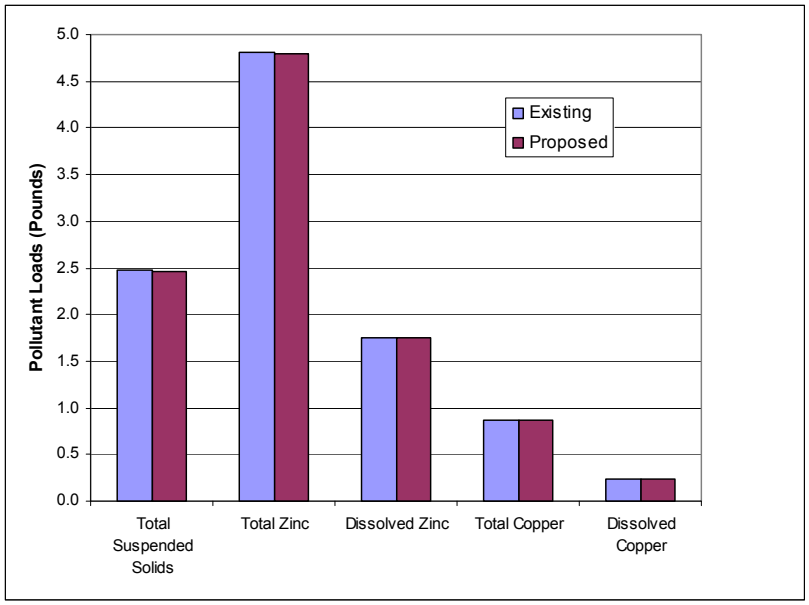
Note: TSS values are reported in 1,000 pounds per year.

Exhibit 5-5: Existing and Project Annual Pollutant Loads in Pounds per Year for the Goff Creek Basin



Note: TSS values are reported in 1,000 pounds per year.

Exhibit 5-6: Existing and Project Annual Pollutant Loads in Pounds per Year for the Valley Creek Basin



Note: TSS values are reported in 1,000 pounds per year.

Exhibit 5-7: Summary of Existing and Project Annual Pollutant Loads (pounds per year)

Water Body	Existing Conditions					Project Build Alternative				
	Total Suspended Solids (TSS)	Total Zinc	Dissolved Zinc	Total Copper	Dissolved Copper	TSS	Total Zinc	Dissolved Zinc	Total Copper	Dissolved Copper
Sturtevant Creek	22,424.8	43.7	15.9	7.9	2.1	16,763.3	35.5	14.5	6.7	2.1
Yarrow Creek	9,746	19.0	6.9	3.5	0.9	9,416.8	18.7	7.0	3.4	0.9
West Tributary to Kelsey Creek	10,113.5	19.7	7.2	3.6	0.9	7,634.4	16.9	7.2	3.2	1.0
Goff Creek	1,864.5	3.6	1.3	0.7	0.2	1,812.9	3.6	1.3	0.7	0.2
Valley Creek	2,469.1	4.8	1.7	0.9	0.2	2,464.3	4.8	1.7	0.9	0.2
Total	**46,618.2**	**90.8**	**33.0**	**16.5**	**4.4**	**38,091.8**	**79.5**	**31.8**	**14.9**	**4.5**
Net change from existing conditions	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**-8,526.4**	**-11.2**	**-1.2**	**-1.6**	**0.1**
Percent change from existing conditions	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**-18%**	**-12%**	**-4%**	**-10%**	**2%**

Floodplains

The project will not encroach upon any existing floodplains and will not substantially change downstream floodplains or flooding characteristics. The only mapped floodplain within the project limits are at the SR 520 crossing of Valley Creek, and the project is not anticipated to encroach on the floodplain. The project will also include the required detention facilities to eliminate stormwater peak flow rate increases due to the increase in impervious surfaces.

Groundwater

To control seepage at retaining walls and fill embankments, WSDOT will install underdrains. The underdrains will be installed as part of the permanent storm drain system. The drains will be installed above groundwater levels and seepage will be routed back into the environment.

Another permanent effect from the project related to groundwater will be the lowering of groundwater levels in the area of NE 12th Street where permanent dewatering is required. Underdrains will be installed to lower the groundwater table at this location. No domestic wells were identified in the study area that could be affected by dewatering.

Although the project will increase the total impervious surface area within the project limits and thus very locally reduce groundwater recharge, the total amount of recharge to the shallow aquifers will not be measurably affected. Most recharge occurs over a larger area away from the project footprint where exposed aquifers will not be covered by new pavement from this project. The net increase in impervious surface will be minimal in relation to the size of the recharge area. The project will add 11.4 acres of impervious surface in areas that are currently exposed aquifers. This represents a tiny fraction (0.008 percent) of the entire aquifer recharge area (1,468 acres).

Additionally, the potential effects from pollutants on groundwater will generally decrease as a result of improved stormwater quality treatment and management (see the Water Quality subsection above).

Does the project have other effects on water resources that may be delayed or distant from the project?

Delayed or distant effects are typically described as "indirect" effects from construction or operation of a project. WSDOT describes indirect effects in its *Environmental Procedures Manual* as follows:

> …[an] effect caused by the proposed action that is later in time or farther removed in distance, but still reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems.

For this project (as well as other similar highway improvement projects), the indirect effects are those that cause more development to occur because accessibility to local areas improves. Because the Bellevue area is highly urbanized, it is not expected that this project will substantially affect land use in the study area. Therefore, no indirect effects to surface waters, water quality, floodplains, or groundwater are expected because of this project.

Were potential cumulative effects on water resources considered?

Cumulative effects are effects that result from the incremental effects of the proposed project when added to other past, present, and potential future actions. Cumulative effects are important to consider during the construction and operation of a project. Effects from multiple projects, whether occurring simultaneously or in series, can add to the effects of other actions and eventually lead to a measurable environmental change. It is important to note, however, that cumulative effects can be positive or negative, depending on the environmental resource being evaluated.

This project will be constructed in accordance with current regulatory standards, and the temporary and permanent BMPs associated with the project will minimize adverse effects. The project will include construction of new stormwater treatment and detention facilities that minimize the project's contribution to cumulative effects on water

resources, and also improve upon existing conditions by providing treatment for previously untreated stormwater from existing impervious surfaces.

Additional detail about cumulative effects of the project may be found in the Cumulative Effects Technical Memorandum.

What effects would occur under the No Build Alternative?

Effects of construction on water resources in the study area would not occur under the No Build Alternative.

Stormwater treatment facilities would not be constructed and operated under the No Build Alternative. One of the beneficial effects of the project is the operation of enhanced stormwater treatment facilities to capture and treat portions of the existing impervious surfaces; this helps to reduce the overall pollutant loadings to the streams. Water quality will continue to degrade without the Build Alternative.

No effects on floodplains and groundwater in the study area would occur under the No Build Alternative.

SECTION 6 MEASURES TO AVOID OR MINIMIZE EFFECTS

What measures will be taken to mitigate effects during construction?

Surface Water, Water Quality, and Groundwater

WSDOT will use standard BMPs to avoid and reduce potential effects from this project during construction. These BMPs are designed in accordance with the WSDOT HRM. Ecology has conditionally approved WSDOT's revised HRM for use as an equivalent approach to Ecology's *Stormwater Management Manual for Western Washington*. Some of the potential BMPs and construction practices that will be used as part of the project are listed below:

- WSDOT will prepare and implement a Temporary Erosion and Sedimentation Control (TESC) plan. A TESC plan consists of structural and operational measures to control the transport of sediment. Structural measures consist of the construction of temporary structures to reduce the transport of sediment, such as silt fences or sediment traps. Operational measures consist of good housekeeping practices, such as removing mud and dirt from trucks before they leave the site, covering fill stockpiles or disturbed areas, or avoiding unnecessary vegetation clearing.
- If the structural and operation BMPs listed in the HRM do not adequately control the discharge quality to meet the state requirements, then other methods may be used. Such methods may include, but not be limited to, chemical treatment of stormwater or the use of flow-through sand (or similar media) filtration systems. These advanced treatment systems could be used on an as-needed basis.
- In-water work (or where concentrated construction site discharge may flow directly to surface waters), site grading, and initial stabilization will be scheduled to occur during the dry season, May 1 through September 30.
- Where construction must occur within stream channels, it will occur "in the dry" (stream flows will be temporarily diverted around the work site, where practicable, to prevent turbidity). In-stream work is expected to occur in the unnamed tributary to Sturtevant Creek. An HPA,

What is a silt fence?

A silt fence consists of a temporary sediment barrier made of synthetic fabric stretched between posts, with a shallow trench located upslope. The silt fence is "keyed" into the ground to prevent water from running under the fence.

What is a sediment trap?

A sediment trap consists of a temporary ponding area formed by an earthen embankment or an excavation. Both silt fences and sediment traps are designed to slow the flow of water, allowing sediment to settle out.

issued by the Washington Department of Fish and Wildlife (WDFW), will list the requirements for performing in-stream work.

- WSDOT will use alternative means to treat construction site runoff such as overland flow across a vegetated surface, temporary curbing to prevent clean runoff from flowing across the disturbed areas, and stormwater ponds as temporary settling/holding ponds.
- WSDOT will limit construction disturbances to the minimum area needed, the shortest duration, and an appropriate distance away from water bodies, as practical. Seasonal work windows will be identified and implemented.
- WSDOT will use structural BMPs such as fencing, landscaping, erosion matting, hydro mulching, soil tracking, detention/sediment trap basins, and vegetated buffers as described in the HRM, as appropriate.
- Construction disturbance will be limited to the smallest feasible area. Natural undisturbed areas should be avoided and disturbed as little as possible. Clearing activities will be staged such that construction areas are cleared no earlier than one week ahead of starting construction, where practicable. If this is impractical, then cleared areas will be immediately mulched, covered with plastic, or otherwise stabilized.
- WSDOT will reduce the use, transfer, and storage of hazardous materials in sensitive areas. A Spill Prevention, Control, and Countermeasures (SPCC) plan will be established for construction activities and will also detail the procedures that will be followed in the event of a spill to prevent or minimize effects on groundwater.
- WSDOT will design and implement a construction dewatering plan. The dewatering plan will consist of operational measures for temporarily and/or permanently lowering the groundwater table below levels of construction excavation. WSDOT will be required to obtain an NPDES (National Pollutant Discharge Elimination System) permit. WSDOT will ensure that water encountered during construction meets the standards specified in the NPDES permit prior to

discharge to a surface water body. If necessary sediment ponds will be used to allow sediment to settle out, thereby improving water quality, prior to discharge.

- WSDOT will identify and develop staging areas for equipment repair and maintenance away from all drainage routes. WSDOT will require that washout from concrete trucks not be dumped into storm drains or onto soil or pavement that carries stormwater runoff. Thinners and solvents will not be used to wash oil, grease, or similar substances from heavy machinery or machine parts. WSDOT will designate a washdown area for equipment and concrete trucks.

Floodplains

Due to the flooding problems in Valley Creek, flow control mitigation measures will have to be implemented to prevent any temporary increases in flow rates to the stream. The method of protecting the downstream system will be determined during final design. WSDOT will assure that construction-phase flow control will be provided to assure that existing peaks and durations of peaks are maintained for discharges to Valley Creek.

What measures will be taken to mitigate the effects of operation?

Surface Water and Water Quality

The project will be designed and operated to meet current federal, state, and local standards for stormwater management. Hydrologic and hydraulic design criteria are based on requirements in the WSDOT HRM and *Hydraulics Manual*.[32] Additional design guidance and project-specific design criteria will be obtained through the permitting process and prior agency coordination.

The proposed water quality and quantity BMPs described in this report and included in the project design are integral parts of the project. Without these facilities, there would be negative environmental effects due to the construction of the project. With proper design, implementation, and maintenance of BMPs, stream crossings, and highway runoff

[32] *WSDOT, 2006b.*

control facilities, there will be no need for additional measures to minimize effects on water quantity and quality.

Stream mitigation for the effects on the unnamed tributary to Sturtevant Creek and its buffer will occur at Sturtevant Creek. The stream mitigation site is located along Sturtevant Creek near the southeast quadrant of the intersection of NE 4th Street and I-405. The stream mitigation will be designed to meet the following goals:

- Increase hydrologic conductivity with two small riparian wetlands.
- Increase fish rearing habitat.
- Improve riparian buffer conditions.
- Increase organic material input.
- Slightly increase floodplain storage.

The mitigation will meet these goals by installing large woody debris and other stream channel enhancements. The stream buffer will be revegetated with plant species native to the area, and invasive vegetation removal and control will be implemented.

Floodplains

The project will not encroach upon any existing floodplains and will not substantially change downstream floodplains or flooding characteristics. Therefore no mitigation is proposed.

Groundwater

To minimize the effects from groundwater drawdown due to the installation of underdrains, WSDOT will include special provisions in the design, such as discharging drain flow back into affected surface water and wetlands.

WSDOT will require that the supplier bringing fill soil onto the site provide documentation that the fill exceeds Washington State soil cleanup standards. If documentation is not available, then WSDOT will require testing of imported fill soils prior to placement. WSDOT will test suspected contaminated soils encountered during project construction. Where necessary, WSDOT will require their removal from the site and proper disposal in accordance with Washington State regulations.

WSDOT has well-established design and construction practices for managing the types of groundwater conditions anticipated for the project. With the implementation of these practices and by following standard BMPs, potential negative effects on groundwater resources will be minimized.

SECTION 7 UNAVOIDABLE ADVERSE EFFECTS

Does the project cause any substantial adverse effects that cannot be avoided?

The project will add impervious surfaces to the study area, and this is an unavoidable negative effect on surface water and water quality. The replacement of pervious surfaces (grass slopes, forests, meadows, etc.) with roadway pavement alters the natural hydrologic cycle. However, by providing a new stormwater management system and including BMPs and other treatment of highway runoff quantity and quality that meets all applicable federal, state, and local standards, the adverse effects will be minimized. Stormwater facilities will both maintain the rate of stormwater runoff at existing conditions or less for the range of design storm events and remove pollutants from runoff generated by the project above existing conditions. Stormwater facilities will not be designed to reduce the flow rates and durations for events less than 50 percent of the 2-year storm and events greater than the 50-year storm event. Therefore, there may be increases in flow rates and durations outside of the range of design storm events. Because stormwater will not be able to infiltrate as much as under existing conditions, there will be a slight, unavoidable increase in the volume of runoff. Base flows may also increase.

The project will cause no unavoidable adverse effects on floodplains or groundwater.

SECTION 8 REFERENCES

GIS Data Sources

Exhibit 2-1

Washington State Department of Transportation (WSDOT). 2006 – 2007. I-405 Staff; project limits.

Exhibit 2-3 – Sheets 1 through 6

WSDOT. 2006 – 2007. I-405 Staff; project limits, existing right-of-way, proposed right-of way, relocated noise wall, proposed retaining wall, proposed stormwater features, proposed new pavement.

Exhibit 4-1

WSDOT. 2006 – 2007. I-405 Staff; Basins. Updated 2007 by Anchor Environmental, LLC

Puget Sound LiDAR Consortium, LiDAR, 2002. http://pugetsoundlidar.ess.washington.edu/About_PSLC.htm

Exhibit 4-3

WSDOT. 2006 – 2007. I-405 Staff; Basins. Updated 2007 by Anchor Environmental, LLC

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Base Data

All GIS exhibits contain one or more of the following as base layers:

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APPENDIX A GROUNDWATER WITHDRAWAL RIGHTS CERTIFICATES

Water Right Tracking System
Department of Ecology
WR Document List Sorted By Priority Date Report

Reported By: MSNO461		Groundwater Withdrawal Rights Currently on File with Dept of Ecology										
Report Date: 1/4/2007												
File #	**Cert #**	**Person**	**Priority Dt**	**Purpose**	**Qi**	**UOM**	**Qa**	**Ir Acres**	**TRS**	**QQ/Q**	**Src's**	**1stSrc**
G1-*00182CWRIS	518	King Cnty Water Dist 68	3/20/1946	MU	300	GPM	487		25.0N 05.0E 29	SE/SW	1	WELL
G1-*00490CWRIS	360	King Cnty Water Dist 68	3/25/1947	MU	700	GPM	780		25.0N 05.0E 32	SW/SW	1	WELL
G1-*00582CWRIS	521	King Cnty Water Dist 68	7/9/1947	MU	700	GPM	780		25.0N 05.0E 20	SE/NW	1	WELL
G1-*02405CWRIS	1284	Schafer Construction Co	3/24/1952	DM	75	GPM	26		25.0N 05.0E 20	SW/SE	1	WELL
G1-*03281CWRIS	2044	CROSS T J	6/23/1953	DM	60	GPM	14		25.0N 05.0E 27		1	WELL
G1-*03828CWRIS	2246	GROCOCK R H / J M	12/23/1954	IR,DS	6	GPM	7.6	1	25.0N 05.0E 20	SE/NW	1	WELL
G1-*04562CWRIS	2901	STOREY R C	4/4/1957	ST,IR	18	GPM	4	2	25.0N 05.0E 22	NW/NW	1	WELL
G1-000480CL		GRAVES KATHERINE H.		DG		GPM			25.0N 05.0E 22		1	
G1-000481CL		GRAVES KATHERINE H.		DG		GPM			25.0N 05.0E 22		1	
G1-002186CL		BACKUS MANSON F.		ST,IR		GPM			25.0N 05.0E 22		1	
G1-004733CL		LAMONT R. H.		IR,DG		GPM			25.0N 05.0E 21		1	
G1-010400CL		JONES SIDNEY T.		DG		GPM			25.0N 05.0E 29		1	
G1-017549CL		JENSEN HOWARD K.		DG		GPM			25.0N 05.0E 28		1	
G1-018664CL		WHIPPLE EVARTS W.		IR,DG		GPM			25.0N 05.0E 20		1	
G1-022914CL		WRIGHT FRANCIS E.		DG		GPM			25.0N 05.0E 28		1	
G1-028831CL		REIMER WAYNE J.		ST,DG		GPM			25.0N 05.0E 22		1	
G1-029650CL		PETERSON RICHARD E.		DG		GPM			25.0N 05.0E 27		1	
G1-031404CL		HARDING RUFUS L.		IR,DG		GPM			25.0N 05.0E 21		1	WELL
G1-031615CL		SMATHERS GARRETT A.		DG		GPM			25.0N 05.0E 33		1	
G1-033009CL		ARSHON HENRY		DG		GPM			25.0N 05.0E 33		1	
G1-033863CL		FEIK AARON J.		DG		GPM			25.0N 05.0E 22		1	
G1-035377CL		MEUSSNER ROBERT C.		DG		GPM			25.0N 05.0E 22		1	
G1-036192CL		HOBER NORMAN N.		DG		GPM			25.0N 05.0E 21		1	
G1-042485CL		SORENSON FRED R.		ST,DG		GPM			25.0N 05.0E 27		1	
G1-043205CL		BEZONA WALTER W. JR.		DG		GPM			25.0N 05.0E 22		1	WELL
G1-043517CL		HUSTON WILLIAM E.		DG		GPM			25.0N 05.0E 20		1	
G1-044055CL		PIELEMEIER P. W.		IR		GPM			25.0N 05.0E 32		1	LAKE SAMMAMISH
G1-046405CL		ITO HIROSHI		DG		GPM			25.0N 05.0E 28		1	
G1-046735CL		KENWORTHY DEAN		ST,DG		GPM			25.0N 05.0E 22		1	
G1-048219CL		WILKOWSKI EDWARD J.		DG		GPM			25.0N 05.0E 22		1	KELSEY CREEK
G1-048442CL		HADFIELD WILLIAM A.		ST,DG		GPM			25.0N 05.0E 22		1	WELL
G1-050438CL		KEYES GILBERT W.		DG		GPM			25.0N 05.0E 28		1	WELL
G1-051064CL		BRUCE IVAN M.		DG		GPM			25.0N 05.0E 27		1	
G1-054979CL		BETROZOFF JOHN W.		DG		GPM			25.0N 05.0E 21		1	
G1-057568CL		BATCHELOR JR. JAMES T.		ST,DG		GPM			25.0N 05.0E 22		1	
G1-058581CL		VANKLEECK WILLIAM E.		IR,DG		GPM			25.0N 05.0E 33		1	WELL
G1-059932CL		STANLEY MATTHEW		DG		GPM			25.0N 05.0E 22		1	
G1-065335CL		SHANK CORWIN P.		IR,DG		GPM			25.0N 05.0E 22		1	WELL

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Water Right Tracking System
Department of Ecology
WR Document List Sorted By Priority Date Report

File #	Cert #	Person	Priority Dt	Purpose	Qi	UOM	Qa	Ir Acres	TRS	QQ/Q	Src's	1stSrc
G1-065352CL		SCHONING DORIS E.		ST,IR		GPM			25.0N 05.0E 27		1	WELL
G1-065505CL		KAJIMURA TSUTOMU		DG		GPM			25.0N 05.0E 32		1	
G1-070973CL		GALLANAR ROGER W.		DG		GPM			25.0N 05.0E 22		1	
G1-071595CL		RONGHOLT DONALD J.		ST,DG		GPM			25.0N 05.0E 22		1	
G1-072029CL		LONG SAM O		IR,DG		GPM			25.0N 05.0E 21		1	WELL
G1-072964CL		BUSTAD PARKER, MASTERS,		DG		GPM			25.0N 05.0E 27		1	
G1-073336CL		SCHWARTZ CARL		DG		GPM			25.0N 05.0E 21		1	WELL
G1-073658CL		MATHIS JAMES M.		ST,DG		GPM			25.0N 05.0E 22		1	
G1-074850CL		SUNSET EQUIPMENT CO.		DG		GPM			25.0N 05.0E 28		1	
G1-077661CL		FOXWORTHY LAUREL R.		DG		GPM			25.0N 05.0E 27		1	WELL
G1-079968CL		GEIVETT GEORGE C.		ST,DG		GPM			25.0N 05.0E 22		1	
G1-080065CL		SIMONE RUDY V.		ST,DG		GPM			25.0N 05.0E 21		1	WELL
G1-080437CL		PIKE T. R.		DG		GPM			25.0N 05.0E 21		1	WELL
G1-082142CL		REINSCH FRANCIS C.		DG		GPM			25.0N 05.0E 22		1	WELL
G1-084695CL		FERRIS E. M.		DG		GPM			25.0N 05.0E 21		1	
G1-084765CL		SLOMAN MAE P.		DG		GPM			25.0N 05.0E 20		1	WELL
G1-087121CL		PATTERSON WILLIAM B.		ST,IR		GPM			25.0N 05.0E 22		1	
G1-087429CL		TROY WALTER T.		ST,IR		GPM			25.0N 05.0E 33		1	
G1-087613CL		NELSON KENNETH W.		IR,DG		GPM			25.0N 05.0E 22		1	
G1-089313CL		HALVERSON WARREN		IR,DG		GPM			25.0N 05.0E 22		1	
G1-089663CL		STEPHENSON ROBERT L		IR		GPM			25.0N 05.0E 22		1	
G1-089697CL		SPAHR FRED J		IR		GPM			25.0N 05.0E 29		1	
G1-092349CL		COBAUGH JOHN L		IR,DG		GPM			25.0N 05.0E 22		1	
G1-093088CL		ERICKSON GERALD M		DG		GPM			25.0N 05.0E 22		1	
G1-094303CL		POMEROY FLETCHER J		IR,DG		GPM			25.0N 05.0E 21		1	
G1-095502CL		GROCOCK RICHARD H		IR,DG		GPM			25.0N 05.0E 20		1	WELL
G1-101089CL		SMITH MARILYN I		DG		GPM			25.0N 05.0E 22		1	
G1-102054CL		ELDRED ROBERT A		DG		GPM			25.0N 05.0E 22		1	
G1-106547CL		STORM ROBERT H		DG		GPM			25.0N 05.0E 27		1	
G1-107798CL		DONAHUE DONALD G		DG		GPM			25.0N 05.0E 22		1	WELL
G1-107956CL		LOEDING RICHARD L		DG		GPM			25.0N 05.0E 20		1	WELL
G1-108102CL		COUNTS JACK C		DG		GPM			25.0N 05.0E 22		1	WELL
G1-108467CL		COUGHLAN GLENN B		IR,DG		GPM			25.0N 05.0E 22		1	
G1-110096CL		HOLLAND ROBERT V		ST,DG		GPM			25.0N 05.0E 21		1	WELL
G1-120517CL		NOLAND LYLE J		IR,DG		GPM			25.0N 05.0E 27		1	
G1-123349CL		SIEGRIST H H		ST,IR		GPM			25.0N 05.0E 21		1	
G1-123499CL		BELLE-VENTURE CORP		IR,DG		GPM			25.0N 05.0E 27		1	WELL
G1-124264CL		MASTERS ROBERT T		IR,DG		GPM			25.0N 05.0E 27		1	
G1-124692CL		MERCER BEACH PROPERTIES		ST,IR		GPM			25.0N 05.0E 22		1	WELL
G1-124956CL		HORTS HARRIET W		IR,DG		GPM			25.0N 05.0E 33		1	WELL
G1-125698CL		STEPHENS RUTH B		ST,IR		GPM			25.0N 05.0E 28		1	

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Water Right Tracking System
Department of Ecology
WR Document List Sorted By Priority Date Report

File #	Cert #	Person	Priority Dt	Purpose	Qi	UOM	Qa	Ir Acres	TRS	QQ/Q	Src's	1stSrc
G1-126714CL		JONSON CARL A		IR,DG		GPM			25.0N 05.0E 21		1	WELL
G1-126942CL		TIMBERS RICHARD L		IR,DG		GPM			25.0N 05.0E 22		1	
G1-127676CL		MC CULLOUGH FOY JR		ST,IR		GPM			25.0N 05.0E 22		1	WELL
G1-128603CL		WALLICK F H		ST,IR		GPM			25.0N 05.0E 22		1	
G1-129160CL		LYNN OSCAR W		IR,DG		GPM			25.0N 05.0E 28		1	
G1-129161CL		LYNN OSCAR W		IR,DG		GPM			25.0N 05.0E 28		1	
G1-130537CL		WALLICK HILDA		DG		GPM			25.0N 05.0E 22		1	
G1-134196CL		TAYLOR HARRY V		DG		GPM			25.0N 05.0E 32		1	
G1-138513CL		EVANS CO THE		No ID		GPM			25.0N 05.0E 28		1	
G1-139092CL		ODDSON HARLAND A		DG		GPM			25.0N 05.0E 22		1	WELL
G1-140640CL		HARRIS RAY E		ST,IR		GPM			25.0N 05.0E 21		1	
G1-141859CL		FLETCHER JACK C		ST,IR		GPM			25.0N 05.0E 29		1	
G1-143378CL		GRANT GORDON G		ST,IR		GPM			25.0N 05.0E 28		1	WELL
G1-143828CL		DAWSON GRACE I		IR,DG		GPM			25.0N 05.0E 22		1	
G1-144108CL		SMS ASSOCIATES		IR,DG		GPM			25.0N 05.0E 27		1	
G1-144223CL		MARCHIORO KAREN		DG		GPM			25.0N 05.0E 21		1	WELL
G1-144619CL		GRIFFITH DALE G		DG		GPM			25.0N 05.0E 27		1	WELL
G1-147342CL		BURNS S F DBA		IR,DG		GPM			25.0N 05.0E 20		1	WELLS
G1-147539CL		CRAWFORD WILLIAM W		ST,IR		GPM			25.0N 05.0E 20		1	
G1-148626CL		RANKIN FRANCES R		ST,IR		GPM			25.0N 05.0E 27		1	WELL
G1-148628CL		RANKIN FRANCES R		IR,DG		GPM			25.0N 05.0E 27		1	WELL
G1-149791CL		MOORE ELMER W		IR,DG		GPM			25.0N 05.0E 21		1	WELL
G1-151597CL		MC DONALD JOHN C		IR,DG		GPM			25.0N 05.0E 21		1	
G1-151818CL		STOCK SIDNEY		DG		GPM			25.0N 05.0E 21		1	
G1-153058CL		FENN ROBERT W		DG		GPM			25.0N 05.0E 27		1	WELL
G1-155521CL		JEREMIAH VIRGIL P		ST,IR		GPM			25.0N 05.0E 21		1	
G1-155698CL		ULRICH DALLAS D		DG		GPM			25.0N 05.0E 27		1	WELL
G1-155939CL		HUNT LAURASON T		DG		GPM			25.0N 05.0E 22		1	WELL
G1-160587CL		PRATT JOHN B		IR		GPM			25.0N 05.0E 33		1	WELL
G1-20777CWRIS		HARDING RUFUS L	7/27/1973	IR,DS	30	GPM	5	2	25.0N 05.0E 21		1	WELL
G1-21527CWRIS		RUFFELL J R & B M	4/23/1974	DS,CI	20	GPM	3		25.0N 05.0E 27	SW/NE	1	WELL
TOTAL RECORDS:	147											

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File #	Cert #	Person	Priority Dt	Purpose	Qi	UOM	Qa	Ir Acres
S1-*03173CW	624	KIETZ A	10/6/1930	IR,FS	0.2	CFS		10
S1-*03268CW	1442	REYNOLDS F	12/30/1930	IR,DS	0.05	CFS		5
S1-*04873CW	1969	EAGER L L	6/12/1939	IR	0.01	CFS		0.5
S1-*04901CW	1721	CROASDILL .	7/14/1939	IR,FR	0.1	CFS		4
S1-*04971CW	1955	ELWANGER	9/14/1939	IR,DM	0.2	CFS		20
S1-*05807CW	2847	BORGER R S	3/25/1943	ST,IR	0.07	CFS		7
S1-*06499CW	2329	KNELL P G	6/27/1945	IR	0.03	CFS		3
S1-*07527CW	2699	NORMAN JAI	11/7/1946	DS	0.01	CFS		
S1-*09111CW	4466	HAILEY H D	9/24/1949	DS	0.01	CFS		
S1-*09387CW	3817	LANGLAND A	2/15/1950	DS	0.01	CFS		
S1-*09441CW	4206	CARLQUIST	3/7/1950	DS	0.01	CFS		
S1-*11761CW	6597	HARDING R I	10/16/1952	IR	0.05	CFS	10	5
S1-*12307CW	7277	GROCOCK R	4/28/1953	IR	0.08	CFS	16	8
S1-*12654CW	5784	WHIPPLE E V	11/12/1953	IR,DS	0.01	CFS		1
S1-*12761CW	6091	BLAKESLY C	2/10/1954	FR,DS	0.01	CFS		
S1-*13009CW	7329	KAROLEVITZ	7/6/1954	DS	0.01	CFS		
S1-*13181CW	6752	FUCHEK L C	11/8/1954	FS	0.04	CFS		
S1-*13342CW	6573	NELSON L F	3/15/1955	IR,DS	0.03	CFS	4	2
S1-*18049CW	9020	YOUNKER R	7/17/1963	IR,FS	0.05	CFS	1	0.5
S1-*18187CW	9845	WEBER E R	10/4/1963	ST,IR	0.014	CFS	1.5	0.75
S1-*23183CW	11764	WHITESCAR'	5/28/1971	FS	0.031	CFS		
S1-00636CW		Bellevue City	12/24/1970	RE	0.2	CFS		
S1-029649CL		PETERSON RICHARD E.		DG		CFS		
S1-049515CL		TRAFF ROBERT S.		ST		CFS		
S1-051065CL		BRUCE IVAN M.		DG		CFS		
S1-074251CL		DILLARD D A MRS		IR		CFS		
S1-080064CL		SIMONE RUDY		DG		CFS		
S1-092350CL		COBAUGH JOHN L		IR,DG		CFS		
S1-093341CL		ROBERTS JOHN A		IR,DG		CFS		
S1-094917CL		TUTTLE GERALD G		No ID		CFS		
S1-098814CL		CALLAHAN ETHEL L		IR,DG		CFS		
S1-123350CL		SIEGRIST H H		ST,IR		CFS		
S1-126943CL		TIMBERS RICHARD L		ST,IR		CFS		
S1-144032CL		GRIFFITH DALE G		No ID		CFS		
S1-148625CL		RANKIN FRANCES R		ST		CFS		
S1-148627CL		RANKIN FRANCES R		ST		CFS		
S1-161893CL		RYAN T V		IR		CFS		

TRS	QQ/Q	Src's	1stSrc
25.0N 05.0E 2	SW/SE	1	UNNAMED STREAM
25.0N 05.0E 27		1	UNNAMED STREAM
25.0N 05.0E 27		1	MERCER SLOUGH
25.0N 05.0E 2	SW/SW	1	KELSEY CREEK
25.0N 05.0E 27		1	UNNAMED STREAM
25.0N 05.0E 22		1	UNNAMED STREAM
25.0N 05.0E 27		1	KELSEY CREEK
25.0N 05.0E 2	NE/NE	1	UNNAMED SPRING
25.0N 05.0E 2	NW/SE	1	MERCER SLOUGH
25.0N 05.0E 2	NW/SE	1	UNNAMED STREAM
25.0N 05.0E 2	SE/SE	1	MERCER SLOUGH
25.0N 05.0E 2	NW/NW	1	UNNAMED SOURCE
25.0N 05.0E 2	SE/NW	1	NORTHRUP CREEK
25.0N 05.0E 2	NW/NE	1	UNNAMED STREAM
25.0N 05.0E 27		1	KELSEY CREEK
25.0N 05.0E 27		1	UNNAMED STREAM
25.0N 05.0E 27		1	KINSLEY CR *
25.0N 05.0E 2	S2/NE	1	NELSON CREEK
25.0N 05.0E 22		1	HERFORD CR *
25.0N 05.0E 2	NW/SW	2	UNNAMED STREAM
25.0N 05.0E 3	NE/NE	1	UNNAMED STREAM
25.0N 05.0E 3	SE/SE	1	KELSEY CREEK
25.0N 05.0E 27		1	
25.0N 05.0E 21		1	UNKNOWN
25.0N 05.0E 27		1	STREAM
25.0N 05.0E 33		1	KELSEY CREEK
25.0N 05.0E 21		1	STREAM
25.0N 05.0E 22		1	GOLDSMITH
25.0N 05.0E 21		1	LAKE WASHINGTON
25.0N 05.0E 20		1	SPRIN / STREAM
25.0N 05.0E 21		1	SPRINGS
25.0N 05.0E 21		1	STREAM
25.0N 05.0E 22		1	HERFORD CREEK
25.0N 05.0E 27		1	SPRINGS
25.0N 05.0E 27		1	SPRINGS
25.0N 05.0E 27		1	PONDS
25.0N 05.0E 33		1	KELSEY CREEK