Summary Responses to Comments

FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Brightwater Regional Wastewater Treatment System

Summary Responses to Comments

Scope of Supplemental EIS

What is the scope of this Supplemental EIS and why was it prepared?

King County issued the Final Environmental Impact Statement (EIS) on the proposed Brightwater Regional Wastewater Treatment System in November 2003. Since that time, new information about the Southern Whidbey Island Fault (SWIF) has become available. The purpose of this Supplemental EIS is to analyze the new information and its relationship to the Brightwater Treatment Plant site and to evaluate the significant adverse environmental impacts that could result if an earthquake were to occur on the SWIF and damage treatment plant facilities. It also includes mitigation measures related to these potential environmental impacts.

This Supplemental EIS responds to the August 3, 2004, decision by the King County Hearing Examiner. The decision was the conclusion of an administrative appeal of the EIS alleging that the EIS failed to adequately address seismic conditions at the Route 9 site and thus was not adequate under SEPA. The appeal also alleged that the EIS did not identify and evaluate an adequate number of reasonable alternatives to the preferred proposal.

The Hearing Examiner found that the EIS was adequate at the time it was issued for purposes of the two sites analyzed for the location of the Brightwater Treatment Plant, the Executive's decision to select the Route 9 site, and the analysis of potential seismic impacts to the conveyance tunnels and pipelines. However, the Hearing Examiner ruled that King County was required to conduct a trenching investigation of a suspected fault on the Route 9 site before it could rely on the EIS for future permitting decisions. If the trenching were to disclose that the suspected fault, LiDAR Lineament 4, was active, then King County would be required to publish a supplemental EIS to evaluate the impacts.

King County conducted the required trenching, as described in Chapter 2 of the Supplemental EIS. The trenching revealed a fault-like feature, a fold with minor faults, that is active. (This feature is referred to in this Supplemental EIS as a "fault.") Thus, as required by the Hearing Examiner, King County has evaluated in this Supplemental EIS the significant adverse impacts that could result if a major earthquake were to occur on the fault.

What previous State Environmental Policy Act (SEPA) review has been conducted on the Brightwater project and what issues have already been addressed?

The SEPA Rules (WAC 197-11-600) require a supplemental EIS to evaluate impacts resulting from new information or substantial changes to a proposal that would result in significant adverse environmental impacts. It does not require repetition of previously evaluated impacts, such as the impacts of constructing and operating the Brightwater conveyance system or analysis of reasonable alternatives analyzed earlier in the SEPA process. SEPA also allows phased environmental review [WAC 197-11-060(5)]. Phased review assists agencies and the public to focus on issues that are ready for decision and exclude from consideration issues already decided or not yet ready for decisions. Broader environmental documents may be followed by narrower documents that incorporate prior discussion by reference and concentrate solely on the issues specific to the current phase of the proposal. Consistent with this approach, King County has published the following documents and evaluated the following impacts:

- **Regional Wastewater Services Plan Final EIS (1998)**
  The RWSP EIS evaluated the environmental impacts of the capital improvement program to provide wastewater services to the region for the next 30 years. (Please see the RWSP Final EIS and Section 2.4 of the Brightwater Final EIS.)

- **SEPA Determinations of Nonsignificance for King County Council Ordinances 14043, 14107, and 14278 Related to Brightwater Site Selection (2000 and 2001)**
  The Environmental Checklists for each of the ordinances evaluated the environmental impacts of the policies and criteria used for screening potential sites, narrowing the number of sites to a reasonable number for consideration, and selecting specific sites for evaluation in the Brightwater EIS prior to final site selection. (Please see Chapter 2 of the Brightwater Final EIS for a description of the process.)

- **Brightwater Regional Wastewater Treatment System Final EIS (2003)**
  The Brightwater Final EIS evaluated the environmental impacts of locating the treatment plant at either of two alternative sites—the Unocal site in Edmonds and the Route 9 site in unincorporated Snohomish County—and associated conveyance options and outfall zones, as well as a No Action Alternative. It also evaluated the impacts of alternative treatment technologies, the performance of the conveyance system during an earthquake, the operation of a treatment plant on surrounding communities (including potential risks to sensitive populations), chemicals used in the treatment process, the safety relief point, emergency flow management, and all other relevant elements of the natural and built environment in the project area.

- **Addenda to the Brightwater Final EIS (2004)**
  King County issued four addenda to the Brightwater EIS. This included Addendum 3, which provided additional information on geotechnical and seismic studies characterizing the Southern Whidbey Island Fault (SWIF), geotechnical data for design of the conveyance system and outfall, and additional discussion of impacts and mitigation related to seismic and geologic issues. (Please see Section 1.3 of the Supplemental EIS.)

Each of these prior SEPA documents are incorporated by reference into this Supplemental EIS (please see the Fact Sheet at the beginning of the document).

What issues are beyond the scope of a SEPA analysis and/or beyond the scope of this Supplemental EIS?

The purpose of an Environmental Impact Statement prepared under the State Environmental Policy Act (SEPA) is to provide decision makers and the public with complete environmental information about a proposed project—existing site conditions, probable significant adverse environmental impacts, and reasonable mitigation. A supplemental EIS is issued when new information becomes available or substantial changes in the proposal are identified that are likely to have probable significant adverse environmental impacts that have not been analyzed (WAC 197-11-600).

This Supplemental EIS provides analysis of new information on the SWIF that has become available since publication of the Brightwater Final EIS in November 2003 and Addendum 3 in April 2004, and responds to the August 3, 2004, decision by the King County Hearing Examiner. The Supplemental EIS focuses solely on seismic impacts and mitigation related to constructing and operating the Brightwater Treatment Plant at the Route 9 site. It does not include an evaluation of impacts that were reviewed in previous documents or that are not required to be evaluated under the SEPA Rules.

The SEPA Rules specify the contents of an environmental impact statement (WAC 197-11-440). The elements of the environment that are to be analyzed under both the Natural Environment and the Built Environment are identified in WAC 197-11-444. Other sections of the SEPA Rules specify topics that are not required. These include WAC 197-11-448, which specifies the relationship of an EIS to other considerations:

(1) SEPA contemplates that the general welfare, social, economic and other requirements and essential considerations of state policy will be taken into account in weighing and balancing alternatives and in making final decisions. However, the environmental impact statement is not required to evaluate and document all of the possible effects and considerations of a decision or to contain the balancing judgments that must ultimately be made by the decision makers. Rather, an environmental impact statement analyzes *environmental* impacts and must be used by agency decision makers, along with other relevant considerations or documents, in making final decisions on a proposal. The EIS provides a basis upon which the responsible agency and officials can make the balancing judgment mandated by SEPA, because it provides information on the environmental costs and impacts. SEPA does not require that an EIS be an agency's only decision making document.

(2) The term "socioeconomic" is not used in the statute or in these rules because the term does not have a uniform meaning and has caused a great deal of uncertainty.

(3) Examples of information that are not required to be discussed in an EIS are: Methods of financing proposals, economic competition, profits and personal income and wages, and social policy analysis (such as fiscal and welfare policies and non-construction aspects of education and communications). EISs may include whether housing is low, middle, or high income.

WAC 197-11-450 addresses the topic of a cost-benefit analysis:

> A cost-benefit analysis (WAC 197-11-726) is not required by SEPA. If a cost-benefit analysis relevant to the choice among environmentally different alternatives is being considered by an agency for the proposal, it may be incorporated by reference or appended to the statement as an aid in evaluating the environmental consequences. For purposes of complying with SEPA, the weighing of the merits and drawbacks of the various alternatives need not be displayed in a monetary cost-benefit analysis and should not be when there are important qualitative considerations.

Many of the comments received on the Draft Supplemental EIS related to impacts that are beyond the scope of the Supplemental EIS. These fall into two main categories—those that have been adequately analyzed in one or more of the SEPA documents listed above and those that are not required by the SEPA Rules to be analyzed in an EIS.

Impacts that have been adequately analyzed in previous SEPA documents and are not being reevaluated in this Supplemental EIS include:

- Alternative options, candidate sites, and other Brightwater systems previously considered
- Application of the engineering and environmental constraints in the candidate site screening process, including the 0.5 km distance from a documented fault
- The impacts (including seismic impacts) of constructing and operating the 195th Street conveyance system, including the combined influent/effluent tunnel
- The environmental impacts that could be experienced by neighboring communities from constructing or operating the Brightwater treatment system, including potential impacts to schools and other sensitive receptors, and mitigation
- Options to, or phasing of, the Brightwater (North End Treatment Plant) alternative in the Regional Wastewater Services Plan, such as increased storage, increased management of inflow and infiltration, and/or increasing capacities at other existing treatment plants
- Population and flow studies and updates demonstrating the need for Brightwater to be operational by 2010
- Technologies for treating wastewater
- Approvals necessary from the Washington State Department of Ecology to operate the plant
- Impacts of treatment plant construction and operation on aquifers and private wells
- Odors associated with operating the treatment plant

Comments that are beyond the scope of the Supplemental EIS because they are beyond the scope of SEPA environmental review, as described above, include comments on the following topics:

- Cost information, including costs of building on a seismically active site, costs of repairing facilities following a major seismic event, costs of habitat restoration in Little Bear Creek, medical costs to people from the worst case scenario (Note that no medical costs are anticipated to be incurred because the analysis in the Supplemental EIS concluded that there will be no need for medical treatment.)
- Costs of potential mitigation measures, such as the suggestion to berm the digesters
- A cost/benefit analysis of the project
- Intangible economic costs and benefits
- Potential economic impacts to downstream businesses
- Concerns about devaluation of properties (property values) next to or in proximity to the Brightwater Treatment Plant
- Construction costs to remove liquefiable soils
- A risk assessment of human health impacts (It is not necessary to conduct a risk assessment of human health associated with operation of the treatment plant because applicable regulations for construction and operation of the treatment plant incorporate risk evaluations in their rulemaking and/or establishment of standards. As a result, compliance with these regulatory standards will ensure adequate protection of human health.)
- History of power outages experienced by local utilities that are not relevant to the ability to supply power to the Brightwater Treatment Plant
- Information on how other utilities may respond to a major seismic event on the SWIF
- Requests to provide Material Safety Data Sheets (MSDS)

Will any additional SEPA review take place in the future?

If, in the future, new information or substantial changes in the proposal are identified that indicate that probable significant adverse environmental impacts could result from the proposal, King County will evaluate whether such information or changes require additional environmental review under SEPA, and, if so, the appropriate SEPA document for providing the additional environmental review.

Executive's Decision

What criteria will the King County Executive use in deciding whether to proceed with construction of the Brightwater Treatment Plant at the Route 9 site?

The Executive's decision

In December 2003, following a 4-year site selection process and publication of the Brightwater Final EIS, the King County Executive chose the Route 9–195th Street System Alternative from among three action alternatives and the No Action Alternative as the preferred alternative for the Brightwater Regional Wastewater Treatment System. After the Executive selected the Route 9 site for the treatment plant, further seismic studies revealed the presence of an active earthquake fault, Lineament 4, on the Route 9 site and the existence of other lineaments on or near the site whose origin is unknown. The decision that the Executive will be making after publication of the Final Supplemental EIS is whether or not to proceed with construction and operation of the Brightwater Treatment Plant at the Route 9 site given the new information and analysis contained in this Supplemental EIS and prior SEPA documents.

Purpose of an EIS

This Supplemental EIS evaluates the environmental impacts that could result if an earthquake were to cause a surface rupture on the Route 9 site and result in damage to treatment or conveyance facilities on the site. An EIS itself is not the decision on the proposal. Rather, the purpose of an EIS is to provide information on the probable significant adverse environmental impacts of a proposal to those who make decisions. The decision makers must consider the environmental analysis in the EIS, along with other information and policy considerations, to plan and to make decisions on the proposal.

Considerations in making the decision

SEPA contemplates that the general welfare, social, economic, and other requirements and essential considerations of state policy will be taken into account in weighing and balancing alternatives and in making final decisions on a proposal. As mandated by SEPA, the King County Executive will use the information in the Brightwater Final Supplemental EIS, along with prior SEPA documents and other relevant considerations, to make the balancing judgment as to whether or not to proceed with construction of the Brightwater Treatment Plant at the Route 9 site. (Please see Summary Response on Scope of Supplemental EIS and the SEPA Rules, WAC 197-11-448.)

Following publication of this Final Supplemental EIS, the King County Executive will consider the likelihood of seismic hazards on the Route 9 site both from ground shaking and from fault rupture beneath future treatment plant structures. He will also consider the potential impacts of building the Brightwater Treatment Plant in proximity to known and hypothetical earthquake faults on the Route 9 site, including the level of risk to public safety, if an earthquake were to occur. (Please see the Summary Response on Understanding Seismic Risk.) In addition, the Executive will consider steps that could be taken to prevent or reduce damage should an earthquake occur. Other types of information that the Executive will consider include:

- Previous environmental review documents—the Brightwater Final EIS and Addenda 1 through 4
- Comments from other agencies and citizens
- Applicable land use plans
- Projected growth in the wastewater service area in south Snohomish County and north King County
- When additional wastewater capacity will be needed
- The schedule and cost of building a treatment plant at the Route 9 site compared to what would be required if King County were to look for an alternative site
- The impact to the environment that would result if Brightwater is not built by 2010

As part of the Brightwater EIS, King County has undertaken the evaluation called for in WAC 197-11-440(5)(c)(vii) regarding the benefits and disadvantages of reserving for some future time the implementation of the proposal, as compared with possible approval at this time. (Please see Chapter 1 in the Final EIS.) The consequences of deferring the Brightwater project include those described in the No Action Alternative analysis in Chapter 3 and Appendix 3-J of the Final EIS:

> If the Brightwater System is not built, the increasing flows from all parts of the Service Area would continue to go to existing plants, and the increasing volume would ultimately exceed the capacity of the plants and conveyance system to treat the wastewater. There would be a strong likelihood that wastewater would overflow into the local environment ... thereby greatly increasing the risk of environmental health hazards and the potential for degrading the quality of local streams, rivers, and lakes.

The Executive will consider the probable significant adverse environmental impacts that would result if Brightwater were not built by 2010, including the reduction of water quality and increased discharges of untreated or partially-treated wastewater into area water bodies. He will determine whether the benefits of proceeding with construction of Brightwater at the Route 9 site would outweigh any benefits of deferring the proposal until a future time while undertaking a new site selection process.

Public disclosure

When the Executive makes a decision, King County will issue a decision document that explains how the Executive arrived at the decision.

Why would the Executive choose to build at the Route 9 site now that an earthquake fault has been identified on the site?

Why Route 9 was originally selected

Prior to selecting the Route 9 site for the Brightwater Treatment Plant, King County conducted an extensive analysis of alternative sites. The Route 9 site was chosen from an initial pool of 95 prospective sites. The site-selection process is described in Chapter 2 of the Final EIS and Chapter 1 of the Supplemental EIS. Seismic considerations were one of many factors that King County analyzed and that the Executive considered before he determined that Route 9 was the optimal site for the Brightwater Treatment Plant. Among other factors, the Executive selected the Route 9 site because of its proximity to the service area; its large size, which would provide a buffer from neighboring properties; and its flat terrain, soils suitable for structural foundations, and higher elevation relative to the conveyance pipeline and outfall, all of which would facilitate construction and operation of the plant.

In addition, a treatment plant at the Route 9 site would have a low level of impact on aquatic resources and provide an opportunity to enhance wetlands and streams. The Executive's determination that a treatment plant at the Route 9 site would have a limited impact on wetlands was confirmed recently by the U.S. Army Corps of Engineers when it issued a 404 Permit for the Brightwater proposal; the Corps reviewed wetland impacts of many alternative sites prior to issuing the permit. (The 404 Permit is incorporated by reference into this Supplemental EIS; please see the Fact Sheet.)

The reasons stated above continue to establish that siting the Brightwater Treatment Plant at Route 9 is feasible and has distinct benefits, as compared to other alternatives.

Constructing and operating Brightwater to minimize seismic risk

While seismic investigations conducted after the Final EIS was issued have revealed the presence on the Route 9 site of an active earthquake fault on Lineament 4 and a potential fault on Lineament X, the analysis in the Supplemental EIS indicates that it is still feasible to build and operate the Brightwater Treatment Plant at Route 9 in a manner that would limit the risk to public health and safety from a ground surface rupture. Analysis shows that the treatment plant design would protect the plant from substantial damage in the event of a major ground-shaking event, which is much more likely to occur than a ground rupture under treatment plant facilities. As described in Chapter 4 of the Supplemental EIS, it is very unlikely that a ground surface rupture would occur on the Route 9 site during the design life of the Brightwater Treatment Plant. If a rupture were to occur, damage to treatment facilities is expected to be minimal because treatment facilities would be separated by several hundred feet from both the active earthquake fault on Lineament 4 and the potential fault on Lineament X. Historical evidence from around the country and the world suggests that areas more than 200 feet from a ground surface rupture would not be subject to impacts from such a rupture, although these areas would be subject to impacts from shaking. (Impacts of shaking that would result from a regional earthquake were evaluated in the Final EIS; impacts of shaking that would result from a fault rupture on the SWIF are evaluated in this Supplemental EIS.) It is even more unlikely that a ground surface rupture would occur in the area between Lineaments

4 and X on the site, because there is no evidence of magnetic or LiDAR anomalies similar to those associated with Lineaments 4 and X within the proposed area for new treatment plant facilities.

Despite the low likelihood of a ground surface rupture on the site, the Supplemental EIS conducts a worst-case analysis of potential impacts if such a rupture were to occur beneath or near a Brightwater facility. King County will have an emergency response plan in place to address any environmental damage that might occur in the event of a ground surface rupture. (Please see the Summary Response on Emergency Response.)

Alternative sites

When the Executive makes his decision, he will be determining whether to proceed with construction and operation of the Brightwater Treatment Plant at Route 9. He will not be considering alternative sites, other than those analyzed in the November 2003 Brightwater EIS, unless it becomes necessary to do so.

A total of 95 prospective sites were considered in the earlier site-selection process. When the siting process began, King County developed a set of engineering and environmental constraints. The constraints did not represent siting requirements; they were developed as a screening tool to identify sites with more favorable attributes for the location of the treatment plant and as a tool to narrow the large number of potential sites to a manageable number for consideration. The Brightwater project team wanted to avoid the cost of additional seismic mitigation by avoiding known earthquake faults; thus, the constraints included one that would locate the treatment plant more than 0.3 mile (0.5 kilometer) from any known documented fault.

Some sites were eliminated from further consideration based on this seismic constraint; other sites were eliminated based on other constraints, such as impacts to wetlands and streams. At that time, there was no information relating to the Route 9 site that suggested the site should be eliminated from consideration based on the seismic constraint. It therefore continued forward through the siting process. (Please see the discussion in Chapter 2 of the Final EIS.)

Later in the site-screening process, more comprehensive and detailed analyses were conducted on the two treatment plant sites—Route 9 and Unocal—that were selected for analysis in an EIS. In 2004, when new information about the potential location of the SWIF was reported by the USGS, additional earthquake studies were conducted for the Route 9 site. Results of these studies are described in Addendum 3 to the Final EIS. The analyses in Addendum 3 and the Supplemental EIS support the conclusion that the likelihood of a surface rupture earthquake on the Route 9 site during the design life of the Brightwater Treatment Plant is extremely low.

It would be very costly for King County to reinitiate the site-selection process and select an alternative site for the treatment plant. If another treatment plant site were found, it is possible that site-specific investigations could reveal the existence of earthquake faults or other constraints on the alternative site as well. If the King County Executive should decide not to proceed with construction at the Route 9 site, he would then decide whether to implement one of the other alternatives already evaluated in the Brightwater Final EIS—the Unocal System Alternative or the No Action Alternative. He also could decide to expend additional time and resources to update and obtain new information on possible alternative sites and undertake additional environmental review.

Comment Period

Why didn't King County grant an extension to the comment period?

The Draft Supplemental EIS was issued on April 11, 2005, and the 30-day comment period ended May 11, 2005. All references cited in the document were available upon its issuance to give citizens and agencies the full opportunity allowed by SEPA to review and understand the topics discussed. Those wishing to comment were offered a variety of ways to submit comments, including the Web, letters, comment forms, and public testimony.

While it is always possible under SEPA to extend comment periods and King County has done so in other instances, it is not required under SEPA. Moreover, King County must balance these requests with other considerations, such as the region's need for additional wastewater capacity by 2010. The Regional Wastewater Services Plan (RWSP), adopted in 1999, determined that Brightwater must be built by 2010 to prevent overflows and a possible building moratorium in the Brightwater Service Area. The 2004 Update to the RWSP affirmed the need for new treatment plant facilities by 2010. At this point, it is critical that King County complete the environmental review, make any changes that result from that review, and implement the Executive's decision as soon as is feasible and reasonable.

At earlier points in the process, King County was able to offer additional time for public process and extended comment periods for the public to review significantly longer documents; however, because of the urgency of the schedule and the narrow scope of this document, the County no longer has that flexibility. Thus, King County determined that SEPA's 30-day comment period was adequate to allow for informed comment.

Seismic Design Standards

Why was a special earthquake ground motion study carried out for the Brightwater site, rather than accepting the maps in IBC 2003?

The seismic design provisions in Section 1615 of the 2003 edition of the International Building Code (IBC 2003) identify two procedures for estimating earthquake-induced ground motions at a site. One method involves use of seismic hazard maps that were developed by the U.S. Geological Survey (USGS). These maps cover the conterminous United States, as well as a number of other areas. The maps are published in IBC 2003 or can be accessed at the USGS Web site (http://eqhazmaps.usgs.gov/). The second procedure involves performance of a site-specific probabilistic seismic hazard analysis (PSHA). A PSHA is a detailed analysis that incorporates geologic and seismic information known about a site. IBC 2003 allows a PSHA at locations when there is new information about the location or activity of faults, as long as provisions in Section 1615.2 are followed.

The most common approach for estimating ground motions at a location for design purposes is to use the maps or the USGS Web site. These maps are updated by USGS as changes occur in the understanding of regional seismicity and geology, the expected recurrence rates and maximum magnitude of events on known faults and sources, and/or the ground motion attenuation models used to estimate the hazard. The latest update to the USGS hazard maps was completed in 2002. As noted by one of the commenters, this means that the USGS maps may not necessarily reflect the most up-to-date scientific discoveries.

When preliminary information from USGS studies in 2003 provided more scientific support for the existence of active strands of the SWIF in the vicinity of the Brightwater Treatment Plant site, King County decided to conduct a site-specific PSHA for the Route 9 site, rather than waiting for USGS to incorporate new information into its seismic model for the region and for this information to be reflected in an updated IBC document. The intent of the PSHA was to use the best and most current information available when designing the treatment plant. The PSHA follows the IBC 2003 provisions for site-specific hazard analyses and is consistent with other recent PSHAs conducted in the area, such as those that were done for the Seattle Monorail project and the new Tacoma Narrows bridge. The initial analysis was completed in June 2004 before USGS and King County excavated a trench across Lineament 4.

Following the trenching of Lineament 4 and further interpretations by USGS in late 2004 (Sherrod et al., 2005)[1], the initial PSHA was modified in early 2005 to account for the

[1] Sherrod, B.L., Blakely, R.J., Weaver, C., Kelsey, H., Barnett, E., and Wells, R. 2005. *Holocene fault scarps and shallow aeromagnetic anomalies along the Southern Whidbey Island Fault Zone near Woodinville, Washington.* U.S. Geological Survey Open-File Report 2005-1136, 40 p.

trenching results and for another potential fault, Lineament X, which USGS suggested might cross the southern end of the site. This revision resulted in a slight increase in estimated ground motions (Appendix B of the Supplemental EIS).

Based on this current site-specific information, Brightwater Treatment Plant facilities are being designed to withstand ground shaking of 0.65 g, rather than the value of 0.51 g that would be obtained from the current USGS hazard maps. The seismic design of Brightwater therefore is approximately 25 percent more rigorous than the design required by IBC 2003 if the currently published seismic hazard maps were used. While USGS has begun to update its hazard maps to reflect recent information on the activity and location of the SWIF, updated maps will most likely not be available for 12 months or more.

How are the Brightwater Wastewater Treatment Plant structures classified according to the provisions in IBC 2003?

Table 1604.5 of IBC 2003 classifies wastewater treatment plant structures as Category III, unless the structure contains highly toxic materials as defined by IBC 2003 Section 307. If a wastewater treatment plant contains toxic materials according to Section 307, it is assigned to Category IV, is considered an “essential facility,” and requires a Seismic Importance Factor of 1.5. No highly toxic materials that meet the definitions in Section 307 will be contained in the Brightwater Treatment Plant. The treatment plant is therefore designated as Category III. Category III facilities require a Seismic Importance Factor of 1.25, which is 25 percent higher than required for Category I or II structures for seismic forces alone.

The Seismic Importance Factor, as specified in Table 1604.5 of IBC 2003 for different categories (also referred to as the “construction factor” by one of the commenters), is based on the nature of the occupancy of the structure. The Seismic Importance Factors used for Brightwater Treatment Plant design have been added for clarification to each column of Table 3-1 of the Supplemental EIS. (See the Text Changes section of this volume.) The majority of facilities in the Brightwater Treatment Plant are designed as Category III (Seismic Use Group II) with a the Seismic Importance Factor of 1.25. The remainder of the facilities (odor control facilities and chemical storage facilities) are designed as Category IV (Seismic Use Group III) with a Seismic Importance Factor of 1.5.[2]

Although the odor control and chemical storage facilities do not contain highly toxic materials as defined in Section 307 (IBC) and therefore are not required to be designed as Category IV facilities, King County decided to use a Seismic Importance Factor of 1.5 because of the amount of chemicals that would be stored in these facilities. By using a

[2] “Seismic Use Group” in this discussion refers to a classification that IBC 2003 uses for all structures. Seismic Use Group I covers structures designated as Categories I and II in Table 1604.5 of IBC 2003; Seismic Use Group II covers Category III structures; and Seismic Use Group III covers Category IV structures.

higher Seismic Importance Factor, the storage tanks will have an added degree of protection.

The Site Class Definitions in Table 1615.1.1 (IBC 2003) assign sites with liquefiable soils to a special site class requiring site-specific geotechnical investigations and dynamic site response analyses. Did King County conduct these types of analyses?

Site-specific geotechnical investigations and dynamic response analyses were not conducted to determine coefficients required by IBC 2003 because the soils are either not liquefiable or will be removed before construction.

Liquefiable soils (also known as Site Class F soils) are found primarily in the upper 15 to 20 feet at the Route 9 site. The foundation level for many of the structures will be located below the bottom of the liquefiable soils. In this case, the liquefiable soils would be removed during excavation for the structures. At locations where liquefiable soils exist below the planned base of the foundations, King County would remove these soils and replace them either with densely compacted granular soil that is imported to the site or with onsite soil that is mixed with cement. In either case, the soil would be highly resistant to liquefaction during a “design” earthquake. The improved soil also results in better performance under operational loads.

After liquefiable soils are removed from beneath the treatment plant facilities, the site class would change from Site Class F to a site class that is determined on the basis of the replaced soil. IBC 2003 provides specific methods for determining the site class. Results of analyses following these methods indicate that the treatment plant structures would be located on Site Class C soils. For Site Class C, site coefficients in Tables 1615.1.2 (1) and 1615.1.2 (2) of IBC 2003 can be used in place of site-specific dynamic response analyses.

Will the chemical storage facilities, Energy and Cogeneration Building, and Plant Operations Building need to meet any special seismic requirements to satisfy IBC 2003 provisions?

Because the chemical storage facilities will not contain highly toxic materials as defined by Section 307 of IBC 2003, they are not required to be designed as Category IV structures with a Seismic Importance Factor of 1.5. Nevertheless, as noted earlier, King County will design these facilities to this level to provide an added measure of safety. (Please see Table 3-2 in the Supplemental EIS for a complete list of chemicals that will be used at the Brightwater Treatment Plant.)

The Energy and Cogeneration Building and the Plant Operations Building are being designed as Category III (Seismic Use Group II) with a Seismic Importance Factor of 1.25. (Please see the response to the City of Woodinville, Comment G02-19, for a discussion of the main control room that will be located in the Plant Operations Building.) Redundant power supply for the entire plant will be provided by Snohomish Public Utility District, which meets the requirement for dual power supply as discussed in

Chapter 8 of the Brightwater Final EIS. The Energy and Cogeneration Building will provide auxiliary power for the average wet-weather flow capacity of 54 mgd at buildout.

The Draft Supplemental EIS indicates that crack control for liquid-holding structures will provide additional strength beyond what is required by IBC 2003. What does this mean?

IBC 2003 requires that all structures be designed for seismic forces that would have a 2 percent probability of exceedance in 50 years. For the Brightwater Treatment Plant, a site-specific seismic study (a probabilistic seismic hazard analysis, or PSHA) was performed to obtain the seismic input. This study was performed in accordance with the provisions of IBC 2003 Section 1615.2. Under this level of earthquake shaking, the structures are designed to meet life safety requirements and to sustain limited, repairable damage following the “design” earthquake.

A second design requirement must be met for “environmental” structures. All liquid-holding structures at the Brightwater Treatment Plant are considered environmental structures and must be designed to resist a variety of loading conditions—including hydrostatic, soil, and typical dead and live loads (service loads)—without leaking. The non-seismic loads are defined in the American Concrete Institute’s 2001 *Code Requirements for Environmental Engineering Concrete Structures* (ACI 350-01). Concrete, by its very nature, cracks; if the cracks are large enough, the liquid in the structure can leak through the cracks. However, the size and extent of cracks can be controlled (and thus the criterion for watertightness met) by limiting stress in the reinforcing steel used in the wall design. ACI 350-01 provides a method for calculating crack width based on limiting the calculated reinforcing steel stress when the structure is subjected to various load combinations. In addition, ACI provides guidance regarding acceptable crack widths based on the structure’s intended use. Three categories are provided (1, 2, and 3), with 3 having the most stringent (smallest crack width) requirements. All liquid-holding structures within the Brightwater Treatment Plant are classified as Category 3.

To satisfy these two design requirements for liquid-holding structures, walls are first designed to satisfy crack-control requirements under service load conditions (hydrostatic, soil, etc.) and then redesigned, if necessary, until the materials perform satisfactorily under the service loads. The design is then checked under seismic loads and is modified as appropriate to maintain acceptable stresses in the reinforcing steel.

Results of the structural analyses for Brightwater Treatment Plant environmental structures have determined that compliance with ACI requirements for crack control provides greater strength than is required by IBC to resist seismic loads. This means that the liquid-holding structures at the Brightwater Treatment Plant would be stronger than the IBC requirement for seismic design.

What design methods are being implemented to limit damage and reduce impacts from surface ruptures?

Two types of damage could be incurred from an earthquake on the SWIF: damage from very strong ground shaking and damage from fault movement (fault rupture). Strong ground shaking increases inertial loading within a structure or produces secondary effects such as liquefaction or other types of permanent ground displacement not associated with fault movement. Fault rupture damages structures that straddle the fault; nearby structures may be damaged by ground shaking but not by fault rupture.

The effects of very strong ground shaking were taken into account in development of the seismic design forces for Brightwater. As noted previously, a site-specific probabilistic seismic hazard analysis (PSHA), included as Appendix B of the Supplemental EIS, was conducted to determine levels of ground shaking that should be used in design of the Brightwater facilities. The PSHA predicts earthquake ground motions that may occur at the site in the event of an earthquake anywhere in the Puget Sound area, including rupture on other strands of the SWIF, on Lineament 4, and on the postulated Lineament X. The methods used for conducting the PSHA followed IBC 2003 requirements. The resulting ground motion values are higher than would be obtained from the current hazard maps referenced in IBC 2003, as discussed previously. These higher ground motions determine the inertial forces that a structure is designed to withstand. Structures designed in accordance with the IBC 2003 are expected to withstand these ground motions with minimal, repairable damage. Observations following large earthquakes indicate that design codes, such as IBC 2003, are successful in minimizing damage to structures from ground motions.

The other potential effect of strong ground shaking is to the soil supporting or placed around the structure. Ground shaking can cause liquefaction, which results in loss of bearing support, dynamic settlement as soil becomes denser, and slope movement. Each of these effects can result in differential loss in bearing support or differential loading to the structure. If not adequately considered in the design, these effects could result in structural failure. Design studies for the Brightwater Treatment Plant have evaluated the potential for liquefaction, earthquake-induced ground settlement, and slope stability. The results of these studies are being incorporated into the design of plant structures as appropriate.

The other potential source of damage—differential movement resulting from fault displacement—is potentially more difficult to address, particularly if fault displacements are on the order of several feet. The potential for differential movement from fault displacement has been evaluated during the design of the Brightwater facilities in the following manner:

- Based on studies by USGS and King County, the only known active fault onsite is Lineament 4 in the northern portion of the site. No new treatment plant structures are located over or in proximity to Lineament 4; therefore, no mitigation is necessary to address differential movement associated with Lineament 4.

- Lineament X has been assumed, however, to be an active fault for the purposes of siting Brightwater Treatment Plant facilities and assessing worst-case impacts. The combined tunnel carrying influent and effluent pipelines would cross Lineament X. It is customary to allow linear structures such as pipelines to cross fault zones and to provide mitigation for potential damage. The potential for damage to the pipelines at Lineament X that could occur from shearing at the fault zone when one end of the pipe moves relative to the other is being mitigated by providing thicker walls and stronger joints than would be required if no fault movement were hypothesized. In addition, the tunnel will be filled with grout to reduce potential leakage should a pipeline become damaged as a result of fault rupture on Lineament X. No plant structures are located on, in the proximity of, or intersect Lineament X.
- No active faults are known to exist beneath new plant structures between Lineaments 4 and X. Nevertheless, various provisions have been taken for structures and mechanical systems in this zone to provide protection from either strong ground shaking or limited fault displacement. The mitigation includes using valves and weirs to isolate sections of the treatment plant process, providing flexibility at connections between structures and piping, and incorporating additional detailing to mechanical and electrical equipment (e.g., bracing equipment and anchoring tanks, motor control centers, and valves) that will increase the ability of nonstructural components to withstand differential movement. The American Society of Civil Engineers (ASCE) document *Seismic Screening Checklists for Water and Wastewater Facilities* provides additional options that are being considered (2002).

Does IBC have any provisions that address design procedures to use when surface rupture is possible?

Under some circumstances, based on fault type, building type, soil type, expected ground acceleration, and other factors, IBC 2003 does proscribe placement of structures across certain types of faults, as defined in the code. IBC 2003 does not contain any special design procedures that should be followed if a structure is located in proximity to a fault. IBC 2003 does provide design guidance on how earthquake ground motions must be addressed during design.

These IBC 2003 provisions are being followed by the King County design team. IBC 2003 is the industry standard and while special structures such as nuclear power plants have higher design standards, IBC 2003 represents the current state of the earthquake engineering practice. There are no higher standards available for wastewater treatment plants than those provided in IBC 2003; these are the same standards that are used in the design of structures with a high life safety concern, such as high-rise buildings, hospitals, and schools.

The reason that IBC 2003 provides provisions for designing for ground motions and not fault ruptures is that a seismically active region will have many more buildings exposed to ground motion events than surface rupture events from active fault traces. In the case of Brightwater, the likelihood of large ground motions is much higher than the likelihood of a fault rupture during the design life of the facility. Strong ground shaking could result from any one of a number of seismic sources in the Puget Sound area, such as the Seattle Fault, the deep Benioff Zone, and the Cascadia Subduction Zone, whereas surface rupture under the treatment plant facilities would require ground rupture on a hypothetical, unknown active fault that would be located under the plant facilities. In terms of frequency, these off-site sources are much more likely to produce an earthquake and strong ground shaking than rupture of a fault at the treatment plant site.

While there is no direct evidence of a fault on Lineament X on the Route 9 site and no information about a hypothetical fault between Lineaments 4 and X in the area of proposed new plant facilities, the potential for faulting is being considered by King County as design proceeds. Examples of these considerations include separating the alkaline and acidic chemical buildings, adding flexibility to piping systems, and implementing appropriate recommendations in the ASCE (2002) guidelines. All of these additional provisions will improve the performance of the facility in the highly unlikely event that a fault ruptures below one of the new plant structures.

50-Year Design Life

A number of commenters questioned the validity of using a 50-year design life for the Brightwater Treatment Plant in calculating the probability of occurrence of the worst-case earthquake assumed in the analysis for this Supplemental EIS.

Why is the design life based on a 50-year period, rather than the actual life of the structure?

The applicable code for the design of the Brightwater Treatment Plant is IBC 2003. This code requires structures to be designed to a seismic ground motion that would have a 2 percent probability of being equaled or exceeded over a 50-year period. The 50-year period is often referred to by engineers as the “design life”; however, more correctly, it is an “exposure period.” The 2 percent probability of exceedance results in an average return period for the design earthquake of approximately 2,500 years, or 1 chance in 2,500 that the event will occur in any single year. This probability is the same as an annual rate of a 0.0004 occurrence per year.

The ground motion associated with the 2 percent probability of exceedance in a 50-year period differs across the United States. It is higher in California and lower in Florida. These differences result from the activity and location of active faults or fault zones. The U.S. Geological Survey (USGS) has developed maps that show this variation in ground motion for the United States and its territories. These maps are incorporated into IBC 2003. The maps allow a designer to go to any location in the country and determine the ground motion that could occur on average once every 2,500 years. As an alternative to using the maps, a site-specific probabilistic hazard analysis (PSHA) can be conducted in accordance with IBC 2003 requirements. A PSHA was conducted for Brightwater and appears as Appendix B in this Supplemental EIS.

IBC 2003 is applied across the United States to provide a uniform level of protection to the public from seismic hazards. Organizations updating the code over the past 5 years have concluded that a ground motion with a 2 percent probability of being exceeded over a 50-year period and the provisions in IBC 2003 provide the public with an acceptable level of protection from large, infrequent earthquakes. Before adoption of IBC 2003, the Uniform Building Code of 1997 (UBC 97) was used in Washington State. UBC 97 required designs to incorporate ground motions that had a 10 percent probability of exceedance in 50 years. This represents a lower level of protection than the IBC 2003 2-percent-in-50-years standard. In July 2004, the State of Washington adopted IBC 2003 in place of UBC 97.

The level of hazard in IBC 2003 is currently used in the Seattle area for the design of virtually all structures, including high-rise office buildings, hospitals, and schools. This same level of hazard is used across the United States for the design of wastewater treatment plants. A wastewater treatment plant in St. Louis, Missouri, for example, will be designed to the same annual earthquake hazard (2 percent probability of exceedance in

50 years) as the Brightwater Treatment Plant—although the level of ground shaking used for design of the plant in St. Louis may be higher or lower.

The current design basis is reasonably based on the satisfactory performance of wastewater treatment plants throughout the world during recent earthquakes. No history of significant failures has been identified, as discussed in the Summary Response on Other Earthquakes. In fact, good performance has been observed for buildings in the United States subjected to strong earthquakes over the past 20 years. This indicates that the current design levels provide a reasonable level of protection. Additionally, no change in the design criteria has been suggested in view of the inventory of aging buildings in seismically active areas. Finally, with the adoption of IBC 2003 in July 2004, even more stringent standards are in place relative to design standards used over the past 20 years.

Does the risk from earthquake damage increase if the treatment plant structures are used for more than 50 years?

All other conditions considered equal, a longer design life increases the exposure period, which increases the likelihood of a given ground motion being exceeded. For a 100-year period of exposure, the chance of the design ground motion being exceeded doubles from 2 percent in 50 years to 4 percent in 100 years for the same annual rate of earthquake occurrence (or average return period). While the chance of exceedance increases for the longer exposure period, IBC 2003 does not require that the ground motion be adjusted to provide the same exceedance probability as for the 50-year exposure period. In other words, the annual rate of occurrence is maintained at the same level whether the exposure period is 50 years or 100 years. This is not a unique requirement for wastewater treatment plants; it is applied to all structures designed in accordance with IBC 2003, including office buildings, hospitals, and schools.

While the chance of exceedance may increase for the longer exposure period, the actual risk of damage to a treatment plant structure is not necessarily double for the longer design life. The standard of engineering practice is to periodically reevaluate the original seismic design to determine if upgrades, termed “retrofits” by earthquake engineers, are warranted to meet current design standards. As discussed in the Foreword to the Draft Supplemental EIS, King County has implemented a program where wastewater systems are periodically evaluated to assess their ability to withstand seismic requirements in new editions of the building code. If new requirements include significant increases in ground motion, upgrades are performed to reduce vulnerabilities or to meet new code requirements. For example, as part of the West Point Treatment Plant expansion, the roof over the primary clarifiers was upgraded to meet the then current building code (UBC). Work was completed in the early 1990s. Upgrades included increasing the size of the columns that support the roof. Once a facility is reevaluated and upgraded, a new exposure period begins.

One other factor contributes to the ability of the treatment plant to meet earthquake requirements over a longer exposure period. As the plant is used, components are routinely replaced to meet normal maintenance and replacement requirements. This means that few treatment plant components actually are used for 50 years. As these components are replaced, the latest code requirements are considered when selecting and installing the equipment and a new exposure period begins.

New Snohomish County Ordinances

What new ordinances have been adopted subsequent to publication of the Draft Supplemental EIS on April 11, 2005?

On April 18, 2005, the Snohomish County Council adopted Emergency Ordinance 05-029, Relating to the Adoption of Odor Prevention Standards for Wastewater Treatment Plants and Related Facilities (Odor Ordinance), and Emergency Ordinance 05-030, Relating to Seismic Hazard Areas (Seismic Ordinance).

The Odor Ordinance applies only to "wastewater treatment plants and related facilities" and requires that "all wastewater treatment plants and related facilities (including but not limited to conveyance systems, portals, pump stations, and outfalls) . . . eliminate odor emissions so that no detectable odors are present at the property line boundary of such plants and all related facilities." The Odor Ordinance also requires that a wastewater treatment plant proponent "design and operate such odor prevention systems to remove 99.9 percent of odorous compounds at peak load on a 24-hour, 365 days per year basis" (SCC 30.28.092(1)). Finally, the Odor Ordinance requires a project applicant to establish an odor reserve fund in an amount equal to 1 percent of the total cost of the project to ensure the long-term effectiveness of the odor prevention system.

Under Snohomish County's new Seismic Ordinance, the definition of "seismic hazard areas" is expanded beyond the International Building Code definition and now includes areas that the Snohomish County Building Official determines have "known or inferred faults, ground rupture potential, liquefaction potential, or seismically induced slope instability" where such information has been provided to Snohomish County through government reports, geotechnical reports, or the SEPA process.

When a development application is made for any development within a seismic hazard area for any use that may "spill, release, or discharge hazardous materials, waste materials, hazardous liquids, waste liquids, or gases," the Seismic Ordinance provides that the Snohomish County Council, following a public hearing, may impose "reasonable conditions" in addition to those set forth in the state building codes (SCC 30.51.010(1)).

The applicability of the Odor and Seismic Ordinances to the Brightwater project is currently being reviewed by the Central Puget Sound Growth Management Hearings Board and the Skagit County Superior Court. Because no substantive criteria are contained in the Seismic Ordinance and there is nothing in that Ordinance outlining what type of "reasonable conditions" are contemplated, it is difficult to analyze how the project would be affected by the Seismic Ordinance.

Understanding Seismic Risk

Given that the Southern Whidbey Island Fault is considered by some scientists to be very active and that many traces of the SWIF have been identified in the Woodinville-Maltby area, is a surface-rupturing earthquake more likely to occur than described in the Supplemental EIS? King County must protect the public from damage that could result from an earthquake on the treatment plant site.

Evaluation of seismic hazards on the Brightwater Treatment Plant site, which included the potential for liquefaction, ground shaking, and surface rupture, took into consideration the proximity of known or potential faults and the remote probability that such events may occur during the design life of the treatment plant. No one can predict with absolute certainty whether an earthquake will occur in any given location or at any given time. However, seismologists and geologists can study information about earthquake faults and assess a relative degree of risk based on geologic strata that preserve evidence of past seismic activity. Seismologists studying the Southern Whidbey Island Fault (SWIF) may consider it to be very active in a geologic time frame of thousands of years, but it is important to place the risk of seismic activity on the SWIF in the time frame and context of human lives and activities. A seismologist may say that a fault is very active if it shows seismic activity two or three times in the past 16,000 years, but the relative risk of such seismic activity in the future is small when viewed in the context of human activities. The risk of the ground rupturing at a specific location, such as on the Route 9 site, and within a specific short time frame, such as the design life of the proposed treatment plant, is even smaller.

The Brightwater Supplemental EIS reports the most recent information available that quantifies the probability that a surface rupture would occur on the Route 9 site during the design life of the treatment plant. Trenching of Lineament 4 on the Route 9 site in 2004 indicated that at least two, and possibly three, earthquakes have occurred on this fault strand since the last glacial retreat. The oldest earthquake occurred on Lineament 4 about 12,000 to 16,000 years ago; the last known event is thought to have occurred within about the last 2,700 years (since about 1,000 BC). (Please see Chapter 2 and Appendix A of the Supplemental EIS.) Excavations by the U.S. Geological Survey on the Crystal Lake and Cottage Lake extensions of the SWIF indicated a similar pattern, except that evidence of only two earthquakes was observed in these trenches.

Earthquakes have occurred at the Lineament 4 fault on average once every 4,000 to 8,000 years, which is about 100 times longer than the life expectancy of the treatment plant. Stated differently, the likelihood of a surface rupture earthquake occurring on Lineament 4 during the design life of the treatment plant is about 1 percent. Thus, the risk of surface rupture is very small when compared to the risk of other natural events.

During the design life of the Brightwater Treatment Plant, the facility is far more likely to be affected by earthquakes occurring on faults other than the SWIF. As such, the plant site is more likely to be affected by ground shaking than by ground rupture from faulting.

The probabilistic seismic hazard analysis (PSHA) prepared for the Route 9 site (Appendix B of the Supplemental EIS) accounts for potential ground accelerations from all known faults in the Puget Sound region, including known or suspected strands of the SWIF (e.g., Lineaments 4 and X). The Brightwater Treatment Plant is being designed to withstand the expected level of ground shaking, which exceeds ground shaking levels shown in maps in the 2003 International Building Code (IBC). (Please see Chapter 3 of the Supplemental EIS and the summary response on Seismic Design Standards for a discussion of IBC 2003 requirements.)

In addition to the risk of ground shaking, there is some risk of liquefaction onsite during an earthquake; however, this risk is confined to areas that would not be occupied by new wastewater treatment facilities. In areas where new facilities would be constructed, the risk would be mitigated by removing potentially liquefiable soils under proposed facilities and replacing them with very dense imported fill or onsite soil mixed with cement. Either alternative will be highly resistant to the development of liquefaction.

Worst-Case Scenarios

Why is King County evaluating worst-case scenarios?

King County is using a worst-case approach to evaluate the significant adverse environmental impacts that potentially could occur if the Brightwater Treatment Plant were built on the Route 9 site and if a surface rupture of the Southern Whidbey Island Fault (SWIF) were to occur on the site during an earthquake. In the Final EIS, King County did not evaluate worst-case impacts from an earthquake on the site because at the time the Final EIS was published, King County was not aware that any earthquake faults existed on the site. After the Final EIS was issued, further seismic studies revealed the presence of an active earthquake fault, Lineament 4, on the Route 9 site and the existence of other lineaments that have not been identified as active faults.

SEPA requires that an agency analyze only the probable significant adverse environmental impacts that are “likely, not merely speculative” (WAC 197-11-060(4)). The risk of a ground surface rupture of the SWIF on the Route 9 site is very remote—a 1 percent probability during the 50-year design life of the proposed Brightwater Treatment Plant—and therefore does not constitute a probable significant adverse environmental impact that requires SEPA analysis. Nevertheless, King County has prepared a Supplemental EIS in order to comply with the decision of the King County Hearing Examiner in August 2004 (see Chapter 1 of the Supplemental EIS) and to provide additional information to the public and decision makers regarding potential seismic impacts at the Route 9 site.

Evaluating the probable significant adverse environmental impacts of a ground surface rupture resulting from an earthquake on the SWIF beneath a wastewater treatment plant is difficult because there is no historical record to provide guidance about what the impacts of such an event would be. The State Environmental Policy Act (SEPA; WAC 197-11-080) allows an agency to proceed with the evaluation of a proposal in the face of data gaps or scientific uncertainty concerning significant impacts if information relevant to adverse impacts is essential to a reasoned choice among alternatives, but is not known, and the cost of obtaining the information is exorbitant, or the means to obtain it are speculative or not known. SEPA states “If the agency proceeds, it shall generally indicate…its worst case analysis and the likelihood of occurrence, to the extent this information can reasonably be developed.” In order to evaluate the potential impacts of a ground surface rupture on the Route 9 site, King County developed three worst-case scenarios for consideration. This worst-case analysis provides the public and decision makers with sufficient information about the seismic conditions at the Route 9 site and about the likely type and severity of possible impacts to facilitate an informed and reasoned decision on the proposal.

How were the worst-case scenarios selected? Do they really represent the worst case?

SEPA states that EISs need to analyze only reasonable alternatives (WAC 197-11-402):

> The word “reasonable” is intended to limit the number and range of alternatives, as well as the amount of detailed analysis for each alternative.... A range of alternatives or a few representative alternatives, rather than every possible reasonable variation, may be discussed. (WAC 197-11-440(5))

King County has followed the spirit of this SEPA guidance to develop a range of representative worst-case scenarios rather than trying to evaluate every possible scenario that could occur.

King County elected not to conduct further trenching analysis on Lineament X or in the area between Lineaments 4 and X. (Please see Summary Response on Trenching.) Instead, in drafting this Supplemental EIS, King County elected to assume that Lineament X is an active fault and that an undiscovered hypothetical fault may exist anywhere on the site, including under the proposed Brightwater facilities. King County further assumed that a large earthquake would occur at some point during the design life of the Brightwater Treatment Plant. Staff and consultants considered where treatment facilities would be located on the Route 9 site in relationship to known and hypothetical faults. They considered which treatment facilities or structures could be affected by a surface rupture if one were to occur at different locations on the site, and they considered which facilities could contain the greatest volume of wastewater, solids, or stored chemicals at the moment when an earthquake occurred. They assumed that the earthquake would occur when the plant was operating at full capacity (54 mgd) after the plant was expanded in 2040. They then selected for analysis in this Supplemental EIS those scenarios that would pose the greatest risk and have the worst impact on the environment if they were to occur.

Although not all possible scenarios were evaluated, the three “what if” scenarios selected for consideration reflect various levels of seismic risk and represent the full range of potential worst-case outcomes.

What would happen if the earthquake were of a larger magnitude or if multiple ruptures occurred?

King County developed the scenarios taking into consideration the rule of reason, as described above. Some commenters noted that earthquakes could occur that are larger than those considered in the Supplemental EIS and that multiple ruptures could occur simultaneously. The Supplemental EIS does not consider earthquakes greater than magnitude 7.5. This is because, based on available information, seismologists do not expect the SWIF to produce an earthquake of a magnitude greater than 7.5, and it would not be useful or reasonable to analyze a scenario that the data indicate would not occur.

The Supplemental EIS also does not describe a scenario in which multiple ruptures would occur on the site at the same time, although it is theoretically possible that ruptures could occur on multiple traces of the SWIF. Figure 6 in the USGS Open-File Report 2005-1136 (Sherrod et al., 2005) shows 14 lineaments as components in what might be called a "mega-SWIF" in the Woodinville-Maltby area.[3] However, only Lineaments 4, X, and GA have been shown to be present on the Route 9 site and only Lineament 4 is known to be active.

Earthquakes of any given magnitude produce a given amount of energy consistent with that magnitude. The amount of energy released would remain the same whether it traveled along one fault trace or many. If all of the energy were to be concentrated along one fault trace on the Route 9 site, the resulting surface displacement likely would be greater than if the faulting were distributed along several fault traces. The average displacement produced by a magnitude 7.5 earthquake on the SWIF would be about 3 to 6 feet whether it were to occur along only one trace or be distributed along multiple ruptures. If distributed, the displacement on each fault would be a fraction of the total displacement. This would result in less damage to facilities and structures than the damage assumed in Scenarios A, B, and C in the Supplemental EIS.

The amount of ground shaking produced by an earthquake of a given magnitude would be approximately the same regardless of whether a surface rupture occurred along one or many traces. The impact of strong ground shaking on the Brightwater site would be minimal because the Brightwater facilities are being designed to withstand the expected level of ground shaking in accordance with IBC 2003. Please see Chapter 3 of the Supplemental EIS and the Summary Response on Seismic Design Standards.

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[3] Sherrod, B.L., Blakely, R.J., Weaver, C., Kelsey, H., Barnett, E., and Wells, R. 2005. *Holocene fault scarps and shallow aeromagnetic anomalies along the Southern Whidbey Island Fault Zone near Woodinville, Washington.* U.S. Geological Survey Open-File Report 2005-1136, 40 p.

Trenching

The Brightwater Supplemental EIS describes results of two trenches that were excavated by the U.S. Geological Survey (USGS) and King County. The purpose of these trenches was to investigate the potential for fault rupture at Lineament 4, which crosses the northern portion of the Route 9 site. A number of commenters posed questions about the extent of trenching that was conducted, specifically why trenching was not conducted between Lineaments 4 and X and at Lineaments GA and X. The following text responds to these questions.

Why was trenching limited to two locations?

There are several reasons why King County limited trenching onsite to the two locations on Lineament 4. First, despite considerable expense, the information garnered by the trenching of Lineament 4, while of general interest in understanding the seismology of the region and the SWIF in particular, did not alter the conclusions on adverse environmental impacts that were reported in Addendum 3 to the Brightwater Final EIS. Thus, information that may be gained by additional trenching is not essential to a reasoned choice among alternatives. Please see the Summary Response on Worst-Case Scenarios.

It is important to recognize that the trenching effort described in the Supplemental EIS is part of the most comprehensive seismic investigation that has ever been undertaken as part of an EIS for a wastewater treatment plant in the Puget Sound area. The investigation also greatly exceeds the seismic studies done for EISs on other recent large projects, including the Seattle Monorail, Sound Transit light rail system, Safeco Field, and Qwest Field. Some of these projects are located over or cross the Seattle Fault. The fact that trenches were excavated at the Brightwater Treatment Plant site is therefore very unusual for an EIS in the Puget Sound area.

As described in the Final EIS, Addendum 3 to the Final EIS, and this Supplemental EIS, the main seismic issues for the Route 9 site are (1) strong ground shaking, (2) soil liquefaction, and (3) surface fault rupture. The ground shaking incorporated into design of the facilities includes the contribution from a major earthquake on the local trace of the SWIF. The resulting ground motions are 25 percent greater than required by maps published in the current code (IBC 2003). The potential for soil liquefaction at the Route 9 site was recognized in the Final EIS; it is being mitigated by locating the wastewater treatment structures in non-liquefiable soils or excavating and replacing the susceptible soils with very dense imported granular soils or onsite soils treated with cement. Both types of soils are highly resistant to liquefaction and therefore eliminate the liquefaction concern. Surface fault rupture is more difficult to address.

Conclusively establishing the presence or absence of faulting is commonly attempted by trenching to expose geologic features in the shallow subsurface. The trenches, however, need to expose “meaningfully old” sediments. Meaningfully old sediments ideally would be a combination of old and young sediments. For example, a trench exposing only

unfaulted sediments that are 2,000 years old would not establish the absence of active faults. Similarly, a trench exposing only **faulted** sediments that are 200,000 years old would not establish that the faults are active. For the Brightwater Supplemental EIS, it was assumed that active faults could occur below the wastewater treatment facilities, regardless of any evidence (or lack of evidence) for faulting. If additional trenching were conducted and faults found, the conclusions of the Supplemental EIS regarding disclosure of significant adverse impacts would not change. In other words, the worst-case scenario was assumed to occur.

The worst-case scenario approach taken in the Supplemental EIS is a methodology allowed by SEPA (WAC 197-11-080) to address potential environmental impacts where the scientific data may possess a level of uncertainty. Some uncertainty will always remain about the potential for faulting at the Route 9 site, regardless of the type or extent of investigation. As pointed out by the Sno-King Environmental Alliance in Comment O01-02, the magnetic and topographic anomalies identified by USGS do not clear the remainder of the area from faulting. In fact, King County believes that no amount of investigation could completely “clear” the area on the Route 9 site that is planned for development or achieve a point of absolute certainty that the site was completely free of seismic anomalies. By making the assumption in the Supplemental EIS that a fault could occur anywhere beneath treatment plant facilities, it was possible to assess the consequences of fault rupture independent of the likelihood or location of the rupture.

To the extent possible, King County is incorporating worst-case assumptions into the location and design of Brightwater facilities. New treatment facilities will be located far from the potential zones of deformation for Lineaments 4 and X. The potential for damage to the influent and effluent pipelines as a result of fault rupture on Lineament X is being minimized by providing thicker walls and stronger joints to withstand the shearing that may occur at the fault zone as one end of the pipe moves relative to the other. In addition, the combined tunnel that carries these pipelines is being filled with grout to minimize leakage should a pipeline become damaged.

For these reasons and in light of the considerable seismic information and extreme improbability of a surface fault rupture at the Route 9 site during the life of the treatment plant, King County concluded that, under the SEPA rule of reason, no additional investigation of seismic anomalies was required. Nevertheless, to provide information to the public and decision makers, King County has conducted a worst-case analysis that can be used along with the extensive seismic data that have been included in the Final EIS, Addenda to the Final EIS, and this Supplemental EIS.

Why not trench and perform additional geophysical investigations in the area between Lineaments 4 and X?

When conducting seismic trenching studies, it is desirable to have an identifiable trenching target. For example, a combination of LiDAR data and a subtle surface feature potentially associated with an underlying fault that is in an area believed to be undisturbed from past grading activities provided a trenching target for Lineament 4. Without such a target, an investigator who digs a trench and does not find a fault would not know whether this result was because no fault was present or because the investigator did not dig in the right place or did not dig deep enough.

Figure 6 in the USGS Open-File Report 2005-1136 (Sherrod et al., 2005) does not show an aeromagnetic lineament, scarp, or LiDAR lineament between Lineaments 4 and X beneath new treatment plant facilities on the Route 9 site.[4] Moreover, any topographic anomalies in this area are not meaningful indicators of active faults because the entire site has been disturbed. Based on the available information, including conclusions reached from discussions with USGS on other potential fault or lineament locations between Lineaments 4 and X, King County has concluded that there are no suitable targets to justify additional trenching.

In the absence of trenching targets, two options are available. One option involves conducting aerial or ground magnetic surveys and then trenching locations that have features that could be faults. However, as discussed above, “meaningful old” sediments have to be exposed, which is not easily achieved. The other option is to trench the full distance from Lineament 4 to Lineament X. Such a trench could be over 4,000 feet long and up to 20 feet deep if the trench were constructed in the same manner as used for Trench 2a at Lineament 4. Over 100,000 cubic yards of soil would have to be excavated to meet expected depth requirements, and significant dewatering would be needed to enter portions of the trench. In either option, several months of work would be required to plan, conduct, and interpret results from the effort. The cost of either option would be significant. King County spent about $375,000 to trench and analyze Lineament 4, with two trenches whose combined length was only 200 feet.

Under the rule of reason that guides analysis in the Supplemental EIS, the cost and delay of undertaking a particular methodology are relevant factors for the agency to consider. King County has determined that the cost and delay to the project of trenching between Lineaments 4 and X are not reasonable considering that the Brightwater System, which is an essential public facility, needs to be in operation by 2010 and that the worst-case analysis in the Supplemental EIS includes a hypothetical scenario in which a fault rupture occurs between Lineaments 4 and X.

What is Lineament GA?

USGS identified a linear anomaly in the northern part of the Route 9 site on the basis of a ground magnetic survey. They named the anomaly “Ground-Magnetic Anomaly GA” and described it in Open-File Report 2005-1136 (Sherrod et al., 2005). The ground magnetic survey conducted by the USGS covered an irregular area surrounding Trench 2a in the northwestern corner of the Route 9 plant site. Ground-Magnetic Anomaly GA was one of

[4] Sherrod, B.L., Blakely, R.J., Weaver, C., Kelsey, H., Barnett, E., and Wells, R. 2005. *Holocene fault scarps and shallow aeromagnetic anomalies along the Southern Whidbey Island Fault Zone near Woodinville, Washington.* U.S. Geological Survey Open-File Report 2005-1136, 40 p.

five northwest-trending ground magnetic anomalies that were interpreted by USGS, as described in USGS Open-File Report 2005-1136 and shown on Figure 4 in their report as dotted lines. The anomalies ranged in length from a maximum of 288 feet to a minimum of 129 feet.

Ground-Magnetic Anomaly GA was not trenched in October 2004 because Trench 2a could not be extended farther to the southwest due to the presence of a designated wetland and wetland buffer. Ground-Magnetic Anomaly GA is located entirely within the wetland and wetland buffer area.

In the 2005 Open-File Report, USGS concludes that the "Pleistocene glacial deposits are apparently the lithologic source of the linear anomalies seen in ground-magnetic profiles." USGS describes three possible explanations for the ground-magnetic anomalies, two of which are not necessarily of seismic origin: (1) contrasting depositional processes within the Pleistocene sediments, (2) concentrations of secondary magnetic minerals, or (3) faulted offsets of Pleistocene deposits. USGS favored the third interpretation because of the linear nature of the anomalies and their orientation relative to the Little Bear Creek LiDAR lineament (Lineament 4), linear aeromagnetic anomalies, and the onshore extension of the SWIF.

The USGS model to explain Ground-Magnetic Anomaly GA seems to suggest that the top of the glacial till might be offset vertically by 16 feet (5 meters). This observation is important because if Ground-Magnetic Anomaly GA is caused by faulted glacial till and the overlying post-glacial deposits are not displaced, then the most recent movement of the fault would be more than 16,000 years old and, therefore, the fault would not be an active fault by the 11,000-year age criterion.

If Ground-Magnetic Anomaly GA is caused by faulted glacial till and the overlying post-glacial deposits are displaced, such a fault probably would be considered active. However, a 16-foot (5-meter) vertical offset at the base of the post-glacial outwash deposits undoubtedly would be associated with at least subtle features on the landscape that could be detected in the LiDAR topography. King County and USGS researchers examined the LiDAR data in the area of the treatment plant site. As previously reported, USGS found scarps associated with Lineament 4 and Lineament X. However, similar scarps were not identified in positions that could be projected through the Route 9 site on the trend of Ground-Magnetic Anomaly GA.

The length of Ground Magnetic Anomaly GA as indicated by the black dotted line on Figure 4 in USGS Open-File Report 2005-1136 is less than 250 feet. The anomaly was defined by the magnetic field intensities measured on seven lines. Based on the magnetic field intensity values, if Ground-Magnetic Anomaly GA is related to faulted magnetic glacial till deposits, either the fault does not persist to the southeast of Ground-Magnetic Anomaly GA on Figure 4 in the USGS report or the magnetic characteristics on opposite sides of the fault are sufficiently uniform that a linear magnetic anomaly is not produced.

Based on the data collected during the trenching analysis, King County believes that the variability in the magnetic properties of glacial till and post-glacial outwash deposits overlying older rocks at greater depths appears to be the explanation of at least one of the anomalies and certainly contributes to, if not controls, explanations of the other ground magnetic anomalies, including Ground-Magnetic Anomaly GA. Therefore, King County believes that either Ground-Magnetic Anomaly GA is not an active fault or, if it were, it would be expressed by features less prominent that those exposed in Trench 2a.

The undeformed post-glacial sediments exposed in the southwest 85 feet of Trench 2a are a clear indication that pervasive active faulting does not exist at this location. The character of glacial till at depth over the approximate 275-foot width between Ground-Magnetic Anomaly GA and LiDAR Lineament 4 is unknown except at a few locations where geotechnical borings were drilled into it. Glacial lake and till deposits exposed in Trench 2b showed a more complicated deformation history than the sediments exposed in Trench 2a. Part of the deformation history exposed in Trench 2b probably is caused by the weight of overriding ice of the last glacial advance. The ice from that glacial advance retreated past the area of the Route 9 site approximately 16,000 years ago. On the basis of these considerations, King County believes that Ground-Magnetic Anomaly GA is not evidence of a zone of pervasive active faulting at the Route 9 site.

Please see the Text Changes section of this volume. Figure 2-3 of the Supplemental EIS has been revised to show the location of Lineament GA, and a new appendix (Appendix G) has been added that describes in more detail the analysis of the USGS ground magnetic study in the North Mitigation Area of the Route 9 site.

Why not trench Lineaments X and GA?

Trenching Lineaments X and GA may add some limited amount of information to an understanding of the SWIF, but this information would not contribute meaningfully in any way to defining the surface fault rupture hazard at the locations of the planned wastewater treatment facilities. The combined tunnel carrying influent and effluent pipelines will cross Lineament X, which has been assumed to be an active fault for purposes of assessing worst-case impacts. It is customary to allow linear structures such as pipelines to cross fault zones and to provide mitigation for potential damage.

Two other factors also are relevant to trenching Lineaments X and GA:

- The extent of Lineament GA as defined by USGS is entirely within a wetland area, in which ground-disturbing activities are restricted under federal, state, and local regulations.
- Past development precludes the recognition of surface features along Lineament X that could be suggestive of underlying faulting. Without evidence supporting probable locations of faulting, any trenches excavated in the estimated location of Lineament X would not necessarily conclusively demonstrate or prove the absence of faulting. However, features along Lineament X appear to be similar to or less prominent than Lineament 4 and support an interpretation that the estimated zone of deformation for Lineament X is not likely to be significantly more prominent than the zone of deformation now known to be associated with Lineament 4 (see

Appendix A of the Supplemental EIS). For this reason, the assumption that Lineament X could potentially rupture to the same degree as Lineament 4 is considered a reasonable, conservative assumption for this worst-case analysis.

Could there be a pervasive zone of faulting throughout the Route 9 site, rather than a single trace or a set of discrete traces of the SWIF?

Information obtained from trenching of Lineament 4 sufficiently characterizes the potential frequency and magnitude of future earthquakes at the plant site. Unfaulted and undeformed post-glacial sediments exposed in the southwest half of Trench 2a demonstrate that a pervasive zone of active faulting is not present throughout the site. Additional trenching studies are not likely to result in significant new information or the disclosure of new impacts that have not already been analyzed in the Brightwater Supplemental EIS.

Zone of Deformation

What was the basis for determining the probable zones of deformation for Lineaments 4 and X on the Route 9 site?

A zone of deformation is the expected area of influence around a main fault trace where the ground could possibly warp, fold, or rupture.

In addition to examining Trench 2a at LiDAR Lineament 4, King County studied the zones of deformations in published scientific reports for other faults in the Puget Sound region that had been trenched by the U.S. Geological Survey (USGS) and that had sharper surface expressions than LiDAR Lineament 4 (meaning that they probably were produced by earthquakes as big or bigger than those on LiDAR Lineament 4). These faults were the Utsalady Fault on Whidbey Island and the Waterman Point Fault on the Point Glover Peninsula, as described by Johnson et al. (2003, US Geological Survey MF-2420) and Nelson et al. (2003, US Geological Survey MR-2423).[5] Both of these faults were trenched in multiple locations. Neither of these faults is part of the Southern Whidbey Island Fault (SWIF).

Johnson et al. (2003) described trench exposures at two locations across scarps on the Utsalady Fault on Whidbey Island. The Utsalady Fault is part of the Northern Whidbey Island fault zone. The Teeka Trench on the Utsalady Fault exposed a narrow fault zone that was no more than about 10 feet (3 meters) wide. The Duffers Trench exposed a zone of disturbance approximately 66 feet (20 meters) wide, with a number of minor faults and two more significant faults. One of the more significant faults was about 3 feet (1 meter) wide. The other more significant fault was approximately 8 feet (2.5 meters) wide.

Nelson et al. (2003) described trench exposures at three locations across scarps on the Waterman Point Fault on Point Glover Peninsula south of Bainbridge Island and east of Bremerton. The Waterman Point Fault is a west-trending trace of the Seattle Fault Zone. The Madrone Ridge Trench on the Waterman Point Fault exposed a zone of faulting that was less than 26 feet (8 meters) wide. The Snowberry Trench exposed a zone of faulting

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[5] Johnson, S.Y., Nelson, A.R., Personius, S.F., Wells, R.E., Kelsey, H.M., Sherrod, B.L.,Okumura, K., Koehler, R., Witter, R., Bradley, L.-A., Harding, D.J., 2003, *Maps and data from a trench investigation of the Utsalady Point fault, Whidbey Island, Washington:* U.S. Geological Survey Miscellaneous Field Investigations MF-2420.

Nelson, Alan R.; Johnson, Samuel Y.; Kelsey, Harvey M.; Sherrod, Brian L.; Wells, Ray E.; Okumura, Koji; Bradley, Lee-Ann; Bogar, Robert; Personius, Stephen F. *Field and laboratory data from an earthquake history study of the Waterman Point Fault, Kitsap County, Washington.* U.S. Geological Survey Miscellaneous Field Studies Map 2423.

about 23 feet (7 meters) wide. The Nettle Grove Trench exposed a zone of faulting that was about 13 feet (4 meters) wide.

Based on their review of this research and the observations in the LiDAR Lineament 4 trench, King County’s seismic experts concluded that, even if the zone of deformation of LiDAR Lineament 4 were comparable to the largest fault described above, it would be expected to be less than 66 feet (20 meters) wide. Thus, the location of the new plant facilities relative to LiDAR Lineament 4 or Lineament X significantly exceeds the expected zone of deformation that would be associated with either Lineament 4 or Lineament X.

Other Earthquakes

A number of commenters asked about damage that has been observed during other large earthquakes and how such damage relates to the Brightwater Treatment Plant. The following discussion addresses these comments.

Why were the four earthquakes identified in Section 4.4 of the Supplemental EIS used to discuss damage to wastewater treatment plants?

The four earthquakes identified in Section 4.4 of the Supplemental EIS—the magnitude (M) 7.1 Loma Prieta Earthquake, the M 6.7 Northridge Earthquake, the M 6.9 Kobe Earthquake, and the M 7.6 Chi Chi Earthquake—were discussed because the potential impacts from earthquake-induced damage was expected to be similar to the worst-case earthquake assumed in this analysis for the Brightwater Treatment Plant. These earthquakes were large earthquakes with magnitudes and ground shaking levels similar to earthquakes that could occur on the Southern Whidbey Island Fault (SWIF). Also, they occurred in areas with large population centers, the documentation of damage was relatively complete, and the designs of structures employed the latest standards.

The similarity in ground motions estimated in the probabilistic seismic hazard analysis for the Route 9 site and the ground motions recorded for the Northridge and Kobe Earthquakes is illustrated in Figure SR-1 (below). The peak acceleration on the vertical axis defines the strength of shaking, and the horizontal axis shows the distance from the fault. The measured accelerations during these two earthquakes were comparable to accelerations predicted for the Route 9 site. As discussed below, damage to wastewater treatment plants from these two earthquakes was very limited.

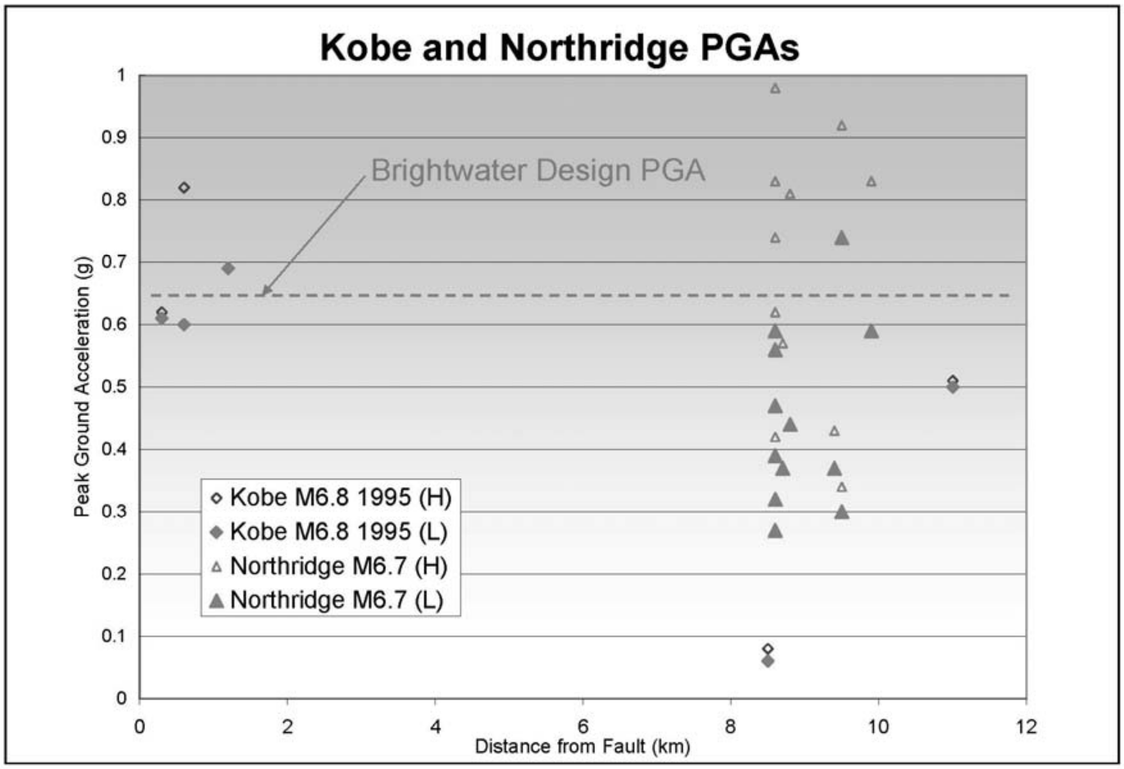

Figure SR-1. Peak Ground Accelerations for the Kobe and Northridge Earthquakes

Did these large earthquakes result in any damage to wastewater treatment plants?

None of the four earthquakes resulted in catastrophic environmental damage from failure of wastewater treatment plants. From a ground shaking perspective, all treatment plants in the affected regions performed well. The only damage to treatment plants that King County was able to identify was from ground movement (i.e., lateral spreading and settlement) associated with liquefaction of soils—not fault rupture—as noted in Section 4.4 of the Supplement EIS. Three of the four earthquakes (Loma Prieta, Kobe, and Chi Chi) had surface fault rupture, but the surface rupture did not occur near any wastewater treatment plants. The fourth earthquake, Northridge, did not have a distinct zone of rupture at the ground surface.

The one case of damage to wastewater facilities was the Higashinada wastewater treatment plant during the 1995 Kobe Earthquake in Japan. The Higashinada wastewater treatment plant is located on an island in Osaka Bay separated from the mainland by a channel. Liquefaction and lateral spreading heavily damaged the plant. Up to about 3 feet (1 meter) of vertical settlement and 6 feet (2 meters) of lateral movement occurred. The movement damaged one of the treatment plant structures, as discussed in Section 4.4 of the Supplement EIS. The most serious damage involved uncontrolled release of wastewater when the gravity influent line coming into the plant was broken where it crossed the channel, causing the entire plant influent volume to be discharged into Osaka Bay. Within several weeks following the earthquake, temporary baffles were installed on either side of the broken line to provide some level of treatment before the wastewater discharged into Osaka Bay. Wastewater flow was reduced after the earthquake because several pump stations in the conveyance system were damaged and inoperable. This damage resulted in overflows of untreated wastewater at other locations in the conveyance system. The potable water system was also damaged by the earthquake, resulting in less wastewater entering the conveyance system. It took approximately 2 months to fully restore potable water service.

Because the amount of ground movement that damaged the Higashinada treatment plant is comparable to the magnitude of potential fault movement at the Route 9 site, the damage at the Higashinada wastewater treatment plant is considered an indicator of the potential effects of a worst-case event at the Route 9 site. However, in contrast to the postulated conditions under the worst-case scenario for the Brightwater Treatment Plant, the damage at the Higashinada wastewater treatment plant involved uncontrolled release of large volumes of wastewater from an influent pipeline. Influent would be pumped rather than flow by gravity to the Brightwater plant; discharge could be quickly controlled by shutting down the influent pump system. Despite the apparent severity of damage from the influent pipeline failure at Higashinda, the damaged structure was repaired within 12 months and no catastrophic environmental damage occurred.

While liquefaction has been the cause of damage during other earthquakes, it would not be a cause of damage at the Brightwater Treatment Plant site. As discussed in the Summary Response on Seismic Design Standards, the potential for liquefaction would be mitigated beneath the Brightwater Treatment Plant structures by removing and replacing liquefiable material with a very dense imported fill or with a mix of soil and cement. Both of these materials would be nonliquefiable.

Has King County identified any wastewater treatment plants that are located over faults, and have any of these been damaged by fault rupture?

There are many thousands of water and wastewater treatment plants worldwide, and there are many thousands of faults, some known and some unknown. For example, the Northridge Earthquake occurred on a previously unknown fault. Considering the number of treatment plants and the number of faults worldwide, it is reasonable to expect that there are some treatment plants located above either identified or unidentified faults. However, when a search was performed in response to this question, King County could not identify specific treatment plants that are located above active faults, nor could it identify any treatment plants that had been damaged by fault rupture.

King County also researched information that would document the distance between treatment plants and active faults. No documented information was found during this search. However, the few regulations from other areas governing facility setbacks from faults typically apply to occupied structures. As noted in Chapter 3 of the Supplemental EIS, California’s Alquist-Priolo Act restricts construction of new structures for human occupancy across or within 50 feet of an active fault. The Alquist-Priolo Act specifically defines human occupancy as being 2,000 person hours per year. By this definition, many of the Brightwater Treatment Plant facilities, including the primary sedimentation basins, aeration basins, and digesters, would be exempt from the requirements in the Alquist-Priolo Act and would be allowed to be located over active faults.

Generally, the standard of engineering practice is to avoid locating buildings over known active faults, if possible, particularly for structures that are occupied and that could result in life safety issues if the structure were to collapse as a result of fault movement. In special cases a non-occupied structure might be constructed over an active fault if the risk of damage from fault rupture was shown to be acceptably low and the cost of relocating the facility was unacceptably high. This is particularly the case for long linear structures such as pipelines and tunnels. However, it might also be applied to process structures within a wastewater treatment plant.

At the Brightwater Treatment Plant site, King County has found no topographical, LiDAR, or geophysical evidence to suggest that an active fault exists between Lineaments 4 and X in the area of proposed new facilities. The closest known fault, Lineament 4, is hundreds of feet north of the nearest new treatment plant structure. Although the conveyance line crosses Lineament X, it is common and accepted engineering practice in seismically active areas to route pipelines over faults.

Is it reasonable to discuss ground motions from deep earthquakes, such as the Nisqually Earthquake, when evaluating the potential effects of a shallow fault rupture on the SWIF?

It is important to realize that the Brightwater Treatment Plant is being designed for ground shaking from multiple sources, including a deep, distant earthquake such as the Nisqually Earthquake. The Supplemental EIS refers to the Nisqually Earthquake because it occurred recently (2001) and is often mentioned during discussions of seismic activity in the Puget Sound area.

The design of the Brightwater Treatment Plant structures will account for earthquake-induced ground motions that originate from various potential locations—off the coast of Washington, deep below the Puget Sound, and in the shallow crust where the SWIF is located. Chapter 2 of the Supplemental EIS provides a discussion of these sources. Although earthquakes could occur on any one of these seismic sources in the future, some of these sources are much more likely to be the cause of seismic shaking on the Route 9 site than, for example, an event on the SWIF. The building code used for the design of the Brightwater Treatment Plant requires consideration of all of these potential sources through use of a probabilistic method. The intent of the probabilistic method is to account for the likelihood of earthquake occurrence on the various sources, the potential size of the earthquake, and the distance from the source to the site. For example, while the Nisqually Earthquake resulted in low levels of ground shaking in the project area, as discussed in Chapter 2 of the Supplemental EIS, an earthquake on the same deep source (Intraslab or Benioff Zone) but located directly below the project site would result in stronger ground shaking. The probabilistic method considers the likelihood of all the sources including the closest earthquake source, which in this case is a strand of the SWIF.

If a rupture were to occur on the SWIF, there would be strong ground shaking centered along the zone of rupture. The level of this shaking at the treatment plant site was estimated based on the maximum magnitude and the distance of the site to the center of rupture. The results of this deterministic evaluation indicated that the level of ground shaking would be comparable to the level determined from the site-specific probabilistic seismic hazard analysis (PSHA) being used to design the Brightwater Treatment Plant, as discussed in Chapter 3 and presented in Appendix B of the Supplemental EIS. The design level based on the PSHA is four times higher than that resulting from the Nisqually Earthquake, indicating that the current code requires consideration of a much higher level of shaking than what the Nisqually Earthquake generated.

Chemicals

What chemicals will be used at the Brightwater facility, how and where will they be stored, and how hazardous are they?

Table 3-2 of the Supplemental EIS summarizes the types and quantities of chemicals included in individual structures at the Brightwater treatment plant site. Section 3.2.2 identifies the chemicals that would be stored at the facility and describes measures that would be incorporated into the design of the Brightwater facilities to prevent the mixing of chemicals. As noted in Table 3-2, all chemicals would be "double contained." The chemicals would be stored in individual tanks that would be surrounded by a concrete-walled enclosure with the capacity to contain the contents of two of the tanks. Alkaline and acidic chemicals would be stored separately, about 1,200 feet apart to avoid any possibility of mixing.

With the exception of dry polymer and carbon, all chemicals that would be stored at the Brightwater Treatment Plant would be in the liquid phase; no gaseous chemicals would be used. The compounds stored onsite and referenced in Table 3-2 of the Supplemental EIS are all water-based chemicals, with low vapor pressures. A low vapor pressure indicates a low potential for volatilization (i.e., release to the atmosphere as a vapor).

King County does not use any chemicals that are classified as "highly hazardous" by EPA's Risk Management Program or OSHA's Process Safety Management Program. Highly hazardous chemicals are those with offsite consequences if leaked or spilled—meaning that the chemicals have the potential to cause harm to members of the public beyond the boundary of the facility if they are accidentally released. The chemicals proposed for use by King County at Brightwater are classified as hazardous, but they do not present the potential for offsite consequences.

If an earthquake caused any of these chemicals to be released where would they go and how would they behave? What measures are included in the project design to reduce potential impacts of such a release?

Section 4.7.4 of the Supplemental EIS describes what would happen to chemicals stored onsite if they were released as the result of damage from an earthquake. Section 5.3.5 describes impacts to Little Bear Creek that could occur if released chemicals were to reach the creek. Section 5.5.3 describes potential odor and air emission impacts if chemicals were released, and Section 5.5.4 describes potential measures to mitigate such impacts. Section 5.6.4 describes potential impacts to environmental health if chemicals were released, and Section 5.6.5 describes potential measures to mitigate such impacts.

The International Fire Code requires that incompatible materials, including alkaline and acidic chemicals, be separated by a minimum of 20 feet and that each type of chemical have a secondary containment area adequate to hold the volume of the largest chemical storage tank. At Brightwater, the bulk storage for these two types of chemicals would be separated by about 1,200 feet, with alkaline chemicals located near the north end of the site and acidic chemicals near the south end. Each area would have secondary containment with the capacity to hold the volume of two storage tanks. Both facilities would be designed with a Seismic Importance Factor of 1.5 to provide greater strength than the minimum 1.25 factor required by code (IBC 2003). Both bulk storage facilities would be at approximately the same elevation, with a rise in the grading between the two areas sufficient for each area to drain to a separate stormwater detention and treatment system. The chemicals therefore could leak onto the ground surface and enter the onsite stormwater drainage systems only in the highly improbable event of (1) ground fault rupture simultaneously occurring along two currently unknown strands of the SWIF 1,200 feet apart, (2) these ruptures damaging both the primary and secondary containment tanks at each location, and (3) the chemicals spilling out of the secondary containment. Sodium hypochlorite (alkaline chemical) would enter the North Roadway Runoff Canal; the acidic chemicals would enter the South Canal. The two canals would be separate and independent stormwater systems. The roadway system within the plant will be graded to provide positive and independent drainage into each canal.

The stormwater systems would collect surface water, store it for a period of time, and slowly release it via outlet structures into Little Bear Creek. The north and south stormwater systems would be completely independent, entering Little Bear Creek at different points, approximately 1,000 feet apart. Detention times in the North Roadway Runoff Canal would range between 12 days for the 2-year storm event and 4 days for the 100-year storm event; storage volume would be approximately 1.5 million gallons. The storage volume for the South Canal would be slightly larger (approximately 2 million gallons). Although this canal serves a slightly larger drainage area, detention times would range from 4 to 11 days. Please note that the probability of a 100-year storm occurring simultaneously with the maximum potential earthquake is very low.

If sodium hypochlorite were to enter the North Roadway Runoff Canal, it would be diluted by the stored water and react with any organic content on the surface and in the canal. A slight aroma of chlorine would be present, much like a public swimming pool, but no significant release of gas to the atmosphere would occur.

To further reduce the potential for chemicals to reach Little Bear Creek and mix, isolation of the outlet structures in the north and south canals would be provided. A remotely controlled fail-closed valve would be placed at the outlet of each canal to control discharge from that canal. The valves would be closed on command or would close automatically if there was a loss of power. The text of Section 5.3.7 of the Supplemental EIS has been revised to describe these valves (see the Text Changes section of this volume). Closure of the valves would prevent release of chemicals to downstream water bodies, including Little Bear Creek. Isolating the chemicals in each of the canals would preclude mixing of the two chemicals and formation of chlorine gas. Because the stormwater systems would be isolated immediately following an earthquake and the systems would have several days of storage, sufficient time would exist to ensure that the valves were closed and the system isolated. Non-toxic neutralizing agents, which could be stored onsite, could then be added to one or both canals to render the chemicals nonreactive.

These measures would make it extremely improbable that both the acidic and alkaline chemicals would reach Little Bear Creek. If the chemicals somehow were to reach the creek despite these control measures, it is highly unlikely that they would do so in a reactive form. A sequence of extremely unlikely events would have to take place for them to reach the creek in such a form. These events would involve the release of chemicals as the result of earthquake damage and the subsequent failure of all of the containment and capture mechanisms described above. If the two types of chemicals did reach the creek in reactive form, they could theoretically mix to form chlorine gas. This gas would quickly dissipate.

As described in Section 5.5.3 of the Supplemental EIS, under extremely improbable circumstances, a relatively small amount of chlorine gas could form if chemicals stored in one of the odor control buildings were to mix. In the unlikely event that chlorine gas formed in and escaped from one of the buildings, it would travel no more than 50 feet from the building before its concentration fell below toxic levels. Atmospheric temperature inversion conditions could result in higher concentrations, but levels are still projected to be below toxic levels.

In the highly unlikely event that a surface rupture were to occur under the digesters and the digesters failed, digester gas could be released to the atmosphere. Digester gas consists primarily of methane and carbon dioxide, with small amounts of hydrogen sulfide. Methane is an odorless gas that is considerably lighter than air (specific gravity of methane = 0.55; specific gravity of air = 1.0). Methane is not toxic, but can act as an asphyxiant. If released, methane would rise straight up into the atmosphere, regardless of weather conditions, and would be dispersed within a few feet of the digesters to low levels that would not threaten human or animal health. Carbon dioxide is an odorless gas that is heavier than air (specific gravity = 1.5). Carbon dioxide is not harmful in low concentrations (humans exhale carbon dioxide), but can also act as an asphyxiant. If released to the atmosphere, carbon dioxide would quickly disperse below hazardous levels within a few feet of the digesters. Hydrogen sulfide is heavier than air (specific gravity = 1.2), toxic in high concentrations, and odorous. If released to the atmosphere, it would also quickly disperse below toxic levels within a few feet of the digesters. However, hydrogen sulfide odor, even at very low concentrations, is easily detectable by the human nose and could be detected offsite for a short period of time.

What would be the effects of the chemicals on humans?

As described in Chapter 5 of the Supplemental EIS, direct contact with stored chemicals at the site could result in toxic human health responses, if the concentration of chemicals was high enough. As indicated above, none of the chemicals stored at the plant would be expected to have offsite consequences if released.

Section 3.2 of the Supplemental EIS describes measures to lessen the potential for release of these chemicals in the event of an earthquake. Please also see the Summary Response on Emergency Response for steps that would be taken to respond to a chemical release, including measures to protect life and health.

Emergency Response

A number of comments were made regarding emergency response at the Brightwater Treatment Plant in the event of an earthquake. Most of these comments related to one or more of the following areas:

- Cleanup of released chemicals, wastewater, or solids
- Repair of facilities (including restoration of electric, water, and natural gas services)
- Treatment of wastewater under various conditions (e.g., loss of electricity)
- Conveyance and discharge of influent or effluent
- Notification of emergency responders, municipalities, and citizens

The Supplemental EIS describes King County's approach to emergency response in each of these areas. The remainder of this summary response identifies the sections of the Supplemental EIS that address each area, along with any additional pertinent information.

How would King County clean up any chemicals, wastewater, or solids released after an earthquake?

Section 3.2 of the Supplemental EIS describes how Brightwater facilities would be designed to lessen earthquake impacts, including measures to contain spills of chemicals, wastewater, or solids. Sections 5.3.7, 5.4.4, and 5.5.4 discuss how any spills of wastewater or solids would be captured and handled both at the Brightwater Treatment Plant site and at offsite facilities. In addition, Section 4.8.5 states that an emergency response plan would be prepared for the Brightwater System similar to those being used at the West Point and South Treatment Plants. These plans detail steps to be taken to contain and clean up hazardous material spills. Brightwater's emergency response plan would provide the same detail.

How would King County repair any of its facilities damaged in an earthquake?

Section 4.8.5 of the Supplemental EIS describes the steps that would be taken to identify any Brightwater plant and offsite facilities damaged by an earthquake and to repair them. This section also discusses approximate repair times under different circumstances.

Section 3.2.2 discusses sources of emergency and auxiliary electrical power that King County could use to provide power to the plant if electricity was not available from the power grid. This section also describes the levels of treatment that these power sources would support. Section 4.3.5 describes general time frames for and factors involved in restoration of power to the plant. It also describes power sources for the influent pump station. Section 4.8.1 provides information on the sources of power to the plant and the estimated time for repair of power lines to the plant.

Section 4.3.7 discusses sources of water to the plant and time frames for restoration of water service to the treatment plant from different sources.

Section 4.3.9 discusses the source of natural gas to the plant and the expected time for restoration of natural gas service to the plant if service was disrupted by an earthquake.

How would King County's Brightwater facilities continue to provide wastewater treatment after an earthquake?

The Supplemental EIS discusses the levels of treatment that the system could provide under various post-earthquake conditions. Sections 3.2.2 and 4.8.1 discuss the levels of treatment that different levels of electrical power would support. Section 4.8.4 describes the types of treatment the plant could provide under several facility damage scenarios, including bypassing flows around the plant to the effluent pipeline. Section 4.8.5 provides estimated time frames for repair of plant facilities under each of the three earthquake scenarios discussed in the Supplemental EIS. Section 3.5.2 discusses the Emergency Flow Management System that could be activated to divert wastewater flows from Brightwater to one of King County's other treatment plants in the event that Brightwater's ability to treat wastewater was impaired.

Section 4.3.7 discusses the amounts of potable and recycled water needed for plant operation and the estimated time needed for restoration of potable water service to the plant. Section 4.3.9 discusses the effects of an interruption of natural gas service to the plant and the estimated time for restoration of that service.

How would King County's conveyance facilities be affected if Brightwater facilities were impaired by an earthquake?

Section 3.5.2 of the Supplemental EIS describes King County's Emergency Flow Management System. This system would be activated in the event the Brightwater system was impaired. The Wastewater Treatment Division has prepared an Emergency Flow Management Protocol that details steps to be taken to reroute flows under various conditions. This document will be updated to include the Brightwater System before that system goes into operation.

Sections 4.5.3, 4.6.3, and 4.7.2 of the Supplemental EIS describe where wastewater in the conveyance system tributary to the Brightwater plant would go if conveyance and/or treatment facilities were damaged under each of the three scenarios discussed in the Supplemental EIS. These discussions indicate possible locations of wastewater overflows and estimated times for conveyance facility repairs. Sections 5.3.3, 5.3.4, and 5.3.5 also indicate likely locations of wastewater overflows under each of the three scenarios addressed in the Supplemental EIS and discuss potential impacts of those overflows. Section 5.3.7 discusses potential mitigation for these impacts.

Who would King County notify and coordinate with under emergency conditions following an earthquake and how would this notification and coordination be done?

Section 4.8.5 of the Supplemental EIS describes the steps to be taken immediately following an earthquake. Among these steps would be to establish contact with the King County Emergency Coordination Centers and work with Snohomish County through these centers. Section 5.7.4 provides more detail on how King County would coordinate with other jurisdictions, in accordance with the King County Emergency Management Plan (2003). This section states that King County would coordinate with other emergency service providers in the vicinity of the Brightwater Treatment Plant, including utilities. Among these utilities would be the City of Woodinville and Snohomish County public works departments. Also, the emergency response plan for each King County treatment plant specifies which agencies to notify in case of chemical spills. King County has begun early stages of coordination with utilities and emergency service providers. Coordination will continue during the design, construction, and implementation process to ensure that each utility/service provider understands its respective roles and responsibilities in the event of an emergency and that lines of emergency communication are established and understood by all providers. Sections 5.6.5, 5.7.1, and 5.7.2 describe how King County would work with local jurisdictions to notify the public about overflows.