## 3.2 WATER RESOURCES

This section characterizes water resources on the site and in the site vicinity. Potential impacts to these water resources from infrastructure development and full buildout under the Proposed Actions (Alternatives 1 and 2) and the No Action Alternative are also evaluated. This section is based on the February 2005, Technical Report on Geology, Soils, and Ground Water prepared by Associated Earth Sciences, Inc. (see Appendix A); the February 2005, Draft Master Drainage Plan prepared by Hugh G. Goldsmith & Associates, Inc. and NW Hydraulic Consultants, Inc. (see Appendix B); and the March 2005, Water Quality Technical Report prepared by A.C. Kindig & Co. (see Appendix C).

### 3.2.1 Affected Environment

#### Surface Water Quantity

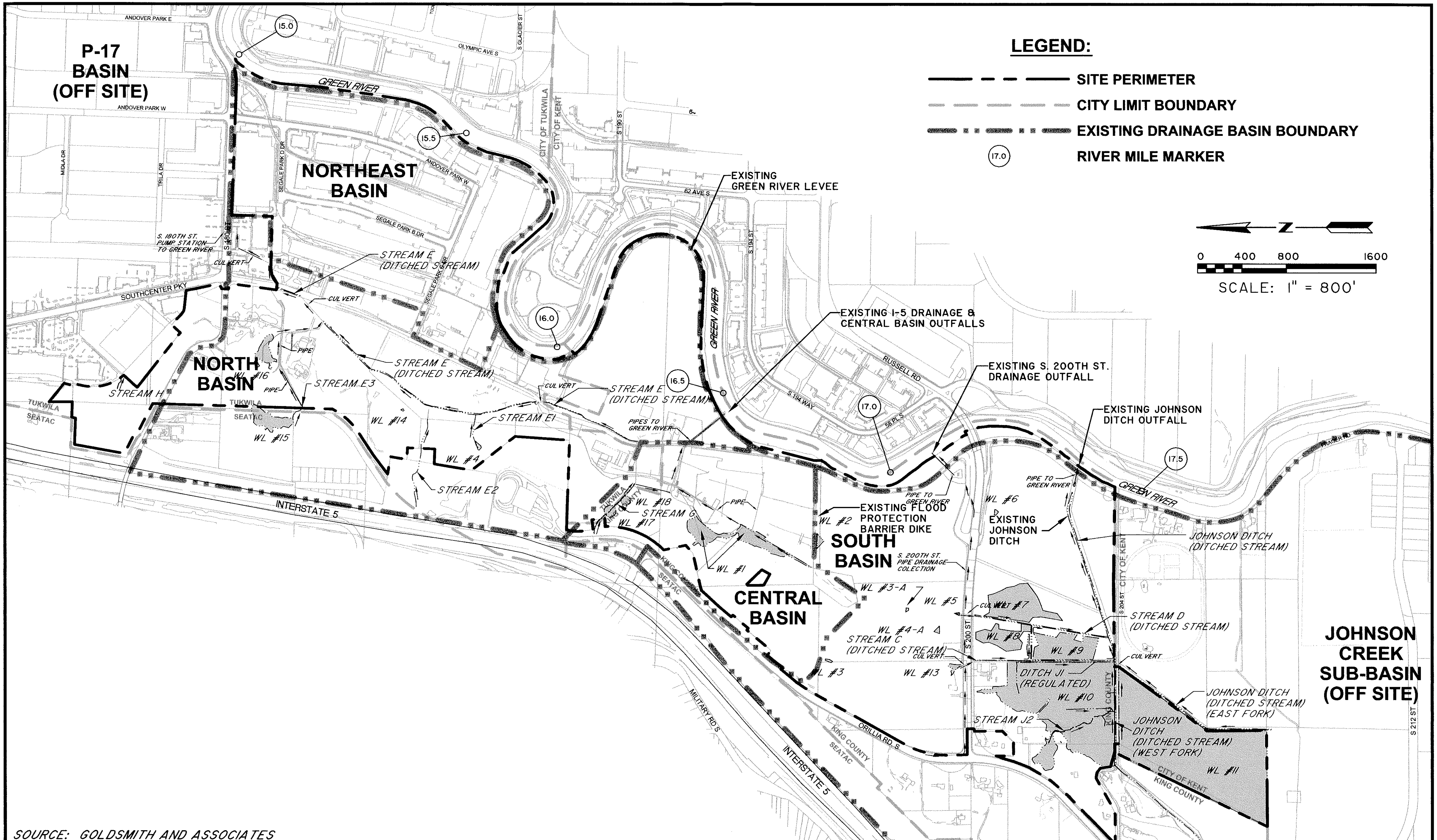
Drainage Basins

*Green River Basin*

The site lies entirely within the Green/Duwamish River drainage basin. The Green River forms the eastern boundary of the site. The river drains a basin area of approximately 309,000 acres. The Green River trends westward for about 40 miles from its headwaters near Stampede Pass to the City of Auburn, then turns and flows northwestward for about 20 miles to the confluence of the Black River, where it becomes known as the Duwamish River. The Duwamish River continues northwestward for about 11 miles and enters Elliott Bay through two tributaries known as the East and West Waterways. The Green River's flow is regulated by Howard Hanson Dam at river mile (RM) 53, which maintains the flow at or below 12,000 cubic feet per second (cfs) measured at the Auburn Gauge. The site is located between RM 17.8 and RM 14.

*Johnson Creek Basin.* The Johnson Creek basin (as informally known) is considered to consist of the Green River tributary area to the river outfall located at approximately RM 18 (at the mouth of existing Johnson Ditch). The Johnson Creek basin is approximately 850 acres, extending from the Tukwila South site southward and westward along the Green River valley. The basin currently includes approximately 141 acres of the Tukwila South site (the majority of the south basin onsite; see the description of this onsite basin below). Runoff from the upper reaches of the basin, from the hillside and from the agricultural land in the lowlands flows into ditches that carry discharge to existing Johnson Ditch (a ditched stream) and to the Green River via a gravity outfall with flood gates. In times of high Green River water levels, the runoff ponds behind the Green River levee until the river stage drops, allowing the ditch to drain via the gravity outfall. (see Figure 3.2-1 and the following discussion under Johnson Basin Floodplain Hydrology for further information).

*P-17 Basin.* The P-17 basin, as described in the City of Tukwila Comprehensive Surface Water Management Plan (November 2003), is a 1,339-acre drainage basin consisting of all of the tributary area draining to King County's P-17 pump station (located approximately at Minkler




BLUMEN CONSULTING GROUP, INC

**Figure 3.2-1**
**Existing Drainage Basins and Drainage Features**

**Tukwila South Project EIS**

Boulevard). Approximately 790 acres of the P-17 basin lies within the City of Tukwila, the remainder lies with the City of SeaTac. Surface water runoff from the P-17 basin is collected and conveyed mainly through a network of catch basins and underground pipes. Runoff from the northern portion of the basin is routed to the P-17 pump station. It is assumed that the southern portion of the basin drains directly to the Green River to outfalls, including the discharge from the City's S 180th Street pump station (located adjacent to S180th Street near the Southcenter Parkway intersection). Due to some complex plumbing and hydraulics within S 180th Street, the Comprehensive Plan considers that the S 180th Street tributary area is a part of the P-17 basin (see Figure 3.2-1 and Appendix B for further information on this basin).

*S 180th Street Pump Station.* The majority of stormwater runoff from the S 180th basin area is conveyed to the Green River via the S 180th Street pump station. This pump station consists of three 5,600 gallon per minute (gpm) pumps and one 2,800 gpm pump that discharge to a 66-inch high pressure storm drainage pipe that conveys runoff from I-5. The 66-inch outfall pipe discharges to the Green River near S 180th Street. Stormwater runoff contained in the 66-inch pressure pipe bypasses the S 180th Street pump station (see Appendix B for details on drainage to the pump station). The current system capacity of the S 180th Street pump station was analyzed for this EIS. According to the analysis, excess capacity is available in the system (see Appendix B for details).

*Onsite Basins.* All surface water runoff from the site flows to the Green River. Surface flows originate from groundwater seeps and pipe outfalls along the onsite western hillside. This drainage either flows overland and is dispersed across agricultural fields or is collected by ditched streams and ditches that provide conveyance to discharge outfalls at the Green River. Stormwater from the Segale Business Park in the northeast basin is collected in stormwater pipes. There are four existing drainage basins on the site: the northeast basin, the north basin, the central basin and the south basin. These onsite basins are defined by four distinct discharge outfalls to the Green River (see Figure 3.2-1).

*Northeast Basin.* The total area of the northeast basin is 98.8 acres, all of which is located on the Tukwila South site (see Figure 3.2-1). This basin consists primarily of the Segale Business Park, which drains to existing stormwater drainage pipes to the northeast in Andover Park W. The area drains via a 48-inch drainage pipe under the Segale Business Park roads, northeasterly along Andover Park W to King County's P-17 pump station. The basin discharges to the Green River via the P-17 pump station and a 12-inch gravity outfall at RM 14. Drainage reports prepared for construction in the Segale Business Park indicate that some of the stormwater control system under the business park roads may experience surcharging.

*North Basin.* The total area of the north basin is 198.8 acres, 156.7 acres of which are located on the site (see Figure 3.2-1). Most of the tributary flows from the north basin are ultimately collected in Stream E and conveyed to the City's S 180th Street pump station vicinity via a 36-inch culvert under S 180th Street. Discharge to the Green River is either via the S 180th Street pump station and a pressurized pipe at RM 15 or via a 12-inch diameter gravity pipe that conveys discharges into the P-17 basin. The S 180th pump station only operates during peak flows; the majority of flow is conveyed through storm pipes to the P-17 pump station and ultimately the Green River.

*Central Basin.* The total area of the central basin is 66.6 acres, 59.9 acres of which are located on the site (see Figure 3.2-1). The majority of the central basin on site is collected in stormwater pipes and conveyed to the Green River; the remainder of the basin in agricultural uses most likely infiltrates, except in infrequent, intense storms. This basin discharges to the Green River via a 24-inch gravity outfall, through the Green River levee, at RM 16.8. A second outfall through the levee to the Green River is located in the central basin. This is a 36-inch stormwater pipe that conveys runoff from I-5 directly to the Green River via this "tightline." No drainage from the site enters this tightline. Therefore, discharges from this outfall are not considered part of the central basin flows. Any development of the site would be required to maintain this tightline from I-5.

*South Basin.* The total area of the south basin is 832.4 acres, 173.1 acres of which are located on the site (see Figure 3.2-1). The onsite portion of this basin consists of the area lying south of the existing flood protection barrier dike (at S 196th Street, if extended) and north of S 204th Street. The site area also includes approximately 20 acres south of S 204 Street in the Johnson Creek Basin. Most drainage collects in the system of linear ditches and ditched streams onsite. The south basin discharges through the levee to the Green River via a gravity outfall (the existing Johnson Ditch outfall) at RM 17.5. Drainage from the south basin to the existing Johnson Ditch outfall is primarily from baseflow seeps emanating from the base of the hillside to the west and from stormwater runoff during large storms and high groundwater conditions. During low groundwater conditions, and nominal rainfall, very little, if any, runoff flows overland prior to infiltrating into the valley alluvial soils (see the following discussion of Groundwater Quantity and Appendix A for details). The wetlands in the lower elevations of the basin are hydrologically maintained partially from these seep baseflows, but primarily from the tributary basin flow and groundwater flow from the site. A very small portion of the site (with the exception of the seep baseflow) contributes to the southern wetlands.

The south basin includes the existing improvements to Orillia Road and S 200th Street that were completed by King County and City of Kent in the mid to late 1990s. Drainage from the majority of these roadway improvements is split. It is assumed that the intent of the split was to isolate runoff that would receive water quality treatment from the rest of the south basin runoff. Water quality treatment consists of a wetpond facility located near the S 200th Street bridge (over the Green River) with its own gravity outfall to the Green River. The remainder of the runoff (above water quality treatment levels) would either discharge to the wetpond or to Stream C.

## Drainage Features

### *Streams and Ditches*

Regulated watercourses include all ditches and streams, and the Green River that meet the City of Tukwila's regulated watercourse definition (see the footnotes to Table 3.3-1 for these definitions). Some of the regulated onsite watercourses remain in natural channels (i.e., Streams E-1, E-2, E-3, G and H), and others are ditched (i.e., Streams C, D, E, J-2 and existing Johnson Ditch). Ditch J-1 is a regulated watercourse (agricultural ditch) with no evidence on an historic basis, but may be accessible to fish under high-water conditions. Nonregulated ditches with no evidence of an historic basis include Ditches A and B..

Several watercourses emanate from the western hillside onsite and discharge to the valley floor. These watercourses include, from north to south, Streams H, E-3, E-2, E-1, G, Ditch J-1, ditched Stream J-2 and existing Johnson Ditch. Where the streams discharge onto the valley floor, they are either ditched or directed to piped conveyance systems. Streams E-1, E-2 and E-3 discharge to Stream E, which eventually discharges to the S 180th Street pump station vicinity. The pump station discharges to a pressurized stormwater pipe that also conveys untreated stormwater drainage from I-5 to the Green River at approximately RM 15. Stream G discharges to a catch basin and then a pipe that conveys runoff to the Green River outfall at approximately RM 16.8. Ditch J-1 and Stream J-2 discharge to existing Johnson Ditch and existing Johnson Ditch discharges to the Green River via the outfall at RM 17.5. The outfall has been fitted with a flood gate to prevent flooding (see Figure 3.2-1**,** Section 3.3, Plants and Animals – Fisheries and Appendix E for additional information).

Other onsite watercourses include Streams C and D. Stream C conveys groundwater discharge from a north-south trending 36-inch diameter concrete drainage pipe in the center of the former borrow pit in the southwest portion of the site. Stream C discharges to Wetland 13, which discharges to a culvert under S 200th Street. The culvert discharges onto the valley floor into a continuation of Stream C which flows for approximately 500 feet, and then turns east and joins Stream D. Stream D begins at Wetland 5 and collects runoff from the fields to the north and south of S 200th Street. Stream D discharges to existing Johnson Ditch (see Figure 3.2-1, Section 3.3, Plants and Animals – Fisheries and Appendix E for additional information).

### *Springs*

Several springs are present along the western hillside. In general, two spring systems discharge along the slope, one at approximately elevation 160 to 170 feet mean sea level (fmsl), and a second at approximately elevation 60 to 70 feet mean sea level (fmsl). Springs also occur on the valley floor during the wetter, winter months when water levels in the regional alluvial aquifer rise and where ground surface is low, such as in the Wetland 7 through 11 area. Groundwater is also present locally above the alluvial aquifer on top of a near surface layer of peat and organic silt. Water builds up on low permeability layers, causing ponding of water to occur on the ground surface (see the Groundwater Quantity section for details).

### *Wetlands*

The site contains 19 wetlands totaling approximately 48.7 acres, based on previous and current delineations (the boundaries of the wetlands were confirmed by the Corps of Engineers and Washington Department of Ecology during site visits conducted in January and March 2005). The wetlands are scattered from the north to south end of the site. Many wetlands are small, and several are hydrologically isolated (see Section 3.4, Wetlands, and Appendix F for details).

## Flood Protection

A levee system is located adjacent to the Green River, and parallels the river onsite. The majority of the site lies at an elevation below the crown of the Green River levee. A flood protection barrier dike bisects the site from east to west at S 196th Street. The flood barrier dike protects properties to the north of the dike, including in Tukwila's Urban Center, in the event of a Green River levee failure upstream.

## Green River Management Agreement/Green River Pump Operations Procedures Plan

The Cities of Tukwila, Auburn, Renton, and Kent, together with King County entered into an agreement in 1985 (updated in July 2002) to maintain the Green River levee system and manage stormwater discharges to the Green River in a coordinated manner. Termed the Green River Management Agreement (GRMA, 1985), this document describes specific studies and improvements which were to be made to the levee system to improve flood protection in the valley. In addition, the GRMA placed restrictions on the size and operations of new and existing pump stations in the Green River valley.

An associated document, the Green River Pump Operations Procedures Plan (POPP, 1985) provides additional technical detail on coordinated stormwater management during periods of high Green River flow. The POPP provides specific requirements associated with the design of new outfalls. In particular, there are requirements regarding new, non-pressurized gravity outfalls to the Green River and new pumping plants. Numerous criteria for the design and operation of new outfalls are specified in the POPP (see Appendix B for details on these criteria).

It is understood that the flow at City of Auburn that discharges to the Green River has now been set at 12,000 cfs rather than 9,000 cfs, as stated in the POPP.

## Hydrologic Analysis

The existing hydrology of the onsite drainage basins was analyzed using the Hydrologic Simulation Program – FORTRAN (HSPF) model. HSPF is a sophisticated computer model that simulates land surface and in-stream hydrologic processes on a continuous basis. The model is commonly used to transform a long time-series of rainfall records and evaporation data into a concurrent time-series of streamflow data, based on continuous accounting of: hydrometric data, soil moisture levels, land use runoff response and storage area routing (see Appendix B for additional information on the HSPF model, including the assumptions and data used in the analysis).

Groundwater analysis was performed to evaluate groundwater/surface water interaction in the onsite drainage basins. A network of observation wells, equipped with continuous hourly recording devices, was established across the site. Groundwater contributions to the base flow of onsite watercourses was evaluated through a comparison of seasonal groundwater fluctuations recorded in the onsite wells and physical stream properties (see Appendix A for additional information on the groundwater analysis).

### *Johnson Creek Basin Floodplain Hydrology*

Runoff from the upper reaches of Johnson Creek basin, from the hillside to the west, and from the agricultural lowlands flows into ditches and ditched streams that carry discharge to existing Johnson Ditch and ultimately to the Green River via a gravity outfall with a flood gate. In times when the Green River water levels are high, runoff ponds behind the Green River levee until the river stage drops, allowing existing Johnson Ditch to drain via the gravity outfall. This ponding has been observed for many years, and is presumed to be the basis of the Johnson Creek basin floodplain elevation documented by the Federal Emergency Management Agency (FEMA).

Using the HSPF model, runoff entering the existing Johnson Ditch ponding area was quantified for this EIS. The model used the observed flood elevation of the ponding area together with other basin parameters to simulate existing basin hydrology. The complex hydraulic interaction between the gravity drainage of the site and the Green River was accounted for in the model. The calculated 100-year recurrence stage for existing Johnson Ditch under existing conditions is 22.2 feet. This is consistent with the FEMA-delineated 100-year floodplain for this area of the valley, and is consistent with observed flood conditions (see Appendix B for details).

*South and Central Basin Hydrology*

Existing stormwater discharge rates from the south basin to the Green River were estimated for this EIS as the combined discharges from the south and central basins. This includes discharge from the central basin via the existing gravity outfall, discharge from the water quality pond near S 200th Street, and discharge across the southern site boundary to existing Johnson Ditch and the ponding area. Using the HSPF model, these discharge rates were estimated as approximately 8.2 cfs and 13.5 cfs for the 2- and 10-year storm events, respectively (see Appendix B for details).

## Surface Water Quality

Surface waters in the State of Washington are regulated for quality by Chapter 173-201A WAC, administered through the Washington State Department of Ecology (Ecology). The state water quality standards are intended to protect all beneficial uses of surface waters, including the protection of aquatic biota. On July 1, 2003, Ecology adopted new State Water Quality Standards that were used in the water quality analysis for this EIS (see Appendix C for a discussion of the revisions to the previous standards).

The Green River and its tributaries are designated by Ecology as used for salmon and trout spawning, non-core rearing, and salmon migration, referred to as 'Non-core Salmon/Trout' (see Table 2-1 in Appendix C for the water quality standards for this category). The Non-core Salmon/Trout use category applies to the Green River from river mile (RM) 11 north of I-405 upstream to RM 42.3, which is about 10 RM upstream of Auburn. This reach includes the Green River along the eastern site boundary. All streams that are tributary to the Green River within this reach are also in the Non-Core Salmon/Trout use category. The reach of the Green River adjacent to the site also has a Primary Contact Recreation Use Category, which affects the fecal coliform standard (see Table 2-1 in Appendix C).

### Washington State Drinking Water Standards

The purpose of drinking water regulations is to ensure health quality standards are maintained for public drinking water supplies. Drinking water standards established by the Washington Department of Health (WDOH) comply with the Federal Safe Drinking Water Act of 1974 and subsequent 1986 amendments. Maximum contaminant levels are defined and divided into primary and secondary categories. Primary standards are based on chronic, non-acute, or acute human health effects. Secondary standards are based on factors other than human health effects, for example, taste, odor and color. Groundwater standards and drinking water standards are similar, but not identical (see Washington State Groundwater standards later in this section).

### Section 303(d) Threatened and Impaired Water Bodies

Section 303(d) of the 1972 Federal Clean Water Act (CWA) requires states to identify and list threatened and impaired water bodies. The CWA requires the list to be updated and submitted for review and approval by the U.S. Environmental Protection Agency (EPA) every 4 years. The purpose of the listing is to identify water body segments where, with pollution control measures, applicable standard(s) are not expected to be met for the listed water quality parameters.

The draft 2002/2004 water quality section 303(d) cites the Green River between RM 11 and RM 42.3 (including the river adjacent to the site) as limited for dissolved oxygen, fecal coliform bacteria, mercury, and temperature (Ecology 2004). The Final 1998 303(d) list indicated that the Green River was limited for chromium, mercury, fecal coliforms and temperature (Ecology 1998). A Total Maximum Daily Load (TMDL) program was approved in January 1993, for the Duwamish Waterway and Green River from RM 11 to 42.3 for ammonia-nitrogen as a result of the relocation of the Renton Wastewater Discharge plant, which affects waste load allocation for wastewater plan discharge permits.

A Green River TMDL is under development for fecal coliform bacteria, dissolved oxygen, and temperature (Ecology 2004). Although mercury is listed on the 303(d) list, Ecology usually does not administer TMDL's for mercury or other toxins which bioaccumulate. Mercury has been listed in various rivers in the state and region, and Ecology will be implementing a regional study for mercury over the next 5 years. A TMDL is not proposed for chromium, even though it was included on the 1998 303(d) list, because the listing was based on samples questioned by Ecology due to discrepancies in lab and field techniques. Ecology re-sampled chromium in 2002 and 2003 to verify the listing and found that chromium was within the water quality standards. Green River water quality sample collection and water quality model development are currently ongoing by King County and Ecology for the purposes of preparing the TMDL. Ecology is working with the Muckleshoot Indian Tribe, King County and other interested parties to develop a cohesive set of TMDLs addressing water quality limitations in the entire Lake Washington and Duwamish/Green River watersheds (see Appendix C for details on these TMDLs).

## Section 305(b) Washington State Water Quality Assessment Report

The purpose of the Section 305(b) report is to present to the U.S. Congress and the public the current conditions of the state's waters. Section 305(b) of the federal Clean Water Act requires each state to prepare a water quality assessment report every two years. The Washington State Year 2002 Section 305(b) Report has been prepared and submitted to the EPA as required. The 1998 and 2002 305(b) reports are global in summary and scope, with no information on specific water bodies. The last 305(b) report that characterized specific water bodies was the 1994 report. The 1994 305(b) report addressed and supported any impaired uses, sources and causes of documented impairments of the Green River (see Appendix C for details on the impairments).

## Antidegradation Policy (Code of Federal Register [CFR] 40.131.120)

The federal antidegradation policy is incorporated in two sections of the Clean Water Act. Federal antidegradation policy requires that states develop and adopt a statewide antidegradation policy and identify methods for implementation that include the maintenance and protection of existing stream and water uses and water quality. Washington State's antidegradation policy is found in the Water Quality Standards for Surface Waters of the State of Washington WAC 173-201A-3 (see above).

## Surface Water Monitoring

Surface water quality standards apply to receiving water and not water within a pipe. Baseline water quality data were collected specifically for this EIS to establish background (pre-development) water quality conditions both on- and off-site. Ten "routine" surface water quality monitoring stations were established from which four samples were collected. At eight routine stations, one summer baseflow (August 28, 2003) and three wet season storms were sampled (December 10, 2003, February 2, 2004, and March 24, 2004). At the remaining two stormwater stations, the Segale Business Park and the Frager Storage Yard, samples were collected from the stormwater manhole access points during storms generating runoff. These two stations were sampled October 13, 2003, December 10, 2003, February 2, 2004, and March 24, 2004.

All of the routine monitoring included collection of the following parameters:

| | | |
|---|---|---|
| Total phosphorus | Ortho phosphate | Alkalinity |
| Total suspended solids | Fecal coliforms | Temperature |
| Total oil and grease | Ammonia nitrogen | pH |
| Total Petroleum Hydrocarbons | Total metals | Hardness |
| Nitrate plus nitrite nitrogen | Dissolved oxygen | Conductivity |
| Dissolved lead, copper, and zinc | Biochemical oxygen demand (BOD) | Turbidity |

### *Northeast Basin Water Quality*

Segale Business Park stormwater was monitored to directly measure the quality of stormwater runoff from the portion of the site in the northeast basin. For purposes of the evaluation, the northeast basin stormwater discharge quality was conservatively compared directly to Green River Non-Core Salmon/Trout and Primary Contact Recreation Use Category criteria. Untreated northeast basin stormwater did not meet all of the Non-Core Salmon/Trout Use Category quality criteria. The business park stormwater had pH below the minimum criterion during one storm, and dissolved copper, lead and zinc were above the maximum criteria during several storms. Northeast basin stormwater quality did not meet the Primary Contact Recreation Use Category criterion for fecal coliforms (see Table 2-5 in Appendix C).

### *North Basin Water Quality*

Stream E-2 was selected to be representative of the springs and seeps discharging from the undeveloped portions of the western hillside prior to mixing with valley floor drainage or entering the agricultural ditch and ditched stream system. Stream E-2 contributes a majority of the base flow from the steep slope to Stream E. Stream E receives drainage from the driving range, farm and groundwater fed streams E-1, E-2, and E-3, of which Stream E-2 is the main contributor. Stream E-2 water is of better quality than that in Stream E for a majority of the parameters measured (see Table 2-3 in Appendix C). The good water quality delivered to Stream E from the western hillside springs (Streams E-1, E-2 and E-3) as represented by the Stream E-2 water quality, is not maintained in conveyance through Stream E to the pump station vicinity, which delivers the water ultimately to the Green River. The cool and well oxygenated hillside baseflow water warms and undergoes some depletion of oxygen in transit through the Stream E system. In addition, the influence of untreated stormwater runoff to Stream E is evident in its higher concentrations of fecal coliforms, oil and grease, dissolved copper and zinc, and BOD than is present in the hillside baseflow water. Although the west slope springs forming Streams G and H discharge to the Central Basin, Stream E-2 water quality is assumed to be representative of their water quality as well (see Table 2-4 in Appendix C).

### *Central Basin Water Quality*

Stormwater was sampled from a catch basin located west of Frager Road, in the storage yard of Seattle Tractor. Stormwater generated from the storage yard is routed through oil and water separators, but does not receive any other water quality treatment. Runoff from the storage yard combines with baseflow from the seeps collected at the toe of the slope on the west of the yard and is directed to the Green River via an outfall at approximately RM 16.7. The sampling station is located below all inputs to the discharge pipe to the Green River, and, therefore directly reflects the surface water quality delivered to the Green River from the central basin.

As with the northeast basin, water quality standards apply to the receiving water and not to water within a pipe. However, unlike the northeast basin, there are no off-site influences to the quality of discharge entering the Green River from this discharge outlet, which is directly measured at the sampling station. Therefore, the discharge was compared to the Green River Non-Core Salmon/Trout and Primary Contact Recreation Use Category criteria. Stormwater runoff in this discharge did not meet all of the Salmon/Trout Use Category quality criteria. Dissolved oxygen concentrations were below the minimum water quality standard for some samples collected. One sample had fecal coliform concentrations above the Primary Contact Recreation Use Category criterion for fecal coliforms. Biochemical oxygen demand was high in an October 2003 sample at the same time that fecal coliforms, total suspended solids, turbidity, and nitrate+nitrite-nitrogen were high. Dissolved lead, copper, and zinc were often above chronic water quality standards (see Table 2-6 in Appendix C**)**.

### *South Basin Water Quality*

*Stream C.* A monitoring station was selected for Stream C on the north side of S 200$^{th}$ Street, at the outlet from Wetland 13 where water enters a culvert passing under the road and drops into Stream C on the south side of the road. As for Stream E-2 baseflow water quality, baseflow into Stream C had good water quality for all parameters, with the exception of one low dissolved oxygen value. Dissolved metals, copper, lead, and zinc were all within chronic water quality standards (see Table 2-7 in Appendix C).

The area north of S 200$^{th}$ Street was formerly operated as a sand and gravel borrow pit. Prior to backfilling the borrow pit, a drainpipe was installed at the base of the excavation area to drain groundwater from the fill. There are limited portions of the filled borrow pit that contain total petroleum hydrocarbons, such as diesel, gasoline, and heavy oil-range organics, arsenic, cadmium, and lead above the Model Toxics Control Act Cleanup Regulations. The concentrations detected in the soil and groundwater do not present an immediate threat to human health or the environment. Stream C surface water inflow station total petroleum hydrocarbons, oil and grease, and dissolved lead concentrations were consistently within water quality standards. The site has been enrolled in Ecology's Voluntary Cleanup Program and an Ecology approved compliance monitoring program has been initiated. Upon completion of the compliance monitoring program, a 'No Further Action' determination will be requested from Ecology for the site (see Section 3.5, Hazardous Materials for further information).

*Stream D.* Surface water samples were collected at Stream D upstream of its outlet into existing Johnson Ditch, on the north side of S 204$^{th}$ Street. This station measured the combined Streams C and D tributary drainage. Streams C and D outlet water quality is poor relative to the quality of Stream C input baseflow. Stream D outlet water is characterized by lower dissolved oxygen, higher BOD, and higher concentrations of turbidity, total suspended solids, fecal coliforms, ammonia-nitrogen, dissolved lead, and dissolved zinc than the good quality baseflow input to Stream C, due to agricultural influence contributions to the ditches and hydrologic conditions within them (see Table 2-8 in Appendix C).

*Existing Johnson Ditch.* Surface water samples were collected from existing Johnson Ditch on the north side of S 204th Street at the point it enters the southwestern portion of the site, upstream of the Streams C and D inflow point. Samples were also collected from Johnson Ditch outflow located approximately 200 feet from its discharge to the Green River. The water quality within Johnson Ditch was found to improve as it flows easterly through the site to its discharge to the Green River. The Johnson Ditch outflow water is more oxygenated and has lower concentrations of nutrients, fecal coliforms, and dissolved metals than the Johnson Ditch inflow water quality. This is likely the result of Streams C and D (and Ditch J-1, although it is intermittent and not included in the monitoring program) volume contributions to Johnson Ditch downstream of the Johnson Ditch inflow station. During the non-flood winter storms, Stream D influence was always of better quality for dissolved oxygen, pH, ammonia-nitrogen, total phosphorus, dissolved copper, and oil and grease than the inflow Johnson Ditch water quality station. During the summer baseflow, Stream D inflow to Johnson Ditch was always of better quality for total suspended solids, nitrate+nitrite-nitrogen, total phosphorus, dissolved copper, lead, zinc, and fecal coliforms (see Tables 2-9 and 2-10 in Appendix C).

*Upstream Green River Station.* A sampling station was selected immediately upstream of the site near S 212th Street at RM 18.3. This station was selected to match Ecology's ambient water quality monitoring program, which collected water quality data at RM 18.3 from 1990 through 1991, and 1993 through 1994. The upstream Green River station water quality met the Non-Core Salmon/Trout Use Category criteria for pH and dissolved oxygen. Several of the temperature measurements did not meet the Non-Core Salmon/Trout Use Category criteria. The Green River did not meet the Primary Contact Recreation Use Category Criteria. Fecal coliform concentrations were high and dissolved lead concentrations were above the chronic water quality standard in two samples (see Table 2-11 in Appendix C).

*Downstream Green River Station.* Surface water samples were collected at approximately RM 14 on the Green River near the site to supplement data collected by Ecology. The samples were within the range of the existing Ecology data measured at RM 12.4. The data collected for the EIS analysis were combined with those from Ecology to characterize the existing Green River water quality immediately downstream of the site. Some of the downstream temperature measurements were above the Non-Core Salmon/Trout Use Category criteria. Several of the dissolved oxygen values were below the water quality standard during the summer. Several of the samples exceeded the frequency of excursions allowed by the Primary Contact Recreation Use Category criterion. Two of the dissolved lead samples were above the chronic water quality standard (see Table 2-12 in Appendix C).

Samples collected at both the upstream and downstream stations of the Green River were similar in quality for a majority of the parameters assessed. The downstream Green River station had slightly higher nutrients than the upstream station, likely due to agricultural influences between the two stations. The upstream Green River oil and grease and TPH levels sampled in March 2004 were higher than previous measurements at this station, and were higher than the concentrations measured at the downstream station.

### Onsite Watercourse Riparian Condition

Vegetation adjacent to watercourses can improve water quality by filtering pollutants, removing nutrients, preventing sediment introduction, introducing leaf litter and insects important to stream production, and lowering temperature through shading. Riparian conditions are considered good/very good for supporting water quality in Streams E-1, E-2 and G, and the upper portion of Stream J-2; moderate for supporting water quality in Stream E-3, the lower portion of Stream D, and existing Johnson Ditch; and poor for supporting water quality in Streams C and E, Ditch J-1, the upper portion of Stream D, the lower portion of Stream J-2, and the east fork to existing Johnson Ditch (see Appendices C and E for further information).

### Onsite Wetland Water Quality

The water quality function of wetlands proposed to be filled or rehabilitated under the Tukwila South Sensitive Area Master Plan was evaluated in this EIS using the Washington State Wetland Functional Assessment Method (WAFAM) method. WAFAM quantifies in relative terms a wetland's ability to provide certain water quality functions based on its hydrogeomorphic (HGM) classification and other features (see Appendix F for further information).

### Onsite Ditch Temperature

A field survey was conducted on July 22, 2004, to evaluate temperature changes as water passes through the site during warm summer conditions. The survey was intended to show how well riparian conditions along the ditches and ditched streams are maintaining the cool water temperatures known to exist in the groundwater discharges as they pass through the onsite ditch system in transit to the Green River. In general, ditch conveyance warmed the cool baseflows considerably in transit to the Green River (see Appendix C for details).

### Agricultural Chemical Use

The driving range and llama farm (116 acres) in the northern portion of the site are managed with fertilizers and herbicides. The south basin contains actively cropped pasture lands, corn fields and hay fields (112 acres). Corn fields are actively worked throughout the south and central portions of the site. The agricultural fields are managed with fertilizers and herbicides. Fertilizers are sources of nutrients, particularly nitrogen and phosphorus. Traces of heavy metals may also be included in some fertilizer blends. Herbicides have varying levels of mobility, persistence and toxicity to fish and aquatic invertebrates (see Appendix C for further information).

No analysis of pesticides was performed on samples collected from the onsite water quality stations. The degree or frequency with which any of these compounds occur in the onsite ditches and ditched streams is not known; however it is reasonable to assume that some amount of pesticide produce could enter the ditches and ditched streams when overland flow occurs from rainstorms shortly after application.

## Groundwater Quantity

Several types of field explorations were conducted at the site to understand groundwater conditions onsite and in the site vicinity. These explorations included: 1) reconnaissance and mapping of current site geologic and hydrogeologic conditions; 2) drilling and completion of 12 observation wells; 3) stream reconnaissance; and 4) groundwater level monitoring. Field investigations were performed between August 2003, and July 2004.

Regional mapping of groundwater occurrence and flow has been performed by the US Geological Survey for southwestern King County, Washington. The Tukwila South site is included in this mapping area. Based on this mapping, nine hydrogeologic units are present below the Tukwila South site, including: five aquifers, three confining units, and one basal undifferentiated unit.

Information obtained from the project-specific subsurface exploration and geologic reconnaissance, in combination with regional hydrogeologic mapping, has been used to describe groundwater in the vicinity of the site. According to this information, five principal groundwater 'regimes' occur in the site vicinity. These include from oldest to youngest: (1) $Opog_2$ aquifer, (2) $Qpog_1$ aquifer, (3) Ova aquifer, (4) an alluvial aquifer, and (5) seasonal ponded water.

The surficial geology map (Figure 10 in Appendix A), distribution and groundwater flow direction map (Figure 3.2-2) and hydrogeologic cross sections (Figures 11 and 12 in Appendix A) illustrate the geology and hydrogeology beneath the site.

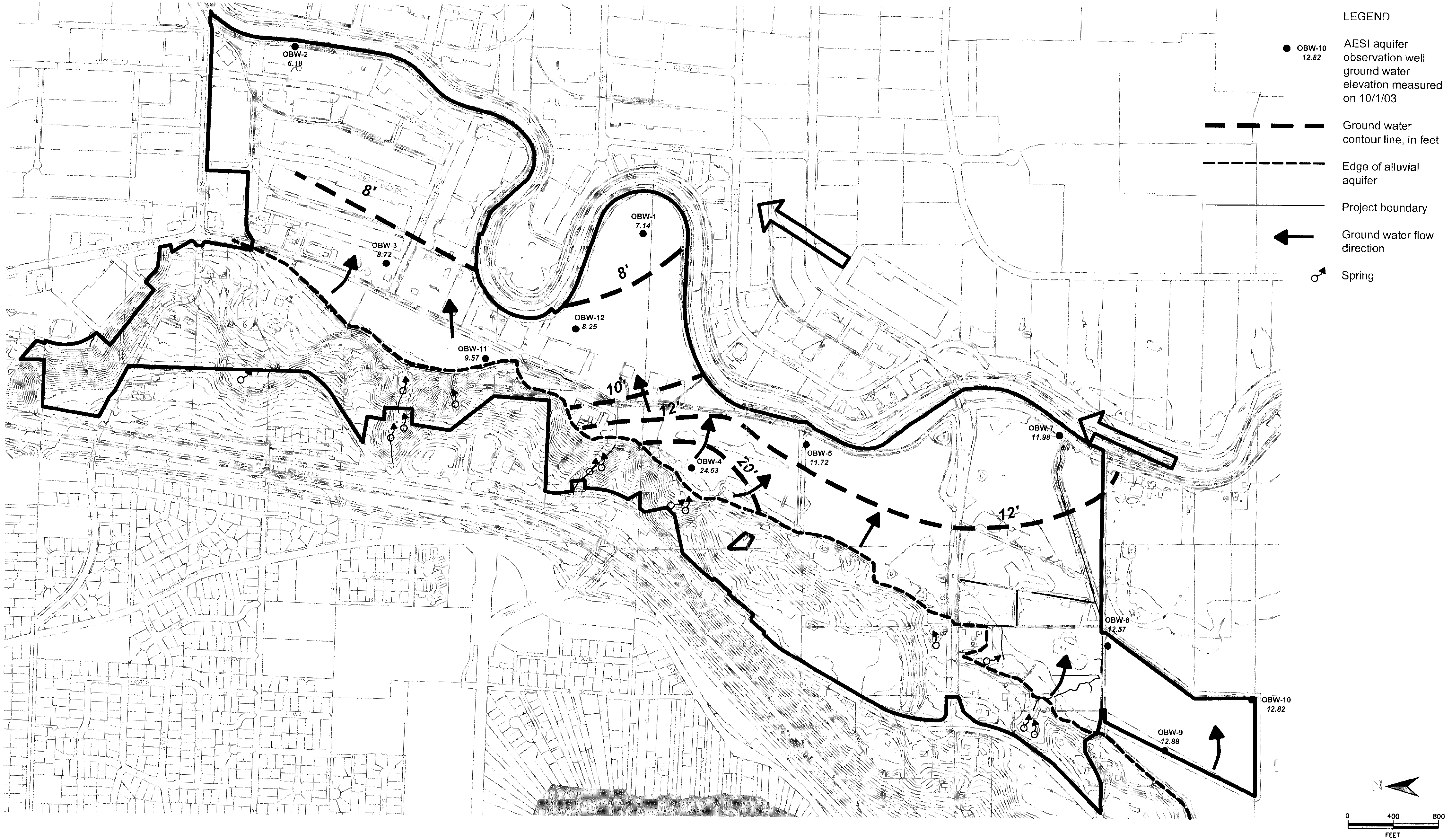
## $Qpog_2$ and $Qpog_1$ Aquifers

Sediments beneath the site identified as $Qpog_2$ and $Qpog_1$ are coarse units with till lenses, as well as clay and silt lenses. In areas, these sediments are hydraulically connected to the shallower Qva aquifer (see below).

Regionally, the $Qpog_2$ and $Qpog_1$ sediments are mapped as underlying the Angle Lake Plateau located less than one mile to the west of the site. These sediments range from not present to about 200 feet in thickness, and average about 85 feet in thickness. Groundwater flow in these sediments is generally to the west to Puget Sound and to the east into the Duwamish/Green River Valley, from a generally north-south groundwater divide centered in the Angle Lake vicinity. Nine water wells draw from this aquifer in the vicinity of the site (see Table 5-2 in Appendix A for details on these wells).

In the site vicinity, the lower portions of the $Qpog_2$ and $Qpog_1$ sediments are water-bearing and discharge as springs along the western hillside of the Green/Duwamish River Valley. Where the intervening $Qpog_t$ diamict is absent, or where $Qpog_1$ is not differentiated for $Qpog_2$, the $Qpog_2$ and $Qpog_1$ aquifers are referred to as $Qpog_{1,2}$.

A distinct spring line representing discharge from the $Qpog_1$ aquifer is present at approximately elevation 160 fmsl along the northern portion of the western hillside (including the areas from Stream G northward to Wetland 15). Discharge from this spring line forms the headwaters to Streams G, E-1 and E-2 and Wetland 15 (and Stream E-3, which forms from Wetland 15 overflow). Additional spring flow enters Stream E-2 at approximately elevation 60 fmsl from the $Qpog_{1,2}$ aquifer. Along the western hillside south of Stream G, the next spring location is lower in elevation, at 80 to 90 fmsl and is interpreted to represent discharge from the $Qpog_{1,2}$ aquifer, where the intervening $Qpog_t$ diamict layer appears to be absent. $Qpog_{1,2}$ springs are also interpreted to contribute flow to the upper portions of Streams J-2 and C. The $Qpog_1$ diamict




Source: Goldsmith and Associates

Figure 3.2-2

Local Groundwater Flow

Tukwila South Project EIS

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layer could potentially occur at a higher elevation on the south portion of the site. This would place the layer generally above the elevation of Orillia Road and offsite. Flow measurements were taken at a number of locations along the western hillside and are presented in Table 5-3 in Appendix A. Monitoring wells MW-1 through MW-7 located immediately north of S 200th Street and east of Orillia Road are completed within fill material and $Qpog_2$ sediments. Water level elevation data from these wells is presented in Table 5-4 in Appendix A.

Recharge to the $Qpog_2$ and $Qpog_1$ aquifers is interpreted to be from leakage through overlying fine-grained units and, where $Qpog_2$ and $Qpog_1$ sediments are present at or near ground surface, from direct precipitation and wetlands.

## Qva Aquifer

Regionally, Qva sediments are mapped as underlying the Angle Lake Plateau to the west of the site. The top of the unit generally slopes downward from east to west. As with the $Qpog_2$ and $Qpog_1$ sediments, Qva sediments are absent beneath the Green River Valley. Qva sediments are interpreted to be absent below approximately elevation 270 feet. Therefore, these sediments are not present beneath the site.

Similar to the $Qpog_2$ and $Qpog_1$ aquifers, groundwater flow in the Qva sediments is generally to the west to Puget Sound and to the east into the Green/Duwamish River Valley, from a generally north-south groundwater divide centered in the Angle Lake vicinity. Four wells mapped in the vicinity of the site draw from this aquifer.

Recharge to the Vashon Advance aquifer is interpreted to be from leakage from the overlying Vashon lodgement till sediments, which includes leakage from Angle Lake and other water bodies on the till surface. In some areas on the Angle Lake Plateau, Vashon advance outwash is present at groundwater, and would be directly recharged by precipitation.

## Alluvial Aquifer

The alluvial aquifer is contained in a thick sequence of sands and gravels including reworked lahar sediments, interbedded with fine grained floodplain deposits in the Green/Duwamish River Valley. Alluvial sediments (Qal) that are mapped in the Green/Duwamish River Valley have been documented to be over 400 feet in thickness in areas. Qal sediments thin in the upvalley direction, and toward the margins of the valley. Regional groundwater flow in the alluvial aquifer generally corresponds to the topography of the river valley, eventually flowing down-valley to the Puget Sound. Groundwater flowing in the alluvial aquifer discharges primarily to the Green/Duwamish River and other streams along the valley floor. Groundwater flow paths near the Green/Duwamish River could reverse during periods of high flows in the river. Six wells mapped in the vicinity of the site draw from this aquifer. The aquifer contains considerable groundwater storage and contributes to Green River flows during dry periods. Recharge to the alluvial aquifer is provided from direct precipitation, infiltration from the Green River during high water stages, groundwater from aquifers daylighting along the hillside and groundwater flow-through from the upgradient portion of the alluvial aquifer.

Groundwater levels in the alluvial aquifer were monitored in a network of onsite observation wells from September 2003 to October 2004. See Table 5-5 in Appendix A for the results of this monitoring over the last 12 months.

Local groundwater flow paths in the alluvial aquifer are affected by a number of variables. Water levels near the base of the western hillside are affected by streams or wetlands occurring from $Qpog_1$ and $Qpog_2$ aquifer seepage (usually discharging as springs, which form wetlands or streams). Groundwater levels near the Green River are affected during periods of high flows. Tidal effects are evident in the furthest down-gradient observation well (see Appendix A for details).

### Ponded Water

A seasonal ponded water zone is present on the valley floor during the wetter months of the year (see the previous Johnson Creek Basin Floodplain Hydrology section). Rainfall will generally soak into the ground through relatively permeable soil until it encounters a barrier to further downward movement, at which point it begins to 'pond' over the top of the barrier. The barrier to downward movement is less permeable than the overlying soil, but is often somewhat 'leaky', and can slowly let small amounts of water through via infiltration.

During the winter, when rainfall exceeds the amount of water able to infiltrate, excess water builds up above the barrier, and begins to pond. Since the ponded water zone is usually rainfall dependent, it occurs at different depths in the shallow soils over the top of the barrier, depending upon the amount of rainfall in the recent past. Ponded water zones may dry up all together between periods of significant rainfall. Water usually leaves ponded zones (water loss or output is termed 'discharge') by evapotranspiration (the combination of evaporation and moisture lost through 'breathing' by plants), by becoming springs, or by entering stream channels or wetlands at points where the top of the ponded water table intersects the ground surface.

Water elevations in the seasonal ponded water zone can differ from the water levels in the regional alluvial aquifer (formed in Green/Duwamish River alluvium). Water elevations in the alluvial aquifer may be near water year lows while the ponded water zone elevations may be at or near the ground surface. This would likely occur near the start of the wet season, when infiltrated rainfall build up a groundwater mound quickly on top of the organic silt/peat layer, while the alluvial aquifer begins to rise more slowly. Later in the wet season, the alluvial aquifer may also be at or near ground surface. Toward the end of the wet season, the water elevations in the alluvial aquifer would remain high and slowly begin to drop back toward water year lows toward the end of summer/beginning of fall. Water elevations in the ponded water zone would likely drop more quickly after the end of the wet season, because direct rainfall is the primary source of recharge.

## Groundwater Quality

### Washington State Groundwater Quality Standards

The goal of the Washington State groundwater quality standards is to protect groundwater quality and existing and future beneficial uses through an antidegradation policy and definition of maximum contaminant level (MCL) criteria (Ecology 1990). Regulations require that contaminants proposed for entry to groundwater be provided with all know, available and reasonable methods of prevention, control and treatment prior to entry (see Table 2-2 in Appendix C for the Washington State groundwater quality standards).

### Water Users

The nearest water users (as obtained from information on file with Department of Ecology) to the site include a number of wells and spring systems on the west hillside of the Green/Duwamish River Valley, near the intersection of S 200th Street and Orillia Road; two water users in the valley south of S 204th Street; and a well and spring system on the north end of the site, also on the west hillside, due west of the Segale Business Park. These water users are summarized in Table 5-2 in Appendix A.

As shown on Figure 13 in Appendix A, a number of water users are also present within a mile of the site on the Angle Lake Plateau and up-valley from the site, south of S 212th Street. These water users are either far upgradient or otherwise disconnected from the Tukwila South site.

### Baseline Groundwater Quality

Three groundwater wells (OBW-3, OBW-12 and OBW-8) were sampled for water quality between November 2003, and March 2004, to characterize existing groundwater quality conditions. Water quality differed greatly between the three groundwater wells. There is no particular trend in groundwater quality pertaining to the direction of groundwater flow from south to north (from well OBW-8 to OBW-3) that directly correlates to land use influences, but localized influences on wells from agricultural practices and untreated stormwater runoff may be occurring during some times of the year. Well OBW-3 is located in the Segale Business Park, immediately north of Segale Park C Drive. Groundwater quality in well OBW-3 was poor. Ammonia-nitrogen, phosphorus, suspended solids, and fecal coliforms were all uncharacteristically high for groundwater from time to time (see Table 2-13 in Appendix C). This well may be influenced by septic discharge from private homes on the western hillside (at the llama farm immediately north of the driving range) and fertilizer use on the driving range. Well OBW-12 is located in the central portion of the site adjacent to the Green River, approximately 200 feet east of Frager Road. Fecal coliforms were elevated in one sample from this well (see Table 2-14 in Appendix C). Well OBW-8 is located on the south side of S 204th Street, adjacent to existing Johnson Ditch. Ammonia-nitrogen concentrations measured in this well were relatively high; however, not as high as those measured at well OBW-3. Fecal coliforms in one sample at well OBW-8 exceeded the groundwater quality standard (see Table 2-15 in Appendix C). The source of fecal coliforms likely are agricultural and wildlife influences onsite and from upgradient areas south of the site.

## 3.2.2 Impacts

Following is an analysis of probable significant impacts related to surface and groundwater resources. Impacts are discussed separately for the infrastructure development and buildout phases. Alternatives 1 and 2 would include major infrastructure construction to facilitate site development as described briefly below and in more detail in Chapter 2 of this Draft EIS. Under Alternatives 1 and 2, the proposed amount of site grading, potential for impacts related to water quantity and quality, assumed impervious surface areas and proposed practices to manage stormwater to avoid or minimize impacts would be similar.

## Alternatives 1 and 2

### Infrastructure Development Phase

As part of the infrastructure development phase, the site would be mass graded, and roads, utilities and comprehensive temporary and permanent stormwater control infrastructure for full buildout of the site would be installed (see Chapter 2 for details on the construction sequencing).

#### Surface Water Quantity

A Preliminary Master Drainage Plan (MDP) was prepared for the Tukwila South project, and currently reflects the applicant's proposal. The MDP provides an engineering overview of the proposal and major infrastructure required for development of the site, including site work and drainage control. It also provides an analysis of the water resource-related impacts of the EIS alternatives. A drainage analysis and stormwater control plan is included in the MDP. The MDP is intended to meet the objectives of the drainage review requirements of the 1998 King County Surface Water Design Manual (KCSWDM) that has been adopted by City of Tukwila (see Appendix B for the full Preliminary MDP). A Final MDP will be required in conjunction with application for mass grading permits.

##### *Site Grading*

Site grades for the Tukwila South project would be established as part of an overall mass earthwork program during the infrastructure development phase (see the Earth section and Chapter 2 for further information on site grading). This mass earthwork program would include construction (installation) of the comprehensive temporary and permanent stormwater control facilities designed to serve full buildout. The Southcenter Parkway grade and overall site sub-grades would be established to insure proper drainage to the stormwater control facilities. The flood protection barrier dike and habitat mitigation plan elements would also be constructed during the infrastructure development phase. See Chapter 2 and Appendices B and C for a more complete description of the proposed construction sequence.

Under Alternatives 1 and 2 9.45 acres of onsite wetlands would be filled out of a total of approximately 48.7 acres of existing wetland area on the Tukwila South site. Filling of all or portions of five streams/ditches would also be required for both Alternative 1 and 2. The majority (approximately 80 percent) of the onsite wetland areas and their buffers, together with the natural streams, would generally be protected under Alternatives 1 and 2. Impacts to wetlands and watercourses would be offset by implementation of the Sensitive Area Master Plan in the infrastructure development phase. The plan includes rehabilitation of wetlands, creation of off-channel fisheries habitat in the Green River and implementation of a stream mitigation plan, including relocation and restoration of Johnson Creek (see Section 3.3, Plants and Animals – Fisheries, Section 3.4, Wetlands, Appendix E and Appendix F for details).

##### *Stormwater Control*

Following are descriptions of the proposed short- and long-term construction stormwater control systems, and the permanent, comprehensive stormwater control system which would be installed during the infrastructure development phase.

*Temporary Stormwater Control.* During the first construction season, stormwater would be collected in temporary erosion and sedimentation control (TESC) collection traps which would be retained in four areas in the north, central and south portions of the site. The collection traps would be located where closed depressions exist or can be formed. A pressurized line and series of pumps would link all of the four temporary collection traps together and ultimately link each collection trap to the stormwater polymer treatment ponds (to remove suspended sediments), that would be constructed during the first year. The temporary stormwater retention system would be operable during the first construction season while the long-term polymer treatment system for construction runoff is completed. No surface discharge of stormwater offsite is planned during the first construction season until the long-term construction stormwater polymer treatment system is completed and operating. The onsite storage capacity for stormwater runoff would be much greater than the runoff volume that could possibly occur during the dry season (April 1 through October 31), when construction would occur.

At the end of the first construction season, the long-term construction stormwater treatment system would be installed. This system would collect, pump and discharge all site construction runoff through temporary settling traps, a two-cell polymer treatment system located at the south end of the site, or alternatively into one of two batch release cells for testing prior to discharge through a controlled outlet to the Green River. The polymer treatment system would have the capacity to store or detain 1.5 times the 10-year, 24-hour runoff volume. The system would have a storage capacity of about 3,012,700 cubic feet (cf) (as compared to the 1,927,500 cf required by Ecology) (see Appendix C for details).

*Permanent Stormwater Control.* A comprehensive, permanent stormwater control system for the Tukwila South project would be installed in the infrastructure development phase. The stormwater control system would be designed and constructed in accordance with the standards and specifications set forth in the King County Surface Water Design Manual (SWDM) (1998), which has been adopted by the City of Tukwila. The stormwater control system would include a conveyance system and two major water quality treatment and runoff control facilities (one each in the north and south portions of the site). These facilities would be constructed as combined wet-detention ponds (or wet ponds/wet vaults) and would be sized to meet the water quality treatment and runoff control requirements for the entire site, as well as the area to the west of the site (to I-5) if it was developed, at full buildout (see Appendix B for details).

Future developed area drainage would be consolidated as part of the mass grading program into two major subbasins: north and south (the existing Segale Business Park comprises a third subbasin, the northeast basin). The north stormwater facility (to be located in Planning Area B; see Figure 2-3) and south stormwater facility (to be located in Planning Area I) would be constructed as “combined wet-detention ponds”. Figure 3.2-3 shows the proposed basin boundaries and locations of the north and south stormwater control facilities. Consolidation into two major facilities would preclude the need for multiple stormwater control facilities across the site.

The south pond would provide for permanent water quality treatment and Level 1 flow control for discharge to the Green River through a new outfall. The required storage volume for the south pond would be 14.7 acre-feet. The north pond would provide permanent water quality treatment and back-up detention storage for flows to the existing S 180$^{th}$ Street pump station vicinity, which ultimately discharges to the Green River. The required storage volume for the north pond

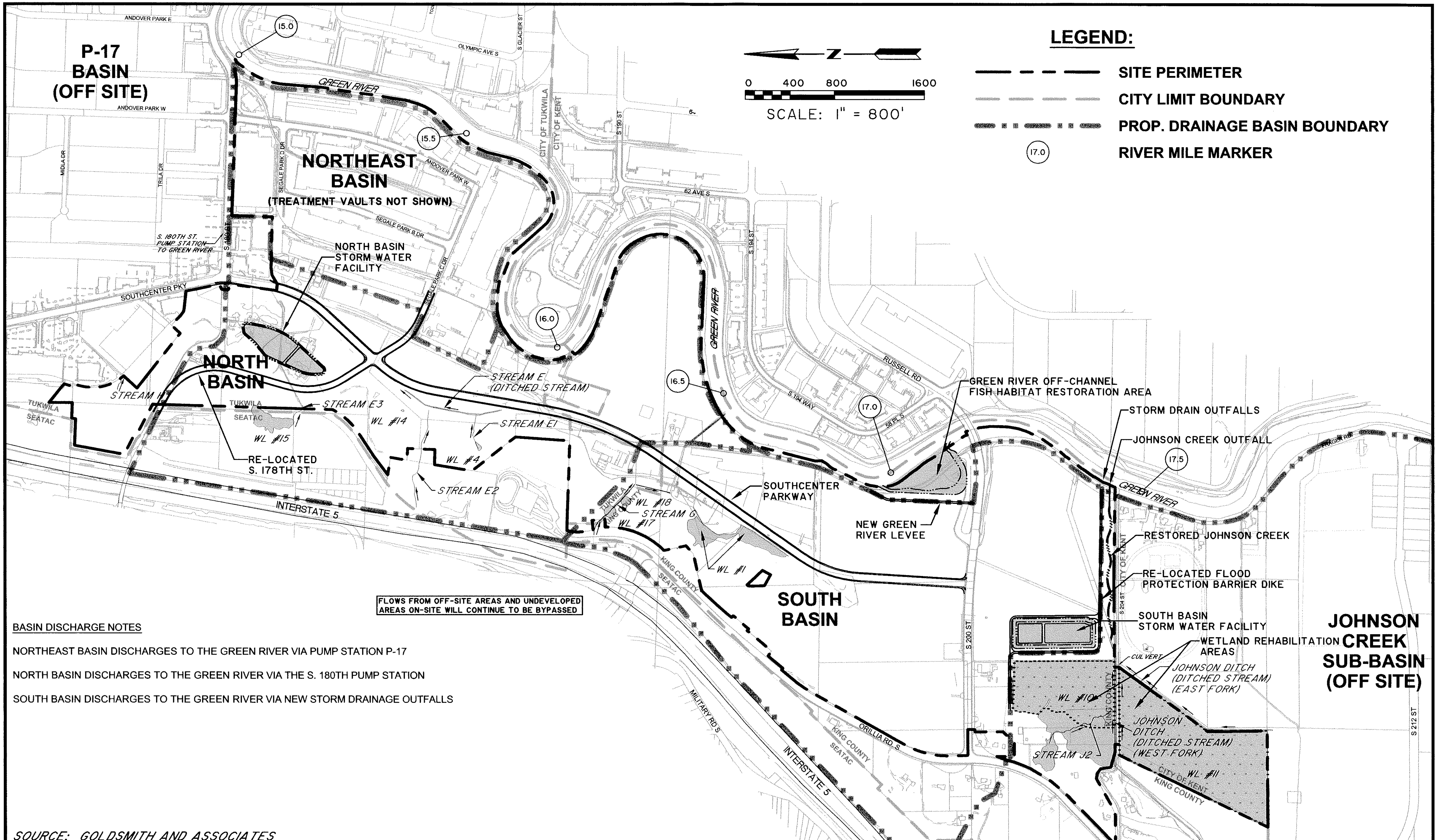


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**Figure 3.2-3**
**Proposed Stormwater Control System**

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would be 12.9 acre-feet. The north pond detention was sized for the S 180th Street pump station capacity. The Hydrologic Simulation Program – FORTRAN (HSPF) model is the most accurate modeling methodology for surface water hydrology. This model was used to estimate the required water quality volume for the north and south ponds and is considered to accurately reflect the hydrology of the site (see the description of the hydrologic analysis later in this section and Appendix B for details on the modeling). The proposed water quality facilities would meet the Basic Water Quality Menu in the King County SWDM (1998).

Following redevelopment of the Segale Business Park, it is anticipated that impervious surface area would be similar or less than at present; therefore increased stormwater flows from this portion of the site would not result. Stormwater runoff in the northeast basin (Segale Business Park area) would receive wet vault water quality treatment (upon redevelopment); this is currently an area that does not receive water quality treatment. After treatment, discharge from the northeast basin would be routed to the City's P-17 pump station, and ultimately to the Green River.

A key component of the stormwater plan is the intended avoidance of impacts to the Johnson Creek basin by isolating runoff from the developed areas of the site from the remainder of the Johnson Creek basin. The relocated flood protection barrier dike and the south stormwater facility would serve to isolate runoff from the developed areas. In addition, baseflows entering the site from the undeveloped portions of the western hillside would bypass the stormwater system and remain separated from developed area runoff (i.e., north basin baseflow seeps tributary to Stream E, central basin baseflows to Wetland 1, and south basin baseflows tributary to the Johnson Creek basin).

The SWDM contains numerous facility options for water quality treatment. Wet ponds and wet vaults are proposed because of the flat nature of the site, because these facilities can be combined, and because they are space efficient. In recent years alternative means have been developed to maintain natural system hydrology, protect streams from increases in stormwater runoff, and protect wetlands, and are collectively termed "low impact development" or LID. Many of these methods seek to infiltrate stormwater in localized areas where it is generated in order to reduce hydraulic impacts. Other methods seek to reduce stormwater runoff volumes. Infiltration would not be feasible under Alternatives 1 and 2 because of the seasonal high water table underlying the site and the need to fill portions of the site for utility infrastructure requirements. Since stormwater is discharged to the Green River, and not to intervening tributaries, there is no need to employ LID measures to reduce water quality or quantity impacts (see Appendix C for further information).

Because of the very flat nature of the site, the inflow pipes to the north and south wet ponds are expected to be permanently filled with water for lengths that could exceed 2,000 feet under the proposed preliminary design. Maintenance measures are proposed to prevent sediment accumulation in the inflow pipes, since the backwater effect would lower flushing (periodic cleansing of the pipes with water) rates. The backwater in the pipes would not impair the wet pond water quality treatment, because the wet pond volume would not be reduced and full treatment would continue to be provided for all water entering the pond (see Appendix C for further information). However, permanent inundation of pipes would make maintenance of the pipes and associated pond more difficult and costly. The City is investigating modifications to the proposed design that could avoid permanent water in inflow pipes.

### *Flood Protection Barrier Dike Relocation*

Relocation of the flood protection barrier dike from S 196th Street to the southern boundary of the site (approximately 120 to 140 feet north of S 204th Street) is proposed during the infrastructure development phase. At its existing location, the flood protection barrier dike precludes development south of the dike, because it would be infeasible to obtain flood insurance. The flood protection barrier dike would be relocated in the infrastructure development phase and would provide emergency flood protection for the entire site. It would extend from the Green River levee, across the valley at a corresponding elevation (35 feet). The relocated flood protection barrier dike would separate the realigned and restored Johnson Creek and the wetland rehabilitation area from the developed portions of the site, and would provide for continuation of the existing hydrologic support to these areas.

Site grading for the flood protection barrier dike would require filling portions of the Johnson Creek basin flood storage area (approximately 30 acres or 105 acre-feet of flood plain storage below elevation 22.0, the 100-year flood elevation). Changes in hydrology and the loss of flood storage as a result of relocating the flood protection barrier dike were analyzed using the HSPF model. Based on the analysis, the proposed design of the Johnson Creek restoration project and new outfall to the Green River would not increase the 100-year flood elevation in the Johnson Creek ponding area (at elevation 22.0), but would provide for continued fish use of the creek (see Appendix B for further information on this analysis).

## Surface Water Quality

During infrastructure development, temporary erosion and sediment control (TESC) best management practices (BMPs) would be implemented and maintained in accordance with a Stormwater Pollution Prevention Plan (SWPPP) that would be prepared as required by the National Pollutant Discharge Elimination System (NPDES) permit (see the description of the temporary stormwater control system above).

Construction would also require an individual Section 401 Certification from Ecology, which would specify measures to reasonably assure that water quality standards would be met. Together, the NPDES permit and 401 Certification would include a variety of measures for construction stormwater discharge intended to result in no adverse impacts to water quality in receiving waters.

Temporary Erosion Sediment Control (TESC) Best Management Practices (BMPs) would be required by the NPDES permit to prevent uncontrolled sediment release to onsite watercourses, wetlands and the Green River. Sediment discharge to wetlands could adversely affect water quality or, in extreme cases, fill localized portions of the wetlands if water is channelized and contains high sediment loads. Impact risk would rise during construction in the wet season, because of the increased difficulty in preventing erosion when soils are saturated and exposed during wet weather. However, relatively rare summer storms could also have the same result. Minor turbidity and minor sediment-related impacts to onsite wetlands or ditches and ditched streams would not have long-term adverse impacts, because they are generally not long-lasting, and because wetlands and ditches are deposition environments by nature. However, short-term water quality impairment and related habitat degradation could occur if inputs were sustained or if sustained and significant turbidity reached the Green River. Short-term water quality impacts could include increases in turbidity, suspended and settleable solids, and phosphorus loading from eroded soils.

On the flat valley floor where most earthwork would occur, the existing levee along the Green River functions as a barrier to uncontrolled sediment transport. The predominantly flat site grade and levee barriers to water flow would serve to protect the Green River from construction –related impacts, provided the four existing onsite ditch and drainage systems (Stream E, the Segale Business Park stormwater system, the industrial storage yard system, and the existing Johnson Ditch system) are protected from uncontrolled runoff and sediment impacts during Southcenter Parkway construction, S 178th Street relocation, mass grading and culvert relocation. After the first year of construction, relocation of the flood protection barrier dike to the south of S 200th Street and its stabilization would create a barrier between site work and the large area of retained and restored wetlands on either side of S 204th Street, as well as the restored new Johnson Creek channel. No planned construction discharge would be directed to retained wetlands or watercourses on the site.

Construction on the western hillside could increase the risk of erosion and landslide hazard; with the proper implementation of BMPs, significant impacts would not be expected (see Section 3.1, Earth and Appendix A for further discussion of erosion/sedimentation issues).

Erosion and subsequent sedimentation could also occur if TESC BMPs were implemented but failed as a result of poor installation, unusually intense rainfall, or through lack of planned maintenance and control under the SWPPP. Impacts of erosion could only occur from the site if sediment-laden stormwater was (1) pumped to the Green River without adequate treatment, (2) allowed to flow into Stream E, which conveys water to the S 180th Street pump station vicinity, (3) allowed to flow into the ditch/ditched stream systems connected to the new Johnson Creek outfall to the Green River, (4) allowed to escape the Green River Off-Channel Habitat Restoration Area into the Green River, or (5) allowed to escape during construction of the new stormwater outfall to the Green River or abandonment of the existing Johnson Ditch floodgate and outfall. TESC BMPs for construction would be employed to prevent or minimize impacts to water quality from grading and construction work that could expose erodible soils and increase stormwater runoff rates as a result of soil exposure and compaction (see Section 3.1, Earth and Appendices A and C for further descriptions of the specific proposed TESC BMPs).

### *Dewatering*

Dewatering would be required during construction around the Green River Off-Channel Habitat Restoration Area excavation, around the new Johnson Creek excavation, around the southern stormwater ponds during construction, and for other construction elements requiring excavation below the alluvial water table or near wetlands, streams or springs. Dewatering would not occur from inside any excavation, but only from clean groundwater via dewatering wells. Minor dewatering may be necessary for utility installation in Southcenter Parkway, and could occur from within utility trenches as required for construction. This dewatering discharge would enter the site construction stormwater treatment system. Major dewatering would result in clean water bypassing the construction site for discharge directly to the Green River. Neither source of dewatering (major or minor) discharge would adversely affect water quality with the proposed mitigation to avoid or remove turbidity in the dewatering discharge.

### *Petroleum-Based Products*

The use of heavy equipment during construction typically requires onsite fueling and often limited storage of products, such as lubricating oil and hydraulic fluid, which creates a risk for accidental spills. Unintended release of fuels, oil or hydraulic fluid could contaminate soils and, if untended or uncontrolled, migrate to groundwater or into surface water resources. The SWPPP would identify plans for control measures and spill response to prevent or control construction equipment leakage of fuel, oil or hydraulic fluid. Water quality impacts from construction spills could be prevented or limited to very local areas by BMPs and accidental spill provisions, as required by the NPDES permit (see Appendix C for details).

*Concrete Work*

Construction of curbing, foundations, driveways, sidewalks and other infrastructure includes concrete work which can raise pH in stormwater if contact with stormwater occurs during curing. Curing times vary with weather conditions and concrete types. Management of the higher pH runoff where concrete is used, along with pH monitoring, would be necessary to avoid pH impacts to water resources and could be handled through a variety of options at the Tukwila South site. Concrete affected runoff could be isolated from other non-affected construction runoff, depending on the scale of work (see Appendix C for concrete work management options). Rinsing of concrete-related equipment could also raise pH in runoff, and would need to be stringently controlled by provisions of the SWPPP. Concrete equipment wash water would be recycled plant process water, which would be stored with other process water in a separate lined detention pond or above ground storage tank for reuse in the batch plant or disposal/recycling at an approved offsite location (see Appendix C for further information).

*Soil Amendment for Compaction*

Although not expected because of soil conditions and the intent to perform major earthwork during drier weather, concrete products may be required to achieve soil compaction standards where work is necessary in saturated or wet till soils. If soil amendments for soil compaction were required, it would likely be a late-season use to compact a wet till subgrade to allow paving before late fall wet conditions commence, in order to reduce winter erosion potential. The Tukwila South project would seek to avoid such use by scheduling subgrade completion prior to the start of wet weather in the fall. If, despite this intent, the use of Portland cement or an equivalent as a soil amendment is necessary, it could increase the pH in stormwater runoff that comes in contact with the amendment or recently amended and exposed soils.

Management of higher pH runoff would be necessary where concrete would be used to avoid pH impacts to water resources. As identified above, management of concrete affected runoff would be addressed in the SWPPP. BMPs would be employed to prevent adverse impacts during concrete amendment to achieve soil compaction (see Appendix C for details).

Monitoring results from construction of another Puget Lowlands project (the Redmond Ridge Urban Planned Development in Redmond, Washington) were used to evaluate the risk of pH impacts to receiving water from the use of soil amendments at the Tukwila South site. Redmond Ridge used concrete as a soil amendment and monitored runoff during application between August 2000 and March 2003, in response to storms. Samples were collected upstream and downstream of the soil amendment work. Based on the Redmond Ridge data, a slight upward shift in average pH of about 0.2 pH units would be expected. This difference, and the pH values measured at Redmond Ridge, would comply with the state water quality standards for pH (6.5 to 8.5, or background, with a human-caused change of 0.2 pH units). Therefore, because of the many options available for management of concrete-affected runoff under the SWPPP, and data from a comparable development, it was concluded that it would be feasible to avoid adverse pH effects to receiving waters, if concrete products were used for soil compaction at the site.

### *Temporary Concrete Batch Plant*

A temporary (portable) concrete batch plant could be used onsite during the infrastructure development phase, if economically warranted by the need for concrete during construction of the Tukwila South project. The temporary concrete plant could start in operation in 2008 or later, as need dictates. A temporary plant could be required more than once during full buildout. The plant would not service other projects outside of the construction site. A Sand and Gravel NPDES permit would be obtained through Ecology prior to operating the batch plant. If the batch plant is operated for longer than 18 months, it would need to obtain a permit from Ecology for a permanent batch plant.

The portable concrete batch plant would be located in one place onsite, as dictated by need. The batch plant would have the capability to recycle concrete wash water and could have the capability to reuse stormwater from the site as process water by use of lined ponds or possibly above-ground storage tanks (ASTs). Alternatively, stormwater from the batch plant could be routed to the long-term construction treatment ponds for pH adjustment, as warranted, for polymer treatment. The plant would require temporary aggregate stockpile areas that would drain to the long-term construction stormwater management system. The batch plant would be located on a bermed asphalt pad to control drainage. The footprint of the batch plant would likely occupy approximately ½ acre. As a result, stormwater runoff in contact with the plant would be relatively limited. The SWPPP would be required to satisfy requirements for a Sand and Gravel General Permit to cover the period of time the batch plant would be required, in addition to the requirements for the NPDES General Permit for Stormwater Discharge Associated with Construction Activities (see Appendix C for details).

Process water generated during concrete production would be stored in a separate lined detention pond or ASTs located adjacent to the concrete plant. Three options are possible for handling stormwater runoff from the batch plant:

(1) Reuse of batch plant runoff within the temporary batch plant;
(2) Treatment of batch plant runoff with other construction runoff; or,
(3) Transport offsite for recycling.

(See Appendix C for further information.)

### *Summary of Construction Impacts*

Under Alternatives 1 and 2, minor and short-term discharge of fine sediments to the Green River would occur when the Green River Off-Channel Habitat Restoration Area is connected to the river during the second year of construction, despite use of a sediment control (i.e., a sediment curtain) in the river. Discharge of sediment could occur periodically during new outfall construction through the Green River levee or if uncontrolled runoff enters Stream E or existing Johnson Ditch during the first year of construction. With proper site inspection and implementation of the Stormwater Pollution Prevention Plan (SWPPP), and with implementation of all other permit conditions, none of these sediment releases would be expected to result in significant impacts in the short-term, or adversely impact aquatic habitat in the long-term.

Once the flood protection barrier dike is relocated south of S 200th Street and the wetland rehabilitation work is complete, the barrier dike would form a barrier between all further construction and the new Johnson Creek and associated wetlands. Once the Southcenter Parkway extension is completed, it would form a barrier between all further onsite construction work and uncontrolled runoff into the retained portion of Stream E draining to the S 180th Street pump station vicinity. Redevelopment of the existing Segale Business Park could introduce sediment in runoff to the P-17 pump station if storm drains were not closed to uncontrolled runoff.

Nearly all construction runoff would be managed by polymer treatment at the south end of the site and discharged after testing to the Green River. Because of testing prior to batch release, and controlled discharge by pumping at this location, no turbid discharge or pH impacts to the Green River, sufficient to adversely impact habitat through water quality impacts, would be expected.

## Groundwater

Under Alternatives 1 and 2, the site would transition from a predominately pervious site to a developed site with impervious surfaces. Stormwater collected from impervious surfaces would be routed through temporary and permanent stormwater control systems and would eventually discharge to the Green River. These systems would be installed during the infrastructure development phase. Because the site is located in a groundwater discharge area, characterized by relatively short groundwater flow paths, significant adverse impacts to water quantity in underlying aquifers during the infrastructure development phase would not be expected.

Construction on the site would temporarily impact the alluvial (Qal) aquifer through construction dewatering (see the previous discussion of dewatering in this section). Construction dewatering has the potential to reduce water quantity to nearby water users in the alluvial aquifer. The nearest water user within the alluvial aquifer (irrigation well 03R1) is located approximately 1,000 feet south of S 204th Street. However, dewatering analyses indicate that the radius of influence from any dewatering well would be approximately 300 to 500 feet (GeoEngineers, Inc., 2005). Therefore, no probable significant impacts to water users from construction dewatering would occur.

Onsite water sources identified in Table 5-2 in Appendix A that currently provide water to a La Pianta LLC business or tenant would need to be abandoned or replaced prior to mass grading or S 178th Street construction in Planning Area B.

### *$Qpog_1$ and $Qpog_2$ Aquifers*

As part of the initial mass grading, a portion of Planning Area B (see Figure 2-3) would be excavated to provide structural fill material for other portions of the site, and to build the northern stormwater pond. The ground surface would be lowered by up to about 65 feet in some portions of Planning Area B to achieve site grades. Where mass grading would lower the ground surface below approximately elevation 70 to 75 feet, the $Qpog_2$ aquifer could be exposed. Under the proposal, any groundwater seepages would be conveyed through horizontal drains, and the discharge would be transported downslope. No water users or springs are identified downgradient of Planning Area B; therefore, no probable significant impacts would occur.

## Full Buildout

As described above, a comprehensive, permanent stormwater control system for the Tukwila South Project would be installed in the infrastructure development phase. The stormwater control system would be designed and constructed in accordance with the standards and specifications set forth in the King County Surface Water Design Manual (1998). This permanent stormwater control system would be designed to manage runoff from full buildout. As specific development occurs during full buildout, connections to the permanent stormwater control system would be made.

### Surface Water Quantity

*Hydrologic Analysis*

Full buildout under Alternative 1 and 2 would result in an increase in impervious surface areas onsite, including streets, driveway, sidewalks, parking areas and rooftops, thereby decreasing the area available for stormwater absorption. For purposes of analysis, it was assumed that Alternatives 1 and 2 would result in the same total developed footprint and impervious surface area. Because no specific building plans have been developed at this stage, it is assumed that the higher intensity land uses under Alternative 1 would result in taller buildings and separate, multistoried parking structures, as compared to Alternative 2. It is possible that Alternative 1 would result in more parking below buildings than under Alternative 2 (reducing the proportion of exposed parking and increasing the proportion of rooftops); it is also possible under Alternative 2 that less dense development could be more “spread out”, requiring more building and parking area, relative to Alternative 1. Therefore, the assumptions for Alternative 1 are considered conservative.

All drainage calculations and modeling of stormwater runoff in the Draft MDP conservatively assumed that 85 percent of all developed areas onsite would be covered in impervious surfaces. It is unlikely that this impervious surface area coverage would be achieved over the entire developed portion of the site at full buildout, however. Therefore, design of the stormwater control system using this assumption would provide a conservative factor of safety. Further, the assumed site-wide volumes and rates of stormwater runoff, and the areas of pollutant-generating surfaces, are likely overestimated in this Draft EIS.

Since it was assumed that Alternatives 1 and 2 would result in the same total developed footprint and impervious surface area, the hydrologic analysis (and water quality analysis) assumed that they would generate the same volumes and rates of stormwater runoff.

*South 180$^{th}$ Street Pump Station Capacity.* Under Alternatives 1 and 2, stormwater runoff from the north basin would be directed to the S 180$^{th}$ Street pump station vicinity after receiving water quality treatment in the north pond. The Stormwater Management Model (SWMM Model) was used to evaluate the capacity of the pump station. SWMM is an event-based model that simulates hydraulic performance for discrete events (ranging from hours to weeks), rather than a continuous period like HSPF model. The maximum simulated discharge from the S 180$^{th}$ Street pump station would be 31.2 cfs (14,000 gallons per minute) including existing flows and stormwater flows from the site. The operating capacity of the existing pumps in the pump station is 43.7 cfs (19,600 gpm). Therefore, the pump station has adequate existing capacity to handle stormwater flows from the site with development under Alternatives 1 and 2 with one full pump held in reserve (see Appendix B for details).

*North Basin Flow Control and Facility Design.* The above analysis was conducted to verify the performance of the pump station to ensure that adequate storage would be provided in the proposed north stormwater pond to attenuate flows prior to discharge to the pump station. This analysis determined that approximately 12 acre-feet of live storage in the pond would be required to reduce peak flows and allow the existing pump station and the proposed stormwater conveyance to adequately contain all simulated flood events (12.9 acre-feet of storage is proposed).

*South Basin Flow Control and Facility Design.* As described previously, stormwater runoff from the central and south basins would be routed to a stormwater pond in the southern portion of the site prior to discharge to the Green River via gravity and pumped outfalls. All runoff from the central basin would be routed via stormwater pipes to the south basin. The stormwater pond would attenuate increases in peak flows and achieve Level 1 flow control (14.7 acre-feet of storage is proposed). Level 1 flow control from a site with no identified downstream hazards requires future discharge from the site to match the 2-year and 10-year existing conditions peak discharges. Existing peak discharges from the combined south and central basins were simulated using the HSPF model based on data for the 1949-2001 time period. The existing conditions 2-year and 10-year peak flows were estimated to be 8.2 cfs and 13.5 cfs, respectively. The stormwater pond would be designed to match these 2- and 10-year peak discharges for the southern portion of the site (see Appendix B for further information).

*Green River Management Agreement and Pump Operations Procedures Plan Requirements.* As described previously, the Green River Management Agreement (GRMA) and Pump Operations Procedures Plan (POPP) provide design guidelines for outfalls to the Green River. City staff has determined that:

- The north and northeast basins which drain to the Green River via the S 180th Street pump station and P-17 pump station, respectively, would not be subject to POPP, since these pump stations were in place at the time the GRMA was reached and discharges from these pump stations are not regulated under the agreement. (Note: all pump stations within the area served by the King County Flood Control District are subject to Emergency Shutdown Procedures.)
- The south basin discharges would be subject to POPP requirements for runoff from developed portions of the site. These requirements would primarily apply to the proposed south pond pump station. The requirements would be addressed by provisions to contain the 100-year, 7-day runoff volume within the south pond or other low-lying areas of the site, or within the Green River Off-Channel Habitat Restoration Area. This would allow the pump station in this pond to continue to operate at all times, including during 12,000 cfs events in the Green River. The POPP requirements could require that discharges from the site to the Green River be suspended while the River is at flood stages. If unmitigated, this could result in flooding of portions of the site

The 100-year, 7-day storage requirement for the south basin would result in approximately 106 acre feet of storage. The Green River Off-Channel Habitat Restoration Area is proposed to be excavated between approximately elevation 5.0 and the 12,000 cubic feet per second (cfs) stage (assumed to be elevation 32.0) and would provide 118 acre feet of storage. Therefore, the provisions of the POPP requirement for the south basin would be met.

An analysis of the south pond and south pond overflows to the Johnson Creek basin was performed. The analysis was conducted over the historic period of record to determine if there would be any impacts if the south pond pump station were to be shut down for all durations that the Green River was flowing at or above 12,000 cfs. The analysis of the Johnson Creek basin floodplain with the south pond pump shut down showed that the floodplain would be maintained and would not exceed predeveloped levels (see Appendix B for additional information).

*Backwater Analysis.* Pursuant to King County Surface Water Design Manual (SWDM) Core Requirement #4, all engineered conveyance system elements must be analyzed, designed and constructed to provide protection against overtopping, flooding, erosion and structural failure. Because the stormwater conveyance within the Southcenter Parkway extension would be new construction, it must be designed with sufficient capacity to convey and contain the 25-year peak flow. In events larger than the 25-year design event, the pipe system may overtop provided the overflow from a 100-year event does not create or aggravate a severe flooding or erosion problem.

The King County Backwater model was used to perform a backwater analysis of the major site stormwater pipes. The model was used to size the stormwater conveyance pipes within the proposed Southcenter Parkway extension that would route runoff to both the north and south stormwater ponds (see Appendix B for details).

*Northeast Basin Surcharging.* As indicated previously, drainage reports prepared for construction in the Segale Business Park indicate that some of the stormwater control system under the business park roads in the northeast basin may experience surcharging. Alternative 1 and 2 would not increase the effective impervious area within the northeast basin; therefore, any surcharging in the system would not likely be altered or exacerbated.

## Surface Water Quality

### *Stormwater Contaminants*

Vehicles are the main contaminant source for mixed use urban developments similar to Tukwila South. Vehicles typically deposit an array of organic and inorganic pollutants to roadways and parking areas, which accumulate and then wash off with stormwater runoff. These include heavy metals, petroleum products, and solids. Oils and greases contain lead and zinc, tire wear contributes zinc, moving parts of automobiles wear and deposit lead and copper, and brake linings and protective coatings to undercarriages contain copper. Streets themselves degrade to some extent, contributing suspended sediments to stormwater runoff. Roadways also collect runoff from landscaping when rainfall is heavy enough to saturate soils. Leaves dropping onto roadways release measurable concentrations of phosphorus as they degrade. Stormwater washes these contaminants from roadways and conveys them to the stormwater control system, where the water is treated and discharged. Concentrations of pollutants in stormwater are highly variable by site, and are affected by numerous factors, such as traffic volume, parking characteristics, storm intensity, rainfall pattern within a given storm, amount of time since the last storm, road maintenance (such as street sweeping), and airborne contributions from adjacent land use. In general, the quality of stormwater runoff from roadway systems appears to strongly relate to adjacent land uses through airborne deposition, although the influence of other variables contributes to stormwater quality.

The following section is a brief overview of stormwater contaminants typical of urban developments, such as Tukwila South.

*Metals.* Data for developed runoff have shown a dramatic decline in lead and all other automotive pollutants from roadways and parking lots since the 1980's, due to improvements in automobile design, automotive emission controls and catalytic converters. Lead (Pb) in stormwater runoff originating from streets is mainly associated with particulates and mainly originates from wear of moving vehicle parts. The primary source of roadway copper (Cu) is wear from vehicle parts, such as brakes, alternators, and radiators. Zinc (Zn) is an abundant trace mineral that occurs naturally in water bodies. A substantial source of zinc on roadways is the result of tire wear. Lesser amounts of zinc originate from brake linings and exhaust emissions. Galvanized metal in structures are also a source of zinc. Zinc is not considered a carcinogenic metal and federal agencies have no specified health limits for zinc. However, Washington State water quality standards for zinc do exist, and are used by King County as an indicator for the management and control of all heavy metals in stormwater.

*Oil, Grease, and Total Petroleum Hydrocarbons (TPH).* Oil and grease have natural vegetative and manmade components. Total petroleum hydrocarbons (TPH) are a subset of oil and grease derived solely from petroleum products and are more volatile than oil and grease. TPH results from spills, leaks, antifreeze, hydraulic fluids, and asphalt leachate. Oil and grease and TPH have poor solubility in water and are hydrophobic, which means they readily separate from the aqueous phase and adhere to solid surfaces when the opportunity is afforded. Appreciable amounts of oil and grease can remain dispersed in water in emulsified form. Oil and grease and TPH that adhere to emergent surfaces are degraded by microbial digestion, sunlight (photochemical degradation), and volatilization.

*Total Suspended Solids (TSS).* Suspended solids are comprised of inorganic and organic material and can be transported by, suspended in, or deposited by stormwater. Suspended solids are generally considered to be one of the most substantial nonpoint source contaminants, because other contaminants bind to fine particulates. Metal ions, organic chemicals, and phosphorus bind to and are transported by fine particulates.

*Nutrients.* Nutrients tend to build up on impervious surfaces. Nitrogen (N) and phosphorus (P) occur in stormwater runoff from: roadways, fertilizers used in landscaping, exterior use of detergents, and sediment erosion. Nitrogen occurs in numerous forms, including dissolved molecular nitrogen, ammonia-nitrogen ($NH_3$-N), and nitrate- and nitrite-nitrogen ($NO_2$-N and $NO_3$-N, respectively). Nitrogen is also reduced to nitrogen gas and volatilized (lost to the atmosphere) through microbial activity (denitrifying bacteria), usually under anaerobic (no or low oxygen) conditions, which can occur in wetlands. Phosphorus, unlike nitrogen, readily binds to aluminum and iron in sediments, where it is immobilized, though still available to plant root uptake. Phosphorus can be converted from mineral form in sediments to dissolved form in water under anaerobic conditions.

*Pesticides and Herbicides.* Some landscaping pesticides and herbicides can be transported in stormwater runoff. The mobility and persistence of pesticides varies greatly. Where measured, the appearance of landscape chemicals in urban settings tends to be sporadic and has not been associated with toxic effects to surface waters. Organic pesticides used in residential gardens are not reported as a significant problem in surface runoff treatment facilities, where their occurrence is unpredictable in measurable quantities. Studies of urban runoff in the 1980s found pesticides in untreated surface runoff at concentrations above chronic standards; however, no violations of standards in receiving waters were noted and it was concluded that, due to dilution, flushing, adsorption, and sediment deposition, no acute toxicity problems were found (see Appendix C for further information on these studies). Other studies performed in the late 1980s and 1990s found that pesticides in untreated runoff were not detected at levels exceeding existing state or federal freshwater aquatic life criteria. Although no violations of state toxicity standards were found, four pesticides (diazinon, mevinphos, malathion [all insecticides], and diuron [an herbicide]) were found in surface waters at levels exceeding maximum concentrations recommended for the protection of aquatic life. As a result, these products have come under increasing scrutiny. The use of diazinon is being phased out. Other pesticides have also come under scrutiny and are being restricted (i.e., Dursban/Chlorpyrifos).

*Fecal Coliforms.* Fecal coliforms in stormwater are an inevitable result of development because natural filtering pathways for stormwater runoff, such as interflow through shallow soils and sheetflow through forest duff and vegetation are replaced by impervious surfaces and stormwater treatment facilities. Residential pets can be a considerable source of fecal coliforms; however wildlife, including birds, are sources of fecal coliforms that collect on impervious surfaces until storms wash them into stormwater facilities. Fecal bacteria densities have been shown to be related to housing density, the percentage of impervious surface, and domestic animal density. Fecal coliforms tend to be extremely variable and peak values are immediately responsive to storms, making average outflow concentrations difficult to predict.

*Biochemical Oxygen Demand (BOD).* BOD is a measure of the amount of biochemically degradable organic matter present, and is defined by the amount of oxygen required for aerobic micro-organisms to oxidize the organic matter. This type of metabolism consumes oxygen and lowers the oxygen content in water. Generally, stormwater runoff from urban development carries a very low biochemical oxygen demand concentration, unlike runoff from agricultural areas with significant livestock use or discharge from wastewater treatment plants. Because EIS Alternatives 1 and 2 assume either urban mixed use or industrial/warehouse and retail areas, BOD is not included in this analysis.

*Temperature.* The temperature of urban runoff during summer storms is often thought to be warm, because of influence from impervious surfaces and wet ponds. However, stormwater runoff in western Washington only rarely coincides with warmer weather. Most stormwater runoff events, and the vast majority of runoff volume, occur during the cooler weather seasons (see Appendix C for further information).

### *Stormwater Quality Analysis*

Stormwater quality was forecast for this Draft EIS by the following method:

(1) Untreated stormwater runoff quality for each assumed land use category was estimated using data from previous studies at sites with similar land uses to each category.

(2) Stormwater runoff from different land use categories to be served by the same stormwater facility was proportionately mixed on the basis of contributing area.

(3) The quality of the combined inflow to each stormwater facility was modified by the expected performance of each proposed facility to estimate the quality of discharge. Basic wetponds designed to King County SWDM (1998) standards are proposed to treat untreated stormwater runoff in the north and south basins. Redevelopment in the northeast basin would be treated by one or more wet vaults built to King County SWDM (1998) standards.

The forecast quality of the treated discharge was directly compared (prior to dilution or mixing) to State surface water quality standards, background water quality in the Green River receiving water and sublethal fisheries effects data from the literature. The first two criteria were described under Affected Environment. Sublethal effects include water chemistry-induced changes in physiology and or behavior that affect the competitive vitality or reproductive potential of a fish population without direct lethal effect. This criterion is presented in Table 3-10 in Appendix C as a literature based 'desirable limit'. The state water quality standards, on the other hand, include a factor of safety to avoid lethal effects, but are not necessarily tied to sublethal effects data. The state water quality standards are intended to protect all beneficial uses of surface water, including the protection of aquatic biota.

Stormwater volumes were used in the water quality assessment to evaluate combined site impacts on the Green River. Combined site water quality impacts on the Green River were evaluated on a seasonal and annual basis.

Stormwater runoff from the site would be treated for quality by wet ponds and wet vault(s). These water quality facilities would be designed consistent with the Basic Water Quality Menu in the King County SWDM (1998). For the water quality analysis, wet pond and wet vault contaminant removal efficiencies were derived from the literature as shown in Table 3-5 in Appendix C. Also see Appendix C for a discussion of the methods used for the water quality analysis.

*Onsite Basin Discharge Water Quality.* An analysis was performed of the discharge to the Green River from each of the site's developed basins (the northeast, north and south basins). As indicated previously, baseflows entering the developed portion of the site from undeveloped on and off site areas on the western hillside would bypass the stormwater system. This analysis evaluated the cumulative impact of the combined onsite basins on the Green River (see Entire Site Water Quality later in this section for layouts to the Green River).

The forecast for untreated stormwater runoff quality under Alternatives 1 and 2 is shown in Table 3.2-1. Untreated stormwater runoff from the site would be improved by transit through either a wet pond or wet vault using the contaminant removal efficiencies shown in Table 3-5 in Appendix C. The forecast quality of treated discharge from each basin is shown in Tables 3.2-2 through 3.2-4.

*Northeast Basin.* A basic wet vault is proposed to provide water quality in the northeast basin upon redevelopment of the Segale Business Park. After treatment, discharge would be routed to the City's P-17 pump station and ultimately to the Green River. No water quality treatment is currently provided in this basin. Stormwater quality of the discharge from the wet vault would be superior in quality to that under existing conditions, and would be superior to the offsite contributions to the P-17 pump station discharge. Therefore, the quality of discharge from the P-17 station to the Green River would be improved relative to the existing condition.

Water quality standards apply to receiving water, and not to water within a stormwater pipe directing water to a pump station. However, for the purpose of this analysis, treated stormwater at discharge from the vault was conservatively and directly compared to the Green River downstream baseline water quality and water quality standards. Wet vault discharge is expected to be within the chronic water quality standards for all parameters assessed, except for fecal coliforms. The fecal coliform concentration in the treated stormwater would be well within the Green River background range, and would be less than under existing conditions. Stormwater BMPs are not well suited for the removal of fecal coliforms and there are no alternative facility designs likely to improve fecal coliform removal.

**Table 3.2-1**
**FORECAST UNTREATED STORMWATER RUNOFF QUALITY BY DEVELOPED BASIN FOR ALTERNATIVES 1 AND 2**

| Parameter | Northeast Basin Wet Vault | North Basin Wet Pond | South Basin Wet Pond |
|---|---|---|---|
| Dissolved Copper (µg/L) | 1.4 | 2.0 | 1.7 |
| Dissolved Lead (µg/L) | 1.5 | 1.4 | 1.3 |
| Dissolved Zinc (µg/L) | 24 | 27 | 29 |
| Nitrate plus Nitrite-Nitrogen (mg/L) | 0.34 | 0.34 | 0.37 |
| Ammonia-Nitrogen | | | |
| Total (µg/L) | 143 | 180 | 152 |
| Unionized (µg/L) | 0.39 | 0.49 | 0.42 |
| Total Phosphorus (mg/L) | 0.11 | 0.11 | 0.10 |
| TSS (mg/L) | 20 | 21 | 19 |
| Turbidity (NTU) | 19 | 20 | 20 |
| Fecal Coliforms (colonies/100 mL) | 320 | 363 | 335 |
| Oil and Grease (mg/L) | 2.9 | 2.7 | 2.8 |

*Source: A.C. Kindig, 2005.*

Dissolved copper, lead and zinc, ammonia-nitrogen, total phosphorus, total suspended solids and turbidity would be reduced relative to existing conditions. All of these parameters would be within state standards in the vault discharge, but would be above the average background concentrations measured in the Green River near the point of discharge. Dissolved zinc and oil and grease concentrations are forecast to be greater than their measured ranges in the Green River; all other parameter concentrations would be within their observed ranges. Dissolved zinc is forecast to be slightly above the fisheries sublethal limit, but would be about 2.7 times less than the maximum state water quality standard for zinc, which includes protection of aquatic biota (see Table 3.2-2).

**Table 3.2-2**
**FORECAST STORMWATER RUNOFF FROM THE NORTHEAST BASIN UNDER ALTERNATIVES 1 AND 2**
**(Discharging to the P-17 Pump Station which Discharges to the Green River)**

| Parameter | Existing Discharge Quality Measured On-Site | Forecast Wet Vault Treated Stormwater | Baseline Downstream Green River (RM 12.4) Water Quality | Water Quality Standards (chronic) (Downstream Green River Standards) | Desirable Fisheries Sublethal Limits (Table 3-10 App. C) |
|---|---|---|---|---|---|
| Dissolved Copper (µg/L) | Range <1.0-5.0 Average 1.6 | 0.85 | Range <1.0-1.2 Average 0.60 | 4.3 (1) | 2.5 |
| Dissolved Lead (µg/L) | Range <1.0-2.0 Average 0.73 | 0.69 | Range <1.0-1.7 Average 0.47 | 0.71 (1) | 11 to 16 |
| Dissolved Zinc (µg/L) | Range 16-49 Average 28 | 15 | Range <1.0-8.0 Average 2.3 | 40 (1) | 12 |
| Nitrate plus nitrite-Nitrogen (mg/L) | Range <0.01-0.09 Average 0.028 | 0.29 | Range <0.01-0.78 Average 0.37 | None | Less than 250 |
| Ammonia-Nitrogen Total (µg/L) Unionized (µg/L) | Range <5.0-92 <0.01-0.25 Average 32 0.09 | 129 0.35 | Range <5.0-152 <0.01-0.42 Average 29 0.08 | 2,100 6.0 | 7,300 20 |
| Total Phosphorus (mg/L) | Range 0.031-0.11 Average 0.068 | 0.058 | Range <0.01-0.21 Average 0.053 | None | No direct adverse effects |
| TSS (mg/L) | Range 5-17 Average 11 | 4.0 | Range 1.0-326 Average 17 | None | Less than 25 to 80 |
| Turbidity (NTU) | Range 11-35 Average 20 | 3.8 | Range 1.4-100 Average 3.7 | <5 NTU over background | -- |
| Fecal Coliforms (colonies/ 100 mL) | Range 130-350 Geometric Mean 235 | 160 | Range 3-2,700 Geometric Mean 64 | 100(2) | -- |
| Oil and Grease (mg/L) | Range <1 Average 0.50 | 0.89 | 0.50 | "avoid sheen" | -- |

*Source: A.C. Kindig, 2005.*

[1] Background dissolved metals standard based on an average hardness of 32 mg/L for the downstream Green River Station (RM 12.4).

[2] The fecal coliform standard is a geometric mean, which no more than 10 percent of the samples exceeding 200 colonies/100 mL.

**Table 3.2-3**
**FORECAST STORMWATER RUNOFF QUALITY FROM THE NORTH BASIN UNDER ALTERNATIVES 1 AND 2**
**(Discharging to the 180th Street Pump Station Vicinity, which Discharges to the Green River)**

| Parameter | Measured Existing North Basin Discharge (at E-Ditch) | Forecast Wet Pond Treated Stormwater | Forecast Wet Pond Treated Stormwater Mixed with North Basin Open Area Discharge | Baseline Downstream Green River (RM 12.4) Water Quality | Water Quality Standards (chronic) (Green River Standards) | Desirable Fisheries Sublethal Limits (Table 3-10 in App. C) |
|---|---|---|---|---|---|---|
| Dissolved Copper (µg/L) | Range<br><1-6.0<br>Average<br>2.8 | 1.2 | 1.3 | Range<br><1.0-1.2<br>Average<br>0.60 | 4.3 (1) | 2.5 |
| Dissolved Lead (µg/L) | Range<br><1-0.50<br>Average<br>0.50 | 0.63 | 0.62 | Range<br><1.0-1.7<br>Average<br>0.47 | 0.71 (1) | 11 to 16 |
| Dissolved Zinc (µg/L) | Range<br><1-9.0<br>Average<br>2.6 | 14.8 | 13.7 | Range<br><1.0-8.0<br>Average<br>2.3 | 40 (1) | 12 |
| Nitrate plus nitrite-Nitrogen (mg/L) | Range<br>0.09-0.40<br>Average<br>0.23 | 0.15 | 0.16 | Range<br><0.01-0.78<br>Average<br>0.37 | None | Less than 250 |
| Ammonia-Nitrogen<br>Total (µg/L)<br>Unionized (µg/L) | Range<br><5.0-420<br><0.01-1.2<br>Average<br>110<br>0.30 | 54<br>0.15 | 49<br>0.13 | Range<br><5.0-152<br><0.01-0.42<br>Average<br>29<br>0.08 | 2,100<br>6.0 | 7,300<br>20 |
| Total Phosphorus (mg/L) | Range<br>0.020-0.062<br>Average<br>0.042 | 0.057 | 0.056 | Range<br><0.01-0.21<br>Average<br>0.053 | None | No direct adverse effects |
| TSS (mg/L) | Range<br>4-12<br>Average<br>7 | 4.2 | 4.3 | Range<br>1.0-326<br>Average<br>17 | None | Less than 25 to 80 |
| Turbidity (NTU) | Range<br>2.1-13<br>Average<br>5.5 | 4.0 | 3.6 | Range<br>1.4-100<br>Average<br>7.3 | <5 NTU over background | -- |
| Fecal Coliforms (colonies/ 100 mL) | Range<br>12-270<br>Geometric mean<br>28 | 181 | 168 | Range<br>3-2,700<br>Geometric mean<br>64 | 100(2) | -- |
| Oil and Grease (mg/L) | Range<br><1.0-3.9<br>Average<br>1.4 | 0.67 | 0.68 | Range<br><1<br>Average<br>0.50 | "avoid sheen" | -- |

*Source: A.C. Kindig, 2005.*

1 Background dissolved metals standard based on an average hardness of 32 mg/L for the downstream Green River Station (RM 12.4).

2 The fecal coliform standard is a geometric mean, for which no more than 10 percent of the samples can exceed 200 colonies/100 mL.

**Table 3.2-4**
**FORECAST STORMWATER RUNOFF QUALITY FROM THE SOUTH BASIN TO THE GREEN RIVER**

| Parameter | Forecast Wet Pond Treated Stormwater | Baseline Upstream Green River (RM 18.3) Water Quality | Water Quality Standards (chronic) (Green River Standards) | Desirable Fisheries Sublethal Limits (Table 3-10 in Appendix C) |
|---|---|---|---|---|
| Dissolved Copper (µg/L) | 1.0 | Range<br><1.0<br>Average<br>0.50 | 4.1 [(1)] | 2.5 |
| Dissolved Lead (µg/L) | 0.58 | Range<br>0.15-2.0<br>Average<br>1.1 | 0.66 [(1)] | 11 to 16 |
| Dissolved Zinc (µg/L) | 16 | Range<br><1.0-6.0<br>Average<br>1.9 | 38 [(1)] | 12 |
| Nitrate plus nitrite-Nitrogen (mg/L) | 0.17 | Range<br>0.01-0.63<br>Average<br>0.33 | None | Less than 250 |
| Ammonia-Nitrogen<br>Total (µg/L)<br>Unionized (µg/L) | <br>46<br>0.13 | Range<br><5-63<br><0.01-0.17<br>Average<br>27<br>0.07 | <br>2,100<br>6.0 | <br>7,300<br>20 |
| Total Phosphorus (mg/L) | 0.050 | Range<br>0.014-0.26<br>Average<br>0.045 | None | No direct adverse effects |
| TSS (mg/L) | 3.7 | Range<br>3.0-314<br>Average<br>23 | None | Less than 25 to 80 |
| Turbidity (NTU) | 4.0 | Range<br>1.3-96<br>Average<br>9.2 | <5 NTU over background | -- |
| Fecal Coliforms (colonies/ 100 mL) | 167 | Range<br>15-820<br>Geometric Mean<br>112 | 100[(2)] | -- |
| Oil and Grease (mg/L) | 0.71 | Range<br><1-3.8<br>Average<br>1.3 | "avoid sheen" | -- |

*Source: A.C. Kindig, 2005.*

[1] Background dissolved metals standard based on an average hardness of 30 mg/L for the upstream Green River Station (RM 18.3).

[2] The fecal coliform standard is a geometric mean, which no more than 10 percent of the samples exceeding 200 colonies/100 mL.

*North Basin.* A basic wet pond is proposed to treat stormwater runoff in the north basin. Discharge from the pond would combine downstream with undeveloped area baseflow and stormwater flow contributions before leaving the site. This water would flow to the S 180th Street pump station vicinity, which pumps water into a pressurized stormwater pipe conveying untreated stormwater from I-5 to the Green River. Taken alone, pond discharge is expected to be within the chronic water quality standards for all of the parameters assessed, except fecal coliforms, although fecal coliforms would be within their respective measured Green River background averages and ranges.

Dissolved copper, dissolved lead, dissolved zinc, ammonia-nitrogen, total phosphorus, and oil and grease are forecast to be above the average downstream background condition in the Green River. All of these parameters except dissolved zinc would be well within the Green River downstream background range.

Relative to the existing condition, north basin flows to the S 180th Street pump station vicinity would improve under Alternatives 1 and 2 for dissolved copper, nitrate- and nitrite-nitrogen, ammonia-nitrogen, total suspended solids, turbidity, and oil and grease, because untreated and Southcenter Parkway stormwater runoff under the existing condition would be replaced by wet pond treated runoff from development. Dissolved lead and total phosphorus would increase slightly, and dissolved zinc and fecal coliforms would increase more substantially. Collectively, the quality of the discharge would be improved for nearly all of the toxic constituents of storm water. Consequently, the quality of discharge from the S 180th Street pump station to the Green River, including the I-5 offsite contribution, would improve somewhat (see Table 3.2-3).

*South Basin.* A basic wet pond is proposed to treat stormwater in the south basin. After treatment, discharge would be routed directly to the Green River through a new outfall via gravity or pressurized pipes, depending on the river's elevation. The pond discharge is expected to be within the chronic water quality standards for all of the parameters assessed, with the exception of fecal coliforms. The fecal coliform concentration in the treated stormwater runoff is forecast to be well within measured background averages and ranges in the Green River.

Dissolved copper, dissolved zinc, ammonia-nitrogen, and total phosphorus concentration are forecast to be above their respective average background values measured at the upstream Green River station. However, all of these parameters would be within their respective background ranges in the Green River (see Table 3.2-4).

*Entire Site Water Quality.* The combined stormwater discharge from all three basins and their anticipated influence on the Green River were evaluated (all three basins under Alternatives 1 and 2 would ultimately discharge to the Green River). The total average annual stormwater discharge from the site under Alternatives 1 and 2 would be 1,003 acre-feet/year. The developed portion of the site would contribute approximately 0.10 percent (or one-thousandth) of the Green River's volume on an average annual basis (the average annual flow in the Green River is 967,220 acre-feet/year). This statistic is useful to understand the order of magnitude of the potential site water quality influence on the Green River.

When stormwater from the entire site is mixed with the Green River on a conservative seasonal basis (i.e., 30 percent flow exceedance), there would be no change to Green River water quality. The existing beneficial uses would be protected as required under the state water quality standards (including antidegradation) and the federal antidegradation policy (see Table

3-17 in Appendix C). The site has little influence on the quality of water in the Green River, because of its small contribution to total flow, and because for most parameters, the discharge quality would be very close to background quality.

Overall, the increase in stormwater volumes and the changes in discharge quality on a combined site basis would have no adverse impacts on Green River water quality downstream, or measurable change to Green River water quality, as a result of the proposed stormwater treatment. No adverse impacts to the Green River water quality would be reasonably expected under Alternatives 1 and 2 for any of the quantified water quality parameters.

(See Appendix C for additional information on how the proposed water quality facilities would address the water quality parameters.)

*Existing Johnson Ditch, Onsite Watercourse, and Wetland Water Quality.* Under Alternatives 1 and 2 existing Johnson Ditch would be relocated and restored in a new low gradient channel. The Johnson Creek mitigation plan would improve water quality by: enhancing and restoring riparian functions that provide nutrients to the creek (via leaf litter and terrestrial insects); filtering and improving the quality of water passing through the buffer; and increasing shade (which would lower the water temperature and increase the dissolved oxygen content of the water conveyed through the creek to the Green River). Baseflows quantity to new Johnson Creek would not change relative to existing conditions. However, onsite baseflow quality to the creek would improve in terms of temperature and agricultural influences. Temperature would be lower; existing agricultural influence (i.e. fertilizer and herbicide use) would cease.

Portions of Stream E and all of Streams C and D and Ditch J-1 would be filled under Alternative 1 and 2. The water quality functions of the ditches and ditched streams proposed to be filled are low, but in some areas they do provide shade, supply of leaf litter and insects, and conveyance of cool base flows to the Green River. Baseflows from these ditches and ditched streams would be conveyed in a pipe under Alternatives 1 and 2. The conveyance of baseflows from these ditches and ditched streams in a pipe would maintain cool temperatures and would protect the baseflows from stormwater influences from the developed site. Leaf litter and insect supply would be removed from Streams C and E, and Ditch J-1 as a result of piped conveyance. These functions would be reestablished with the proposed Green River Off-Channel Habitat Restoration and Johnson Creek restoration.

An analysis was performed to determine whether the net increase in wetland water quality function gained by wetland rehabilitation would fully offset the site-wide loss of water quality function from wetland fill proposed under Alternatives 1 and 2. Onsite wetlands that would be filled currently provide some water quality function. A comprehensive Sensitive Area Master Plan would be implemented during the first year of development to mitigate the fill of onsite wetlands. Water quality functions as measured by Washington State Wetland Functional Assessment Method (WAFAM) would be enhanced by wetland rehabilitation within Wetlands 10 and 11. However, this increase in water quality function would not fully offset the site-wide loss of water quality function from wetland fill. Wetland water quality function for sediment and nutrient removal would increase, while heavy metals and toxic organics removal would decrease.

Overall, Alternatives 1 and 2 would result in an improved water quality condition onsite, improved water quality delivered to streams and wetlands, and improved quality of water reaching the Green River, relative to the existing condition. Water quality wetland functions for metals and toxic organics as measured by WAFAM would be reduced, but overall wetland functions, including habitat, would be increased (see Appendix C for further information).

*Potential Green River Total Maximum Daily Load Impacts (TMDL).* A Green River TMDL is under development for fecal coliform bacteria, dissolved oxygen and temperature (see the Affected Environment section for further information). Following is a summary of the analysis of potential Green River TMDL impacts from Alternatives 1 and 2 (see Appendix C for details).

*Fecal Coliform.* Under Alternatives 1 and 2, fecal coliform concentrations in discharge from the site would rise, although they would be within the observed background range in the Green River and would have no measurable influence on the Green River concentrations downstream of the site during any season (see Table 3-17 in Appendix C). As mentioned previously, fecal coliforms are the inevitable result of development and there are no alternative stormwater facility designs likely to improve fecal coliform removal that could mitigate the anticipated fecal coliform concentrations above standards at the discharges to the Green River. All stormwater treatment facilities operate with saturated flow paths, through which fecal coliforms can be readily transmitted. Fecal coliforms do not “settle out” with other fines in wet ponds. Like all such ponds, the north and south wet ponds could attract waterfowl, which would increase fecal coliforms.

*Temperature.* Under Alternatives 1 and 2, there could be an increase in temperature from: 1) stormwater discharge from wet ponds, 2) changes to baseflows diverted around the site, and 3) the Green River Off-Channel Habitat Restoration Area. However, no adverse impacts to Green River temperatures, or aggravation of an existing temperature problem in the Green River, would result. Wet pond discharge temperatures would be within the range of background temperatures in the Green River during the summer. Therefore, Alternatives 1 and 2 would not be expected to result in any measurable temperature change in the Green River as a result of wet pond treatment. No change to discharge temperature from the northeast basin wet vault would be reasonably expected. Baseflows collected in Streams C and E, and Ditch J-1 would bypass the developed portions of the site in culverts. The baseflow conveyance of water in Streams C and E, and Ditch J-1 would maintain cooler temperatures than under existing conditions. The Green River Off-Channel Habitat Restoration Area would create a backwater refuge area, with slightly warmer temperatures at this point in the river. Any possible increases in temperature caused by the Off-Channel Restoration Area would be within the range that the historic refuge habitat would have caused in the lower Green River, and would be unlikely to counteract the benefits of the refuge habitat for fish.

*Dissolved Oxygen.* Under Alternatives 1 and 2, dissolved oxygen concentrations in the Green River could be influenced by stormwater discharge and baseflow conveyance changes. During the summer, the lower Green River is susceptible to low dissolved oxygen below water quality standards, for which a TMDL is proposed. Alternatives 1 and 2 would not be expected to result in low dissolved oxygen discharge from the site during the summer, because the stormwater ponds would tend not to discharge during the lowest flow season, and because prior monitoring of wetponds in the Puget Lowlands during the summer has shown that low dissolved oxygen does not occur during warm weather, and does not occur during storms when pond contents are well mixed and cooled.

*Hazardous Materials.* Use of the site for emerging technologies under Alternatives 1 and 2 could include shipping, storing and processing hazardous materials. Use, storage and handling of these materials is regulated by numerous city, state and federal codes and requirements. No specific lists of hazardous material can be identified at this point; however, all uses would be required to follow applicable local, state and federal laws to protect public safety and the environment. Emerging technology use of hazardous materials is not expected to present a risk of exposure or accidental introduction to stormwater conveyance systems (also see Section 3.5, Hazardous Materials).

### Groundwater Quantity

The groundwater analyses focused primarily on significant impacts to groundwater recharge beneath the Tukwila South site. The potential for significant impacts to groundwater recharge during full buildout includes:

1. Gain or loss of groundwater recharge resulting from the conversion of undeveloped land to mixed uses.

2. Impacts to underlying aquifers and downgradient groundwater usage as a result of a change in recharge.

3. Impacts to springs as a result of a change in recharge.

Alternatives 1 and 2 would have a similar potential for impacts, as described previously.

#### *Qpog$_1$ and Qpog$_2$ Aquifers*

Development occurring on the upland portions of the site (the western hillside), has the potential to impact recharge to the Qpog$_1$ and Qpog$_2$ aquifers. However, this potential impact would not be expected to be a measurable impact, because the uplands are located in a groundwater discharge zone. Development on the upland portion of the site would include portions of Planning Areas B, G, and I under Alternatives 1 and 2 (see Figure 2-3). Limited development would occur in Planning Area E (in the western portion of the site, which largely contains slopes in excess of 40 percent). Because no water users are located downgradient of the upland development, no impacts to downgradient groundwater usage as a result of a reduction in groundwater recharge would occur.

Springs downgradient from uplands in Planning Areas G and I represent discharge from the undifferentiated Qpog$_{1,2}$ aquifer, and contribute to baseflow in Streams C and J-2. These ditched streams are both tributaries to the existing Johnson Ditch under existing conditions, and would be tributaries to the new Johnson Creek under developed conditions. A reduction in aquifer recharge could reduce summer baseflows in Johnson Creek. Impacts to baseflows are discussed below.

As part of mass grading, a portion of Planning Area B would be excavated to provide structural fill material for other portions of the site, and to build the northern stormwater facility. It would be necessary to lower the ground surface up to about 65 feet in some portions of Planning Area B to achieve these site grades. Where mass grading would lower the ground surface below approximately elevation 70 to 75 feet, the Qpog$_2$ aquifer could be exposed in the cut wall. Any groundwater seepages would be conveyed from the cut wall through horizontal drains, and the discharge transported downslope. The aquifer would be anticipated to be exposed only along the cut wall. The Qpog$_2$ aquifer would not be susceptible to contamination, because only the discharge point of the aquifer would be exposed. No water users or springs are identified downgradient of Planning Area B; therefore, no significant impacts would be expected.

### *Alluvial Aquifer*

Development in the valley floor portion of the site would include Planning Areas C, D, F and H, and portions of Planning Areas B, G and I under Alternatives 1 and 2. No development would occur in Planning Area J (south of S 204$^{th}$ Street). Development occurring on the valley floor portion of the site is unlikely to have any measurable impact on the alluvial aquifer water levels, because the valley floor is in a groundwater discharge zone.

### *Groundwater - Surface Water Interaction*

Development occurring in the upland portions of Planning Areas G and I under Alternatives 1 and 2 could reduce recharge to the underlying undifferentiated $Qpog_{1,2}$ aquifers; however, it is not expected to be a measurable impact because the site uplands are located in a groundwater discharge zone. Therefore, no significant impacts to spring discharge zones from these aquifers would be anticipated.

Spring discharge provides baseflow to a number of onsite water features. Although a reduction in spring discharge could potentially occur to springs in the Johnson Creek basin due to upland development in Planning Areas G and I, the changes would likely be too small to measure. However, existing Johnson Ditch is proposed to be realigned into a more natural configuration. The new Johnson Creek would be lower in elevation than the existing Johnson Ditch, and would intersect more of the alluvial aquifer during the summer low-flow period than currently occurs with existing Johnson Ditch. The influence of the alluvial aquifer on baseflows in the new Johnson Creek would offset any potential reduction in baseflow from $Qpog_{1,2}$ springs. Therefore, no probable significant impacts to baseflow would be anticipated.

## Groundwater Quality

Agricultural fertilizer, pesticide and septic discharge would be discontinued on the site under Alternatives 1 and 2. As a result, groundwater quality onsite would improve, particularly when the groundwater table is high. Under Alternatives 1 and 2, more of the site would be covered in impervious surfaces than at present. Runoff from these surfaces would receive stormwater treatment according to the King County SWM manual (1998) before discharge to the Green River. Treated stormwater would not be infiltrated to groundwater. Overall, groundwater quality would improve onsite, because agricultural uses, septic discharge, and untreated runoff from Frager Road draining to roadside ditches and ditched streams would cease.

There are no potable or non-potable well water users in the vicinity of the site that would be affected by Alternative 1 or 2. Therefore, no adverse impacts to beneficial groundwater quality would be expected to occur.

Use of the site for emerging technologies under Alternatives 1 and 2 could include shipping, storing and processing hazardous materials. Emerging technology use of hazardous materials is not expected to present a risk of exposure or accidental introduction to stormwater conveyance systems.

### Indirect/Cumulative

With implementation of proposed mitigation measures, Alternatives 1 and 2 would not result in an increase in water quality or quantity impacts to the Green River. The Tukwila South temporary and permanent stormwater control systems would be designed and constructed in accordance with the requirements of the King County Surface Water Design Manual (SWDM;1998). No cumulative erosion or sedimentation impacts would be expected on site or in the site area during infrastructure development, with installation of the proposed stormwater control facilities and use of BMPs. The permanent stormwater control system would be sized to handle full development of the onsite area, as well as the offsite area to the west to I-5 (see Figure 3.2-1). Baseflows entering the site from the undeveloped portions of the western slope would bypass the stormwater system and remain separated from developed area runoff.

At full buildout under Alternatives 1 and 2, occasional peaks of fecal coliforms are predicted to occur at the immediate points of discharge from the site to the Green River at concentrations above standards. However, there are no alternative facility designs likely to improve treatment for fecal coliform removal. Fecal coliforms are not expected to adversely affect beneficial uses (for example fish and aquatic habitat) or cause a measurable difference downstream of the site in the Green River. There are no potable or non-potable well water users in the vicinity of the site that would be affected by Alternative 1 or 2. Therefore, no adverse impacts to groundwater quantity or quality in the site area would be expected to occur. No other water-related cumulative impacts would be expected.

## No Action Alternative

Under the No Action Alternative, land uses on the site north of the existing flood protection barrier dike would contain a larger percentage of impervious area as compared to existing conditions. Land uses on the valley floor south of the existing flood protection barrier dike would remain largely pervious in agricultural use. S 178$^{th}$ Street and the existing flood protection barrier dike would not be relocated. Because there would only be limited changes to watercourse conditions, no Johnson Ditch realignment nor Green River habitat creation would be assumed to occur. Rehabilitation of wetlands as proposed under Alternatives 1 and 2 would not occur. There would be less overall site grading; mass grading would be limited to that necessary to construct the Southcenter Parkway extension and establish grades for development north of the flood protection barrier dike. Stormwater control facilities would be installed as needed to accommodate new development.

### Surface Water

Development under the No Action Alternative would have less potential for impacts to water quality than construction under Alternatives 1 and 2, because mass grading would be more limited. Earthwork for road infrastructure and utilities would be less than under Alternatives 1 and 2. Direct effects on water quality from infrastructure development would be relatively small and staggered in space and time as infrastructure and development occurs incrementally. There would be no possibility of sediment transport to the Green River from: relocating the flood protection barrier dike; moving the Green River levee east to allow excavating for the habitat restoration area; excavating a new channel for Johnson Creek; grading to restore Wetlands 10 and 11; or culvert relocation for Streams C and D and Ditch J-1, called for under Alternatives 1 and 2. Culvert relocation of a portion of Stream E would be reduced from that necessary under Alternatives 1 and 2.

Construction of the Southcenter Parkway extension to S 200th Street would require filling of 327 linear feet of Stream E. Stream E is a presumed fish-bearing channelized watercourse. It is reasonable to assume that impacts to the stream and buffer would be mitigated by realignment of the stream channel to an area adjacent to the Parkway (see Section 3.3 Plants and Animals – Fisheries and Appendix E for further information).

Although the risk of sediment transport during infrastructure development would be less due to the absence of near-water work at the Green River and less mass grading would occur, treatment of stormwater during construction under the No Action Alternative would likely use standard sediment trap ponds. These ponds would not work as reliably as the proposed polymer treatment system under Alternatives 1 and 2 to reduce turbidity to near background levels in the Green River prior to discharge, particularly for large-scale construction of industrial or retail uses.

Under the No Action Alternative, stormwater from the Southcenter Parkway extension would discharge to the north, northeast, central and south basins, as under existing conditions. It is assumed that stormwater control in the existing Segale Business Park would remain unchanged. Stormwater control for new development to the north of the flood protection barrier dike at S 196th Street could be constructed on a lot-by-lot basis as development occurs. Alternatively, stormwater control could be constructed on a more centralized basis to serve portions of the site using the existing discharge points from the north and central basins and existing Johnson Ditch as the receiving water in the south basin (see Appendix B for further detail).

Because specific stormwater control facilities cannot be determined at this point under the No Action Alternative, the water quality analysis evaluated the combined site-wide discharge impact on the Green River (see Table 3-18 in Appendix C). On a site-wide basis, water quality at full buildout under the No Action Alternative would be somewhat better than under Alternatives 1 and 2, largely because development would not occur on the valley floor south of the existing flood protection barrier dike. Agricultural influences would continue in the south basin under this alternative, however. Baseflow and stormwater runoff from the undeveloped slopes would not be conveyed to the Green River at the cooler temperatures or with as high a dissolved oxygen content as under Alternatives 1 and 2.

As under Alternatives 1 and 2, no adverse impacts to the Green River water quality would be expected to occur under the No Action Alternative, because the site stormwater contributions to the Green River would be very small relative to the Green River flow, and because the discharged stormwater on a site-wide basis would be similar to background conditions in the Green River. In the northeast basin discharge from the Segale Business Park to the P-17 pump station would not be improved under the No Action Alternative; discharge to the P-17 pump station would improve under Alternatives 1 and 2, because treatment would be provided where none presently exists. In the north basin, discharge under Alternatives 1, 2 and the No Action alternative would be similar in overall quality, and improved relative to the existing condition, because of the removal of agricultural influences and untreated Southcenter Parkway runoff. In the central basin runoff would not be improved under the No Action Alternative; runoff in this basin would improve under Alternative 1 and 2 because only undeveloped area runoff and baseflow would drain to the central basin outfall to the Green River. Under the No Action Alternative, the central basin outfall would receive treated stormwater runoff, which would be expected to meet water quality standards with the exception of sporadic high fecal coliforms. Existing agricultural influences to existing Johnson Ditch would continue under this alternative (see Table 3-18 in Appendix C for a comparison of water quality under the Alternatives 1, 2 and the No Action Alternative).

Some industrial land uses under the No Action Alternative could include shipping, storing, and processing of hazardous materials. To the extent that these are industrial processes, they may be required to be covered under an industrial National Pollutant Discharge Elimination System (NPDES) permit, which requires preparation of a Stormwater Pollution Prevention Plan (SWPPP) to show how all hazardous materials and process waters would be handled and kept out of the stormwater control system. To the extent that they are related to non-industrial processes, their use and handling would be regulated by local, state and federal laws. No specific list of hazardous material can be identified at this point; however, all uses would be required to follow applicable local, state, and federal laws to protect public safety and the environment.

## Groundwater

As under Alternatives 1 and 2, construction under the No Action Alternative would temporarily impact the alluvial (Qal) aquifer through construction dewatering. Dewatering would likely be necessary or required during construction of: utility installation during the Southcenter Parkway extension and construction of other elements requiring excavation below the alluvial water table or near wetlands, streams or springs. Realignment of S178$^{th}$ Street and the associated potential for groundwater impacts would not occur. No significant impacts to water users from construction dewatering would occur, because of the distance to the nearest water user within the alluvial aquifer.

The potential for significant impacts to groundwater quantity under the No Action Alternative would be similar to that described under Alternatives 1 and 2. Stormwater collected from impervious surfaces would be routed through a stormwater control system and would eventually discharge to the Green River. Because the site is located in a groundwater discharge area, characterized by relatively short groundwater flow paths, significant adverse impacts on water quantity in the alluvial (Qal) aquifer, Qva aquifer, and $Qpog_1$ and $Qpog_2$ aquifers would not be expected.

As under Alternatives 1 and 2 at full buildout, development occurring in the upland portions of the site could have the potential to impact groundwater quantity in the $Qpog_1$ and $Qpog_2$ aquifers, but this would not be expected to be a measurable impact, because the site uplands are located in a groundwater discharge zone. Because no water users are located downgradient of the proposed upland development, no impacts to down gradient groundwater usage as a result of a reduction in groundwater recharge would occur. Development occurring on the valley floor portion of the site would be unlikely to have any measurable impact on the alluvial aquifer water levels, because the Green River valley is in a groundwater discharge zone. Development occurring in the upland portion of Planning Area G under the No Action Alternative could reduce recharge to the underlying undifferentiated $Qpog_{1,2}$ aquifers, but would be unlikely to result in a measurable impact, because the site uplands are located in a groundwater discharge zone. Therefore, no significant impacts to spring discharge zones from these aquifers would be anticipated.

Groundwater quality under the No Action Alternative would be somewhat improved over existing conditions due to the eventual replacement of agricultural uses north of the flood protection barrier dike at S 196$^{th}$ Street with industrial/retail development. It is assumed that development would include a stormwater control system with water quality treatment facilities. However, agricultural influences south of the flood protection barrier dike would continue as under existing conditions. Agricultural fertilizer and pesticide use would continue in the south basin.

### 3.2.3 Mitigation Measures

**Infrastructure Development**

- A temporary stormwater retention system would be installed during the first construction season per the requirements of the King County Surface Water Design Manual (SWDM) (1998) adopted by the City of Tukwila. No surface discharge of stormwater offsite is planned during the first construction season until the long-term construction stormwater polymer treatment system is completed and operating.

- Monitoring and erosion control measures would be employed for stormwater discharge associated with construction activities per a National Pollutant Discharge Elimination System (NPDES) permit from the Department of Ecology (Ecology) to protect water quality.

- If a concrete batch plan is employed onsite, monitoring and erosion control measures would be employed per a Sand and Gravel NPDES Permit from Ecology.

- The requirements of a Section 401 (Clean Water Act) Certification from Ecology would be followed to protect water quality.

- A stormwater pollution prevention plan (SWPPP) would be prepared and implemented as required by the NPDES permit, and would be updated as warranted. The SWPPP would contain specific best management practices for each construction season.

- Construction runoff sediment would be removed via a collection and polymer treatment system, including testing prior to discharge (see Appendix C for details).

- Temporary erosion and sediment control (TESC) best management practices (BMPs), as specified in the King County (1998) and Ecology (2001) manuals, would be implemented. See Tables 3-2, 3-3 and 3-4 in Appendix C, Section 3.1, Earth, and Appendix A for specific TESC BMP measures.

- A temporary dike adjacent to the Green River would be installed for construction of the off-channel habitat restoration area to prevent river water from entering the work area or construction water from directly entering the river.

- A sediment curtain would be placed around all work areas in the Green River when: breaching the dike at the end of the Green River Off-Channel Habitat Restoration Area; constructing the new Johnson Creek; installing the south basin stormwater outfalls; or abandoning the existing Johnson Ditch outfall (if warranted by the specific work and river elevation).

- Runoff from areas of recent uncovered concrete work would be managed by one or more of the methods described in Section 3.4.1 of Appendix C.

- Concrete related equipment would be rinsed following the restrictions described in Section 3.4.1 of Appendix C.

- If Portland cement or equivalent product is proposed for use as a soil amendment to meet compaction standards in a SWPPP under the NPDES permit for construction discharge, mitigation measures described in Section 3.4.1 of Appendix C would be followed.

- If a batch concrete plant is used onsite one or more of the following options would be used to manage stormwater in contact with the batch plant:
  -- Reused as process water within the batch plant;
  -- Treatment with other construction runoff in the polymer treatment system;
  -- Reused for dust suppression onsite; and/or
  -- Transported off-site via tanker trucks for recycling at offsite concrete batch plant(s) or to other authorized receiving sites, in accordance with applicable local, state and federal laws.

- If recommended by the geotechnical engineer, perforated conduit would be installed at the cut areas at the toe of the western hillside for construction of the Southcenter Parkway extension to intercept and convey groundwater and stabilize wet, sloping soils.

- The new Johnson Creek would be designed to be lower in elevation than the existing Johnson Ditch, and would intersect more of the alluvial aquifer during the summer low-flow period. The influence of the alluvial aquifer on increasing baseflows in the lower portion of new Johnson Creek would offset any potential reduction in baseflow from $Qpog_{1,2}$ springs.

### Full Buildout

- Stormwater would be managed per the requirements of the King County SWDM (1998) adopted by the City of Tukwila. No treated stormwater discharge would be directed to wetlands or tributary drainages to the Green River (except emergency overflow to new Johnson Creek).

- A wetland rehabilitation plan would be implemented to compensate for the fill of low-value wetlands. Under the plan, wetland water quality functions onsite would be increased slightly relative to existing conditions for sediment and nutrients (see Section 3.4, Wetlands, and Appendix F for further information).

- The Johnson Creek mitigation plan would improve water quality by: enhancing and restoring riparian functions that would provide nutrients to the creek (via leaf litter and terrestrial insects); filtering and improving the quality of water passing through the buffer; and increasing shade (which would lower the water temperature and increase the dissolved oxygen content of the water conveyed through the creek to the Green River).

- Baseflows and undeveloped area stormwater runoff currently conveyed in Streams C and E, and Ditch J-1 would be piped and protected from stormwater influence from the developed portions of the site. Conveyance of baseflows and undeveloped area stormwater in a pipe would maintain cool temperatures and increase the oxygen content of water transported to the Green River.

- The removal of leaf litter and insect supply from filling Streams C Ditch J-1 and portions of Stream E would be offset by improved riparian functions in the off-channel habitat restoration area at the Green River and by restoration of Johnson Creek.

- The relocated flood protection barrier dike would separate the new Johnson Creek and wetland rehabilitation area from developed area stormwater runoff, while providing for continuation of the existing hydrology supporting Johnson Creek and the wetland rehabilitation area.

- Design measures, including a pump for each pond, would be employed to ensure that the inflow pipes to the north and south wet ponds could be flushed free of accumulated sediment during maintenance work. Alternatively, the stormwater system design could be modified to prevent standing water from accumulating in inflow pipes.

- To mitigate potential flooding on the site from suspension of discharges in accordance with the Green River Pump Operational Procedures Plan (POPP) requirements, an exemption would be sought from the King County Flood Control District to allow continued pumping from the south basin to the Green River.

- The POPP would require approximately 106 acre-feet of storage as flood mitigation. The Off-Channel Habitat Restoration Area provides approximately 118 acre-feet of additional in-river storage.

- Open air grate manholes could be provided along stormwater discharge lines to enhance dissolved oxygen.

- Waterfowl use of wet ponds could be discouraged by planting the pond fringes with shrubs rather than grasses (to the extent feasible and consistent with protection of pond berm integrity), to prevent them from increasing fecal coliforms in the ponds and their discharge.

### 3.2.4 Significant Unavoidable Adverse Impacts

Occasional peaks of fecal coliforms are predicted to occur at the immediate points of stormwater discharge from the site at concentrations above standards, although their concentrations in any given storm are difficult to predict and would vary widely. It is recognized that stormwater BMPs are not well suited for the removal of fecal coliforms, because they all operate using saturated flow paths. There are no alternative facility designs likely to improve treatment for fecal coliforms. Fecal coliforms would not be expected to adversely affect beneficial uses (i.e., fish and aquatic habitat downstream) or cause a measurable difference downstream of the site in the Green River.