Technical Memorandum

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Date: October 17, 2006

Subject: SR 520 Bridge Replacement and HOV Project EIS Review

Project No.: 30907

This technical memorandum represents a series of comments on, and concerns about, the Draft Environmental Impact Statement (DEIS) for the proposed SR 520 Bridge Replacement and HOV Project. The DEIS was jointly prepared and submitted by the Federal Highway Administration (FHWA), the Washington State Department of Transportation (WSDOT), and Sound Transit.

Otak, Inc. was retained by the University of Washington to review, interpret, and comment on portions of the DEIS—specifically, those sections addressing wetland, water resources, wildlife, and geological issues in the Seattle and Lake Washington portions of the project. Comments and concerns for each of these resources are grouped together below under separate subheadings.

The stated purpose of an EIS is to respond to the requirements of the National Environmental Policy Act (NEPA) as well as the State Environmental Policy Act (SEPA). The EIS describes a project that has potential for significant adverse environmental effects, identifies alternatives to the project, and identifies and analyzes the potential adverse environmental effects, including ways and means to avoid, minimize, and mitigate for adverse environmental effects. An EIS is designed to represent a full disclosure document—one which identifies and analyzes environmental effects as thoroughly and objectively as possible.

The DEIS for the proposed SR 520 Bridge Replacement and HOV Project falls short of a thorough and objective identification and analysis of potential environmental effects of the project. As presented in the DEIS, several important analyses of environmental effects are either not performed, performed using questionable assumptions or inappropriate analyses, or some of the conclusions within the DEIS are based on analyses or data that are not provided within the DEIS or

its Technical Appendices. Numerous negative environmental effects which are likely to occur are minimized or dismissed. Furthermore, key conclusions regarding significant adverse environmental effects of the project provided in the various Technical Appendices are omitted from the main text of the DEIS. In many places within the DEIS, the language reads more as advocating the project rather than as a neutral description and assessment of the project and its potential effects.

Following are four sections presenting our specific comments addressing each of the resources we were asked to assess: Wetland; Water Resources; Wildlife Habitat; and Geology. General comments within each section are followed by specific comments and associated examples in tabular form.

Wetlands

The DEIS wetland analysis relies on old regulation and policy standards from the City of Seattle and Department of Ecology (Ecology), resulting in a four-fold difference in required buffers and discrepancies in wetland ratings. Although Technical Appendices reports may have been completed prior to the formal adoption of current standards (standards in place at the time of the publication of the DEIS), all of the draft versions of current codes and policies were available at the time of the original report preparation. Thus the wetland ratings and buffers are significantly under-represented in the DEIS.

Several discrepancies and inconsistencies occur in the DEIS text analyzing potential wetland impacts from the proposed project. Technical Appendix E (Ecosystems) has discrepancies between text and exhibits that describe wetland impacts. The text consistently underestimates impacts that are shown in exhibits (tables and figures), and may mislead the reader as to the extent of wetland impacts. There is minimal quantification of wetland impacts, only qualitative statements that impacts between alternatives are similar.

Statements on wetland impacts from shading and temporary construction techniques made in Appendix E are not substantiated with scientific literature citations or other available evidence. In general, the wetland section lacks peer-reviewed literature sources to justify statements on potential wetland impacts. Furthermore, the acreages of wetlands that will be impacted from shading is inconsistent among analyses: Appendix E and the DEIS text claim that wetland shading impact will occur immediately beneath all bridge structures, whereas the Appendix E Addendum claims that only twenty percent of the area beneath the proposed bridge structures will count as impact, based on a single reference not provided.

No substantive discussion of compensatory mitigation occurs in the DEIS. It is not clear what opportunities are under consideration or what opportunities exist in the project area or the watershed, although Appendix E mentions some potential mitigation sites.

Table 1 provides a series of wetland-specific comments and the appropriate locations in the DEIS documents.

Table 1 Wetland Comments		
Section	Page or Exhibit Number	Comment
Draft EIS	Exhibit 4-17	Buffer impacts for the Pacific St. interchange option listed in Exhibit 4-17 (6.6 acre) are higher than shown on Exhibit 7 in Appendix E (4.8 acre).
Draft EIS	Page 5-47	Union Bay wetlands are described as Category II wetlands, which contradicts Exhibit 26 in Appendix E, which identifies them as Category I. The statement that all direct wetland impacts from filling are due to bridge pilings does not account for filling by stormwater pond outfall near Museum of History and Industry. Wetland impacts from shading by new bridges are considered less than existing structures but there are no scientific literature citations to substantiate this conclusion. Although some of the new bridges will be higher than current structures, they will also be wider, resulting in a different shade impact zone. The potential effects are not quantified rationally nor are there any citations as to what parameters were used to determine impact/no impacts from shading.
Draft EIS	Page 5-49	A replacement ratio of 3:1 is described for mitigation of impacts to Category I wetlands, which contradicts Exhibit 28 in Appendix E which uses 4:1 ratio.
Appendix E—Ecosystems Discipline Report	Page 19 and Exhibit 11	Wetlands were rated using the 1993 Ecology system instead of the significantly revised 2004 system. They state that the revised ratings would be applied during the permitting stage, however it should be used now so users of the DEIS are informed of current standards. The wetland rating system strongly influences the proposed buffer widths based on Ecology's *Wetlands in Washington State, Volume II* recommendations.

Table 1 (cont.) Wetland Comments		
Section	Page or Exhibit Number	Comment
Appendix E—Ecosystems Discipline Report	Exhibit 12	The most recent version of the City of Seattle Municipal Code (25.09.160) should be used to identify the City's standards for wetland classification and buffer width requirements. This would require 200-foot buffers for these high functioning Category I wetlands instead of the 50-foot buffers listed in Exhibit 12. All calculations of buffer impacts from both construction and operations of the roadway should be revised to reflect this four-fold increase in buffer width.
Appendix E—Ecosystems Discipline Report	Page 51	The fifteen proposed stormwater treatment cells (20' x 40') attached to bridge columns are not considered direct wetland or lake impacts, only shading impacts. However, 12 out of 15 cells will displace existing wetlands (POW, PEM, and PSS) to create stormwater treatment facilities. We estimate that only 3 out of 15 cells occur in open water and may not be considered wetland impacts. In addition, there is no documentation that this experimental design has been proven to effectively treat stormwater. It should not be considered wetland enhancement.
Appendix E—Ecosystems Discipline Report	Exhibit 21	Direct impacts in Wetland LWS-4 have different values in graphic (0.12 acre) versus summary table (0.14 acre). Although the acreage differences are minor, the inconsistencies are troubling.
Appendix E—Ecosystems Discipline Report	Exhibits 21 and 23	Pedestrian/bicycle path between SR 520 and Lake Washington Blvd. ramp crosses Wetland LWS-4 and its buffer, but there is no listing of impacts. Any path in this area should be tallied as part of the impacts.
Appendix E—Ecosystems Discipline Report	Pages 72-73	Temporary construction impacts from shading by work and detour bridges are estimated to be 4+ years under 4-lane and 5+ years under 6-lane alternative. Although this area will eventually be revegetated, these timeframes represent generations of wildlife displaced from habitats, and involve significant periods of time following construction for the wetland and upland habitats to re-establish to current conditions. Furthermore, disruption of the established wetland communities due to construction can allow highly invasive non-native species (e.g. Himalayan blackberry, reed canarygrass, etc.) that favor disturbed conditions to establish. These "temporary" impacts should be accounted for in the mitigation approach.

Table 1 (cont.) Wetland Comments		
Section	Page or Exhibit Number	Comment
Appendix E—Ecosystems Discipline Report	Pages 73-74	Installation and eventual removal of 1,600 pilings under 4-lane and 1,800 pilings under 6-lane alternative for work and detour bridges will disturb wetlands, but this impact is downplayed. The report indicates that the 4-lane alternative will have more construction impacts than the 6-lane alternative.
Appendix E—Ecosystems Discipline Report	Page 80	The area of potential wetland creation from removing old bridges is not quantified. The DEIS (Page 5-49) states that 0.6 acres of onsite wetland creation could occur by removing ramps on the WSDOT-owned peninsula near the Arboretum. However, there are other opportunities for wetland creation/restoration from removing existing ramps that aren't quantified.
Appendix E—Addendum to Ecosystems Discipline Report	Exhibit 4 and 7	Inconsistent labeling of wetland in University Slough area that is impacted by Pacific St. interchange option. Exhibit 4 identifies this as Wetland UB-2 but Exhibit 7 identifies as Wetland UB-1. Assume that UB-2 is correct.
Appendix E—Addendum to Ecosystems Discipline Report	Exhibit 6	Exhibit 6 underestimates wetland impacts when compared to Exhibits 7 and 11, and Exhibit 23 in Ecosystems Discipline Report. There is discrepancy between wetland impacts shown in Exhibit 6 compared to other exhibits for the original 6-lane alternative (6 acre vs. 6.94 acre), Pacific St. interchange option (5.3 acre vs. 8.05 acre), and second Montlake bridge option (6 acre vs. 7.05 acre).
Appendix E—Addendum to Ecosystems Discipline Report	Exhibit 10	Wetland impacts from bridge columns shown in Exhibit 10 for Portage Bay are not calculated correctly. If each column covers 78.5 square feet, then both the Pacific St. interchange option and second Montlake bridge option impact 2,826 square feet.
Appendix E—Addendum to Ecosystems Discipline Report	Exhibit 13	Exhibit 13 lists replacement ratios for Category II – IV wetlands although the Seattle segment only contains Category I wetlands. Exhibit 13 underestimates wetland impacts from shading compared to Exhibits 7 and 11 for the original 6-lane alternative (1.3 acre vs. 6 acre), Pacific St. interchange option (1.6 acre vs. 4.78 acre), and second Montlake bridge option (1.3acre vs. 6.26 acre), claiming that only twenty percent of shaded wetlands count as impacts for the project.
Appendix E—Addendum to Ecosystems Discipline Report	Page 29	A replacement ratio of 1:1 will be used to compensate for shading impacts to wetlands. However, it is unclear whether this has been approved by federal, state, and city agencies. Because shading impacts is the main reason for mitigation there needs to be agency approval and confirmation of this approach.

Table 1 (cont.) Wetland Comments		
Section	Page or Exhibit Number	Comment
Appendix J—Indirect and Cumulative Effects Discipline Report	Page 8	One of the sources of data for population growth is too restrictive. The use of permit applications for proposed development within 0.25 miles of project corridor underestimates the potential affects of the build alternatives.
Appendix J—Indirect and Cumulative Effects Discipline Report	Page 58	Cumulative negative effects to wetlands due to additional transportation projects in the area are identified and deemed possible. This information is not divulged in the DEIS main text.
Appendix J—Indirect and Cumulative Effects Discipline Report	Pages 43-44	The assessment of indirect effects on water resources and wetlands from population growth was only measured by increased impervious surface in watersheds. We disagree with the assumption that indirect impacts to wetlands can be quantified by impervious surface percentages.

Water Resources

Two reports are incorporated by reference into Technical Appendix T—Water Resources which should be considered for review but are not provided in the DEIS:

- CH2M HILL, Parametrix, Inc., Parsons Brinckerhoff, and EnviroIssues. 2002. Trans-Lake Washington Project. AKART and Water Quality Studies for an SR 520 Replacement Floating Bridge. Prepared for the Washington State Department of Transportation Office of Urban Mobility and Sound Transit. December 23, 2002.
- The SR 520 Bridge Replacement and HOV Project Preliminary Stormwater Management Report (CH2M HILL and Parametrix 2004)

Chapter 8-24, 25, 26—talks about unavoidable impacts but these are not specified in the DEIS.

Table 2 contains a series of specific comments concerning water resources in the DEIS and Appendix T—Water Resources.

Table 2 Water Resources Comments		
Section	Page or Exhibit Number	Comment
Appendix T—Water Resources	Page 82	The technical appendix provides a limited evaluation of temporary construction effects on surface water bodies by determining construction actions that may disturb soil and in-water sediments, and by evaluating the potential for accidental spills of hazardous materials. However, areas where erosion and sediment disturbance would be a problem are not identified, nor are Best Management Practices to reduce the risks specified. Instead, this is all left to the TECS plan that is not yet prepared. This lack of information makes it difficult for the reader to fully understand the problems associated with these direct impacts to water quality.
Appendix T—Water Resources	Page 86	*"It is unlikely that turbidity would increase in the photic zone (the area of the lake or water body where there is enough light for photosynthesis to take place), and therefore turbidity from project construction would not adversely affect plant photosynthesis or lake productivity. Similarly, water column concentrations in these same upper layers of the lake would be unlikely to reach concentrations that would adversely affect fish (1,000 mg/L for 24 hour [Parametrix 1997]) in this same zone."* The report cited here is not available for review so there is no way to verify these scientific findings.
Appendix T—Water Resources	Page 83	*"Construction of the new bridges would involve work in and near the waters of Portage Bay and Lake Washington. Construction of work bridges, installation of new columns for the Portage Bay Bridge and the approaches to the Evergreen Point Bridge, and anchoring of the floating bridge pontoons would all take place in the open water, as would construction of the Union Bay Bridge under the Pacific Street Interchange option."* There is no discussion of how this is going to be done or the specific impacts that will result. The DEIS does provide general water quality impacts from general construction activities, but does not address the effects from this work, some of which reflect new technologies that may have impacts which have not yet been determined. Rather, the DEIS states that WSDOT will *"mitigate the project's potential effects on water quality"* because they will *"implement plans to control erosion, sedimentation, and spills during construction consistent with the requirements of federal, state, and local permits related to in-water work."* More detail is needed in order to determine if this alternative is viable first.
Draft EIS	Page 8-24, 8-25	The DEIS indicates that there will be increased turbidity, but fails to mention to what degree or the potential impacts.

Table 2 (cont.) Water Resources Comments		
Section	Page or Exhibit Number	Comment
Draft EIS	Page 8-25	Construction impacts are discussed as temporary, but this project could potentially take a decade to complete. There is not an adequate discussion of the treatment of water quality from storms during the construction phase. Specifically, the impacts to water quality, not just related to construction-generated parameters, but from the runoff from the "temporary" roads and associated structures.
Draft EIS	Page 5-45 and 6-6	*"The quality of water discharging to Lake Union and Portage Bay during storms would generally be better than the quality of water today because stormwater facilities would treat runoff from the road surface, which is currently untreated."* *"Although the new bridge would have substantially more impervious surface than the current bridge, new stormwater treatment facilities would meet or exceed current federal and state water quality standards."* Although these statements are true, they are misleading. The assumptions are based on the fact that there is currently no water quality treatment and therefore treatment of future runoff will be beneficial over current conditions. However, this assumption is not supported in the Technical Appendix T. Instead, the amount of pollution-generating surface under the alternatives is substantially higher than that of today. And, in fact, the treatments proposed for water quality provide relatively limited improvements over current conditions for some parameters. Rather, they are needed to simply maintain the same quality in the case of some metals (copper and zinc). In some areas (such as Portage Bay) some pollutant levels under the proposed alternatives will actually be higher than the levels monitored in today's runoff (see Exhibit 29 in Appendix T).
Appendix T—Water Resources	Page 64	*"From these calculations (Exhibit 32), the water resources discipline team determined that the proposed BMPs for the 4-Lane Alternative would not increase the amount of pollutants discharged to Lake Washington compared to existing 2002 conditions. This would represent an improvement over 2030 discharges under the Continued Operation Scenario (CH2M HILL et al. 2002). The same improvement would occur for the 6-Lane Alternative, except that oil/grease pollutant loading rate would increase by 57 percent compared to 2002 conditions and zinc would increase by 18 percent."* It is unclear how the discipline team determined water quality pollution in this scenario. Furthermore, a pollutant loading rate increase of 57 percent for oil/grease and 18 percent for zinc is significant and needs further discussion to define these impacts on the aquatic environment.

Table 2 (cont.) Water Resources Comments		
Section	Page or Exhibit Number	Comment
Appendix T—Water Resources	Page 59	Modeling of pollutant loading for the water quality parameters is presented using amounts that are not comparable to standards and therefore it is difficult to determine their ecological significance (see Exhibit 29). Specifically, WSDOT presents loadings in pounds per year (mass per unit time) vs. qualities presented more typically in mass per unit volume (typically mg/L) for ecological comparisons to Ecology, NOAA Fisheries, EPA, or U.S.F.W. criteria.
Draft EIS	Page 12	The resource agencies disagree with the method that WSDOT uses to calculate pollutant levels in stormwater runoff. WSDOT's method uses the roadway surface area as a basis for calculating the quantities of pollutants that will be discharged in stormwater runoff. NOAA Fisheries and the U.S. Fish and Wildlife Service prefer a method that uses the average daily traffic volumes on the roadway to estimate pollutant quantities. We agree with the agencies.
Appendix T—Water Resources	Page 66	Although metals are included in the analysis, they are presented for total metals only, which limits the understanding of the impact of these parameters on aquatic species. Total metals account for the total runoff metal content, some of which is dissolved and some of which is particulate bound. Total metals do not have ecological significance except with regard to their attachment to sediments. Conversely, the dissolved portion is bioavailable and therefore has a greater ecological relevance. The dissolved phase fraction should therefore be shown in order to make biologically based conclusions about water quality impacts.
Draft EIS	General Observation	Some water quality parameters which are important to understanding the ecological impact of the project have not been presented in the DEIS. These include the dissolved forms of metals such as copper and zinc, hardness, pH, and Polyaromatic Hydrocarbons (PAHs). The toxicity of metals may also change relative to other parameters such as pH, alkalinity, hardness and the like. As stated above, these data are not provided in the DEIS.
Draft EIS	General Observation	It is not possible to anticipate the toxicological impacts from stormwater runoff containing metals without knowing the concentrations of specific metals in their dissolved and particulate phases. Therefore, WSDOT should estimate on a per-storm basis the likely range of metals and PAH concentrations, as well as the range of concentrations in υg/L.

Table 2 (cont.) Water Resources Comments		
Section	Page or Exhibit Number	Comment
Draft EIS and Appendix T—Water Resources	General Observation	Regional studies have shown that even low concentrations of metals can have sub-lethal impacts on salmonids. A discussion of these sub-lethal effects should be included in the DEIS. Specifically, they need to address the impacts of more zinc and copper in the runoff at Portage Bay West under the 4-lane alternative, and the increase in zinc to Portage Bay East under the 6-lane alternative.
Draft EIS	General Observation	Finally, estimates of loading of PAHs and metals and other toxicants coming from cars into receiving waters, not just from a total fraction but from a dissolved phase fraction, is not provided. More information is needed to understand how these contaminants are going to partition into sediments or as dissolved particulates. As such, the way contaminants are received by the water body will dictate their relative toxicity. This is particularly relevant to the proposed BMPs that remove sediments and their associated fraction of contaminants. Although sediments will be removed through the treatment process, the DEIS does not account for the dissolved fraction of contaminants not bound in the sediments.

Wildlife Habitat

Project effects to wildlife and wildlife habitat are generally minimized in the DEIS. Construction effects of noise and activity are briefly acknowledged, but the lengthy period of construction (four to eight years) is not addressed. Pile-driving activities are identified as potentially causing fish injuries and fish kills in Appendix E. This is minimized in the DEIS text. Habitat loss and impact are noted as occurring due to the project, and Appendix E notes that wildlife will experience negative impacts as a result. The DEIS fails to mention this analysis in some sections, and minimizes it in others.

Table 3 provides a series of specific comments related to wildlife habitat, and the appropriate locations in the DEIS and Appendix E—Ecosystems.

Table 3 Wildlife Habitat Comments		
Section	Page or Exhibit Number	Comment
Appendix E—Ecosystems	Page 153	Wildlife use of the project area is minimized in Appendix E. Species of concern, including great blue herons, red-tailed hawks, etc. use the habitat in and around the project area more frequently than the analysis claims.
Draft EIS and Appendix E—Ecosystems	Page 5-45 and 5-49 in the EIS, Page 192 (Appendix E)	According to the DEIS language, many of the mitigation measures will occur "if feasible", "if practical", or "could" occur; with some other phrasing that indicates a degree of uncertainty associated with the mitigation procedures. Very few specifics on wildlife and/or fish mitigation are given in the DEIS and Appendix E, although more mitigation specifics for fish are given in Appendix E.
Draft EIS and Appendix E—Ecosystems	Chapter 8: Construction Effects	Neither the DEIS nor Appendix E explores the effects of shading and artificial light (nighttime during and post-construction) on salmonid behavior (feeding behavior, prey capture, schooling, migration, etc.). Yet there is a fairly robust literature that examines behavioral changes in response to different lighting regimes, indicating that migratory behavior is generally disrupted. For example, migrating juvenile salmon may move away from their shallow water migratory routes into deeper water, in order to avoid over- or in-water structures. Numerous large bridge columns are proposed to be inserted into the shallow waters of Lake Washington, yet no mention of avoidance behavior by salmonids is included. Additionally, the DEIS claims that only a negligible effect from an increase in pontoon surface area of 21.5 or 27.3 acres from a current 10.4 acres would occur. Such a conclusion is questionable. Certainly, shading and "shoreline effects" (the increase in non-native piscivorous predators, e.g.) will potentially be greater. Appendix E specifically mentions that fish often behave as if solid structures in the water are similar to shoreline areas—thus, non-native piscivores may show an increase in use of the pontoon habitat, which the DEIS fails to address.

Table 3 (cont.) Wildlife Habitat Comments		
Section	Page or Exhibit Number	Comment
Appendix E—Ecosystems	Page 132	Indirect/cumulative environmental effects of constructing the pontoons off-site and floating them to the bridge site are not addressed in the DEIS. The DEIS claims that the environmental effects are addressed in a different document. This is true, but disingenuous. The pontoons will be constructed as part of the Hood Canal project. From Appendix E: *"These would be constructed at a graving dock to be built as part of the Hood Canal Floating Bridge Project.* *A graving dock is a large, gated channel excavated next to the shoreline of a body of water. When a group of pontoons and anchors have been constructed, the graving dock is flooded to float the pontoons and anchors. For this project, flooding of the graving dock would follow a protocol developed by WSDOT, in cooperation with WDFW, NOAA Fisheries, and USFWS, for construction of the Hood Canal Bridge pontoons. Work dates at the graving dock would be limited by fish restrictions, as detailed in the Hydraulics Project Approval (HPA) for the Hood Canal Floating Bridge Project to be issued by WDFW. All applicable screening requirements would be followed during pumping operations. The graving dock gate would then be opened, and a tug would tow the pontoons and anchors out of the graving dock into the adjacent body of water. The pontoons and anchors would be towed to the Evergreen Point Bridge site in Lake Washington.* *The Hood Canal Floating Bridge Project will satisfy the ESA's requirements for construction and operation of a graving dock by obtaining Biological Opinions from USFWS and NOAA Fisheries. Continued operation of the graving dock to manufacture the pontoons and anchors for the Evergreen Point Bridge will be covered in a Biological Assessment to be submitted to NOAA Fisheries and USFWS for the SR 520 Bridge Replacement and HOV Project."* The construction and operation of the graving dock is expected to result in fish take under the ESA, requiring the issuance of Biological Opinions, and is a project directly associated with the SR 520 bridge replacement. This is not even mentioned in the DEIS. No analysis or mention occurs as to whether the use of the graving dock for constructing SR 520 bridge pontoons will result in an increase in graving dock operational activities or in an increase in negative impacts to fish. No analysis or mention of impacts occurs as to whether aquatic resources are negatively impacted as a result of towing the pontoons from the graving dock to Lake Washington.

Table 3 (cont.) Wildlife Habitat Comments		
Section	Page or Exhibit Number	Comment
Draft EIS	Page 4-40	Analyses and effects determinations for wildlife and wildlife habitat are not adequately performed for the project-related vegetation removal and staging activities within parks and sensitive areas—between 32.13 and 47.7 acres of upland habitat are expected to be permanently removed. The DEIS notes that much of that upland habitat is relatively rare in the urban environment, but then indicates that the "effects of project development in these areas would vary according to existing habitat quality." No negative effects to wildlife utilizing such habitat are noted.
Draft EIS and Appendix J—Indirect and Cumulative Effects	9-6 and 9-7 (Draft EIS), Page 58 and 60 (Appendix J)	Appendix E identifies negative cumulative effects to wildlife habitat as occurring due to the project. A reduction in habitat value to wildlife due to wetland loss is noted, as well as a decline in wildlife abundance due to vegetation loss and general degradation of habitat. Appendix J states that "*direct habitat loss and disturbance is expected to result in reduced population abundance of sensitive wildlife species in the vicinity*." This information is not included in the DEIS text.
Draft EIS and Appendix X—Pacific Street Interchange Options Analysis		No mention is made of additional negative impacts to wildlife under the Pacific St. Interchange Option in either the DEIS or Appendix X. However, currently contiguous habitat in the Arboretum and on Marsh Island will be fragmented by building new on- and off-ramps to the north and south. The ramps may form physical barriers to wildlife movement, and will definitely create a greater level of disturbance to wildlife than currently exists, both during construction and subsequent operation of the bridge. Additionally, higher volumes of traffic will be conducted through the Arboretum than under current conditions, as all traffic exiting or entering onto SR 520 from south of the Montlake Cut will utilize the Arboretum on- and off-ramps. The DEIS provides no analysis of how an increase in traffic activity could impact wildlife in the Arboretum, or how a localized increase in vehicle exhaust, shading by the ramps, disturbance during construction, etc. might impact sensitive plants in the Arboretum.

Geology

The DEIS does not appear to adequately address two major issues with respect to geological hazards. The potential impacts of the project including construction on surficial processes such as hill slope stability, soil loss, excessive stream bank erosion, and stream incision is not discussed. In

addition, there is no thorough analysis of potential risks associated with geologic hazards, such as earthquakes, and how they would influence the proposed roadway in its various potential forms.

Landslide Hazards

The Geology and Soils Documentation section lists slope stability studies conducted by Shannon & Wilson, Inc., however the results of their work are not presented in the Technical Appendix. This information should be compiled in a map or series of maps that display factors of safety along the road embankments. Information should also be provided about the frequency and magnitude of potential landslide triggering events including not only seismic events, but the impact of frequent use by large vehicles. For example, the exposure of the Lawton clay member and sandy layers of the Vashon till adds to the instability of the steep slopes in the vicinity of the Portage Bay Bridge. This fact is mentioned in the Appendix, but there are no detailed maps of the exposures relative to the proposed alignments and alternatives.

Seismic Hazards

Assessing potential seismic hazards requires detailed probabilistic mapping of the anticipated effects of ground shaking and liquefaction. The data appears to have been collected by Shannon & Wilson, Inc., but it is not presented in the Technical Appendix. Data for constructing maps of ground-shaking intensity should include measurements of intensity, ground acceleration, and ground velocity. These data should be combined with information about the type and thickness of sediments to determine the likelihood of hazards associated with liquefaction. Such information should be presented as maps along the proposed alignments within the Technical Appendices.