Chapter 5

Environmental Impacts if a Major Earthquake Were to Damage Brightwater Facilities and Mitigation of Impacts

DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Brightwater Regional Wastewater Treatment System

Chapter 5
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If an earthquake were to damage Brightwater Treatment Plant facilities, significant adverse environmental impacts could result. The type and extent of impacts would vary depending on which facilities were damaged, the extent of the damage, the ability of the conveyance system to route the wastewater flows to other treatment facilities or appropriate overflow or diversion locations, and the length of time required for repairs.

This chapter evaluates potential significant adverse environmental impacts and identifies possible mitigation measures for the three hypothetical worst-case earthquake scenarios described in Chapter 4. The evaluation shows that long-term impacts would be limited, and, in most cases, could be mitigated through implementation of proven remediation measures.

5.1 What Does SEPA Require?

5.1.1 Analysis of Impacts

The analysis of impacts in this chapter has been prepared consistent with the State Environmental Policy Act (SEPA) (43.21C RCW and WAC 197-11). SEPA requires analysis of environmental impacts that are significant, adverse, and probable. In situations where information essential to a reasoned choice is not known and the means to obtain it are too costly, speculative, or not known, an agency may proceed in the face of uncertainty. In such cases, the agency must provide a worst-case analysis of impacts and indicate the likelihood of occurrence, to the extent this information can reasonably be developed (WAC 197-11-080).

The only two identified lineaments on the Route 9 site, based on the work of USGS and all other technical data developed to date, are at Lineament 4 and what has been labeled "Lineament X". None of the new structures proposed by King County will be within hundreds of feet of either lineament. Thus there are no new impacts raised by the new seismic information which have not already been analyzed and mitigated in the original Brightwater EIS. There has been no evidence identified by USGS or any other experts to suggest any additional lineament between Lineament 4 and Lineament X. Accordingly there is arguably no need whatsoever under SEPA to do any further analysis beyond the EIS and subsequent addenda. This is especially true given that the likelihood of any lineament in this area resulting in a surface fault in the design life of the Brightwater facilities (estimated to be 50 years) is extremely remote. Under SEPA's "rule of reason", analysis of remote and speculative impacts is not required in an EIS.

Nonetheless, King County has decided to err on the side of more evaluation and information to the public and decisionmakers by providing a "worst-case" analysis as part of this Supplemental EIS. SEPA provides minimal guidance at WAC 197-11-080 as to what kind of analysis is supposed to be included as part of a worst-case analysis. There is no recognized methodology.

The worst-case analysis in this Supplemental EIS focuses on various seismic scenarios. Experience in this nation and around the world confirms that predicting when, where, and how strong an earthquake will be is a highly speculative endeavor and not capable of being estimated with any precision. While endless tests might yield some information, that information does not produce, in the seismic area, any reliable level of certainty.

At the Route 9 site, for example, attempting to trench the entire site would be very expensive and time-consuming and would not necessarily lead to any greater certainty as to the likelihood of a surface rupture in the next 50 years. Part of the cost of doing this additional testing would be the loss of time, which in this case is especially important, given the region's paramount need to have a new regional wastewater plant by 2010 in order to protect water quality in the streams and rivers in the region, as well as in Lake Washington and Puget Sound. An added cost of not having a third regional wastewater treatment plant in place by 2010 would be the likelihood of a building moratorium being imposed, with resulting adverse impacts on the land use plans of all jurisdictions in the service area.

Given the uncertain nature of additional seismic investigation at Route 9 and the cost, both direct and indirect, of added investigation beyond that summarized in this Supplemental EIS, King County has opted to do a "worst-case" analysis in this Supplemental EIS. It errs on the side of very conservative analysis of what might happen in the very unlikely event of any of the seismic scenarios happening and what the impacts, mitigation measures, and unavoidable impacts might be.

Even though none of these scenarios are "probable", decisionmakers will have this added "what if?" information in hand when making regulatory decisions related to Brightwater facilities.

The analysis of impacts in this Supplemental EIS is based on information available at this time concerning the location of earthquake faults on or near the Route 9 site. It includes interpretation of data gathered recently by the U.S. Geological Survey (USGS) and King County using several methodologies—aeromagnetic, ground magnetic, and LiDAR surveys and excavation of trenches on and near the Route 9 site (see Chapter 2).

As described in Chapters 1 and 4, King County believes that the likelihood of a major earthquake causing surface fault rupture anywhere on the Route 9 site is extremely remote during the design life of the Brightwater Treatment Plant. Given that it is not probable that a surface rupture would occur on the Route 9 site, it is not required that King County prepare an EIS. However, the King County Hearing Examiner requested that a Supplemental EIS be prepared if recent activity of a fault was discovered on the Route 9 site (see Chapter 1). Moreover, King County is mindful of the SEPA definition of significance (WAC 197-11-794(2)): “An impact may be significant if its chance of occurrence is not great but the resulting environmental impact would be severe if it occurred.” Even though the seismic impacts evaluated in this Supplemental EIS are not probable and arguably not significant, King County is evaluating the environmental impacts of three hypothetical scenarios that represent the worst impacts that could result during an earthquake if the ground surface were to rupture on the Route 9 site and damage treatment facilities:

- Scenario A assumes a surface rupture on Lineament 4 and very strong ground shaking on the site with limited damage to facilities.
- Scenario B assumes a surface rupture on Lineament X, very strong ground shaking on the site, and a break in the combined tunnel at the south end of the site.
- Scenario C assumes the very remote possibility of a surface rupture on the site caused by an unknown and hypothetical fault somewhere between Lineaments 4 and X. For this analysis, the hypothesized rupture would occur beneath new treatment plant structures on the site accompanied by very strong ground shaking and extensive damage to the new structures that were located directly on the hypothetical fault. The impacts of a surface rupture between Lineaments 4 and X would differ depending on which treatment facilities were affected by the rupture. Scenario C describes what would happen if a surface rupture were to occur under the following structures:
  - Facilities that would have the greatest impact on groundwater (aeration basins)
  - Facilities that would have the greatest impact on surface waters (digesters)
  - Facilities that could result in chemical leaks (chemical storage facilities, odor control buildings, diesel storage tank)

  The analysis of Scenario C assumes that a rupture would occur over a width of approximately 50 feet and, therefore, would not occur under multiple process units or buildings. It also assumes that the impacts described under Scenario C would not be cumulative. For example, because of the site layout and the likely trajectory of a fault that would be parallel to the only known active fault on the site (Lineament 4), a rupture would not occur under both the aeration basins **and** the digesters.

The type and extent of damage to facilities and the resulting environmental impacts that could occur if the ground surface were to rupture on the Route 9 site as the result of a major earthquake would depend on several factors, including where onsite the surface rupture occurred, which facilities were damaged, and the extent of the damage. Weather conditions would influence both the quantity and quality of wastewater being treated or conveyed when the earthquake occurred and the ability of the conveyance system to route the wastewater flows to other treatment facilities or appropriate overflow or temporary diversion locations (e.g., Puget Sound) following the earthquake.

Impacts have been analyzed based on conditions that are projected to exist in the year 2050, after the treatment plant will have been enlarged to a capacity of 54 mgd and when buildout in the Brightwater Service Area is expected to occur. If an earthquake were to happen prior to that time, impacts would be less than described in this chapter because flow volumes would be proportionally less. This analysis recognizes that it is difficult to anticipate “existing conditions” or impacts to the “affected environment” far into the future, so assumptions have been made about future conditions and impacts based on what is known today and can reasonably be anticipated for the future.

5.1.2 Identification of Mitigation Measures

The SEPA Rules require that an EIS indicate mitigation measures that could be implemented to avoid, minimize, rectify (repair), reduce, eliminate, compensate, or monitor environmental impacts (WAC 197-11-768). Mitigation measures must be related to specific adverse environmental impacts that are clearly identified in the EIS, and they must be reasonable and capable of being accomplished (WAC 197-11-660). King County would take many steps to prevent impacts from occurring in the unlikely event that an earthquake did occur on the Route 9 site.

This chapter lists specific mitigation measures related to impacts identified in the analysis. In addition, please see Chapter 3 for a discussion of how Brightwater facilities are being designed to prevent or minimize damage during an earthquake. Also see Chapters 3 and 4, which discuss King County’s Emergency Flow Management Plan and emergency response procedures.

5.2 How Is the Discussion of Impacts and Mitigation Organized?

This chapter is organized by the elements of the environment listed in the SEPA Rules (WAC 197-11-444) that likely would be affected by damage to Brightwater facilities. It does not evaluate the impacts that would be caused by the earthquake itself. (For example, the earthquake would cause earth impacts, but the damage to the treatment plant and potential resulting overflows would not affect earth.) Rather, the discussion focuses on the significant impacts that would be caused by the treatment plant if facilities were damaged by a major earthquake. The elements of the environment that are evaluated are surface water, groundwater, air, environmental health, and public services and utilities. Impacts to recreation are covered in environmental health. Impacts to plants, animals, and wetlands (biological resources) are incorporated into the discussion of surface water. If treatment facilities were damaged in an earthquake, it is not anticipated that the damage would have a significant impact on earth, energy and natural resources, noise, land and shoreline use, aesthetics, light and glare, cultural resources, or transportation. (The impacts on these and other elements of the environment that would result from the construction and operation of the Brightwater Regional Wastewater Treatment System under normal conditions are evaluated in the Final EIS.)

Each element of the environment considered below includes a discussion of the significant impacts that could occur under each of the three hypothetical worst-case scenarios—Scenarios A, B and C—followed by a discussion of mitigation measures that could be implemented to address identified impacts. The scenarios under each impacts discussion are presented in the order of their potential probability of occurrence. While all three scenarios are extremely unlikely to occur, Scenario A is the least unlikely to occur of the three, followed by Scenario B (less unlikely) and Scenario C (most unlikely scenario). Scenario C is the most unlikely to occur because no data exist to indicate the presence of a fault under the proposed facilities.

Tables appear at the end of this Supplemental EIS that summarize the assumptions, assumed damages, impacts, and mitigation for each scenario—Scenario A, B, and C.

5.3 What Impacts Would Occur to Surface Waters and Biological Resources from an Earthquake on the Route 9 Site? What Can Be Done to Minimize or Mitigate Impacts?

Surface water resources in the Brightwater project area were described in Chapter 6 and Appendix 6-A of the Final EIS for the Brightwater Regional Wastewater Treatment System, and the proposal's impacts on freshwaters and marine waters were analyzed. Chapter 7 of the Final EIS included a discussion of potential impacts to plants, animals and wetlands, including fish and other species protected under the Endangered Species Act. This section of the Supplemental EIS discusses impacts to surface waters (both marine waters and freshwaters) and how particular organisms and habitats would be adversely affected if a surface rupture during a very strong earthquake were to damage Brightwater facilities, as described under hypothetical worst-case Scenarios A, B, and C (Chapter 4). It describes the conditions under which overflows would occur to freshwater streams and Lake Washington or to the marine waters of Puget Sound. Figure 5-3 illustrates the surface waters that potentially could be affected.

The impacts to the larger freshwater and biological environments that would occur under Scenarios A, B, and C are discussed first. Because impacts to Little Bear Creek vary significantly among the scenarios, they are discussed separately from impacts to fresh waters in general. This is followed by a discussion of the impacts to the marine waters of Puget Sound that would occur under Scenarios B and C.

Following the evaluation of impacts is a discussion of measures that could be taken to minimize or mitigate identified impacts to streams and Lake Washington and to the marine waters of Puget Sound.

5.3.1 Overview of Impacts to Marine Waters

Under all hypothetical scenarios, the Brightwater Treatment Plant would be shut down following an earthquake on the Route 9 site, and all discharges through the Brightwater effluent pipeline would stop until inspections were completed and permanent or temporary repairs were made. Influent would be rerouted temporarily to the West Point Treatment Plant and/or the South Treatment Plant. The influent potentially would receive at least primary treatment at these plants before being discharged through each treatment plant's respective outfall to Puget Sound. Any contaminants that remained in the wastewater because of the lack of secondary treatment would be dispersed into and mixed with the currents by the deepwater outfalls.

When the Brightwater Treatment Plant was shut down for inspection and repairs, the volumes of Brightwater flows that could be conveyed to the West Point and South Treatment Plants would be limited by the lack of available storage room in the pipelines leading to those plants. This could result in wastewater overflows to freshwater streams and Lake Washington at points along the conveyance pipelines leading to the plants. The limited amount of untreated and partially treated wastewater that would be discharged through the West Point and South Treatment Plants and the limited duration of overflows would result in only minimal impacts to Puget Sound. The impacts of these discharges were addressed in the Final EIS for the RWSP as the No Action Alternative (King County, 1998).

While all scenarios would result in untreated or partially treated wastewater discharges to Puget Sound for a short period of time following an earthquake, impacts to the marine waters of Puget Sound nevertheless would vary with each scenario. This is because under Scenario A, flows would be routed to the other treatment plants, and untreated or partially treated discharges through the Brightwater effluent pipeline would not occur. As soon as repairs were made, treated discharges would resume at Brightwater. However, under Scenarios B and C, temporary bypasses would be constructed around damaged Brightwater facilities to allow discharges of untreated or partially treated wastewater through the Brightwater effluent pipeline to the marine waters of Puget Sound near Point Wells.

Untreated or partially treated discharges to Puget Sound would occur for a shorter period of time under Scenario A than under Scenarios B and C. This is because repairs under Scenario A would take 1 to 2 days, while repairs under Scenario B could take up to 6 months, and repairs under Scenario C could take up to 1 year. Treated discharges to Puget Sound would resume under each scenario when repairs were complete.

5.3.2 Overview of Impacts to Freshwaters

Wastewater overflows to freshwater streams (North Creek, Swamp Creek, and the Sammamish River) and Lake Washington could occur under any of the earthquake scenarios. Overflows may or may not actually occur, and the duration of overflows, volume of overflows, and severity of impacts would vary. What actually would occur would depend on the type and degree of damage to treatment facilities, the weather conditions at the time the Brightwater Treatment Plant was shut down, the amount of storage available in the conveyance system, and the time needed to begin diversions to other treatment facilities or to the Brightwater effluent pipeline.

During the dry season (April through October) in the Greater Seattle area, rainfall is typically low and infrequent, but the dry season occasionally is punctuated by intense but brief storm events (Figure 5-1). The Brightwater wastewater conveyance system would be able to contain average dry weather flows under Scenarios A, B, and C (Table 4-2), thus untreated wastewater overflows would not occur. However, overflows could occur for short periods (days) during the dry season when intense but brief storms occur.

During the wet season (November through March), the amount of rainfall varies. Rainfall generally is intermittent with periods of heavy precipitation alternating with periods of little or no rain. As a result, the amount of stormwater that enters the system through infiltration and inflow varies as well. Under Scenarios A, B, and C, as the volume of flow conveyed by the wastewater system varied, intermittent periods of overflows would alternate with periods when no overflows occurred.

During storm events, the Brightwater conveyance system would be able to store the increased wastewater flows for a period of time, generally up until volumes reached maximum monthly flow (Table 4-2). Once volumes exceeded maximum monthly flow, overflows would occur because storage in the Brightwater conveyance system and diversion of flows to other treatment plants would not be sufficient to contain overflows. The analysis in this Supplemental EIS assumes that a 20-year storm event[1] would coincide with any of the three hypothetical earthquake scenarios and that the 20-year storm could result in peak hourly flows to the Brightwater Treatment Plant. This kind of storm may not occur in any given year, and, when it does, it generally would last no more than a few days. (Figure 5-2 illustrates how long peak flow in Brightwater influent might last during a 20-year storm.) Overflows would begin sometime after the storm had started and would continue for a few days afterwards until infiltration and inflow into the wastewater system had begun to attenuate.

5.3.3 Impacts to Freshwaters and Biological Resources—Scenario A

Under Scenario A, the Brightwater collection system would have adequate capacity to contain average dry weather and maximum monthly wet weather flows (Table 4-2). If the treatment plant were shut down temporarily to inspect and repair pipe connection leaks, overflows to freshwater streams and Lake Washington would occur only during storm conditions when flows exceeded the maximum monthly flow (See Figure 4-4). During peak flow conditions from a 20-year storm (the flow rate assumed to be the “worst case”), overflows would begin after storage was exceeded. Overflows would continue for up to 6 hours after the earthquake, the time required to configure the North Creek and

[1] A 20-year storm is the largest storm that occurs on average, once in 20 years.

York Pump Stations to pump the influent to the South Treatment Plant in Renton. During this transition period, high wastewater flows caused by heavy rain would overflow into North Creek and into the Sammamish River between the North Creek and Kenmore Pump Stations. Wastewater also would overflow into Lake Washington at emergency outfalls at the Juanita, Kirkland, Yarrow Bay, Medina, North Mercer and South Mercer Pump Stations.

These emergency overflows into Lake Washington would reduce the volume of overflows into the Sammamish River and would prevent wastewater overflows onto land. Once the North Creek and York Pump Stations began to reroute flows, overflows would continue into the Sammamish River at the Hollywood and Woodinville Pump Stations, into the Sammamish River between the North Creek and Kenmore Pump Stations, and into Swamp Creek and Lake Washington. These overflows could last for 1 to 2 days, depending on rainfall, and could result in temporary degradation of sediments and water quality; this, in turn, would result in short-term environmental impacts to plants and animals. Following damage repair, the treatment plant would resume full capacity and overflows caused by extremely wet weather would cease.

Sediments

If there were overflows to surface waters, organic material in the wastewater could be deposited on sediments in North Creek, Swamp Creek, the Sammamish River, and Lake Washington. The decomposition of organic matter would consume oxygen in the sediments, potentially leaving too little oxygen (hypoxia) for invertebrates to survive. However, given the short expected duration of discharges, if any, under Scenario A, hypoxic conditions would not be likely to develop and impacts to invertebrates from changes in sediments would be minimal.

Water Quality

Based on the anticipated characteristics of the partially treated or untreated wastewater, wet-weather overflows into freshwaters could cause a temporary decline in oxygen concentrations and pH levels, an elevation of nutrient levels, and an increase in turbidity. Also, the concentrations of a number of chemical contaminants such as ammonia, copper, lead, and phenol *(*see Appendix D*)* would increase and exceed Washington State Surface Water Quality Standards. Some of these (such as ammonia) could cause immediate mortality to aquatic organisms. The degradation of water quality might, in turn, cause adverse impacts to fish, invertebrates, and plants. The degree of impact would depend on the location and volume of overflows, the extent of mixing in the receiving waters, and the duration of exposure to the degraded water.

Exceedances of water quality thresholds associated with the overflows would be higher in Swamp Creek and the Sammamish River than they would be in Lake Washington because dilution would be less in the streams than it would be in the lake. As a basis for comparison, studies that have examined the ecological risks of discharges from combined sewer overflows (CSO)[2] have determined that there is little risk of impacts to aquatic life or juvenile salmon (King County, 1999). CSO discharges are generally more dilute than untreated wastewater, and the dilution achieved once freshwaters entered Lake Washington would be likely to reach or exceed that represented in CSOs. See the discussion of impacts related to elevated concentrations of bacteria under Environmental Health later in this chapter.

Water quality within surface waters likely would return to background conditions soon after overflows ceased, perhaps within days. Under Scenario A, impacts such as algal blooms would likely be noticeable only during the first growing season (summer), although the excess nutrients might not leave the Lake Washington system for another year or so.

Plants

The exceedances of water quality standards during overflows may result in the mortality of some aquatic plants. However, the potential duration of overflows under Scenario A is limited to less than two days, and plant mortality may not be noticeable. Impacts would be greater in the dry season because this is the growth period for plants, although intense storms are infrequent during the dry season. Complete recovery of the plant communities would be expected to occur within the first growing season following cessation of overflows.

Invertebrates

The changes in sediments and water chemistry that could occur from wastewater overflows (e.g., high ammonia concentrations, reduced dissolved oxygen concentrations, low pH, and elevated solids concentrations) could cause mortality to sediment-dwelling invertebrates. Freshwater mussels that inhabit tributaries of the Sammamish River are known to be sensitive to water quality conditions and may suffer mortality. After overflows ceased, invertebrate communities would be expected to recolonize by the end of the first growing season (spring/summer).

Fish

A number of fish species including salmonids and non-salmonids are present in the North Lake Washington Basin, which could be affected by localized overflows following a major earthquake. Overflows to small streams would present the greatest risk, because dilution in these receiving waters would be limited. Immediate mortality of fish in streams and the Sammamish River could occur during overflows due to toxic levels of ammonia in the wastewater. In areas where dilution was sufficient to reduce ammonia

[2] CSO discharges occur when high rainfall causes the capacity of the conveyance system to be exceeded and the excess wastewater volume overflows into natural waterbodies. These CSO discharges prevent backup of sewage into private property.

concentrations, such as in Lake Washington, other stress factors such as suspended solids and low dissolved oxygen would put fish at risk. However, fish in Lake Washington likely would be able to adapt by local migration to avoid affected areas; low levels of mortality could occur but would be unlikely. Many fish likely would return to the Sammamish River and the creeks within weeks, although a year or more may be required for species richness and abundance to return to pre-overflow levels.

There are three species of salmon that inhabit the North Lake Washington Basin, which includes North Creek, Swamp Creek, Little Bear Creek, and the Sammamish River. These species are chinook (*Oncorhynchus tshawytscha*), coho (*Oncorhynchus kisutch*), sockeye (*Oncorhynchus nerka*), and kokanee, a landlocked subpopulation of sockeye. Chinook are listed as Threatened, and coho are listed as a Species of Concern under the Endangered Species Act (ESA). The chinook and sockeye are candidate species for listing as Threatened by the Washington State Department of Fish and Wildlife. These salmon use the Sammamish River and Lake Washington as a migration pathway to their spawning grounds in the creeks.

Salmon are susceptible to the same stress factors discussed previously for other fishes. High stormwater flows and solids deposition in tributaries can suffocate eggs (Kerwin 2001), and changes in water quality can cause mortality in all life stages. Because Swamp Creek provides spawning habitat for salmon during the fall and incubation habitat over the winter, overflow to these streams during the wet season would negatively impact reproduction of salmon by causing mortality to eggs (a sensitive life stage) and reproductive adults. The use of Swamp Creek, the Sammamish River, and Lake Washington by emerging fry in the spring and summer, as well as other life stages of salmon, makes the dry season also a period of risk for mortality in young salmon. Although overflows under Scenario A, if they occurred at all, would last only a couple of days, localized mortality of salmon could be high if such overflows occurred during sensitive life stages for salmonid species, and years would be required for the local populations to recover.

Wildlife

Various wildlife species, including Special Status Species, inhabit the riparian and lake habitat that could be affected by wastewater overflows following treatment plant shutdown as a result of a major earthquake. Special Status Species potentially occurring near the Brightwater Treatment Plant site (including bats, a variety of terrestrial and marine birds, amphibians, and butterflies) were described in Appendix 7-A to the Final EIS. Wildlife such as deer, coyote, and pheasant, may use the affected freshwaters only as a drinking source, while others, such as bald eagles, may depend on these areas for food. Impacts to terrestrial wildlife that inhabit wetlands and riparian zones are not likely under Scenario A.

A great blue heron rookery area exists along Swamp Creek in Kenmore that could be affected by wastewater overflows in Scenario A. Great blue heron prefer to prey on fish (EPA, 1993) and adults breed and nest in colonies in the springtime. Similarly, bald eagle nests have been identified along the Sammamish River in Kenmore (see Appendix 7-A to the Final EIS). If extreme wet weather overflows following an earthquake were to coincide with the nesting season for the great blue heron colony or bald eagles, and if substantial fish kills were to ensue, the Kenmore heron colony or bald eagle pairs could experience difficulty finding prey locally to feed their chicks. Therefore, there would be some risk of nestling mortality from starvation. However, the overall likelihood of any nestling mortality under Scenario A is small.

Wetlands

During peak-flow conditions, overflows could occur in wetlands adjacent to receiving surface waters, including Swamp Creek and the nearshore areas of Lake Washington. There are numerous small wetlands within these areas, as well as significant regional wetlands, such as the Swamp Creek Wetland. However, overflows to wetlands (after Brightwater flows have been diverted to other treatment plants) would be less likely than overflows into the Sammamish River.

Worst-case impacts to wetlands resulting from Scenario A would vary according to the volume and duration of overflows. After wastewater flow diversion to other treatment plants began, overflows would be expected to occur only under peak flow conditions that could last as long as 36 hours. In this case, untreated wastewater would enter surface water bodies and, in some cases, could enter wetlands associated with these surface water bodies. Solids filtered from wastewater overflows by wetlands could alter the sediment structure, making it inhospitable habitat to some invertebrate species. Solids deposition likely would be greatest for overflows occurring during the wet season, because overflow volumes and durations likely would be greatest during these periods.

Other effects of wastewater overflows on wetlands would be similar to those described for the other affected freshwaters. Lowered water quality may cause acute mortality of fish and other aquatic life. Because wetlands are important breeding grounds for amphibians, poor reproductive success may be observed, particularly if overflows occur during the spring breeding season. However, the likelihood of this coincidence in timing is very low in Scenario A. The duration and volume of any overflows would determine the extent of impact; overflows of hours to days would have a lower impact than overflows that lasted for a longer time. Scenario A would result in overflows with a maximum duration of up to approximately 36 hours.

Little Bear Creek

Under Scenario A, up to 300,000 gallons of wastewater could leak from buried pipes connecting process units. Until the underdrains were plugged or became clogged, small amounts of this wastewater could reach Little Bear Creek through the stormwater system temporarily reducing water quality. If the underdrains were blocked, little to none of this leaked wastewater would reach Little Bear Creek by surface flow, because the flows would infiltrate to shallow groundwater onsite. If unremediated, contaminated groundwater could reach Little Bear Creek after several years. Refer to the discussion of worst case impacts to Little Bear Creek from contaminated groundwater and potential remediation strategies later in this chapter.

5.3.4 Impacts to Freshwaters and Biological Resources—Scenario B

Under Scenario B, where a surface rupture on Lineament X would cause a break in the combined tunnel and eliminate treated wastewater discharge to Puget Sound, overflows could occur within several hours of the earthquake (Table 4-2 and Appendix D). Overflows to freshwater could occur at flows above maximum monthly flows, after storage within the conveyance system was exceeded. Overflows would continue for up to 6 hours after the earthquake, the time required to configure the North Creek and York Pump Stations to pump the influent to the South Treatment Plant in Renton. During this transition period, high wastewater flows caused by heavy rain would overflow into North Creek and into the Sammamish River between the North Creek and Kenmore Pump Stations. Wastewater also would overflow into Lake Washington at emergency outfalls at the Juanita, Kirkland, Yarrow Bay, Medina, North Mercer and South Mercer Pump Stations.

These emergency overflows into Lake Washington would reduce the volume of overflows into the Sammamish River and would prevent wastewater overflows onto land. Once the North Creek and York Pump Stations began to reroute flows, overflows would continue intermittently (depending on rainfall) into the Sammamish River at the Hollywood and Woodinville Pump Stations, into the Sammamish River between the North Creek and Kenmore Pump Stations, and into Swamp Creek and Lake Washington.

Depending on where the combined tunnel were to break and the extent of the damage, a temporary pipeline would be constructed at the location of the tunnel break to divert influent flows into the effluent pipeline. This temporary modification would take up to 6 weeks to construct. When completed, the diversion into the effluent pipeline could accommodate a flow rate of up to 130 mgd. This would reduce the volume and frequency of overflows into freshwaters since the wastewater would be discharged through the marine outfall into Puget Sound, but freshwater overflows could still occur for short periods of time during very wet weather. All overflows would be expected to cease within approximately 6 months when repair of the combined tunnel would be completed.

Freshwater overflows, although intermittent in frequency, could result in degradation of sediments and water quality, which, in turn, would result in environmental impacts to plants and animals, as described under Scenario A. Impacts to freshwater and biological resources under Scenario B would be similar in nature to those described for Scenario A; however, potential impacts would be greater than they would be for Scenario A. This is because overflows could occur intermittently for a longer period of time, depending on the weather conditions during the 6 weeks required to construct the temporary diversion into the effluent pipeline to Puget Sound, thus the recovery time would be longer under Scenario B.

The recovery time for Lake Washington would depend on the weather conditions during the 6 weeks that it took to construct the temporary diversion to the Brightwater effluent pipeline to Puget Sound, which would affect the volume of overflows to freshwaters. Recovery could take years due to long-term nutrient effects; however, recovery time can be estimated based on the earlier recovery of Lake Washington after decades of the continuous input of partially treated wastewater into the lake. After the King County regional wastewater system was constructed in the early 1960s, wastewater inputs ceased, and water quality in Lake Washington recovered within 4 years (Caldwell et al., 1976). Using this as a basis for comparison, water quality in Lake Washington would be expected to reach near background levels within 2 years after overflows occurred following an earthquake on Lineament X because the pollutant loading to the lake would be well under half the loading that occurred from wastewater discharges in the 1960's even if the weather following the earthquake was extremely wet.

Sediments

During overflows, organic material in the wastewater would be deposited on sediments in Swamp Creek, North Creek, the Sammamish River, and Lake Washington. This organic matter would be decomposed by bacteria and fungi, which could grow to high densities and form "slimes" and "mats" visible to the naked eye. In addition, the decomposition of organic matter would consume oxygen in the sediments, potentially leaving too little oxygen (hypoxia) for invertebrates to survive. When chemical reactions occur in an environment where oxygen is consumed faster than it is replaced, the acidity of the sediments could cause an increase in the toxicity of some metals and adversely affect aquatic life.

Because deposited solids would not be removed naturally except by very large and rare storm events, there would be a potential for long-term exposure of aquatic organisms to particle-bound contaminants brought in by wastewater overflows. This could result in accumulation of persistent contaminants, including metals. Organisms that could be exposed to particle-bound contaminants, even after overflows ceased, would be sediment-dwelling invertebrates, fish, and aquatic-feeding wildlife. Long term impacts to these organisms could result in reduced species diversity in depositional areas within the receiving water system, such as in the Swamp Creek wetland and at the mouth of the Sammamish River.

Water Quality

Based on the anticipated characteristics of the untreated wastewater, storm-induced overflows into freshwaters could cause a decline in oxygen concentrations and pH levels, an elevation of nutrient levels, and an increase in turbidity; a number of contaminants could exceed Washington State Water Quality Standards. The degradation of water quality could, in turn, cause adverse impacts to fish, invertebrates, and plants. The degree of impact would depend on the location and volume of overflows, the extent of mixing in the receiving waters, and the duration of exposure to the degraded water.

Oxygen concentrations in proximity to a sustained untreated wastewater discharge, if it were to occur, could decline to levels that cause mortality to fish and invertebrates. Elevated levels of nutrients (nitrogen and phosphorus) in the wastewater could stimulate a cycle of plant growth and decomposition that would cause degradation of water quality and subsequent adverse impacts on organisms in the food web (such as decreased species diversity and mortality). These impacts could be delayed until the dry season when plant growth is greatest.

The time required to return to pre-overflow water quality conditions would depend upon the frequency and duration of overflow events. Water quality within Swamp Creek and the Sammamish River would likely return to background conditions soon after overflows ceased, perhaps within days. Recovery of Lake Washington would require longer. This is because the residence time of Lake Washington water is about two-and-a-half years.

Plants

While wastewater overflows were occurring during wet weather as a result of severe damage to the combined tunnel, aquatic plants could experience mortality from a reduction in water quality. For example, the increased turbidity could block sunlight needed by algae and other aquatic plants to grow. This would mainly be a factor in the creeks and in the Sammamish River; dilution in Lake Washington would potentially eliminate any impacts to plants from turbidity. The long-term impacts to plants would be different. Sustained wet weather overflows could cause significant impacts to aquatic plant communities. Although wastewater overflows that occur during the wet season would not overlap with the prime growth season for plants, much of the nutrients added to freshwaters in the wet season would remain until the dry season (dissolved in water and in solids settled on the sediments) resulting in a period of very rich plant growth. This would be followed by plant death and decomposition and subsequent reduction in dissolved oxygen in the water. Algae and rooted and floating plants would benefit from the additional nutrient input. However, the additional nutrients also would stimulate the growth of exotic nuisance species, such as water milfoil and cattails, which can compete with and replace local species. Ultimately, the excess plant growth would decrease water and sediment quality for fish and other aquatic life, potentially endangering their health.

Invertebrates

The changes in sediment and water chemistry that could occur from wastewater overflows (e.g., high ammonia concentrations, reduced dissolved oxygen concentrations, low pH, and elevated solids concentrations) could cause mortality to sensitive sediment-dwelling invertebrates, decreased diversity and shifts in species dominance. Freshwater mussels inhabiting tributaries of the Sammamish River are known to be sensitive to water quality conditions and could suffer mortality. The mussel community might never recover from sustained overflows, if they were to occur, due to a lack of upstream recolonization sources.

Fish

Potential impacts to fish under Scenario B would be similar to Scenario A but of greater magnitude. Immediate mortality of fish in streams and the Sammamish River could occur during storm-induced overflows due to toxic levels of ammonia in the wastewater. In areas where dilution is sufficient to reduce ammonia concentrations, such as in Lake

Washington, other stress factors such as suspended solids and low dissolved oxygen could put fish at risk. After overflows ceased, the delayed effects of nutrient enrichment and reduced dissolved oxygen concentrations could cause further fish kills, particularly in areas of streams and northern Lake Washington where organic matter accumulates. There may be a long-term risk of adverse health effects for bottom-dwelling fish, such as bullhead, from exposure to contaminants associated with deposited solids.

Wildlife

Wildlife species may or may not be affected by overflows during wet weather. However, the likelihood of impacts would be greater under Scenario B than under the other scenarios because of the greater duration and frequency of overflows to surface waters. Overflows could degrade water quality in the manner described earlier in this section, and wildlife potentially would be deterred from using affected areas as a drinking water source if other cleaner water sources were available. Aquatic food sources for wildlife, such as fish, could be sparse in affected freshwaters. If wildlife were exposed to wastewater, there could be a risk of short-term adverse health effects, such as sublethal illnesses. In addition, contaminants associated with sediments, such as metals, could pose a long-term health risk to aquatic-feeding species like the bald eagle. As described for Scenario A, there would be some risk of bald eagle and great blue heron nestling mortality if overflows were to coincide with the nesting season.

Wetlands

Storm-induced overflows could occur in wetlands adjacent to receiving surface waters including Swamp Creek, North Creek, and the nearshore areas of Lake Washington. Solids filtered by wetlands from the wastewater overflows could have the same adverse impacts described for Scenario A, but the impacts would be more likely to occur. Under Scenario B, overflows could occur intermittently over 6 months. Solids deposition likely would be greatest for overflows occurring during the wet season, because overflow volumes and durations would likely be greatest during these periods.

Water quality effects of wet-weather overflows on wetlands would be similar to those described for the other affected freshwaters. Excess nutrients could stimulate plant growth, and degradation of deposited organic matter potentially could lead to low oxygen and acidic conditions in both sediments and water. Thus, mortality of aquatic invertebrates and fish could occur. Bacterial and fungal mats also could develop. Because wetlands are important breeding grounds for amphibians, poor reproductive success could be observed, particularly if overflows were to occur during the spring breeding season.

Little Bear Creek

As for Scenario A, up to 300,000 gallons of wastewater could leak from buried pipes connecting process units. Until the underdrains were plugged or became clogged, small amounts of this wastewater could reach Little Bear Creek through the stormwater system temporarily reducing water quality. Under Scenario B, about 440,000 gallons of untreated, partially treated, and fully treated wastewater could leak from the combined tunnel at the south end of the treatment plant site if the combined tunnel were to fail (see Table 4-3). Little to none of this leaked wastewater would reach Little Bear Creek by surface flow, because the tunnel would be 25 to 30 feet below the ground surface at this location. The wastewater would infiltrate into the groundwater system. If unremediated, contaminated groundwater could reach Little Bear Creek after several years. Refer to the discussion later in this chapter of worst-case impacts to Little Bear Creek from contaminated groundwater and potential remediation strategies.

5.3.5 Impacts to Freshwaters and Biological Resources—Scenario C

Under Scenario C, an unknown and hypothetical fault would rupture under treatment facilities on the Route 9 site. Impacts to surface waters would vary depending on where on site the rupture occurred and which treatment facilities were damaged. If a fault were to rupture under the aeration basins, impacts to surface waters would occur at the same locations described for Scenario B; however, potential impacts would be of lesser magnitude because wet weather overflows could last up to 7 days while a bypass to the effluent pipeline was being installed, as opposed to intermittently over the several weeks needed to construct a temporary diversion to the effluent pipeline and the months that would be needed to repair the combined tunnel. If a fault were to rupture under the digester facilities, however, impacts to Little Bear Creek would be significant, as described below.

At peak flow conditions, whether a fault were to rupture under the aeration basins, the digesters, or the chemical storage area, both the treatment plant and influent pump station would be temporarily shut down for inspection. As a result, wastewater overflows could begin within a few hours. During peak flow conditions (the flow rate assumed to be the "worst case"), overflows could begin after storage was exceeded. Overflows would continue for up to 6 hours after the earthquake, the time required to configure the North Creek and York Pump Stations to pump the influent to the South Treatment Plant in Renton. During this transition period, high wastewater flows caused by heavy rain would overflow into North Creek and into the Sammamish River between the North Creek and Kenmore Pump Stations. Wastewater also would overflow into Lake Washington at emergency outfalls at the Juanita, Kirkland, Yarrow Bay, Medina, North Mercer and South Mercer Pump Stations.

These emergency overflows into Lake Washington would reduce the volume of overflows into the Sammamish River and would prevent wastewater overflows onto land. Once the North Creek and York Pump Stations began to reroute flows, overflows would continue intermittently (depending on rainfall) into the Sammamish River at the Hollywood and Woodinville Pump Stations, into the Sammamish River between the North Creek and Kenmore Pump Stations, and into Swamp Creek and Lake Washington. Overflows could last up to 7 days, the estimated time for system repairs to be made or for bypass systems to be put in place between damaged process units onsite and for the wastewater treatment system to restart and send flows to the outfall in Puget Sound.

The impacts to the freshwater environment from wastewater overflows (with the exception of Little Bear Creek) would be similar to those described for Scenario B for sediments, water quality, plants, invertebrates, fish, wildlife, and wetlands. However, the potential long-term health risk to organisms would be less and the recovery time could be faster because of the reduced duration of potential overflows to streams and Lake Washington. Duration would be less because after a few days or sooner, excess flows would be pumped into the Brightwater effluent pipeline and discharged to the marine waters of Puget Sound. Recovery time for the affected streams would range from days to weeks, while recovery time for Lake Washington could be a year or more. In the extremely unlikely event that a fault were to rupture directly under the digester complex, potential impacts to Little Bear Creek would be great, as described below.

Impacts to Little Bear Creek from Damage to Aeration Basins

If a fault were to rupture under the aeration basins, more than 9 million gallons of wastewater could leak out of the basins. Little to none of the leaked wastewater would be expected to reach Little Bear Creek via surface flows, unless it were to leak to the underdrain system. More than likely, the underdrain system would be plugged or become clogged causing spilled wastewater to infiltrate to shallow groundwater, but if the underdrain were to continue to function, partially treated wastewater would be conveyed to the western side of the treatment plant site and would be discharged to the wetscapes (natural stormwater treatment areas) or through one of the SR-9 culverts into Little Bear Creek. Unless the contaminated water could be intercepted at the wetscapes, it would result in high levels of fecal coliforms and other pathogens as well as suspended solids, turbidity, biological oxygen demand, and nutrients entering the creek. Poor water quality conditions would persist in the creek until the wastewater in the damaged basins had completely emptied or were pumped out and disposed of by other means.

It is more likely that partially treated wastewater would leak to the subsurface from the cracked basins and infiltrate into the shallow groundwater. If unremediated, contaminated groundwater could reach Little Bear Creek after several years. See the discussion later in this chapter of worst-case impacts to Little Bear Creek from contaminated groundwater and potential remediation strategies.

Impacts to Little Bear Creek from Damage to Digesters

If a fault were to rupture under the digesters, cracks would be expected to develop in these aboveground tanks. Up to 4 million gallons of wastewater solids could escape to the ground and flow west across the treatment plant site toward SR-9 and Little Bear Creek. The impacts to the creek if the digesters were to fail would be substantially greater than under any of the other scenarios due to substantially greater discharges of wastewater to Little Bear Creek, as discussed below.

A multi-step approach was used to assess the worst-case impacts to Little Bear Creek, as described in Appendix E. The approach used modeling to simulate the flow volume and flow path of the escaped, partially treated biosolids (referred to as wastewater solids), followed by an evaluation of impacts on water quality and aquatic life in the creek.

Minimal Flood Damage

If the digesters were to crack, the wastewater solids from the digesters would flow across SR-9 creating a traffic hazard for a brief period of time until the overland flow subsided, about one-half hour after the earthquake. The flow would continue west, into nearby Little Bear Creek (Figure 5-4).

These flows could pose a flood hazard to some structures in the flow path. Once in Little Bear Creek, the flow would attenuate as it moved downstream. Assuming the unlikely event of four digesters releasing most of their contents (4 million gallons), the peak flow in the creek would be comparable to that of a 5-year storm event for a short period of time. Little Bear Creek flows for about 3 miles downstream of the project site to its junction with the Sammamish River at river mile 5.4. The creek has a relatively well-defined channel, with only limited flood problems even during a 100-year flood event. Because of this, the inflow of the wastewater solids would be expected to cause little physical flood damage downstream of the project site. The flood conditions along the creek would last only a short time; the flows at the mouth of the creek at its confluence with the Sammamish River would peak about 1-1/2 hours after the earthquake and return to near-normal within about 3 hours after the earthquake. The flood effects in the creek would be substantially the same under both dry-weather and wet-weather conditions. In the extremely unlikely event that the earthquake occurred during a flood event on Little Bear Creek, the additional flow from the escaping wastewater solids would intensify the flood damage that would occur along the creek. Overall flooding along the creek would still be expected to remain relatively limited.

Adverse Water Quality Impacts

The escaping wastewater solids would negatively impact the water quality in Little Bear Creek from the treatment plant site to the creek’s confluence with the Sammamish River. The wastewater solids would have a very high concentration of suspended solids and would be anaerobic (a dissolved oxygen concentration of zero). Several constituents, including ammonia and hydrogen sulfide, would be at concentrations above the lethal level for fish and most other aquatic organisms. The pH within the creek would not be greatly affected. However, with a temperature of about 100 degrees F, the wastewater solids from the digesters would be higher in temperature than that of the creek, causing temporary warming of the stream. If an earthquake were to occur during August, a period of low summer base flow in the creek (average 7 cubic feet per second (cfs)), the creek would have almost no capacity to dilute the wastewater solids during the period of highest inflow. During the winter wet season, when creek flows average around 30 cfs, the creek would provide only minimal dilution during the period of highest inflow.

The combination of low dissolved oxygen with toxic chemical concentrations (including ammonia and hydrogen sulfide) would likely kill most fish and other organisms along the 3-mile stretch of the creek between the treatment plant and the Sammamish River. Some of the wastewater solids would be detained in one or more of the stormwater facilities at the treatment plant site and would be slowly released over a period of several days. During this time, degraded water quality conditions would persist in Little Bear Creek.

Although stream temperature would be expected to return rapidly to near-background conditions within a few hours, the Washington State Water Quality Standards for turbidity, dissolved oxygen, and coliforms (bacteria) might be exceeded for a period of weeks or even months following an earthquake that caused several digesters to develop major cracks.

Impacts to Sammamish River

The wastewater solids from the digesters would flow down Little Bear Creek at a peak rate of 200 cfs to the Sammamish River (Appendix D), where they would receive some dilution. Sammamish River monthly mean flow varies from 58 cfs in August to 450 cfs in December and increases slightly downstream as additional tributaries join the Sammamish River. The worst-case impacts would occur during the low-flow summer period when the wastewater solids would be diluted only slightly. It would be expected that water quality impacts to the Sammamish River would be identical to those described above for Little Bear Creek.

Long-Term Recovery

If the digesters were to crack open and the contents were to enter Little Bear Creek, the physical and biological recovery of the creek would be expected to take up to several years, even with implementation of mitigation measures. The sediment carried into the creek from the project site could take several years to be removed naturally from the streambed. The benthic community would begin to reestablish itself through colonization from the upstream portions of the creek that would be unaffected by the wastewater solids. As these benthic food organisms recolonized the lower portion of the creek, resident fish would return. The severity of impacts on salmon would depend on the timing of the earthquake relative to fish spawning and rearing periods. However, the presence of salmon in Little Bear Creek throughout the year ensures that some life stages would be at risk of mortality (see the description of salmon life history and migration patterns earlier in this chapter). Little Bear Creek supports more sockeye and chinook salmon than do other important streams in the area, such as North Creek or Swamp Creek. It is likely that the populations of one or both of these species in Little Bear Creek would be depressed for a number of years.

Impacts to Little Bear Creek from Damage to Chemical Storage Buildings

An additional potential impact to surface waters at the treatment plant site could result from chemical releases due to damage to the chemical storage buildings under Scenario C. This topic is discussed in more detail in Environmental Health later in this chapter. The stored chemicals of concern to water quality include sodium hypochlorite, sodium hydroxide, ferric chloride, citric acid, and sodium bisulfate. Alkaline chemicals would be stored separately from acid chemicals with approximately 1,200 feet of separation. The total volume of chemicals in each storage area would be about 80,000 gallons. If one entire storage area were ruptured and all tanks were full, chemicals could escape from the containment area and be released to the adjacent treatment plant road system. The escaping chemicals could flow offsite via the Main Entry Road and/or the treatment plant stormwater system. If the material were to reach Little Bear Creek, severe, short-term water quality impacts would occur. These impacts to water quality likely would kill most fish and other organisms in the streams, as described in the previous section on adverse water quality impacts that could result from damage to the digesters. The health and safety impacts of escaped chemicals is discussed later in this chapter under Environmental Health.

5.3.6 Impacts to Marine Waters and Biological Resources—Scenarios B and C

Untreated or partially treated discharges through the Brightwater effluent pipeline to Puget Sound would occur in Scenarios B and C. The impacts to water quality and biological resources in Puget Sound would be similar under both scenarios. Under Scenario B where the combined tunnel would fail, if a temporary pipeline were constructed to divert influent into the Brightwater effluent pipeline, untreated discharges to Puget Sound would occur for up to 6 months while the combined tunnel was being repaired. Under Scenario C, if a bypass were constructed around damaged aeration basins, untreated or partially treated discharges to Puget Sound would occur through the Brightwater effluent pipeline while the aeration basins were being repaired. Under Scenario C, partial treatment of all discharges to Puget Sound would resume within 2 months at the Brightwater Treatment Plant, while full secondary treatment could require from 6 months to one year. Once repairs were made, discharges through the Brightwater effluent pipeline would receive full secondary treatment before being discharged to Puget Sound.

The environmental impacts that would occur to marine waters under peak and maximum monthly flow conditions would likely be similar to one another because dilution at both flow conditions would be so significant that any differences in impacts would be imperceptible. Under these conditions and assuming as the worst-case scenario that all discharges are untreated, the following impacts could occur under Scenarios B and C.

Marine Water Quality

The impacts to water quality in Puget Sound would most likely be greater if Scenarios B or C were to occur during the wet season compared to the dry season because the volume of discharges of partially treated or untreated wastewater would be greater during the wet season. The Brightwater marine outfall would discharge the effluent through a diffuser about 600 feet deep and about one mile offshore; this would dilute the discharges significantly and minimize impacts.

The speed of tidal currents in Puget Sound is about one foot per second, thus the discharged effluent would be entrained quickly into the tidal currents and diluted throughout Puget Sound (Ebbesmeyer, et al., 2002). Washington State Department of Ecology guidelines recommend a minimum dilution of 100:1 at the edge of the chronic mixing zone. However, numerous effluent discharge scenarios were modeled for the

Brightwater outfall; the modeling showed that the median dilution at the edge of the chronic mixing zone, where the discharge would be regulated, would range from 300:1 to 1,821:1 (see Appendix 5-H to the Brightwater Final EIS). This is much more dilute than recommended by Ecology. No marine water quality guidelines would be exceeded at the edge of the mixing zone due to the dilution achieved at the outfall, and, as explained in the Final EIS (Appendix 6-H), the plume would not reach the surface under most conditions. Also, a major earthquake would be considered an “emergency” under King County’s National Pollutant Discharge Elimination System (NPDES) permit from Ecology. Thus bypasses of the treatment process would be permissible until the earliest time that repairs could be completed.

The discharge of untreated or partially treated wastewater would nominally increase the levels of nitrogen (a nutrient) in the Central Basin of Puget Sound. These nutrients could stimulate algae growth and decrease dissolved oxygen levels in the vicinity of the diffuser; however, significant impacts from nutrient enrichment would be unlikely due to the depth of the discharge and the fact that the effluent plume would not rise to the surface where algae could grow.

Marine Benthic Invertebrates

Impacts to benthic invertebrates (invertebrates that live within and near marine sediments) would be greater if an earthquake were to occur in the wet season because the volume of untreated or partially treated wastewater discharges would be greater than in the dry season. However, any impacts would be limited to the immediate vicinity of the diffuser and would not affect important species either economically (e.g., Dungeness crab) or ecologically (e.g., salmonid prey).

Solids would settle out in the vicinity of the diffuser and could smother benthic organisms. Sediments in the immediate vicinity of the diffuser could become hypoxic (low oxygen) from decomposition of organic matter which would cause mortality in benthic invertebrates. The benthic community could be temporarily altered due to enrichment; tolerant species could increase and sensitive species could decrease. However, community structure would return to background conditions after the untreated discharges ceased.

Marine Plants

Impacts to marine plants, such as phytoplankton, would be greatest if Scenarios B or C were to occur in the dry season because the dry season is the growth season for plants. If untreated discharges were to occur for an extended period of time (weeks) during late spring through early fall, an increase in phytoplankton biomass could occur due to elevated nitrogen levels, but this is unlikely to occur because of the reasons described in the Marine Water Quality section. Although phytoplankton growth could accelerate for a period of time, it is unlikely to be noticeable or to cause impacts such as lowered dissolved oxygen.

Marine Fish

Any fishes that live along the bottom and reside in the vicinity of the diffuser for an extended period of time could be at risk from long-term accumulation of contaminants in deposited solids. Bottomfish, such as flatfish, are the only fish that would be present in this area for an extended length of time.

Marine Mammals

Marine mammals are not likely to be directly or indirectly affected by untreated wastewater discharges following an earthquake. Marine mammals travel throughout a very large area in Puget Sound and forage in a wide variety of habitats. The effluent mixing zone is very small compared to this larger area. The likelihood of marine mammals passing through or feeding in the mixing zone and being directly exposed to effluent discharges would be minimal. Marine mammals would not be affected by discharges in areas outside of the mixing zone because dilution of the effluent would be great enough to reduce contaminant concentrations well below water quality standards.

Marine Birds

There would be no impacts from partially treated or untreated effluent that would cause mortality or population declines in marine birds.

Commercial, Recreational, and Tribal Fisheries

The impacts to commercial, recreational, and Tribal fisheries would occur only during open fishery seasons. Fisheries are open during both the wet season and the dry season, but they are of limited duration. There would be no impacts to other fisheries, including marine fish and invertebrates, such as Dungeness crab, because dilution from the diffuser would limit water quality impacts.

5.3.7 Mitigation of Impacts to Surface Waters and Biological Resources

As noted in the Brightwater Final EIS (Chapter 5) and detailed in Chapters 3 and 4 of this Supplemental EIS, in an emergency, King County would implement an emergency system to manage wastewater flows that could not be processed at the Brightwater Treatment Plant for some reason. Wet weather overflows would occur only under extremely rare circumstances where all five components of King County's emergency flow management system had been implemented and flows still exceeded the capacity of the conveyance system (see Chapters 3 and 4). In addition to implementing emergency response procedures, a variety of other mitigation measures could be used to lessen the environmental impacts that would result from an earthquake on the Route 9 site. For a full range of mitigation options for impacts to surface water quality, see Chapter 6 of the Brightwater Final EIS. Impacts and mitigation measures related to biological resources are discussed in Chapter 7 of the Brightwater Final EIS.

Minimizing or Mitigating Impacts to Streams and Lake Washington

Steps that would be taken to minimize or mitigate impacts to freshwater streams and Lake Washington following an earthquake on the Route 9 site would depend on the location of spills or overflow conditions and magnitude of potential environmental impacts. The following measures would be taken as needed:

- Under Scenario B, depending on the extent of the damage, influent flows would be diverted to the effluent pipeline at the location of the tunnel break. It would take up to 6 weeks to put the temporary modification in place after which the diversion to the effluent pipeline could accommodate a flow rate up to 130 mgd. This diversion would substantially reduce the volume of overflows to freshwaters.

- If wastewater solids were to spill from the digesters, the outlets to the South Road Runoff Canal and the South Wetscape would be temporarily blocked, weather and stormwater runoff conditions permitting. This would allow these stormwater facilities to capture a portion of the escaping wastewater solids. Their contents would be pumped out and disposed of in an operating wastewater collection system not affected by the earthquake, which would reduce the amount of time that highly polluted water was discharged into Little Bear Creek from these stormwater facilities.
- For other spills on the treatment plant site, wastewater would be flushed into the drainage system. This wastewater would flow to the stormwater canals and the wetscapes, where it would be pumped to a suitable discharge point in the treatment plant or trucked offsite.
- If wastewater solids were to spill from the digesters, pollutants that remained on the ground would be cleaned up as soon as possible, both onsite and in the area immediately west of the site where the wastewater solids would have spread. This would reduce the amount of residual pollutants that would reach Little Bear Creek in the weeks following the earthquake and would speed up the recovery of water quality conditions to background levels.
- If there were minor cracks in the pipelines within the combined tunnel (under Scenarios A and C), pipeline repairs would be added to King County’s list of scheduled maintenance activities. This activity would be planned to occur during the summer, when all wastewater flows would be the lowest and could be transferred from the Brightwater Service Area to King County’s other two treatment plants with the least risk of overflows. Once all flows were transferred, the conveyance tunnel would be shut down and repairs would be made.
- Offsite spills would be cleaned up in a number of ways:
  - Temporary blockages would be placed in drainage ditches, wastewater and solids would be washed into the ditches, and wastewater and solids would be pumped into tanker trucks.
  - Temporary sumps would be excavated in the ground, and wastewater and solids would be flushed into these sumps.

  - Absorbent materials would be applied to the wastewater and solids.
  - Collected materials would be hauled to an appropriate location for disposal.
- Oil booms would be installed near the mouth of the Sammamish River to catch floating solids and oils from damaged digesters. Oil booms would be employed as soon as possible after digester overflows began.
- A variety of measures would be used to clean up and restore the environment. These would include removing contaminated sediments, grading eroded streambanks, and/or replanting vegetation.
- The Little Bear Creek channel upstream and downstream of the 233rd Place SE bridge would be inspected for signs of sediment deposition, and contaminated sediments would be removed as soon as possible.

The following measures could be considered after weighing their potential negative environmental impacts and costs with their benefits:

- Phosphorus-removal agent could be distributed during overflows to prevent entry of nutrients into Lake Washington.
- Aquatic plants could be harvested or otherwise removed if growth was significant in the dry season.
- Water bodies and sediments could be aerated to lessen the depletion of dissolved oxygen.
- Organic matter could be removed using machinery where accumulation of organic matter was significant.

Minimizing or Mitigating Impacts to Puget Sound

If untreated or partially treated wastewater were discharged through the Brightwater effluent pipeline to Puget Sound under either Scenario B or C, the depth and location of the marine outfall would result in rapid mixing and dilution of the discharge. This would minimize impacts to both water quality and biological resources, as described above. King County would notify Ecology, the grantor of the NPDES permit, that partially treated or untreated discharges were taking place, and appropriate signage would be posted.

5.4 What Impacts to Groundwater Could Occur from an Earthquake on the Route 9 Site? What Can Be Done to Minimize or Mitigate Impacts?

Chapter 6 of the Final EIS for the Brightwater System described existing groundwater resources in the project area and analyzed potential impacts of the system on groundwater resources. The analysis demonstrated that there would be minimal or no impacts to groundwater, including the Cross Valley Aquifer and groundwater discharge to Little Bear Creek, from the construction and operation of the system. Please refer to the Final EIS for details about the type and extent of groundwater resources.

The following discussion specifically evaluates the environmental impacts to groundwater that possibly could occur as the result of the three very unlikely hypothetical worst-case earthquake scenarios described in Chapter 4 and earlier in this chapter. Additional discussion of groundwater impacts is included in Appendix F.

5.4.1 Impacts to Groundwater—Scenario A

Under Scenario A, it is assumed that a limited number of pipes would leak at connections between process units but that process tanks would remain intact with little or no leakage. A reasonably conservative assumption based on experience from past earthquake damage assessments would be that, at the most, 10 to 20 percent of the 1.5 MG of liquids in the connecting piping would leak out, resulting in roughly zero to 300,000 gallons of wastewater leakage. It is also assumed that the underdrain system would be completely plugged so that no wastewater would be diverted to the stormwater drainage system, and all wastewater would be discharged to groundwater. If the underdrain system were only partially plugged, the potential groundwater impacts would be less than impacts if the underdrain were completely plugged. Flow conditions into the plant would not affect the location or magnitude of impacts, because influent flows would be shut off immediately after the earthquake and the depth to groundwater does not change sufficiently on a seasonal basis to warrant season-specific analyses.

Hydrogeology

The first groundwater to be affected would be the groundwater contained in the impermeable dimicton/till/lacustrine soils (Qvd/Qvt/Qvlc) or in the permeable recessional outwash (Qvrf) overlying the dimicton in some areas of the site. The groundwater in the permeable pre-glacial fluvial sediments of the Cross Valley Aquifer (Qpgf) underlying the dimicton/till/lacustrine soils could be impacted next as part of the contaminated groundwater migrated further downward. Figure 5-5 is a schematic cross-section showing the relationship among the geologic units near the Route 9 site. Additional information is provided in the Final EIS.

Unless remediated after the earthquake as discussed below, the contaminated groundwater from the cracked pipe connections would slowly migrate westward beneath the site property toward Little Bear Creek and ultimately would seep into the creek, which is the local groundwater discharge area. As noted in Chapter 6 of the Final EIS, Washington State Department of Ecology files indicate that there are no water supply wells drawing from the shallow unconfined aquifer in the immediate vicinity of the Route 9 site. Because there are no groundwater users between the Route 9 site and Little Bear Creek, the creek is the sole groundwater receptor. Also as discussed in Chapter 6 of the Final EIS, wells in the Cross Valley Aquifer would not be affected because the groundwater flow direction in the aquifer is west from the Route 9 site toward Little Bear Creek and the Cross Valley Aquifer wells are located east and upgradient of the site.

Levels and Duration of Contamination

Typical wastewater contains many dissolved and suspended constituents, including suspended solids, oxygen-demanding constituents referred to as biochemical oxygen demand, pathogens including bacteria and viruses, nitrogen, phosphorus, and a variety of metals and organic compounds. Appendix F includes a more detailed discussion of these constituents.

The suspended solids and much of the associated demand on oxygen would be filtered out as the wastewater infiltrated into the first few feet of soil. However the remaining dissolved constituents would continue to slowly migrate with the groundwater flow. As the dissolved constituents migrated, some would be transformed to other chemical species (e.g., TKN to ammonia to nitrate) and others (e.g., phosphorus and many dissolved metals) either would be adsorbed onto soil clay particles and thus be slowed in rate of migration relative to the average groundwater velocity or would be permanently removed. Other constituents (e.g., nitrate) would travel at the average groundwater velocity. All contaminant concentrations would be lowered by dispersion, diffusion, and dilution as the contaminated groundwater slowly flowed from the source to Little Bear Creek.

The resulting contaminated groundwater would likely exceed Washington State primary and secondary drinking water standards. Primary drinking water standards are legally enforceable standards developed to protect public health; secondary standards are non-enforceable standards intended to prevent aesthetic effects. These exceedances would be greatest within the upper few feet of soil directly beneath the failed piping and would diminish with distance from the source of the wastewater. Unless remedial actions were taken after the earthquake, the contaminated water could eventually migrate through the subsurface into Little Bear Creek and potentially degrade the quality of water in Little Bear Creek .

The location on the treatment plant site where pipes, if they were to leak, would be closest to Little Bear Creek would be at the south end near the point where the combined tunnel ends. From here, the timeframe for the unremediated contaminated groundwater to first reach Little Bear Creek would be very long, probably in the range of 4 to 5 years and up to 15 years for the peak concentration (approximately 50 percent of the initial concentration based solely on dispersion). If unremediated, the groundwater between the plant facilities and the creek could remain contaminated for many decades. However, King County would remediate the groundwater as soon as feasible to reduce the potential for contaminated flows to reach Little Bear Creek (see the discussion of mitigation below).

5.4.2 Impacts to Groundwater—Scenario B

In the highly unlikely event that a major earthquake under Scenario B were to occur, the combined tunnel on the treatment plant site and the pipes within the tunnel could completely fail at Lineament X, and up to 440,000 gallons of wastewater (200,000 gallons of influent, 200,000 gallons of effluent, and 40,000 gallons of reclaimed water) could leak to soil and groundwater. In addition, as in Scenario A, connecting pipes throughout the facility could crack and leak up to 300,000 gallons of wastewater to the soil and groundwater. Flow conditions do not significantly affect the location or magnitude of impacts, because the influent flows would be shut off as soon as possible following detection of the tunnel failure.

Scenario B assumes that, as a worst-case condition, wastewater and reclaimed water would enter the groundwater and flow toward Little Bear Creek. In addition, some groundwater could enter the effluent and reuse pipelines at the point of failure and slowly flow toward the outfall. However, the effluent pipeline would have an isolation valve near Point Wells, and the effluent pipeline would be isolated to prevent any discharge of groundwater at the outfall.

Although the influent and effluent would have different qualities, it is assumed for this worst-case groundwater analysis that all the leaked wastewater would have the highest possible levels of contaminants. Flow conditions were not considered in the analysis because the influent and effluent lines are assumed to be full. Further, depth to groundwater does not change sufficiently on a seasonal basis to warrant season-specific analyses.

The type of impacts to the groundwater and Little Bear Creek would be similar to those described above for Scenario A. The magnitude of the impacts, however, would be greater under Scenario B because wastewater could enter the groundwater both from the combined tunnel and from leaking buried pipes that connect process units. Wells in the Cross Valley Aquifer would not be impacted, as discussed in the Final EIS, because the wells are located upgradient of the Route 9 site.

The timeframe for the unremediated contaminated groundwater to first reach Little Bear Creek would be similar to Scenario A; it would first reach Little Bear Creek in 4 to 5 years, and the attenuated peak contaminant concentration would reach the creek in 15 years (based solely on dispersion). If unremediated, the groundwater between the tunnel and the creek would remain contaminated for many decades. However, King County would remediate groundwater as soon as feasible to reduce the potential for contaminated flows to reach Little Bear Creek.

5.4.3 Impacts to Groundwater—Scenario C

Impacts to groundwater under Scenario C would vary, depending on the facilities that would be damaged by the rupture of an unknown and hypothetical fault on the Route 9 site between Lineaments 4 and X. The worst-case groundwater impacts would result from severe damage to the six aeration basins, the largest liquid-holding tanks in the treatment plant that are mostly below the ground surface. Damage could include major cracking that could result in leakage of affected basins and their connecting pipes. In the very remote chance that this total failure were to occur, all 9.4 MG of the liquid in the basins and the contents from broken connecting pipes throughout the facility could potentially come in contact with the soil and groundwater and, if allowed to remain in this condition, would infiltrate into the groundwater.

As described for Scenario A, the amount of wastewater entering the groundwater system was maximized for the worst-case groundwater analysis by assuming that the underdrain system would be plugged so that no wastewater would be diverted to the stormwater drainage system. Impacts to groundwater would be reduced if the underdrain system were only partially plugged; however, the worst-case condition of a fully plugged system was evaluated.

The soil and groundwater in the immediate vicinity of the aeration basins would become contaminated over time as the wastewater slowly seeped into the ground and mixed with the groundwater. As described for Scenario A, dissolved constituents in the wastewater would ultimately reach Little Bear Creek unless remediated. Wells in the Cross Valley Aquifer would not be impacted, as discussed in the Final EIS, because the wells are located upgradient of the Route 9 site.

Based on modeling results, the timeframe for the unremediated contaminated groundwater from the aeration basins to first reach Little Bear Creek would be very long, on the order of 12 to 15 years, and up to 30 years for the attenuated peak contaminant concentration (based solely on dispersion). It would take the groundwater longer to reach the creek under this scenario than under Scenario A because the aeration basins are farther away from Little Bear Creek and the site is underlain by impermeable soils.

If unremediated, the groundwater between the aeration basins and the creek would remain contaminated for many decades. However, King County would remediate groundwater as soon as feasible to reduce the potential for contaminated flows to reach Little Bear Creek.

A ground rupture beneath the single belowground diesel storage tank onsite would cause the tank to crack and and diesel fuel would leak into the ground. Because the tank would be double-walled, it is unlikely (but not impossible) that the entire 4,000 gallons could leak. If this were to occur, the diesel could migrate to groundwater where it would be remediated in the manner described for other groundwater contamination (see the mitigation discussion below).

5.4.4 Mitigation of Impacts to Groundwater

To minimize or mitigate impacts to groundwater resources from damaged aeration basins or cracked pipes, the leaking basins or pipes would be isolated as quickly as possible and the contents would be pumped to adjacent, undamaged facilities. This action would effectively minimize impacts to groundwater because the very low permeability of the site soils would contain the leaks to the immediate vicinity of the failure for days to weeks following an earthquake. During repair, additional mitigation or remediation could include excavating contaminated soils where accessible near identified leaks or spills. In addition, groundwater that migrated beyond the accessible excavation area could be remediated by a variety of methods including installing wells or cutoff trenches and pumping and treating the contaminated groundwater. A groundwater collection system of this type could be designed to contain contamination within the Route 9 site and eliminate discharge of contaminated groundwater to Little Bear Creek.

Remediation of contaminated soils and groundwater would be coordinated with the Washington State Department of Ecology.

5.5 What Odor and Air Emission Impacts Could Occur from an Earthquake on the Route 9 Site? What Can Be Done to Minimize or Mitigate Impacts?

Chapter 5 of the Final EIS for the Brightwater System analyzed impacts to air resources. The chapter described existing conditions as well as potential impacts to air resources and potential mitigation of these impacts. It described the types of odors typically produced in wastewater treatment systems from hydrogen sulfide, ammonia, amines, fatty acids and mercaptan-based compounds. These odor-producing compounds may be generated from anaerobic decomposition of organic matter containing sulfur and nitrogen or may be present as the result of discharges to the system. Chapter 5 of the Final EIS also discussed air emissions and included tables estimating the specific types and levels of air pollutant emissions that are common at wastewater treatment plants and that could be expected at the Brightwater Treatment Plant.

For all earthquake scenarios discussed below, the extent of odors and air emissions would depend on the type and quantity of material that was leaked, the concentration of odorous materials, and the meteorological conditions at the time of the earthquake. The worst odor impacts would occur during warm, dry weather when there is generally less wind to disperse odors. A greater number of air inversion periods occur during the winter, but the odor potential is typically much lower because of colder wastewater temperatures and higher, more diluted wastewater flows. Air emission impacts are not as dependent on wastewater flow or weather as are odors because the chemical usage by dischargers, including light commercial and residential dischargers, is relatively constant throughout the year.

5.5.1 Odor and Air Emission Impacts—Scenario A

Under Scenario A, in which Lineament 4 would rupture and very strong ground shaking would occur on the Route 9 site, it is anticipated that only minor, repairable structural damage would occur to liquid-holding tanks, digesters, or solids handling facilities, and buried pipes connecting to belowground process units could crack and leak. No damage or only minor damage would occur to the odor control systems, ductwork, and chemical storage facilities. As a result, potential adverse odor and air impacts would be relatively minor. Minimal or no odors or other emissions to the air would occur because the treatment process buildings and/or covers would act as passive control even if odor control systems were out of service.

Wastewater flow conditions would not affect the magnitude or location of impacts to air resources at the treatment plant site under Scenario A. It is assumed that the majority of pipes and tanks at Brightwater would be full except for those taken out of service for cleaning and maintenance.

On or Near the Route 9 Site

Odor impacts would be temporary and minor under Scenario A. Leaks could occur at pipe connections. However, most of these pipe connections are buried; leaking pipe contents would move to subsurface areas and would be collected by the underdrain system, or they would enter the groundwater system (see the groundwater discussion in this chapter). No odors would be experienced as a result of underground leakage. If the wastewater were to make it to the surface under this scenario, localized odors associated with the wastewater would occur and would remain until the leak was cleaned up. For pipes that could potentially break above ground level, localized odors associated with the leaked materials would remain until the materials were cleaned up. It is unlikely that significant odors associated with spills or leaks could be detected offsite.

Some damage could be expected to nonstructural elements of the odor control system, primarily to the ductwork; however, damage would be expected to be minimal and would be repaired within a short period of time (from a few hours to a few days), depending on the availability of resources needed to make repairs and the extent of damage, if any, to other treatment facilities (see Chapter 4). Repair of the odor control system would be considered to be less urgent than repair of damaged wastewater process facilities; the odor control system would be repaired after the liquid and solids treatment facilities had been repaired. Odor releases would be localized only to areas where wastewater leaks are exposed to the atmosphere. If loss of electricity to the odor control systems were to occur (see Chapter 4), the odorous wastewater and sludge would be contained because only minor damage, if any, to buildings, covers, and digesters is assumed. Small fugitive emissions would be present until electricity is restored.

Offsite Locations

If the treatment plant were offline and the storage capacity in the conveyance system were filled, odors could occur offsite during wet weather as the result of wastewater overflows in the collection system (see the discussion of surface water impacts earlier in this chapter). Temporary and localized odors could be detected in the vicinity of the wastewater overflows and at collection system venting portals until the conveyance system filled up with wastewater. The magnitude of the impacts would depend on overflow quantities and duration; odorous compound concentrations; meteorological conditions; temperature, flow, and characteristics of the receiving waters; solids settling; and how quickly the conveyance system filled up with wastewater or the overflow was diluted or neutralized by the receiving waters. The potential for odor generation also would be affected by the dissolved oxygen levels in receiving waters and the biochemical oxygen demand caused by the overflow.

In most cases, overflows lasting from 2 to 8 hours likely would be diluted quickly by the receiving waters and would not cause any noticeable odor impacts to the surrounding area. However, if an overflow were to occur in wetlands or if noticeable solids accumulated along the shore or streambed, localized odors would be present until dilution, cleanup, neutralization, or containment occurred. Impacts to the biological system from solids deposition are discussed in the surface water section earlier in this chapter.

5.5.2 Odor and Air Emission Impacts—Scenario B

Under Scenario B, Lineament X at the southern end of the Route 9 site would rupture, the combined tunnel would break, and very strong ground shaking would occur on the treatment plant site. The impacts of the shaking on treatment plant facilities would be similar to those described for Lineament 4 in Scenario A. The odor control buildings, covered treatment process units, and digesters would likely suffer only minor damage and would remain intact, as in Scenario A, resulting in minimal or no odors or other emissions to the air.

Under Scenario B, if Lineament X were to rupture on the site, the combined influent and effluent tunnel on the treatment plant site would break and the contents would leak. However, the wastewater would not likely reach the surface or cause odors. Some of the contents of the pipelines in the tunnel could drain to the subsurface at the rupture location until the pressure equalized, at which point groundwater could flow into the tunnel (see Chapter 4). It is possible that a “sink hole” could develop over the top of the tunnel break on the treatment plant site, but it is not likely that the contents of the pipelines in the tunnel would reach the surface, and it is unlikely that there would be surface flow associated with a break in the combined tunnel.

Odor impacts at ground level above the break would be minor, if they occurred at all, and would be associated with any wastewater exposed to the air.

Odor impacts associated with minor intermittent wastewater overflows offsite could occur, as described above for Scenario A. However, potential impacts would be greater than those described for Scenario A because the potential period when intermittent overflows would occur is up to 6 months for Scenario B, as opposed to days for Scenario A. No impacts from air emissions would occur.

5.5.3 Odor and Air Emission Impacts—Scenario C

Although Scenario C is the most unlikely scenario to occur, it could potentially create the worst impacts to air resources of the three worst-case scenarios considered. In Scenario C, it is assumed that an unknown and hypothetical fault would rupture somewhere on the treatment plant site between Lineaments 4 and X. The rupture would be accompanied by very strong ground shaking on the site similar to the level assumed in Scenario A. New treatment plant structures above the approximately 50-foot-wide ground area of deformation would sustain extensive damage. Other facilities would sustain minor damage, as described under Scenario A. Process buildings, covered process units, and digester covers could lose their containment and result in localized odors until repaired.

In Scenario C, the following events, if they were to occur, would have odor and air impacts:

- If a rupture were to occur beneath the aeration basins, the basins could crack and release a large volume of partially treated wastewater. Most of the contents would slowly leak to groundwater, although some could leak to surface water depending on where the basins were damaged and whether the underdrain system remained operational.
- If a rupture were to occur under the digesters, wastewater solids could discharge onto the ground surface and a small volume of digester gas could be released to the atmosphere.
- If a rupture occurred under chemical storage areas and the volume of leaked chemicals were to exceed the capacity of the containment areas or the containment areas were severely damaged, the contents could to leak onto the ground surface and the chemicals would enter the onsite stormwater drainage systems.
- If a rupture were to occur under an odor control building or if electricity were not available to power the odor control system, the system would be unable to treat odors produced by treatment facilities.
- If a covered process were to rupture or a building were to lose its containment, localized odor could be present.

Odor and Air Emissions from Damage to Aeration Basins

If a rupture were to occur beneath the aeration basins, the basins could crack and slowly release a large volume of partially treated wastewater. Because these basins are primarily below ground level, the majority of the wastewater would seep into the soil surrounding the tanks. Some wastewater could be released to the surface and could cause localized odors until the leak was cleaned up. Offsite odor impacts could result from wastewater overflows into receiving waters.

Trace air emissions could be expected from wastewater that was released from damaged basins or process piping; these emissions could be expected to occur until the spilled material was cleaned up or contained. Trace volatile organic compounds (VOCs), including regulated compounds, are routinely discharged to the wastewater collection system from residential, light commercial, and industrial sources and then are treated at the wastewater treatment plant. These VOCs could be emitted in trace amounts throughout the entire treatment and collection system.

The impacts from trace air emissions resulting from leakage of the contents of the aeration basins are not expected to differ from the impacts evaluated in Chapter 5 of the Brightwater Final EIS.

Odor and Air Emissions from Damage to Digesters

The quantity of wastewater solids in the digesters would be constant throughout the year (see discussion below) and would not depend on wastewater flow conditions or on weather. If a rupture were to occur beneath the digesters, the digesters could crack and leak a large volume of partially treated solids. Because these tanks would be primarily above ground level, the majority of the tank contents would leak to the ground surface. Very strong odors would be present both onsite and offsite until the contents were cleaned up. If digester contents were to reach Little Bear Creek, any solids deposited in the creek or in downstream water bodies could generate odors (see the surface water section in this chapter).

Odor and Air Emissions from Damage to Chemical Storage Areas

Several chemicals would be used in the wastewater treatment and odor control processes. Bulk chemicals would be kept on the treatment plant site in two large storage, handling, and distribution facilities located near the Reclaimed Water Building and near the Headworks/Primary Odor Control Building. In addition, small quantities of chemicals would be stored in the Sedimentation Support Building, the Headworks/Primary Odor Control Building, the Aeration/MBR Odor Control Building, and the Solids Odor Control Building.

Design of the chemical storage, handling, and distribution facilities for the Brightwater Treatment Plant would be in compliance with federal, state, and local codes and with guidelines and industry standards, including the Federal Risk Management Plan, the General Duty Clauses of the Occupational Safety and Health Administration and Federal Risk Management Plan (EPA, 2000), the International Fire Code (International Code Council, 2003), and the Chlorine Institute’s recommendations for proper chemical delivery, storage, and/or handling to prevent mixing sodium hypochlorite with acids (Chlorine Institute, 2000).

Bulk quantities of alkaline chemicals (sodium hydroxide and sodium hypochlorite) would be stored just west of the Reclaimed Water Building. Bulk quantities of acidic chemicals (ferric chloride, polyaluminum chloride, and citric acid) would be stored just south of the Headworks/Primary Odor Control Building. Each storage facility would house four tanks ranging in size from 8,000 to 18,500 gallons. Alkaline and acidic chemicals, if mixed, would form chlorine gas. To minimize this risk, the International Fire Code requires 20 feet of separation between storage areas for alkaline and acidic chemicals. The two bulk chemical storage facilities on the Brightwater Treatment Plant site would be approximately 1,200 feet apart, a much greater distance than required by code. The 1,200 feet of separation between the alkaline and acidic chemical storage areas is expected make it impossible for the two types of chemicals to mix.

If in the highly unlikely event that a ground rupture were to occur under the new proposed treatment plant facilities, it likely would occur under only one of the two bulk chemical storage areas. However, if under an even more remote chance, both the alkaline and acidic storage areas were damaged and the volume of leaked chemicals were to exceed the capacity of the containment areas or the containment areas were severely damaged, the contents would to leak onto the ground surface and the chemicals would enter the onsite stormwater drainage systems. The stormwater drainage systems for the two storage areas would be separated to prevent the mixing of the two types of chemicals. The alkaline chemicals stored on the north end of the site would drain to the North Roadway Runoff Canal; the acidic chemicals at the south end of the site would drain to the South Canal. These large bulk-chemical storage facilities are separated by sufficient distance such that no mixing of chemicals is expected.

No volatilization or release of leaked chemicals into the atmosphere is expected. The chemicals that would be stored onsite are not very volatile and would have only a slight odor if they were to leak. For example, sodium hydroxide would smell similar to drain cleaner and sodium hypochlorite would have an odor that is slightly stronger than household bleach. The chemical concentration in the air around the containment facilities would be considerably below toxic levels for all chemicals stored onsite.

Odor and Air Emissions from Damage to Odor Control Systems

Odor control systems would be located in three different buildings on the Brightwater Treatment Plant site: the Headworks/Primary Odor Control Building, the Aeration/MBR Control Building, and the Solids Odor Control Building. If a fault were to rupture under one of the odor control buildings, the odor control system in that building would be out of operation while repairs were being made. If a fault were to rupture between the Headworks/Primary Odor Control and Aeration/MBR Odor Control Buildings, both systems could be out of operation for a period of time while repairs were being made. It is assumed for this analysis that only one odor control system would be out of operation following an earthquake. The length of time that would be required for repairs would depend on the availability of resources to complete the repairs and the extent of damage, both to the affected odor control building and to other treatment facilities. Repair of an odor control system would be considered to be less urgent than repair of damaged wastewater treatment facilities.

If an odor control system were to become damaged and out of service during an earthquake, odors could occur onsite in the immediate vicinity of covered or contained wastewater tanks and process units as fugitive emissions escaped through cracks in covers, open hatches, and other areas. These small amounts of emissions would have fewer impacts than a spill or release that occurs directly into the ambient air or in areas not covered or contained. In addition, odors could occur if tank lids were removed to facilitate access to equipment for repair of damaged facilities.

In order to analyze the potential worst-case for odor impacts, it was assumed that untreated or partially treated wastewater or solids would leak from damaged tanks causing spills that would release odors directly to the atmosphere and that odor control systems would be damaged and not operating. Odor releases could be expected in the immediate vicinity of the leak and offsite depending on the severity of leak, specific weather conditions at the time, and length of time necessary to clean up the leak, repair damage to facilities, and restart the odor control systems.

It is unlikely that toxic air emissions could occur under Scenario C unless several events were to occur simultaneously inside one of the odor control buildings. Small amounts of chemicals would be stored inside each of the three odor control buildings. Sulfuric acid, sodium hydroxide, and sodium hypochlorite would be stored in day tanks; each tank would have a volume of about 300 gallons and a separate dedicated containment area designed to hold the entire day-tank volume plus 20 minutes of fire sprinkler flow. If a rupture were to occur beneath one of the three odor control buildings, if the day tanks in these buildings were to rupture or leak their contents beyond the capacity of their respective containment areas, and if the sulfuric acid and the sodium hypochlorite day tanks were to fail and their contents were to mix, chlorine gas could form and could be released inside the building. The probability of all these events occurring is extremely remote; however, under an extreme worst-case event, it could occur. Mixing of these chemicals would not cause an explosion.

The maximum amount of chlorine gas that could be generated in an odor control building is 375 pounds, which is an amount about equal to the volume typically stored for disinfecting a public swimming pool. The chlorine gas would be contained in the odor control building and would not move offsite. If the gas were to leak out of the building, the chlorine gas would travel no more than 50 feet from the building before the concentration would fall below toxic levels, according to Federal Risk Management Plan General Duty Clause guidelines (EPA 2000). Because each of the odor control buildings would be more than 500 feet from the nearest property line, no offsite discharge of chlorine gas is expected.

5.5.4 Mitigation of Odor and Air Emission Impacts

Many features are being incorporated into Brightwater facility design to minimize or mitigate adverse impacts to air resources from damage to the wastewater facilities resulting from a major earthquake. In addition, King County implements several programs, such as staff training and emergency response, that would minimize odor and air emissions.

Siting and Design of Treatment Facilities

Where feasible, facilities are being sited or designed to avoid potential significant adverse impacts to air resources; these siting and design measures, as well as other measures, are as follows:

- In early site layouts for the Brightwater facilities, chemicals were to be stored in two facilities with 24 feet of separation. Spill containment in each facility was designed to meet code requirements for chemicals that need to be stored onsite for treatment plant operation, including disinfection. Even though the possibility that a hypothetical fault could exist beneath the chemical storage facility is extremely remote, it was decided as a result of this SEPA analysis to separate the alkaline and acidic chemicals that under catastrophic conditions could have had the potential to mix and create chlorine gas.
- The design now calls for storage of alkaline and acidic chemicals in separate facilities with a distance of 1,200 feet separating them. The facilities are constructed to IBC 2003 (Seismic Use Group III) standards for seismic protection (see Chapter 3). Each facility would have separate containment features sufficient to handle possible spills or leaks of chemicals. Sufficient volume would be provided in each exterior containment area to hold the contents of two tanks instead of the code-required minimum of one tank. The application of the IBC, the distance between chemical storage facilities, and the containment features would eliminate the potential for release of a damaging amount of chlorine gas if an earthquake were to occur at the treatment plant site.
- The number of piping connections to the chemical tanks below the liquid level would be limited to one tank outlet. This configuration would prevent a tank from leaking through small fittings used for level measurement or through drains in conventional chemical storage facilities because these fittings and drains simply would not exist. The tank outlet, which would be connected to downstream pumps and piping and thereby would be susceptible to breakage, would have a rate-of-change/fail-close valve. All chemicals would need to pass through this valve in order to leave a tank. The valve would automatically shut off if the power were to fail or the withdrawal rate were to exceed a preset level. If a pipe were to break outside the storage tank causing sudden loss of contents, the valve would close automatically and stop further leakage. The level measurement device would be integral to the tank, would not connect to any other pipes or pumps, and therefore would not be susceptible to breakage.
- King County’s emergency response plan includes a number of measures to minimize both odors and air emissions, including hazard identification, training, cleanup, and odor and emission prevention methods.

- Install chemical release detection equipment in the odor control buildings rather than relying on the portable detection equipment commonly used by emergency response teams when responding to chemical spills or digester gas releases.

- King County will maintain spill response kits onsite, as required by current regulations. These include spill covers designed to be placed over storm drain inlets to minimize chemical releases to surface waters.

Emergency Response Program

A number of mitigation measures have been incorporated into the Brightwater emergency response program that would minimize both odors and air emissions. The following measures focus specifically on odors, chemical mixing, digester gas, and air emissions:

- Meet Federal Risk Management Plan and Process Safety Management General Duty Clause requirements for identifying hazards, designing and maintaining safe facilities, reducing potential offsite impacts for worst-case and likely regulated substance releases, and implementing prevention strategies or installing equipment to minimize impacts (EPA, 2000).
- Train staff in the proper handling, cleanup, neutralization, and/or containment of potential offsite spills or overflows.
- Provide procedures, policies, and employee training for response to offsite odor, chemical spills, digester gas, and air emissions release.
- Take all measures necessary to prevent toxic gases from forming, as noted in the discussion of chemical storage tanks. If toxic gases should form despite these measures, then implement emergency response procedures and notify the surrounding community.
- Implement administrative controls that limit the quantity of regulated substances that can be stored onsite.
- Start cleanup and neutralization activities as soon as reasonably possible after an earthquake to minimize odors, odor generation, and air emissions.
- Use portable odor control scrubbers to treat odors at offsite locations or in the tunnel until the spill or overflow is removed, neutralized, and/or contained. (King County owns five portable trailer-mounted odor control scrubbers.)
- Use odor neutralization compounds to treat spills and overflows where their use would be in compliance with regulations and would not cause adverse impacts to the environment.
- Keep reactive chemicals or spills separated to minimize odor or air emissions at offsite locations.

5.6 What Impacts to Environmental Health Could Occur from an Earthquake on the Route 9 Site? What Can Be Done to Minimize or Mitigate Impacts?

Chapter 9 of the Final EIS for the Brightwater System described the affected environment for environmental health. It also provided information and analysis on potential impacts and mitigation measures designed to minimize or avoid potential significant adverse impacts to environmental health that could result from constructing and operating the system. Environmental health risk factors discussed in the Final EIS included chemicals of concern (hydrogen sulfide and methane gases) and pathogens carried by untreated wastewater. Potential environmental health risks related to recreational activities, such as water contact sports, were also discussed in Chapter 14 of the Final EIS.

Potential impacts to environmental health covered in the Final EIS included materials stored and used at treatment plants; spills, leaks, and airborne releases of potentially hazardous materials; and emergency overflows from the wastewater system. Mitigation measures outlined in the Final EIS included siting and design decisions to minimize potential impacts and operational mitigation to avoid or respond to an emergency situation related to spills, leaks, or other releases of potentially hazardous materials. Procedures for responding to emergency overflows in the system were also addressed.

The following analysis of potential impacts to environmental health focuses on worst-case impacts resulting from leaks or spills that could occur at the treatment plant site following a major earthquake under hypothetical Scenarios A, B, or C. The analysis also includes impacts at offsite locations that could result from overflows following an earthquake, including impacts to the public during recreational activities or other incidental contact. The analysis of impacts begins with a discussion of pathways of exposure that would apply to all scenarios that result in spills or leakage. This is followed by a discussion of worst-case impacts specific to each scenario. The possibility of exposure varies with Scenarios A, B, and C; the worst case for exposure would be under Scenario C. It is important to note that these represent worst-case impacts associated with highly unlikely events.

5.6.1 Pathways of Exposure if Contact with Wastewater Were to Occur

Potential impacts to environmental health depend on the type of material inadvertently released, the concentration of the material, the location, and the pathway to human exposure (transmission by water, air, or skin contact).

On or Near the Route 9 Site

The individuals most likely to be exposed to the wastewater would be workers at the treatment plant site, followed by emergency responders at the site, visitors present during the earthquake, and adjacent residents and workers. However, if untreated or partially treated wastewater or wastewater solids were to flow offsite, people could walk, run, or drive through the material. People could also come into contact with wastewater that had flowed into a stream or other surface water body.

While some low levels of toxic constituents could be present, levels would not be expected to be high enough to result in illness or other health effects during the brief period of direct contact associated with a release. Direct contact with untreated or partially treated wastewater or wastewater solids could occur through ingestion or through a cut or wound in the skin. This contact could result in potential health risks including bacterial and viral illness, as described below.

Potential health risks would be highest for the operations and maintenance staff responsible for managing any onsite leaks. These workers would likely come into direct contact with the wastewater as they attempted to deal with the emergency. However, they would not be at a significant health risk because they would follow established procedures for working safely around wastewater, would be trained in emergency response, and would have appropriate safety and health equipment to adequately protect themselves. Emergency responders to the site could be exposed to untreated or partially treated wastewater or wastewater solids while responding to medical, fire, or other emergency situations. These individuals would be unlikely to be significantly at risk because they would also be highly trained in emergency response techniques and would have protective health and safety equipment. Potential for bacterial or viral illness could occur if workers or emergency responders were unable to obtain potable water for cleanup following direct contact with wastewater.

It is unlikely that residents adjacent to the treatment plant could come into contact with untreated or partially treated wastewater or wastewater solids, because leakage is expected to be largely contained onsite except under very unlikely circumstances that are described below under Scenario C. Risks to public environmental health would be very low under the scenarios where any spills or leaks would remain onsite. Under the scenarios that could result in public exposure to untreated wastewater or solids, the result could be bacterial or viral illnesses. Although areas and water bodies affected by wastewater overflows would be posted as health hazards so that members of the public would avoid contact, these potential health risks could occur for up to several days depending on the duration of the overflow (see the discussion of surface water impacts earlier in this chapter).

Exposure to stored chemicals at the site would be very unlikely and could result only from the most extreme hypothetical earthquake in which a surface rupture occurred beneath the chemical storage facilities (see Scenario C below). If the chemicals were ingested or inhaled, a variety of negative responses could occur, including digestive and respiratory tract irritation or damage and other toxic responses. Reactions to the chemicals would be most severe at highest concentrations, but could promote skin irritations in the unlikely event that workers or members of the public came into direct contact with these chemicals in untreated wastewater flows. Potential releases of a small volume of digester gases or other airborne constituents would be limited to the most extreme and unlikely earthquake scenario described below under Scenario C.

Offsite Locations

In the event of a shutdown of plant operations related to a major earthquake, untreated wastewater overflows could occur at offsite locations, including into North Creek, Swamp Creek, the Sammamish River, and the east side of Lake Washington (Figure 5-3). Short-duration overflows could occur under all three scenarios during flow conditions above maximum monthly flow. The public could come into contact with affected water and be unaware that it contained untreated wastewater, even if overflows were posted at the site and reported to the media. This exposure could result in the potential for bacterial and viral illness.

In the event of extended overflows of untreated wastewater, contamination of sediments could occur, as described above in the surface water section. In the most extreme situation, sediment contamination could result in potential bioaccumulation of contaminants in fish and shellfish that could be consumed by humans. Contaminants consumed could include bacterial and viral pathogens, metals, and toxic compounds. If consumed in large enough quantities, these contaminants could cause short-term and potentially long-term illness. This potential risk could persist for months or years if significant quantities of sediments were deposited over an extended overflow period. It would likely result in ongoing monitoring in the vicinity of the overflow to determine when fish and shellfish tissue was safe to consume. While the potential for extended overflows is highly unlikely (see the discussion of surface water impacts earlier in this chapter), King County would assess potential impacts to fish and wildlife and provide notification of any potential health impacts if extended overflows were to occur.

5.6.2 Impacts to Environmental Health—Scenario A

On or Near the Route 9 Site

It is assumed under Scenario A that a rupture of Lineament 4 with very strong ground shaking would occur at the treatment plant site. Of the three scenarios analyzed, Scenario A presents the lowest risk of environmental health impacts resulting from releases of potentially hazardous materials because the least amount of damage to wastewater facilities would occur.

Wastewater would remain onsite and would not come into contact with the public except where underground connecting pipes broke and their contents entered the groundwater. Because pipe connections are buried, leaked fluids either would be contained onsite and would seep into the groundwater if the underdrain were plugged or clogged or would enter the stormwater system via the underdrain and move to Little Bear Creek. Thus, contaminants could reach surface waters through the underdrain resulting in the potential for direct contact with contaminated water in Little Bear Creek in the days following an earthquake unless it were contained within the onsite stormwater system. Environmental health risks associated with these releases would be similar to those described in the section on pathways of exposures above. Plugging the underdrains after the earthquake would limit the amount of contaminated water that could reach surface waters.

If unremediated in the groundwater, low levels of contaminants could reach Little Bear Creek in 5 to 15 years and could potentially impact environmental health. These contaminants could include constituents such as soluble metals. It is not likely that bacteria from the spilled wastewater could persist in the groundwater for up to 15 years; some viruses could persist in the groundwater system for a number of years. Potential environmental health risks could include direct contact through swimming or wading in Little Bear Creek, ingestion of fish or shellfish contaminated by persistent chemicals in groundwater, or ingestion of contaminated water. Because King County would remove the contaminated groundwater before it reached Little Bear Creek, the potential environmental health risks from this pathway are very low.

Offsite Locations

Scenario A presents the lowest risk of environmental health impacts at offsite locations because it poses the lowest potential for conveyance system overflows and for public contact with uncontrolled wastewater discharges to surface waters. The highest potential for risk under Scenario A is associated with a hypothetical earthquake that would occur during flow conditions above maximum monthly flow, i.e., heavy rainfall. Under these conditions, flow volume would exceed the storage capacity of the conveyance system if the treatment plant were shut down for several hours. Overflows could occur into North Creek, Swamp Creek, the Sammamish River, and Lake Washington with potential public health impacts from contact with dilute wastewater (see Figure 5-3 and the surface water discussion earlier in this chapter). Because these overflows would occur only if an extreme storm event occurred at the same time as or immediately following a major earthquake, the potential for direct contact with untreated wastewater is very low.

5.6.3 Impacts to Environmental Health—Scenario B

On or Near the Route 9 Site

Under Scenario B, potential impacts to environmental health would be similar to Scenario A. Very strong ground shaking at the treatment plant site could break connecting pipes and cause leakage both above and below ground. In addition, failure of the combined tunnel could release up to 440,000 gallons of wastewater to groundwater that, if unremediated, could eventually, over a period of years, reach Little Bear Creek, with impacts similar to those described for Scenario A. Environmental health impacts of contamination to Little Bear Creek could include the potential for viral illness. As described for Scenario A, King County would undertake to remediate any contaminated groundwater resulting from an earthquake at the site before it could discharge to Little Bear Creek.

Offsite Locations

Under Scenario B, adverse impacts to environmental health could result from overflows. Overflow locations, as illustrated in Figure 5-3, would present opportunities for human contact with dilute wastewater intermittently during very heavy rainstorms for up to 6 months while the tunnel was being repaired, with the potential health effects described above. In addition, once the temporary bypass to Puget Sound was put into place about 6 weeks after the earthquake, there would be discharges of untreated wastewater through the marine outfall for the remaining 5 months that would be needed for repairs to the combined tunnel.

The environmental health risk associated with these marine discharges is very low, because the discharges through the Brightwater outfall would achieve extensive dilution through the diffuser. There is very low potential for the public to directly contact contaminated water or sediments as a result of partially treated or untreated discharges through the outfall. (See the surface water section earlier in this chapter for additional discussion of water quality impacts associated with these discharges.)

5.6.4 Impacts to Environmental Health—Scenario C

Scenario C was developed to assess the potential damage that could occur to treatment facilities at Brightwater if an unknown and hypothetical fault were to rupture somewhere between Lineaments 4 and X beneath the treatment plant. Very strong ground shaking on the site would accompany such a fault rupture. In the extremely unlikely event that Brightwater would become temporarily out of service as the result of major earthquake, untreated or partially treated wastewater could be released to onsite and offsite locations from cracks in process tanks, leakage at pipe connections, and wastewater overflows. As a result, members of the public could potentially come into direct contact with untreated or partially treated wastewater, with the accompanying health risks as described for Scenario A.

In addition to wastewater spills, chemicals might be released to the environment if the treatment plant chemical storage facilities or odor control buildings were damaged to the point that onsite spill containment capacity was lost or exceeded. Treatment plant employees would be the most likely to come into close contact with the released chemicals first and would be at greatest risk for health impacts. These could include skin irritations, respiratory distress, and other reactions to chemicals in high concentrations. It is unlikely that the public would be exposed to chemicals under this worst-case scenario.

The location of a ruptured hypothetical fault would determine the types of adverse environmental impacts that could be experienced at the site, but it is very unlikely that more than one type of treatment unit would be severely damaged as a result.

On or Near the Route 9 Site

Of the three hypothetical worst-case scenarios, Scenario C would have the worst impacts to environmental health on or near the treatment plant site. In the extremely unlikely event that a surface rupture were to occur under the digester complex and the digesters were to crack, untreated or partially treated solids could flow across the site and across SR-9 and ultimately reach Little Bear Creek, where the public could come into contact with the solids. Digesters have the largest storage volume of the most concentrated wastewater material that could be released to the surface if damaged. As described above, it is possible that individuals could accidentally ingest untreated wastewater or become exposed to contaminants through wounds, resulting in a potential for bacterial or viral illness.

If a hypothetical rupture were to occur under the aeration basins instead of the digester complex, basin contents could leak into the surrounding soil and could result in groundwater contamination that if unmitigated, could ultimately reach Little Bear Creek in a number of years (see the groundwater discussion in this chapter). Groundwater in the area immediately downgradient of the treatment plant site is not used as source of potable water; therefore, there is very low potential for environmental health risks associated with drinking the contaminated groundwater.

If the rupture occurred under one of the odor control buildings and if the tanks inside the building were to rupture, there is a remote possibility that chlorine gas could be formed inside the building. Chlorine gas is highly toxic to humans. Treatment plant workers are trained to handle this type of emergency, and chemical detection systems would be installed in each building. As described earlier in this section, there is a low probability of this event occurring; if it were to occur, the small amount of resulting gas would be contained within the odor control building and dissipate slowly.

If the rupture were to occur below the chemical storage facilities, a number of chemicals could leak, including small quantities of sodium hypochlorite, sodium hydroxide, ferric chloride, polyaluminum chloride, and citric acid. If the rupture were to occur below the odor control facility, sodium hypochlorite, sodium hydroxide, and sulfuric acid could be spilled. Treatment plant workers who came into contact with these chemicals could suffer caustic reactions, such as burns. Most of these chemicals would pose only a minimal risk of volatilizing and being inhaled. Moreover, the chemical concentrations would be below toxic levels in the air and would not be expected to disperse offsite. (See the discussion of odor and air impacts earlier in this chapter.)

Offsite Locations

Overflows of untreated wastewater to freshwater would occur at locations shown in Figure 5-3 and would create environmental health risks if humans came into contact with the wastewater. In addition to overflows of untreated wastewater to freshwater locations, discharges of partially treated or untreated wastewater to Puget Sound could occur intermittently over a period of 6 to 12 months while repairs are being made to the treatment plant. The environmental health risk associated with these marine discharges is very low, because the discharges would occur through the Brightwater outfall and would achieve extensive dilution through the diffuser. There is very low potential for the public to directly contact contaminated water or sediments as a result of partially treated or untreated discharges through the outfall. (See the surface water section earlier in this chapter for additional discussion of water quality impacts associated with these discharges.)

5.6.5 Mitigation of Impacts to Environmental Health

As described in Chapter 9 of the Final EIS and Chapter 4 of this Supplemental EIS, King County has a comprehensive emergency flow management system and a detailed system to inspect, evaluate, and repair its facilities in the event of a wide range of emergencies. King County staff would implement the emergency flow management procedures to contain overflows to the lowest level possible in any type of emergency, including the worst-case scenarios evaluated in this document.

The *King County Emergency Management Plan* (King County, 2003) was developed in accordance with the requirements of RCW 38.52, the Washington State Emergency Management Division's Comprehensive Emergency Management Planning guide, and the Federal Emergency Management Agency's (FEMA) guidance. The Emergency Support Function 3 portion of this plan outlines King County's roles and responsibilities relating to the restoration and continuity of public works functions, including wastewater treatment, in the event of natural disasters or emergencies. For the proposed Brightwater Treatment Plant, King County would coordinate emergency management with the appropriate Snohomish County agencies.

King County would work with local jurisdictions to notify the public about overflow locations to prevent inadvertent contact with contaminated water. Notification could include posting by the local health departments, emergency news media releases, and other methods.

King County would monitor any potentially contaminated groundwater and provide remediation as appropriate. Please see the discussion of mitigation measures in the air and odor section earlier in this chapter.

5.7 What Impacts to Public Services and Utilities Could Occur from an Earthquake on the Route 9 Site? What Can Be Done to Minimize or Mitigate Impacts?

Chapter 17 of the Final EIS for the Brightwater System addressed public services and utilities. The chapter includes a discussion of existing conditions, impacts to public services and utilities, and proposed mitigation. Topics that were covered that are pertinent to the analysis in this Supplemental EIS include fire protection, emergency medical and police services, water, wastewater, storm sewers, electricity, natural gas, and communications, and other utilities.

Chapter 4 of this Supplemental EIS discusses the range of potential impacts to regional services that could result from a major earthquake. As described in this chapter, a major earthquake could have potentially extensive impacts to regional public services and utilities, particularly the roadway network. Losses of bridges or other regional transportation facilities could affect the mobility of emergency services throughout the region, including the potential for emergency services to be provided to Brightwater. Water supply pipelines could be ruptured, resulting in the loss of water supplies in the area until pipelines were repaired.

The worst-case scenarios considered in this Supplemental EIS could potentially increase responsibilities for emergency service providers. If a major earthquake were to occur, emergency responders would be faced with numerous immediate needs.

Damaged transportation systems could delay the arrival of repair and cleanup equipment at the treatment plant or offsite locations. Interruptions to power services could also slow repair and the time it takes to get wastewater treatment equipment back online.

King County would respond to wastewater overflow emergencies in the Brightwater collection system and would notify local utilities. Local utilities would respond to wastewater overflows in their own collection systems resulting from earthquake damage.

5.7.1 Impacts to Public Services and Utilities—Scenario A

On or Near the Route 9 Site

Under hypothetical worst-case Scenario A, a rupture of the fault at Lineament 4 would occur, accompanied by very strong ground shaking on the treatment plant site. Initial emergency response at the treatment plant site would consist of attending to injuries or responding to any fires. Most of the first emergency responders would be trained King County personnel. If additional assistance were needed, emergency responders from local fire and police departments could be called on, although they also would be receiving calls to assist with other emergencies throughout the area.

The Brightwater Treatment Plant would house repair equipment onsite for limited repair of nonstructural facilities and for cleanup of leaks. If specialized equipment were needed for major structural repairs, it would have to be brought to the site by road or by helicopters, if available. The condition of the road system following an earthquake would determine how long it would take for repair and cleanup equipment to arrive.

Offsite Locations

Overflows to surface waters could occur under Scenario A (see the discussion of surface water impacts earlier in this chapter). Overflows would occur only if flows over maximum monthly flow were to occur, the plant were shutdown, and the storage capacity in the conveyance system were exceeded. Impacts to offsite public services from overflows of untreated wastewater from the Brightwater System would be minimal. The local utility most likely to be affected by localized overflows would be Northshore Sewer and Water District, because overflows would likely first occur in the Kenmore area. In accordance with existing procedures for emergency flow management, King County would coordinate closely with affected utilities and provide appropriate notification during an emergency.

Affected communities would need to notify the public of overflows along shoreline areas, which might require immediate posting and, if possible, notification in the media. King County would notify members of the public and appropriate state agencies, including the Departments of Health and Ecology, of any untreated wastewater overflows associated with the King County System.

5.7.2 Impacts to Public Services and Utilities—Scenario B

Under hypothetical worst-case Scenario B, a surface rupture would occur under the combined tunnel at the treatment plant site, accompanied by very strong ground shaking. This earthquake would likely create impacts to public services and utilities similar to those described for Scenario A. Offsite impacts resulting from wastewater overflows would be in the same general locations as described for Scenario A but would occur over a longer duration if the combined tunnel needed extensive repair.

On or Near the Route 9 Site

If the needs for emergency medical and fire services were beyond the level that could be handled by King County personnel, impacts for emergency responders at the Brightwater Treatment Plant from increased demand on public services in the area would be similar to those described previously under Scenario A.

Offsite Locations

Scenario B would result in the potential for intermittent overflows at freshwater locations (Figure 5-3) during large storms for up to 6 months until repairs to the tunnel were completed. During this period, overflows could occur for flows above maximum monthly flow that exceeded the capacity of the conveyance system, including the diversion to Puget Sound. The location of overflows would vary depending on flow conditions (see the surface water discussion earlier in this chapter). Local wastewater utilities and emergency service providers could be affected by increased response calls associated with overflows during the 4 to 6 weeks it would take to put the temporary diversion to the Brightwater effluent pipeline in place. Local wastewater utilities may also need to respond to overflows in their own collection systems.

The local utility most likely to be affected by localized overflows would be Northshore Sewer and Water District, because overflows would likely occur first in the Kenmore area and would likely continue to occur during wet-weather conditions until the Puget Sound diversion was in place and afterwards during extremely wet weather. In accordance with existing procedures for emergency flow management, King County would coordinate closely with affected utilities and provide appropriate notification during an emergency.

Affected communities would also need to notify the public and agencies of untreated wastewater overflows along shoreline areas, which could require immediate posting and, if possible, notification in the media. King County would notify the public and agencies of any wastewater overflows associated with the King County system.

5.7.3 Impacts to Public Services and Utilities—Scenario C

On or Near the Route 9 Site

The need for emergency responders to handle treatment plant injuries and/or fires would be greater under hypothetical worst-case Scenario C than for Scenario A or B, depending on where ground rupture were to occur. Scenario C assumes that major process facilities would be damaged and their contents released. Scenario C would also include very strong onsite ground shaking.

If the rupture occurred under a chemical storage facility, King County personnel would attempt to contain any leaked chemicals using onsite equipment and spill control protocols. If the quantity exceeded the onsite containment/cleanup capacity, King County would likely call specialized emergency responders to assist in spill containment. Given that there would likely be multiple demands on emergency responders after a major earthquake, responding to spills at the Brightwater site would add to the response requirements of these personnel.

Under Scenario C, partially treated wastewater solids from the digesters could exit the Brightwater site, travel across SR-9, and enter Little Bear Creek. If this were to occur, emergency response needs could be increased for a short time as emergency service providers responded to questions, redirected traffic, or performed other duties relating to the flows. It is difficult to predict where these activities would fall in the prioritization of emergency response activities, but offsite overflows would likely result in increased activities for emergency responders, including fire, emergency medical, and police.

The Brightwater Treatment Plant would have backup power and communication (see the discussion of regional services in Chapter 4). Trained King County staff would respond to losses in power, other utilities, and communication capabilities until regional services were restored.

As noted in Chapter 4, drinking water supply lines to the Brightwater plant could be affected by the very strong ground shaking in Scenario C. It is anticipated that water supply pipelines could be broken if they crossed a fault that was ruptured during an earthquake. It is unlikely that the water supply would be contaminated by pollutant releases at Brightwater. If untreated wastewater were to flow offsite (Scenario C), flows would move downgradient from the site. Water supply wells, including those in the Cross Valley Aquifer, are located upgradient of the Brightwater site, thus they would not be contaminated by wastewater. There is a potential that if regional water supplies were damaged, residents near Little Bear Creek might attempt to use stream flows for potable water. However, use of creek water as a source of potable water would be unlikely because of obviously visible sedimentation and contamination. It would be important to alert adjacent residents of any potential stream contamination as soon as possible after the event.

Offsite Locations

The demand on emergency responders and local wastewater utility staff could be increased as they answered questions, redirected traffic, or performed other duties relating to the untreated wastewater overflows to freshwaters that could occur intermittently for up to a week under Scenario C. It is difficult to predict where these activities would fall in the prioritization of emergency response activities, but offsite overflows would likely result in increased activities for emergency responders, including fire, emergency medical, and police.

Because the expected duration for potential intermittent overflows is the longest of the three scenarios considered, Scenario C represents the greatest potential impact to local utilities and emergency service providers responding to overflows.

5.7.4 Mitigation of Impacts to Public Services and Utilities

King County has a multi-step plan to restore Brightwater's functional capability as soon as possible after an emergency (see Chapters 3 and 4). After a major earthquake, King County, working through the Emergency Coordination Center, would coordinate closely with all potentially affected utilities and service providers to implement coordinated emergency response procedures under the extremely unlikely occurrence of any of the hypothetical earthquake scenarios analyzed in this Supplemental EIS. This coordination would include emergency communications, emergency response resource availability, and other considerations. Measures would generally be the same for all earthquake scenarios; however, potential mitigation related to public services and utilities would be the greatest under Scenario C, because it would result in the longest duration for the potential of intermittent overflows. The Brightwater Treatment Plant would be equipped with an essential services emergency generator, a 48-hour fuel supply, and communication capabilities for essential life safety services only. Portable emergency generators would also be available and could be mobilized and in place within hours or days. In the future, onsite auxiliary power generation capable of providing power for some wastewater treatment needs may be added at the Brightwater site.

The *King County Emergency Management Plan* (King County, 2003) was developed in accordance with the requirements of RCW 38.52, the Washington State Emergency Management Division's Comprehensive Emergency Management Planning guide, and the Federal Emergency Management Agency's (FEMA) guidance, including the Disaster Mitigation Act of 2000. The Emergency Support Function (ESF) 3 portion of this plan outlines King County's roles and responsibilities relating to the restoration and continuity of public works functions, including wastewater treatment, in the event of natural disasters or emergencies resulting in the release of hazardous materials. The ESF 8 portion of the plan outlines King County's roles and responsibilities related to the organization, mobilization, coordination, and direction of emergency resources in a disaster.

If a major earthquake were to occur at the Brightwater site, King County would respond to the event in accordance with the procedures outlined in the *King County Emergency Management Plan* in coordination with Snohomish County Emergency Management officials. As part of this effort, King County would coordinate with other emergency service providers in the vicinity of Brightwater, including local fire districts, gas and electric utilities, local sewer and water districts, and public works departments for both the City of Woodinville and Snohomish County. This coordination would focus on the specific issues posed by the particular event (both at the treatment plant site and offsite) in an effort to enhance cooperation with emergency providers and other utilities under emergency conditions.

On or Near the Route 9 Site

Because the existing StockPot Building at the north end of the Route 9 site was constructed prior to the seismic standards that took effect with the adoption of IBC 2003, the building could be severely damaged if a rupture were to occur on Lineament 4 (Scenario A). King County has evaluated the measures that would need to be implemented to retrofit the StockPot Building to life safety standards so that it can be used (King County, 2004) (see Chapter 1).

The Brightwater Treatment Plant would be equipped with an essential services emergency generator, a 48-hour fuel supply, and communication capabilities for essential life safety services only. Portable emergency generators would also be available and could be mobilized and in place within hours or days. In the future, onsite auxiliary power generation capable of providing power for some wastewater treatment needs may be added at the Brightwater site.

Emergency response procedures would be implemented, as described above. King County staff are and will continue to be trained in emergency response procedures, as described above, and will serve as first responders for onsite emergencies.

Offsite Locations

Full-capacity, onsite electrical generation would be provided for the influent pump station to minimize the potential for overflows. Emergency response procedures would be implemented as described above.

5.8 References

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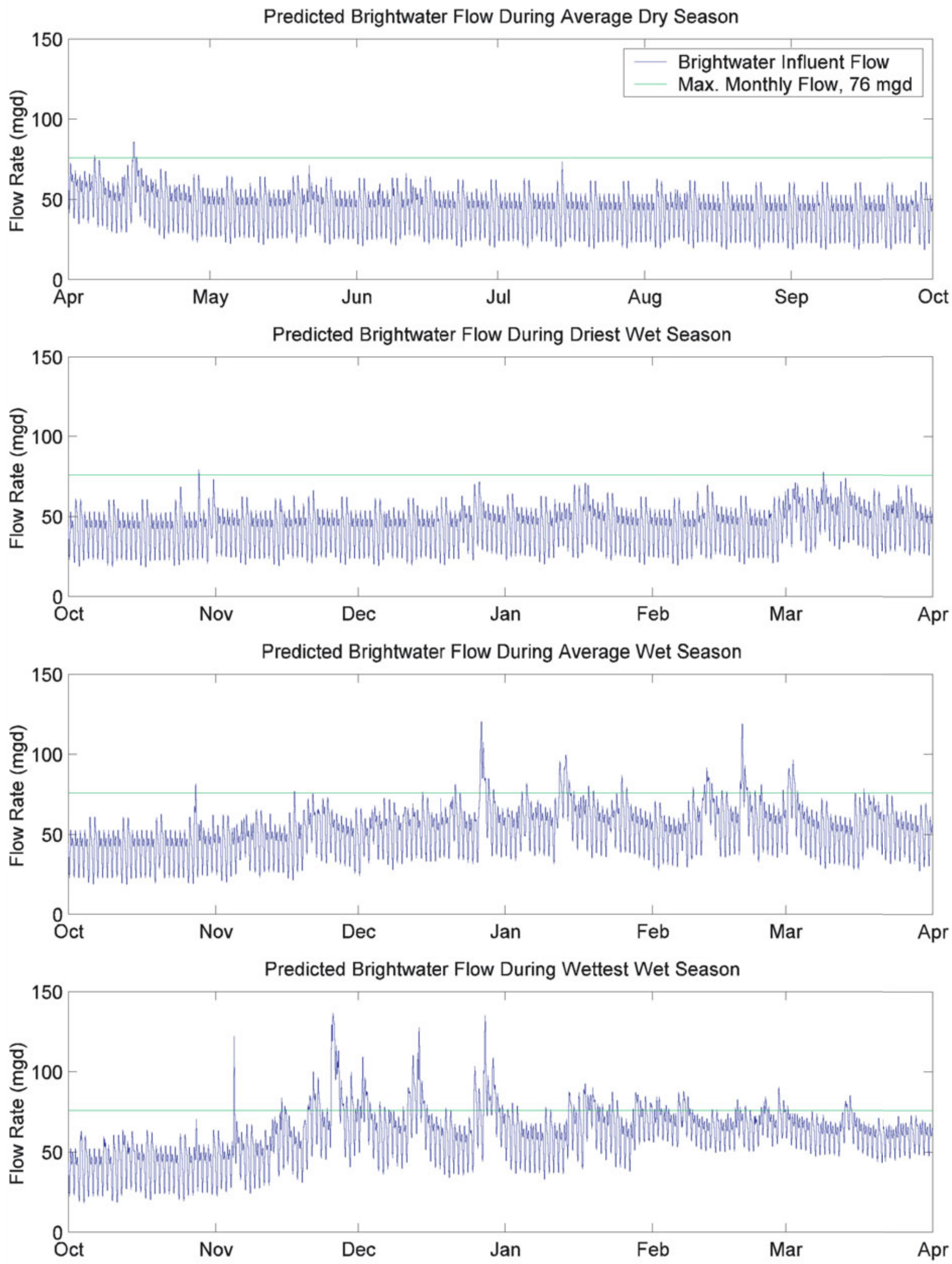
LIST OF FIGURES



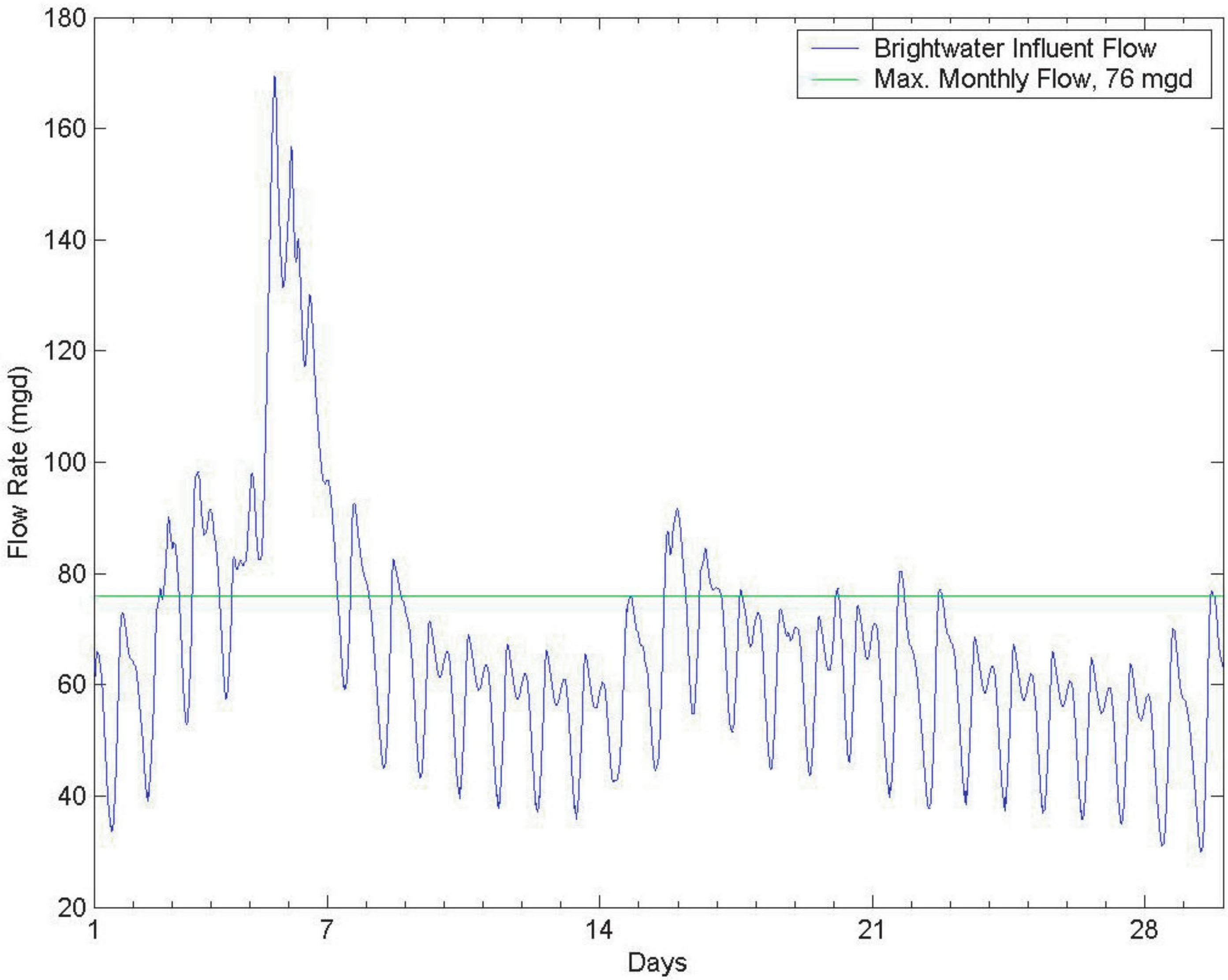
Note: Overflows could occur if the Brightwater Treatment Plant were shut down and flows exceeded 76 mgd (maximum monthly flow).

Data Sources: Nairn at KC WTD
File Name: 0503bwSUPP5-1.ai wgab
Prepared by: KC DNRP VC & Web Unit

Figure 5-1

Brightwater Influent Flows Predicted for Average and Extreme Dry and Wet Seasons

BRIGHTWATER SUPPLEMENTAL EIS



Notes:

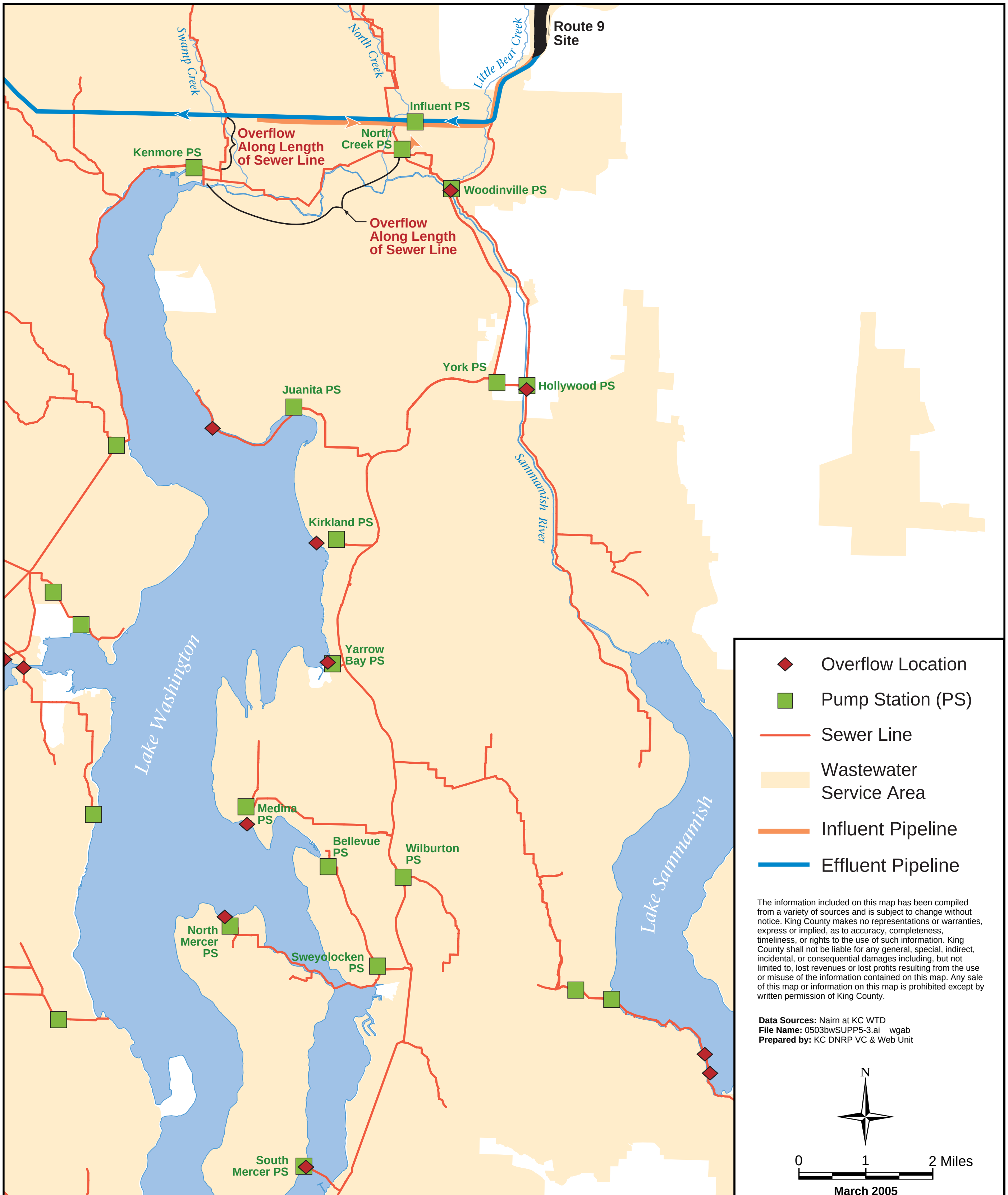
1. This graph was produced by modifying predicted Brightwater influent flows to illustrate hypothetical worst-case conditions.
2. Overflows could occur if the Brightwater Treatment Plant were shut down and flows exceeded 76 mgd (maximum monthly flow).

Data Sources: Nairn at KC WTD
File Name: 0503bwSUPP5-2.ai wgab
Prepared by: KC DNRP VC & Web Unit

Figure 5-2

Conceptual Duration of Brightwater Peak Hourly Influent Flow During the Wet Season

BRIGHTWATER SUPPLEMENTAL EIS



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Wastewater Treatment Division

Figure 5-3

Freshwater Resources and Overflow Locations for Flows Above Maximum Monthly Flow

BRIGHTWATER SUPPLEMENTAL EIS

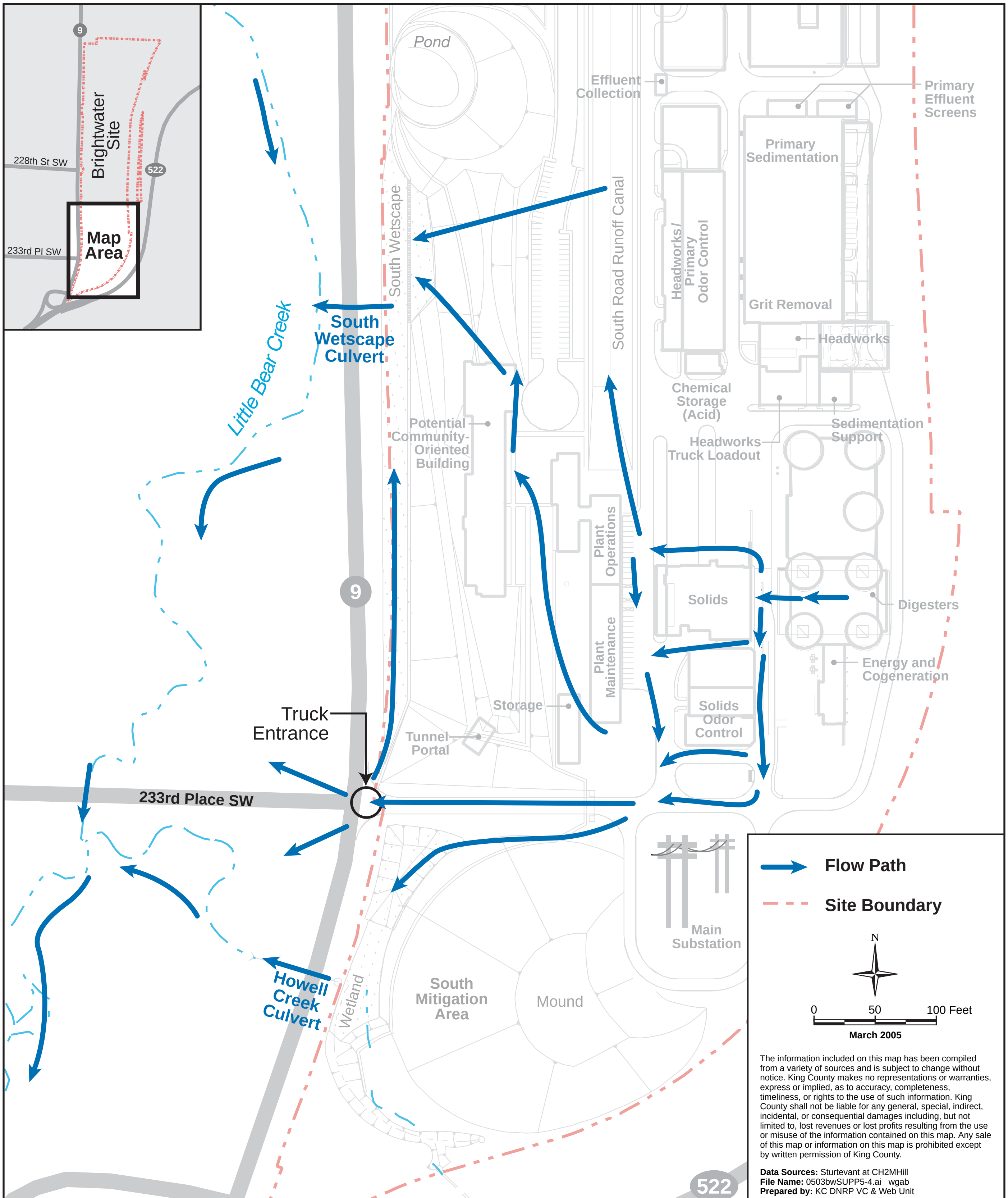

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Figure 5-4

Flow Paths of Discharge from Cracked Digester Tanks

BRIGHTWATER SUPPLEMENTAL EIS

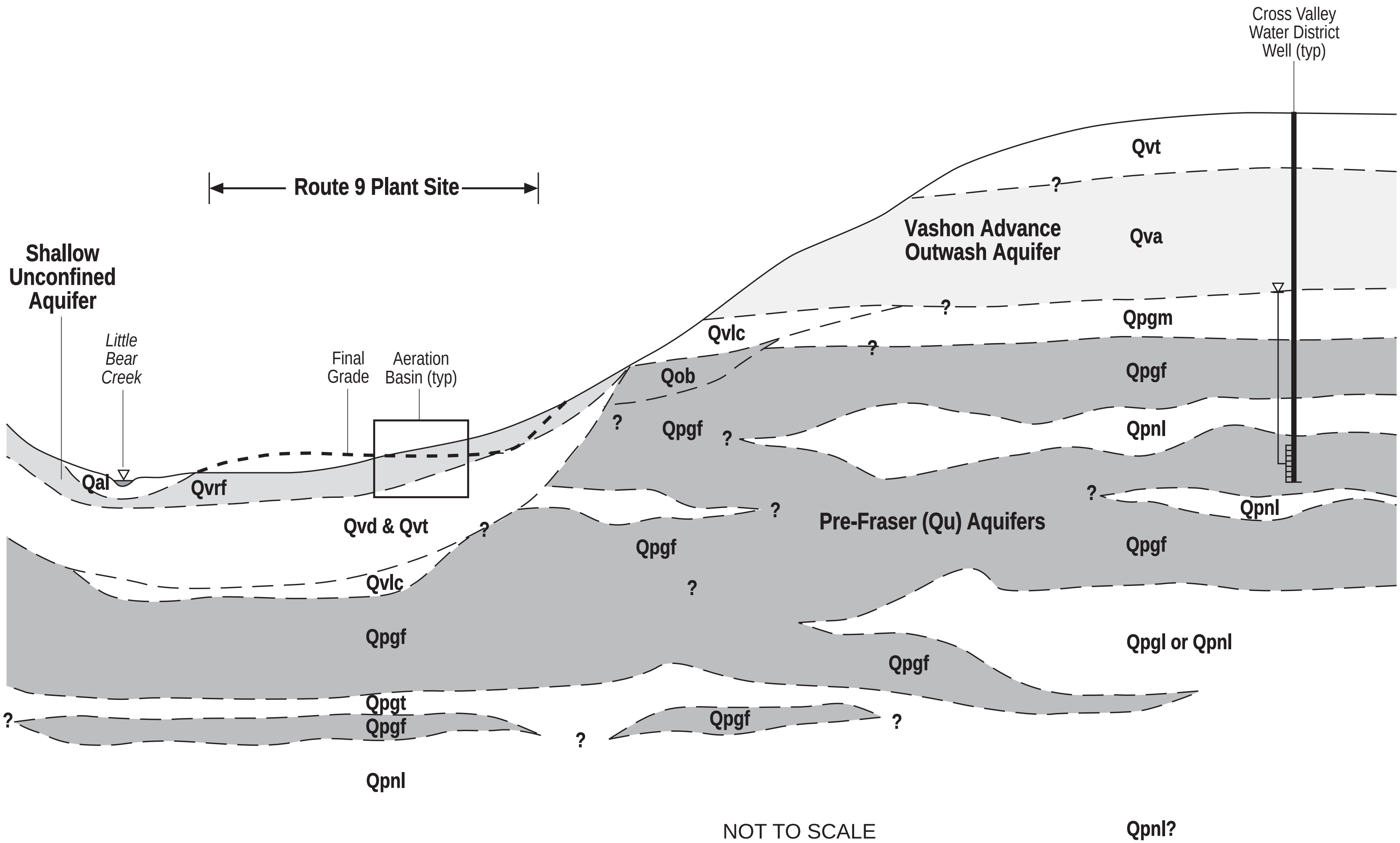

Figure 5-5

Schematic Aquifer Section of the Route 9 Site

BRIGHTWATER SUPPLEMENTAL EIS

King County
Department of
Natural Resources and Parks
Wastewater Treatment Division

Data Sources: CH2M HILL
File Name: 0503bwSUPP5-5.ai wgab157689.AP.EP.36.04_E012005004SEA • Fig F-3 Schematic Aquifer and Dewatering Section_Rt9 • 3/9/05 • dk
Prepared by: King County DNRP VC & Web Unit