INTERSTATE 5 COLUMBIA RIVER CROSSING

Hydrology and Water Quality Technical Report

May 2008

Columbia River CROSSING

TO: Readers of the CRC Technical Reports

FROM: CRC Project Team

SUBJECT: Differences between CRC DEIS and Technical Reports

The I-5 Columbia River Crossing (CRC) Draft Environmental Impact Statement (DEIS) presents information summarized from numerous technical documents. Most of these documents are discipline-specific technical reports (e.g., archeology, noise and vibration, navigation, etc.). These reports include a detailed explanation of the data gathering and analytical methods used by each discipline team. The methodologies were reviewed by federal, state and local agencies before analysis began. The technical reports are longer and more detailed than the DEIS and should be referred to for information beyond that which is presented in the DEIS. For example, findings summarized in the DEIS are supported by analysis in the technical reports and their appendices.

The DEIS organizes the range of alternatives differently than the technical reports. Although the information contained in the DEIS was derived from the analyses documented in the technical reports, this information is organized differently in the DEIS than in the reports. The following explains these differences. The following details the significant differences between how alternatives are described, terminology, and how impacts are organized in the DEIS and in most technical reports so that readers of the DEIS can understand where to look for information in the technical reports. Some technical reports do not exhibit all these differences from the DEIS.

Difference #1: Description of Alternatives

The first difference readers of the technical reports are likely to discover is that the full alternatives are packaged differently than in the DEIS. The primary difference is that the DEIS includes all four transit terminus options (Kiggins Bowl, Lincoln, Clark College Minimum Operable Segment (MOS), and Mill Plain MOS) with each build alternative. In contrast, the alternatives in the technical reports assume a single transit terminus:

- Alternatives 2 and 3 both include the Kiggins Bowl terminus
- Alternatives 4 and 5 both include the Lincoln terminus

In the technical reports, the Clark College MOS and Mill Plain MOS are evaluated and discussed from the standpoint of how they would differ from the full-length Kiggins Bowl and Lincoln terminus options.

Difference #2: Terminology

Several elements of the project alternatives are described using different terms in the DEIS than in the technical reports. The following table shows the major differences in terminology.

DEIS terms	Technical report terms
Kiggins Bowl terminus	I-5 alignment
Lincoln terminus	Vancouver alignment
Efficient transit operations	Standard transit operations
Increased transit operations	Enhanced transit operations

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Difference #3: Analysis of Alternatives

The most significant difference between most of the technical reports and the DEIS is how each structures its discussion of impacts of the alternatives. Both the reports and the DEIS introduce long-term effects of the full alternatives first. However, the technical reports then discuss “segment-level options,” “other project elements,” and “system-level choices.” The technical reports used segment-level analyses to focus on specific and consistent geographic regions. This enabled a robust analysis of the choices on Hayden Island, in downtown Vancouver, etc. The system-level analysis allowed for a comparative evaluation of major project components (replacement versus supplemental bridge, light rail versus bus rapid transit, etc). The key findings of these analyses are summarized in the DEIS; they are simply organized in only two general areas: impacts by each full alternative, and impacts of the individual “components” that comprise the alternatives (e.g. transit mode).

Difference #4: Updates

The draft technical reports were largely completed in late 2007. Some data in these reports have been updated since then and are reflected in the DEIS. However, not all changes have been incorporated into the technical reports. The DEIS reflects more recent public and agency input than is included in the technical reports. Some of the options and potential mitigation measures developed after the technical reports were drafted are included in the DEIS, but not in the technical reports. For example, Chapter 5 of the DEIS (Section 4(f) evaluation) includes a range of potential “minimization measures” that are being considered to reduce impacts to historic and public park and recreation resources. These are generally not included in the technical reports. Also, impacts related to the stacked transit/highway bridge (STHB) design for the replacement river crossing are not discussed in the individual technical reports, but are consolidated into a single technical memorandum.

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Interstate 5 Columbia River Crossing

Hydrology and Water Quality Technical Report:

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ACRONYMS

Acronym	Description
ADA	Americans with Disabilities Act
AFS	American Fisheries Society
API	Area of Potential Impact
BES	Portland Bureau of Environmental Services
BMP	Best Management Practice
BNSF	Burlington Northern Santa Fe Railroad
BPA	Bonneville Power Administration
BRT	Bus Rapid Transit
COE	U.S. Army Corps of Engineers
CRC	Columbia River Crossing
CSO	Combined Sewer Overflow
CWA	Clean Water Act
dB	Decibel
dBA	A-weighted decibel
DEIS	Draft Environmental Impact Statement
DEQ	Oregon Department of Environmental Quality
DO	Dissolved Oxygen
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESH	Essential Salmonid Habitat
ESU	Evolutionarily Significant Unit
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
GIS	Geographic Information System
HCT	High Capacity Transit
HUC	Hydrological Unit Code
InterCEP	Interstate Collaborative Environmental Process
JARPA	Joint Aquatic Resources Permits Application
L_{max}	Maximum Noise Levels
LRT	Light Rail Transit
MCDD	Multnomah County Drainage District
Mgd	million gallons per day
MOA	Memorandum of Agreement
MSFCMA	Magnuson-Stevens Fisheries Conservation and Management Act
NASQAN	National Stream Quality Accounting Network
NEPA	National Environmental Policy Act
NFA	No Further Action
NMFS	National Marine Fisheries Service
NOAA Fisheries	National Oceanic and Atmospheric Administration for Fisheries
NPDES	National Pollutant Discharge Elimination System

Acronym	**Description**
NRCS	Natural Resources Conservation Service
OAR	Oregon Administrative Rule
ODFW	Oregon Department of Fish & Wildlife
ODOT	Oregon Department of Transportation
OHW	Ordinary High Water Line
ORS	Oregon Revised Statutes
PCBs	Polychlorinated Biphenyls
PPM	Parts Per Million
SEPA	State Environmental Policy Act
SMA	Shoreline Management Act
TDM	Transportation Demand Management
TMDL	Total Maximum Daily Load
TSCA	Toxic Substances and Control Act
TSP	Transportation System Management
USFWS	U.S. Fish and Wildlife Service
VOC	Volatile Organic Compounds
WDFW	Washington Department of Fish and Wildlife
WRD	Oregon Department of Water Resources
WSDOT	Washington State Department of Transportation

1. Summary

1.1 Description of the Alternatives

The alternatives being considered for the CRC project consist of a diverse range of highway, transit and other transportation choices. Some of these choices – such as the number of traffic lanes across the river – could affect transportation performance and impacts throughout the bridge influence area or beyond. These are referred to as "system-level choices." Other choices – such as whether to run high-capacity transit (HCT) on Washington Street or Washington and Broadway Streets – have little impact beyond the area immediately surrounding that proposed change and no measurable effect on regional impacts or performance. These are called "segment-level choices." This report discusses the impacts from both system- and segment-level choices, as well as "full alternatives." The full alternatives combine system-level and segment-level choices for highway, transit, pedestrian, and bicycle transportation. They are representative examples of how project elements may be combined. Other combinations of specific elements are possible. Analyzing the full alternatives allows us to understand the combined performance and impacts that would result from multimodal improvements spanning the bridge influence area.

Following are brief descriptions of the alternatives being evaluated in this report, which include:

- System-level choices,
- Segment-level choices, and
- Full alternatives.

1.1.1 System-Level Choices

System-level choices have potentially broad influence on the magnitude and type of benefits and impacts produced by this project. These options may influence physical or operational characteristics throughout the project area and can affect transportation and other elements outside the project corridor as well. The system-level choices include:

- River crossing type (replacement or supplemental)
- High-capacity transit mode (bus rapid transit or light rail transit)
- Tolling (no toll, I-5 only, I-5 and I-205, standard toll, higher toll)

This report compares replacement and supplemental river crossing options. A replacement river crossing would remove the existing highway bridge structures across the Columbia River and replace them with three new parallel structures – one for I-5 northbound traffic, another for I-5 southbound traffic, and a third for HCT, bicycles, and pedestrians. A supplemental river crossing would build a new bridge span downstream of the existing I-5 bridge. The new supplemental bridge would carry southbound I-5 traffic and HCT, while the existing I-5 bridge would carry northbound I-5 traffic, bicycles, and pedestrians. The replacement crossing would include three through-lanes and two auxiliary lanes for I-5 traffic in each direction. The supplemental crossing would include three through-lanes and one auxiliary lane in each direction.

Two types of HCT are being considered – bus rapid transit and light rail transit. Both would operate in an exclusive right-of-way through the project area, and are being evaluated for the same alignments and station locations. The HCT mode – LRT or BRT – is evaluated as a system-level choice. Alignment options and station locations are discussed as segment-level choices. BRT would use 60-foot or 80-foot long articulated buses in lanes separated from other traffic. LRT would use one- and two-car trains in an extension of the MAX line that currently ends at the Expo Center in Portland.

Under the efficient operating scenario, LRT trains would run at approximately 7.5 minute headways during the peak periods. BRT would run at headways between 2.5 and 10 minutes depending on the location in the corridor. BRT would need to run at more frequent headways to match the passenger-carrying capacity of the LRT trains. This report also evaluates performance and impacts for an increased operations scenario that would double the number of BRT vehicles or the number of LRT trains during the peak periods.

1.1.2 Segment-Level Choices

1.1.2.1 Transit Alignments

The transit alignment choices are organized into three corridor segments. Within each segment the alignment choices can be selected relatively independently of the choices in the other segments. These alignment variations generally do not affect overall system performance but could have important differences in the impacts and benefits that occur in each segment. The three segments are:

- Segment A1 – Delta Park to South Vancouver
- Segment A2 – South Vancouver to Mill Plain District
- Segment B – Mill Plain District to North Vancouver

In Segment A1 there are two general transit alignment options - offset from, or adjacent to, I-5. An offset HCT guideway would place HCT approximately 450 to 650 feet west of I-5 on Hayden Island. An adjacent HCT guideway across Hayden Island would locate HCT immediately west of I-5. The alignment of I-5, and thus the alignment of an adjacent HCT guideway, on Hayden Island would vary slightly depending upon the river crossing and highway alignment, whereas an offset HCT guideway would retain the same station location regardless of the I-5 bridge alignment.

HCT would touch down in downtown Vancouver at Sixth Street and Washington Street with a replacement river crossing. A supplemental crossing would push the touch down location north to Seventh Street. Once in downtown Vancouver, there are two alignment options for HCT – a two-way guideway on Washington Street or a couplet design that would place southbound HCT on Washington Street and northbound HCT on Broadway.

Both options would have stations at Seventh Street, 12th Street, and at the Mill Plain Transit Center between 15th and 16th Streets.

From downtown Vancouver, HCT could either continue north on local streets or turn east and then north adjacent to I-5. Continuing north on local streets, HCT could either use a two-way guideway on Broadway or a couplet on Main Street and Broadway. At 29th Street, both of these options would merge to a two-way guideway on Main Street and end at the Lincoln Park and Ride located at the current WSDOT maintenance facility. Once out of downtown Vancouver, transit has two options if connecting to an I-5 alignment: head east on 16th Street and then through a new tunnel under I-5, or head east on McLoughlin Street and then through the existing underpass beneath I-5. With either option HCT would connect with the Clark College Park and Ride on the east side of I-5, then head north along I-5 to about SR 500 where it would cross back over I-5 to end at the Kiggins Bowl Park and Ride.

There is also an option, referred to as the minimum operable segments (MOS), which would end the HCT line at either the Mill Plain station or Clark College. The MOS options provide a lower cost, lower performance alternative in the event that the full-length HCT lines could not be funded in a single phase of construction and financing.

1.1.2.2 Highway and Bridge Alignments

This analysis divides the highway and bridge options into two corridor segments, including:

- Segment A – Delta Park to Mill Plain District
- Segment B – Mill Plain District to North Vancouver

Segment A has several independent highway and bridge alignment options. Differences in highway alignment in Segment B are caused by transit alignment, and are not treated as independent options.

At the SR 14 interchange there are two basic configurations being considered. A traditional configuration would use ramps looping around both sides of the mainline to provide direct connection between I-5 and SR 14. A less traditional design could reduce right-of-way requirements by using a “left loop” that would stack both ramps on the west side of the I-5 mainline.

1.1.3 Full Alternatives

Full alternatives represent combinations of system-level and segment-level options. These alternatives have been assembled to represent the range of possibilities and total impacts at the project and regional level. Packaging different configurations of highway, transit, river crossing, tolling and other improvements into full alternatives allows project staff to evaluate comprehensive traffic and transit performance, environmental impacts and costs.

Exhibit 1-1 summarizes how the options discussed above have been packaged into representative full alternatives.

Exhibit 1-1. Full Alternatives

Full Alternative	Packaged Options				
	River Crossing Type	HCT Mode	Northern Transit Alignment	TDM/TSM Type	Tolling Method[a]
1	Existing	None	N/A	Existing	None
2	Replacement	BRT	I-5	Aggressive	Standard Rate
3	Replacement	LRT	I-5	Aggressive	Two options[b]
4	Supplemental	BRT	Vancouver	Very Aggressive	Higher rate
5	Supplemental	LRT	Vancouver	Very Aggressive	Higher rate

[a] In addition to different tolling rates, this report evaluates options that would toll only the I-5 river crossing and options that would toll both the I-5 and the I-205 crossings.

[b] Alternative 3 is evaluated with two different tolling scenarios, tolling and non-tolling.

Modeling software used to assess alternatives' performance does not distinguish between smaller details, such as most segment-level transit alignments. However, the geographic difference between the Vancouver and I-5 transit alignments is significant enough to warrant including this variable in the model. All alternatives include Transportation Demand Management (TDM) and Transportation System Management (TSM) measures designed to improve efficient use of the transportation network and encourage alternative transportation options to commuters such as carpools, flexible work hours, and telecommuting. Alternatives 4 and 5 assume higher funding levels for some of these measures.

Alternative 1: The National Environmental Policy Act (NEPA) requires the evaluation of a No-Build or "No Action" alternative for comparison with the build alternatives. The No-Build analysis includes the same 2030 population and employment projections and the same reasonably foreseeable projects assumed in the build alternatives. It does not include any of the I-5 CRC related improvements. It provides a baseline for comparing the build alternatives, and for understanding what will happen without construction of the I-5 CRC project.

Alternative 2: This alternative would replace the existing I-5 bridge with three new bridge structures downstream of the existing bridge. These new bridge structures would carry Interstate traffic, BRT, bicycles, and pedestrians. There would be three through-lanes and two auxiliary lanes for I-5 traffic in each direction. Transit would include a BRT system that would operate in an exclusive guideway from Kiggins Bowl in Vancouver to the Expo Center station in Portland. Express bus service and local and feeder bus service would increase to serve the added transit capacity. BRT buses would turn around at the existing Expo Station in Portland, where riders could transfer to the MAX Yellow Line.

Alternative 3: This is similar to Alternative 2 except that LRT would be used instead of BRT. This alternative is analyzed both with a toll collected from vehicles crossing the Columbia River on the new I-5 bridge, and with no toll. LRT would use the same transit alignment and station locations. Transit operations, such as headways, would differ, and LRT would connect with the existing MAX Yellow Line without requiring riders to transfer.

Alternative 4: This alternative would retain the existing I-5 bridge structures for northbound Interstate traffic, bicycles, and pedestrians. A new crossing would carry southbound Interstate traffic and BRT. The existing I-5 bridges would be re-striped to provide two lanes on each structure and allow for an outside safety shoulder for disabled vehicles. A new, wider bicycle and pedestrian facility would be cantilevered from the eastern side of the existing northbound (eastern) bridge. A new downstream supplemental bridge would carry four southbound I-5 lanes (three through-lanes and one auxiliary lane) and BRT. BRT buses would turn around at the existing Expo Station in Portland, where riders could transfer to the MAX Yellow Line. Compared to Alternative 2, increased transit service would provide more frequent service. Express bus service and local and feeder bus service would increase to serve the added transit capacity.

Alternative 5: This is similar to Alternative 4 except that LRT would be used instead of BRT. LRT would have the same alignment options, and similar station locations and requirements. LRT service would be more frequent (approximately 3.5 minute headways during the peak period) compared to 7.5 minutes with Alternative 3. LRT would connect with the existing MAX Yellow Line without requiring riders to transfer.

1.2 Long-Term Effects

Potential hydrologic impacts from the build alternatives include potential flooding, alterations in peak flows and increased runoff volumes to local receiving waters, and decreased water percolation and groundwater storage. Potential water quality impacts would be associated with sedimentation and erosion and accidental spills, particularly during construction, and with pollutants carried in highway runoff.

Other than the installation of piers within the Columbia River/North Portland Harbor, no new or expanded project facilities under the build alternatives would encroach upon the 100-year floodplain for any stream or river within the affected project area. New roads within the floodplain would either be elevated above the Columbia River floodplain or would avoid floodplains altogether. It is extremely unlikely that pier installation would create a discernable backwater effect or create a rise in flood elevations.

The overall net increase in impervious surface area for the build alternatives ranges from 19.5 to 32.3 acres. An increase in impervious surface area typically increases flashiness within receiving waters, and is associated with greater peak flows and increased total runoff volume. Flashiness and impacts from greater peak flows and increased runoff is expected to be negligible within those streams draining the project area. Stormwater regulations for both Oregon and Washington do not require flow controls for project-generated runoff other than for flows discharged to Burnt Bridge Creek. Impacts from increased runoff in Burnt Bridge Creek would be mitigated by developing a stormwater conveyance and detention system in accordance with standards in place at the time of construction.

Impervious surfaces do not allow water to percolate into the ground, thereby increasing the amount of runoff. Decreased water percolation also decreases groundwater storage and the beneficial dilution effects from clean water entering the water table. Alternatives 2 and 3 would create more impervious surface compared to Alternatives 4 and 5.

Alternatives containing BRT transit options have slightly more impervious surface area than those containing LRT options.

New impervious road and transit surfaces would incorporate stormwater management measures to decrease the impact of road stormwater runoff to water quality. Runoff from transportation facilities is typically associated with a suite of pollutants, including suspended sediments, nutrients, PAHs, oils and grease, antifreeze from leaks, cadmium and zinc from tire wear, and copper from wear and tear from brake pads, bearings, metal plating, and engine parts. Fecal coliform, while not a product of roadway surfaces or activities, is known to be conveyed in road runoff. The concentration and load of these pollutants are affected by a number of factors, including traffic volumes, adjacent land uses, air quality, and the frequency and duration of storms. Stormwater management measures would be incorporated into project designs to minimize the potential adverse impacts that road runoff can have on water quality.

Under the current conceptual plan for stormwater management, project-generated runoff from a few sections of new or modified roadway that would normally drain to the Columbia River watershed would be conveyed, treated, and discharged to the Columbia Slough. All other runoff generated by the project would be discharged within the watershed in which it is generated. This transfer of stormwater from the Columbia River to the Columbia Slough could have the adverse effect of raising annual dissolved copper loads above loads anticipated under the No-Build Alternative by up to 26 percent (0.5 lbs/year). Alternatives 2 and 3 (Replacement Bridge) are expected to raise dissolved copper levels substantially higher than those estimated for Alternatives 4 and 5 (Supplemental Bridge). The project-related loads of all other roadway pollutants would decline within the Columbia Slough compared to the loads expected under the No-Build Alternative, since stormwater treatment would be provided where treatment would otherwise not exist.

This reduction is expected (with the exception of dissolved copper noted above for the Columbia Slough) because currently untreated stormwater within the Columbia Slough, Columbia River, and Columbia Slope would be treated under the build alternatives. Pollutant loading under Alternatives 4 and 5 would be lower for all affected watersheds compared to Alternatives 2 and 3, with the exception of the Columbia River. The pollutant loads within the Burnt Bridge Creek watershed would be nearly the same for all alternatives and would be greater compared to the No-Build Alternative. This is a result of more impervious surface within a watershed where stormwater treatment is currently being practiced.

1.3 Temporary Effects

Construction activities involving any of the build alternatives can impact surface water quality by inducing increased erosion, by disturbing the bed and banks of water bodies, by the accidental discharge of construction materials (e.g., wet concrete) or chemicals into the water (e.g., machine fuel), and by the removal of shade vegetation. Many of these potential impacts would be avoided through routine procedures associated with NPDES 1200-CA/1200-C construction permits, such as the creation and implementation of temporary erosion and sediment control plans and spill plans. Construction activities at depressed road sections could potentially create alterations in groundwater by pumping groundwater to depress it below the road surface elevation.

Roadway work would require substantially more land disturbance than the transit components of the project. A comparison of construction disturbance area (and therefore the potential for erosion) among project options indicates that there is little difference among options. While the supplemental bridge crossing is associated with slightly fewer acres of land disturbance related to roadways, overall it would involve about 2.2 percent greater disturbance area compared to the replacement crossing. A transit alignment along I-5 could have greater temporary construction impacts compared to a Main Street alignment, given that the section of the transit corridor near Burnt Creek Bridge is comparatively steep and would have a higher potential for erosion hazards.

There is little to no riparian vegetation that would be removed at the Columbia River's edge. Even if it were removed, given the sheer width and volume of the Columbia River, this loss of shading is not expected to create a discernable increase in water temperatures.

There is little variation in the overall acreage of depressed road sections for the various options. Excavation and pumping near a shallow water table may create a cone of depression and the potential for groundwater contaminant migration from nearby hazardous materials sites. A review of high ranking potential hazardous materials sites (see the Hazardous Materials Technical Report) indicates that there are potential sources of contamination in proximity to proposed depressed road sections, except in the area north of SR 500.

1.4 Mitigation

Mitigation measures to avoid or reduce the long-term and temporary impacts to water resources have been considered during the development of the project alternatives and options. Earlier designs would have involved extending road improvements to include a Burnt Bridge Creek crossing. Direct impacts to rivers and streams have been minimized to limiting the project to one crossing, the Columbia River/North Portland Harbor. State and local regulations include mitigation measures that minimize many of the impacts generally associated with road construction and operation.

Construction impacts include potential sedimentation and erosion hazards, stormwater problems, and accidental spills generally associated with land disturbance activities. Both states' DOT guidelines and local rules and regulations require that sedimentation and erosion control plans, as well as spill prevention plans, be prepared and approved prior to construction. Regulations are in place to control the runoff generated from land development projects. Both ODOT and WSDOT have guidance measures for providing stormwater management for highways, and both Portland and Vancouver have stormwater management requirements. The project would not be constructed until all pertinent jurisdictions are satisfied with the measures enumerated in required plans. Compliance with these measures will assure that project impacts are mitigated.

Other measures that may be considered that are not required by law include, but not are limited to: impervious surface offsets, low impact development, pH monitoring during concrete fabrication, and conducting thorough Hazardous Materials studies in those areas proximate to where groundwater pumping would occur. These and other measures will be further considered as the design and environmental review process proceeds.

2. Methods

2.1 Study Area

This evaluation applied two geographic study areas for determining environmental effects: the primary and secondary areas of potential impact (API) (Exhibit 4-1). The primary API addresses direct and indirect impacts. The secondary API addresses indirect impacts primarily related to traffic flow and development patterns. Within these APIs, the analysis has been further divided into watersheds.

2.1.1 Primary API

The primary API is the area where direct impacts from construction and operation of proposed project alternatives would occur. Most physical project changes would occur in this area, although mitigation could still occur outside of it.

As currently defined, the primary API extends about five miles from north to south. It starts north of the I-5/Main Street interchange in Washington, and runs to the I-5/Columbia Boulevard interchange in Oregon. North of the river, the API expands west into downtown Vancouver, and east near Clark College to include potential high capacity transit alignments and Park and Ride locations. Around the actual river crossing, the eastern and western sides each extend 0.25 miles from the I-5 right-of-way. South of the river crossing, this width narrows to 300 feet on each side. The proposed Park and Ride lot near 39th Street in Vancouver was not included in the original primary API, but it is an area that would be directly affected, thus it is now included in the primary API.

2.1.2 Secondary API

The secondary API represents the area where indirect impacts (e.g., traffic and development changes) may occur from the proposed project alternatives.

As currently defined, the secondary API, which is over 15 miles long, runs from a point approximately one mile north of the I-5/I-205 interchange south to the I-5/I-84 interchange. It also extends one mile on both the east and west sides of the I-5 right-of-way.

2.1.3 Watersheds

Watersheds (or portions of watersheds) have been used as the fundamental geographic area for the evaluation of project alternatives. Water bodies and their associated watersheds located in the primary and secondary APIs demonstrate varying levels of water quality, different designated uses, and various management scenarios.

Water bodies and their drainage areas were delineated using GIS data, Gazetteer maps, information from local governments, the Washington State Department of Ecology (Ecology) Watershed Planning Program, local drainage districts, and the Columbia Slough Watershed Council.

Watersheds and subwatersheds that would be directly affected by project construction and generated runoff are those found in the primary API and include: Columbia Slough, Columbia River (which includes North Portland Harbor), the Columbia Slope (which drains directly to the Columbia River), and Burnt Bridge Creek.

Watersheds and subwatersheds that may be indirectly affected by project operation and potential growth-inducing impacts are found within the secondary API and include: Columbia Slope, Willamette River, Columbia Slough, Salmon Creek (including Salmon Creek, Cougar Canyon, and Tenny Creek), Whipple Creek, Cold Canyon (a subwatershed of Burnt Bridge Creek), and Burnt Bridge Creek.

2.2 Effects Guidelines

The following guidelines from the Federal Transit Administration (FTA) were used to evaluate both water quality and stormwater system impacts:

- If the proposed project would violate an National Pollutant Discharge Elimination System (NPDES) permit for stormwater discharges;
- If the proposed project is likely to contaminate surface or ground waters that will result in an exceedance of federal, state, or local water quality standards;
- If the proposed project is noncompliant with an approved Water Quality Management Plan or Total Maximum Daily Load (TMDL) or,
- If the proposed project area will become flooded or will induce flooding (from stormwater runoff).

2.3 Data Collection Methods

Potential cumulative effects from this project are evaluated in the Cumulative Effects Technical Report. Please refer to this report for an evaluation of possible cumulative effects.

The project team used the following methods and data sources to identify existing conditions and provide the required information for the alternatives analysis.

1. The following studies and plans from local, state, and federal agencies were obtained and reviewed. Those sources identified with an asterisk were found to be the most useful sources of information given their comprehensiveness, more recent data, and overall reliability. Sources included the following:
    - *Burnt Bridge Creek Water Quality Data Trend Analysis, 1998
    - Burnt Bridge Creek Water Quality Monitoring Report, 1994
    - Burnt Bridge Creek Water Quality Monitoring – Quality Assurance Plan, 1994
    - Comprehensive Conservation and Management Plan for the Lower Columbia River, 1999
    - Columbia Slough Background Report, 1989

- Columbia Slough Implementation Plan, 1992
- *Columbia Slough TMDL, 1998
- *Columbia Slough Revitalization Report and Program EA, 1995
- Columbia Slough Sediment Project Annual Report, 2006
- Columbia Slough Watershed Action Plan, 2003
- *Columbia Slough Watershed Characterization, 2005
- Columbia Slough Watershed Water Quality Technical Report, 2003
- Environmental Contaminants and their Effects on Fish in the Columbia River Basin, 2004
- Columbia River Basin National Stream Quality Accounting Network (NASQAN) Program
- Columbia Slope Basin Comprehensive Stormwater Management Plan, 1993
- Columbia River Estuary Water Quality Data, 2006
- Interim Salmon Recovery Plan for the Lower Columbia River Subbasin
- Lower Columbia River – The Health of the River, 1996
- Total Dissolved Gas TMDL for the Lower Columbia River, 2002
- ESA Recovery Planning for Salmon and Steelhead in the Willamette and Lower Columbia River Basins, 2005
- City of Portland Watershed Management Plan, 2005
- U.S. Geological Survey (USGS) NASQAN Program water quality data for the Columbia Basin
- Lower Columbia River Bi-State Water Quality Program – The Health of the River 1990-1996 Integrated Technical Report
- Water-quality data, Columbia River Estuary, 2004-2005: USGS Data Series 213
- Biomonitoring of Environmental Status and Trends (BEST): Environmental Contaminants and their Effects on Fish in the Columbia River Basin, 2004
- PIR Natural Resources Management Plan
- Ducks Unlimited/City of Portland Science Fish and Wildlife Program
- Willamette River Water Quality Data – Department of Environmental Quality
- Salmon Creek Watershed Data – Department of Ecology
- Lake River Watershed Data – Department of Ecology

2. The project team reviewed maps and GIS data, including those showing topography, soils, and floodplains.

    - *Infrastructure*: This information was used to develop impervious area estimates and evaluate runoff potential from project alternatives.

- *Topography*: Topographic maps were used to delineate drainages in areas where as-built and infrastructure records providing drainage information were not available.
- *Flood Insurance Rate Maps (FIRM, Floodway Maps, and flood insurance study reports)*: This information was used to identify 100-year floodplains and floodways located in the project's APIs.
- *Land use maps.* The project team coordinated with land use map reviews conducted as part of the Land Use Technical Report to obtain necessary information regarding land use in each of the project area watersheds.

3. The project team reviewed available water quality characterization studies, Section 303(d) listings, TMDLs, municipal water quality management plans and regulations, and other water quality, water quantity, and floodplains data to determine if streams located in the project area would be affected directly or indirectly by the proposed alternatives. Specific data reviewed includes the following:
   - Existing and proposed drainage patterns at the proposed project site.
   - Designated beneficial uses of project area streams
   - Water quality status in project area receiving waters including existing and anticipated 303(d) listings, TMDLs, and Water Quality Management Plans.
4. The project team reviewed the conceptual stormwater design, which proposes how stormwater may be conveyed, treated, and discharged.
5. The project team consulted with local, state, and federal water quality and stormwater agency representatives and interested parties.
6. The project team made field visits to project area waterways, road alignments and stormwater outfall locations. During site reconnaissance surveys, the project team collected data on existing conditions of project area waterways and existing stormwater facilities and proposed locations for such facilities.
7. The project team calculated new and existing impervious surfaces using CAD and GIS mapping.
8. The project team calculated total disturbed area related to both in-water and out-of-water construction to assess short-term impacts.
9. Annual pollutant load estimates were conducted using *Method 1: WSDOT Data-FHWA Method* as outlined in the WSDOT's guide entitled "Quantitative Procedures for Surface Water Impact Assessment." This method was selected because it provides conservative estimates of pollutant loading for high ADT (>30,000) highways using data derived from observations made on highways throughout Western Washington since 2003. Therefore, it is directly applicable to the project location and is based on recently collected WSDOT data. Existing impervious area data was obtained from the Stormwater: Conceptual Design Draft Technical Report (Kitchin 2007).

2.4 Analysis Methods

2.4.1 Long-Term Operational Impacts

Beneficial and adverse potential long-term operational impacts of the project alternatives on drainage systems and surface and ground water resources for the duration of the project were determined by analyzing and reviewing the following:

- *Floodplain Impacts*. Floodplain impacts of the various alternatives were compared by estimating the approximate footprint of each alternative in local floodplains (i.e., loss of storage) and the extent of potential conveyance constrictions created by bridge crossings.
- *Stream Shading Impacts*. The location and extent of vegetation removal within 50 feet of a waterway was considered for each alternative.
- *Groundwater Infiltration Impacts*. Potential groundwater infiltration impacts were assessed by accounting for the total area of impervious surface over land resulting from new construction. Bridge segments directly over the North Portland Harbor and Columbia River were not included in the impervious tally for this particular impact analysis. Impervious surface area was further distinguished by drainage basin. Physical presence of a roadway was used to determine which drainage basin it was assigned to versus determining basins based on drainage characteristics. For example, if a segment of road overlaid land within the Columbia River watershed, that segment was assigned to the Columbia River for this analysis. However, for the water quality analysis, that same segment might have been assigned to the Columbia Slough drainage if stormwater conveyance plans proposed transferring and treating runoff from that segment to the Columbia Slough.
- *Surface water Quality Impacts*. Long-term surface water quality impacts were assessed based on comparisons of impervious surface areas requiring stormwater collection and by proximity to surface waters. Roadway located underneath another roadway, such as an overpass, was not included in the total for impervious surface area for this particular impact analysis. Where new construction replaces existing impervious surface, the effectiveness of treating the existing road runoff was accounted for. Existing runoff characteristics were determined from topographic maps and field observations. The drainage basins for the impervious discharge of additional runoff were determined to assess the extent of interbasin transfers of stormwater runoff. A pollutant load analysis was performed for key constituents found in road runoff using *Method 1: WSDOT Data-FHWA Method*. Potential erosion impacts were assessed through examination of topographic maps, proximity of ground disturbance to drainage channels/streams, and vegetation loss.
- *Groundwater Quality Impacts*. Long-term groundwater impacts were determined by identifying the proximity of federal, state, and local groundwater protection zones.

- *Existing Drainage System Constraints*. Local jurisdictions were contacted for information about existing drainage system constraints.
- *Beneficial Impacts*. Since stormwater treatment would be provided in areas not currently receiving treatment, beneficial impacts are discussed.

2.4.2 Short-Term Construction Impacts

Construction activities can impact surface water quality by allowing increased erosion, disturbing the banks and beds of water bodies, discharging construction materials and chemicals accidentally, and removing shading vegetation.

Groundwater quality could also be affected by below-grade construction that requires pumping.

Potential short-term construction impacts were determined by evaluating the total area of demolition and construction activities of each project alternative, and the total area of below-grade construction for each alternative.

The short-term construction analysis focuses on:

- area of total disturbance
- impacts from fine sediment and contaminants (such as hydraulic oil, fuel, etc.)
- erosion/soil characteristics
- streambank/slope steepness
- amount of in-water work

2.4.3 Mitigation Measures

The mitigation measures approach will be guided by the following actions. The intent is to provide mitigation measures that are consistent with the mitigation policies of local, state, and federal agencies.

For construction mitigation:

- Designers and construction contractors are required to develop and implement erosion and sediment control plans. Precursor elements to these plans were identified and evaluated.
- Permit or regulatory requirements were identified.
- Designers are required to develop and implement a Stormwater Pollution Prevention Plan. Precursor elements to this plan were identified and evaluated, including construction Best Management Practices (BMPs), such as appropriate measures to prevent accidental spills of chemicals and materials and ways to minimize vegetation removal and/or replant the area. The analysis takes into consideration special requirements or concerns for each particular alternative.

For long-term operational mitigation:

- Local, state, and federal requirements for the prevention of any increase in pollutant loads and flow control or flow duration for stormwater treatment were examined. Any discrepancies among regulatory requirements were assessed, and consensus on an approach for the project was determined.
- Mitigation goals and options for each alternative were identified, including effectiveness and cost.

Stormwater management requirements to mitigate impacts have been characterized conceptually by reviewing proposed stormwater management facilities, identifying whether aboveground or underground treatment and detention facilities could be accommodated, and recommending general types of BMPs, including avoidance and design criteria. The stormwater management approach will be further investigated and determined as part of the Final EIS and final design.

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3. Coordination

State and federal resource agency coordination is being accomplished, in part, through the Interstate Collaborative Environmental Process (InterCEP) Agreement. The InterCEP agreement defines a project-specific process to facilitate coordination, collaboration, and concurrence with state and federal resource agencies. The InterCEP agreement participants include the state and federal transportation agencies (FTA, FHWA, WSDOT and ODOT) federal resource agencies (USFWS, NMFS, EPA, and Corps of Engineers), Washington resource agencies (Departments of Ecology, Fish and Wildlife, and Archaeology and Historic Preservation) and Oregon resource agencies (Departments of State Lands, Environmental Quality, and Fish and Wildlife, and the Oregon SHPO). Numerous meetings with the InterCEP agencies have been conducted over the past 19 months that have addressed various elements of the water resources studies, including study methodology, evaluation criteria, stormwater measures, mitigation measures, and regulatory requirements for complying with the ESA. The InterCEP agreement outlines four key points for concurrence with agencies. Three of those points have already occurred, including Purpose and Need, Evaluation Criteria and Range of Alternatives for the DEIS. The fourth concurrence point will be the Locally Preferred Alternative (LPA) after the DEIS.

Discussions with NMFS and the DOTs regarding Endangered Species Act (ESA)-related stormwater mitigation are ongoing, and until agreement is reached, the approach to stormwater management will be to use whichever guideline among the various jurisdictions is the most stringent.

Further coordination with the City of Vancouver will be required with respect to developing mitigation measures to address one of the project's park and ride facilities that would be located within the Special Well Protection Area designated by the City.

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4. Affected Environment

4.1 Introduction

Resources in the CRC project area are divided into two APIs, primary and secondary. The primary API is further divided into two segments, which extend from Delta Park to Mill Plain (Segment A) and Mill Plain to North Vancouver (Segment B). These segments do not follow watershed boundaries and therefore are not the most accurate means of outlining the affected environment (and determining subsequent impacts) for water resources. Consequently, for purposes of this technical report, watershed boundaries instead of primary API segments are used to describe baseline conditions.

4.2 Regional Conditions

4.2.1 Surface water Hydrology

The Columbia River and North Portland Harbor dominate the topography of the project area. The North Portland Harbor is part of the same body of water as the Columbia River; it is named differently to distinguish that part of the water body south of Hayden Island (North Portland Harbor) from that part of the water body north of the island (Columbia River). The project corridor lies within the Columbia River main valley, with the exception of a small area north of the SR 500 interchange that is located in the Burnt Bridge Creek watershed (Exhibit 4-1). Burnt Bridge Creek flows into Vancouver Lake before discharging to the Columbia River.

Project area elevations vary from approximately 10 feet in the Columbia River floodplain south of North Portland Harbor to about 220 feet at the drainage divide between the Columbia River and Burnt Bridge Creek valleys. South of the Columbia River, the project is located entirely in a relatively flat and low-lying floodplain. Drainage within the floodplain is not well-defined, and the Columbia Slough, which is located parallel to the Columbia River floodplain, actually discharges into the Willamette River. North of the Columbia River, the project corridor is located on gently sloped valley sides.

The secondary API for the project contains eight mapped surface water features (Exhibit 4-1). Three of these surface waters, including Burnt Bridge Creek, the Columbia River, and Columbia Slough, lay within the drainage area of the project corridor and would receive project runoff directly. Both Burnt Bridge Creek and the Columbia Slough ultimately drain to the Columbia River. Therefore, any hydrologic or water quality impacts within these drainages may lead to an indirect effect on the Columbia River.

There are five waterbodies located in the API that do not drain any lands from under the proposed alternatives. These waters include Whipple Creek, Cold Creek (an officially unnamed stream that runs through Cold Canyon), Cougar Canyon Creek, Tenny Creek, and Salmon Creek. Exhibit 4-1 illustrates all project area watersheds.

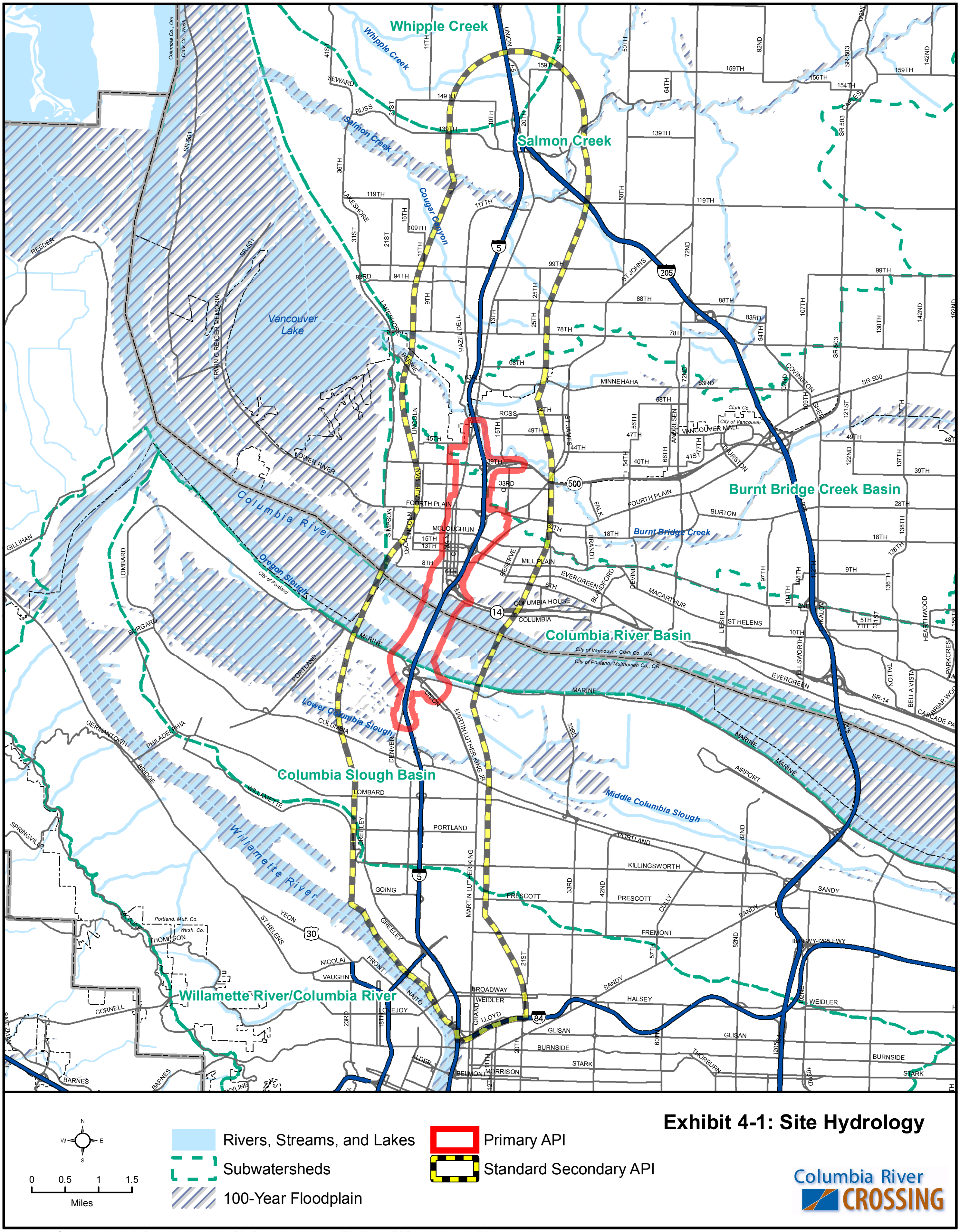


Exhibit 4-1: Site Hydrology

Analysis by C. Hainey; Analysis Date: 23-July-2007; Plot Date: 23-July-2007; File Name: PBR17_Update_1_DN079.mxd

North Portland Harbor, a branch of the Columbia River, and the Columbia River are the only watercourses that cross I-5 within the primary API. Burnt Bridge Creek and Cold Creek cross I-5 north of the API.

Federal Emergency Management Agency (FEMA) designated floodplains located within the project's primary and secondary APIs include Salmon Creek, Burnt Bridge Creek, the Columbia River, and Columbia Slough (Exhibit 4-1). All but Burnt Bridge Creek and Salmon Creek are located in the primary API. As shown, these floodplains are confined to the immediate vicinity of project streams due to levees, or in the case of Burnt Bridge Creek, steeper slopes.

4.2.2 Local Climate

The climate within the project area is characterized by short, dry and warm summers, with a typically cool and wet spring, winter and fall. The Coast Range offers limited shielding from the Pacific Ocean storms while the Cascades provide an orographic lift of moisture-laden westerly winds, resulting in moderate rainfall. Nearly 90 percent of the average annual rainfall of 36.3 inches occurs from October through May. The maximum 24-hour rainfall of 4.44 inches occurred in October 1994. Snowfall accumulations are rarely more than 2 inches, and usually melt within a couple of days.

Average monthly temperatures taken at Portland International Airport vary from 39.6 ºF in January to 68.6 ºF in August. The maximum and minimum recorded temperatures are 107 ºF and -3 ºF. These temperatures occurred in August 1981 and February 1950, respectively. Surface winds seldom exceed sustained wind speeds of 50 mph and have rarely exceeded 75 mph (NOAA 2007).

4.2.3 Groundwater

Within the Oregon side of the project corridor, the project area is located on the unconsolidated sedimentary aquifer of the upper sedimentary subsystem (McFarland and Morgan, 1996). This aquifer consists primarily of late Pleistocene catastrophic flood deposits and Columbia River alluvium. Recharge of the aquifer is primarily by direct infiltration of precipitation, though injection wells and waste water from septic systems are locally important. Median hydraulic conductivity (the rate at which groundwater flows through soil and bedrock) is high, about 200 feet per day, though it varies greatly.

South of the Columbia River, only one well has been identified in the proximity of the project corridor. This well is on Hayden Island and located less than 50 feet from the northbound shoulder of I-5, close to the east corner of the I-5 North Portland Harbor north bridge abutment. It is owned by the City of Portland, and although it is not currently used, the city has indicated that it may reinstate the well for emergency purposes.

North of the Columbia River, the I-5 corridor and other project facilities are underlain by the Troutdale Aquifer. This aquifer is a water supply for the City of Vancouver. The U.S. Environmental Protection Agency (EPA) recently designated it as a Sole Source Aquifer. A sole source aquifer is one "which supplies at least 50 percent of the drinking water consumed in the area overlying the aquifer, and for which there is no alternative source or combination of alternative drinking water sources which could physically, legally and economically supply those dependent upon the aquifer." Under this designation, proposed federal financially assisted projects which have the potential to contaminate the aquifer are subject to EPA review.

Consistent with the sole source aquifer designation and with critical areas management dictated by Washington state law, wellhead protection zones have been designated within the Washington portion of the project. As shown in Exhibit 4-2, "contribution" zones are delineated based on the amount of time that groundwater contamination would take to spread into each zone. There are five wellhead protection areas within the primary and secondary APIs.

The City of Vancouver has designated the entire area within the city boundary as a Critical Aquifer Recharge Area. Exhibit 4-2 shows the two Special Wellhead Protection Areas designated by Vancouver. These areas are surrounded by 1,000-foot and 1,900-foot buffers.

4.2.4 Land Use

South of the Columbia River, land west and east of I-5 between Victory Boulevard and North Portland Harbor generally has an Industrial and Open Space zoning designation, respectively. On Hayden Island, land in the vicinity of the project corridor is zoned Commercial.

North of the Columbia River, areas on the west side of I-5 have extensive residential and commercial development. The Pearson Airpark, Clark College and Fort Vancouver Historic Reserve, which are low density developments, are located east of I-5, between SR 14 and Fourth Plain Boulevard.

4.2.5 Storm Drainage

In general, continuous curbs and concrete barriers confine runoff from I-5 to the highway, and closed (pipe) drainage systems convey flows to surface water outfalls. Runoff from the bridges across North Portland Harbor and Columbia River drains through scuppers to water surface or ground below.

The only flow control or water quality facilities provided for runoff from I-5 are located north of the SR 500 interchange in the Burnt Bridge Creek watershed.

4.3 Watersheds within the Secondary API

This section describes watersheds within the secondary API, non-inclusive of those watersheds occurring within the primary API. Therefore, discussions are provided for the Willamette River, Salmon Creek, Whipple Creek, and Cold Creek (a subwatershed of Burnt Bridge Creek). Watersheds within the primary API that also extend into the secondary API include Columbia Slough, Columbia River, Columbia Slope, and Burnt Bridge Creek. These watersheds are described in Section 4.4.

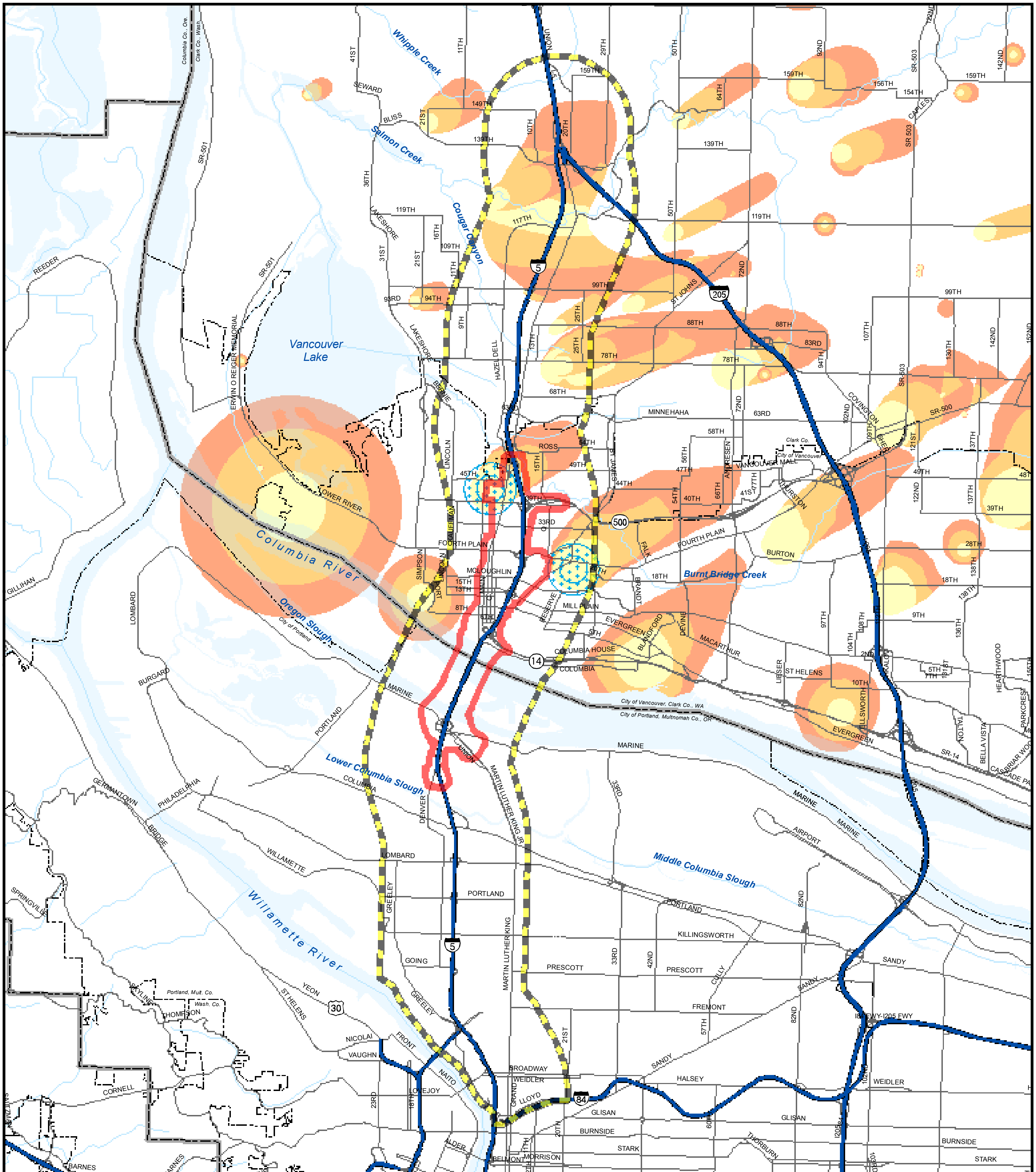


Exhibit 4-2: Wellhead Protection Areas

Primary API

Standard Secondary API

Special Wellhead Protect Areas

1000 and 1900 ft. Buffers

Zone of Contribution

Year 1

Year 5

Year 10

0 0.5 1 1.5

Miles

Columbia River CROSSING

Analysis by C. Hainey; Analysis Date: 23-July-2007; Plot Date: 23-July-2007; File Name: PBR17_Update_2_DN079.mxd

4.3.1 Burnt Bridge Creek Watershed

The Burnt Bridge Creek watershed is composed of 29 square miles of mostly flat to somewhat hilly land. This watershed contains both Burnt Bridge Creek and Cold Creek. More information on Burnt Bridge Creek is found in section 4.4.3. Both Burnt Bridge Creek and its largest tributary, Cold Creek, are within the secondary API.

4.3.1.1 Cold Creek

The Cold Creek stream channel begins just north of Minnehaha Street and passes west through a small wooded canyon on the north side of the Bonneville Power Administration (BPA) Ross Complex. Beyond the BPA facility, it flows under Highway 99 and I-5 and into Burnt Bridge Creek just west of I-5. Although Cold Creek's drainage area is mainly urban, undeveloped areas (including open fields with seasonal wetlands) comprise much of its riparian area. Almost one-third of Cold Creek's drainage area is open space, primarily undeveloped fields with a small amount of forest (Clark County Public Works 2004).

Cold Creek does not receive runoff from any of the proposed project alternatives. FEMA has not mapped a 100-year floodplain for Cold Creek.

The portion of Cold Creek located in the secondary API is not on Washington's 303(d) list for any parameters (Ecology 2007).

4.3.2 Salmon Creek Watershed

The Salmon Creek watershed (Exhibit 4-1) includes 89 square miles of rural, residential, commercial, forest, and industrial land. Salmon Creek, located entirely within Clark County, flows from the foothills of the Cascade Mountains west to Lake River, which in turn flows into the Columbia River (Clark County Public Works 2004). In addition to the Salmon Creek mainstem, two of its tributaries, Cougar Canyon Creek and Tenny Creek, also fall within the secondary API for this project. The existing conditions in these tributaries are discussed in the following sections.

4.3.2.1 Salmon Creek

Salmon Creek is one of the project area's healthier urban streams. It flows 26 miles from its forested headwaters on Elkhorn Mountain through rural, agricultural, residential, and urban areas. The upper part of the watershed includes large-lot residential parcels and forested areas, but becomes increasingly urbanized as Salmon Creek nears I-5 and Vancouver. Salmon Creek Park, which serves as a popular community recreational area, is located at the I-5 crossing of Salmon Creek.

Exhibit 4-1 shows the location of the current FEMA-designated 100-year floodplain for the Salmon Creek watershed.

Salmon Creek is 303(d)-listed for temperature, pH, and dissolved oxygen (Ecology 2007). Ecology also has set Total Maximum Daily Loads (TMDLs) for Salmon Creek for bacteria and turbidity (Ecology 2001).

4.3.2.2 Tenny Creek

Tenny Creek is a small tributary to Salmon Creek that originates at the intersection of NE 88th Avenue and NE 26th Street, near the eastern and northern edge of the secondary API. The creek is piped under I-5 and NW 119th Street before discharging to Salmon Creek approximately 50 feet west of I-5. Residential land uses dominate its watershed.

FEMA has not mapped a 100-year floodplain for Tenny Creek.

The portion of Tenny Creek located in the secondary API is not on Washington's 303(d) list for any parameters (Ecology 2007).

4.3.2.3 Cougar Canyon Creek

Cougar Canyon Creek, an officially unnamed stream flowing through Cougar Canyon, is the first major tributary upstream from the mouth of Salmon Creek and the main watershed for the urbanized Hazel Dell area of Clark County. Lower sections of the stream are piped under parking lots and major roads, while upper parts are ditched and degraded by agriculture (Clark County 1999). Cougar Canyon Creek is piped under I-5 starting east of NE Hwy 99, and resurfaces again on the west side of I-5 before flowing into Salmon Creek.

FEMA has not mapped a 100-year floodplain for Cougar Canyon Creek.

The portion of Cougar Canyon Creek located in the secondary API is not on Washington's 303(d) list for any parameters (Ecology 2007).

4.3.3 Whipple Creek Watershed

Whipple Creek is a small tributary located immediately south of the East Fork Lewis subbasin; it drains directly to Lake River. Agricultural and residential land uses dominate this watershed. The south fork of Whipple Creek passes through the secondary API but is not crossed by I-5. Whipple Creek drains an area of approximately 8.2 square miles (Exhibit 4-1) (Clark County 2001).

FEMA has not mapped the 100-year floodplain for Whipple Creek.

Whipple Creek is on Washington's 303(d) list for fecal coliform.

4.3.4 Willamette River Basin

The Willamette River flows 190 miles through an 11,478 square-mile watershed in western Oregon before reaching the Columbia River (Willamette Partnership 2005). Although the Willamette River itself is not located in the API, portions of its watershed are in the API, and the Columbia Slough, which lies within the primary API discharges to it. Consequently, the Willamette River, which is located approximately 6.7 miles downstream of I-5's Columbia Slough crossing, indirectly receives stormwater runoff from the southern portion of the project area.

Exhibit 4-1 shows the location of the current FEMA-designated 100-year floodplain for the Willamette Basin.

In the Oregon portion of the secondary API, there are numerous public and private outfalls along the Willamette River (BES 2003).

The portion of the Willamette River located adjacent to the secondary API is currently on the Oregon 303(d) list because it does not meet water quality standards for the parameters shown in Exhibit 4-3.

Exhibit 4-3. Lower Willamette River 303(d) Listings

Waterbody	River Mile	Parameter	Season	List Date
Willamette River	0 to 24.8	Dieldrin	Year Around	2002
Willamette River	0 to 24.8	DDT	Year Around	2002
Willamette River	0 to 24.8	DDT Metabolite (DDE)	Year Around	2002
Willamette River	0 to 24.8	Polynuclear Aromatic Hydrocarbons (PAH)	Year Around	2002
Willamette River	0 to 186.4	E coli	Fall/Winter/Spring	2004
Willamette River	0 to 24.8	Aldrin	Year Around	2002
Willamette River	0 to 24.8	Biological Criteria	Undefined	2004
Willamette River	0 to 24.8	PCB	Year Around	2002
Willamette River	0 to 24.8	Manganese	Year Around	2002
Willamette River	0 to 24.8	Iron	Year Around	2002
Willamette River	0 to 24.8	Pentachlorophenol	Undefined	1998

Source: DEQ, 2007.

In addition to the 303(d) listings, DEQ has also set TMDLs for the Willamette River for temperature, mercury, bacteria, and dioxin (2,3,7,8-TCDD) (DEQ 2007). The lower Willamette River also receives discharges from the City of Portland’s combined sewer overflows (CSOs).

4.4 Watersheds within the Primary API

The four watersheds found within the primary API also extend into the secondary API. These watersheds include the Columbia Slough, Columbia River, Columbia Slope, and Burnt Bridge Creek. The Columbia Slope is that part of Clark County, Washington that drains directly to the Columbia River.

Within the primary API, the Columbia Slough, the Columbia River, and Burnt Bridge Creek currently are 303(d)-listed by Oregon and/or Washington. DEQ and Ecology also have set TMDLs for several parameters for these resources.

4.4.1 Columbia Slough

4.4.1.1 Hydrology

The Columbia Slough is a 19-mile complex of shallow channels located on the southern floodplain of the Columbia River (DEQ 1998). The Columbia Slough drains approximately 32,700 acres and originates near Fairview Lake, flowing west to the Willamette River, and discharging near Kelley Point Park (BES 2007).

The Columbia Slough watershed includes Fairview Creek, which drains to Fairview Lake, portions of Fairview, Gresham, Maywood Park, Wood Village, and Portland. Numerous land uses are found in the Columbia Slough's watershed, including heavy and light industries (approximately 24 percent of the watershed's area), high to medium density urban development (~20 percent), parks, opens spaces, and vacant land (~36 percent), agriculture (<1 percent), and the Portland International Airport (BES 2003; DEQ 1998). The Columbia Slough serves as one of Portland's largest open space and wildlife habitat areas (DEQ 1998).

Remnants of lakes, wetlands, and slow-moving channels comprise the Columbia Slough (BES 2003). Over the years the slough system has been extensively dredged, diked, filled, and channelized, principally by the U.S. Army Corps of Engineers (COE), the City of Portland, the Multnomah County Drainage District No. 1 (MCDD), and the Port of Portland. Therefore, it is now a highly managed system that provides watershed drainage and flood control (BES 2003). The hydraulic management of the Columbia Slough can have a significant impact on water quality and uses supported by it (BES 2003).

The Columbia Slough is divided into several reaches, based primarily on hydraulic characteristics (BES 2003). These reaches are all generally shallow and slow-moving (BES 2003). The upper and middle portions of the Slough are highly managed with piped surface water, dikes and levees, and a system of pumps that provide watershed drainage and flood control (Columbia Slough Watershed Council 2005; BES 2005). The lower Slough, which extends from Kelley Point Park to the MCDD levee near River Mile 9.8, is tidal. Stream flow at the mouth of the slough reverses due to tidal influences, although this effect is not noticeable in the project area.

Exhibit 4-1 shows the location of the current FEMA-designated 100-year floodplain for the Columbia Slough. A levee system, part of which is the I-5 embankment, protects most of the floodplain in the vicinity of I-5 against flooding. This levee system also includes Martin Luther King Jr. Boulevard, located east of the Marine Drive interchange.

A levee upstream of the I-5 crossing regulates water entering the lower portion of the Slough, and flows tend to be relatively slow (BES 2003). The watershed surrounding this portion of the Slough is developed with industrial and commercial facilities.

DEQ has defined the same beneficial uses for the Willamette River tributaries (including the Columbia Slough) as for the mainstem Willamette, except for Commercial Navigation and Transport (BES 2003).

4.4.1.2 Water Quality

Within the project area, the Columbia Slough is currently on Oregon's 303(d) list because it does not meet water quality standards for the parameters listed in Exhibit 4-4.

Exhibit 4-4. Columbia Slough 303(d) Listings

Waterbody	River Mile	Parameter	Season	List Date
Columbia Slough	0 to 8.5	Temperature	Spring/Summer/Fall	1998
Columbia Slough	0 to 9.8	Iron	Year Around	2002
Columbia Slough	0 to 9.8	Manganese	Year Around	2002

Source: DEQ, 2007.

In addition to the 303(d) listings, DEQ set TMDLs (and therefore delisted) the following constituents in the Columbia Slough in 1998: chlorophyll a, pH, phosphorous, fecal coliform, dissolved oxygen, lead, DDE/DDT, PCBs, and dioxin (2,3,7,8-TCDD) (DEQ 1998). DEQ also issued a draft TMDL for temperature for the Slough in 2003. The Oregon Public Health Division and City of Portland have issued warnings about eating fish from the Slough due to contamination by PCBs, DDE, and DDT. Until 2003 the Columbia Slough also received discharges from the City of Portland's combined sewer overflows (CSOs).

4.4.1.3 Stormwater Drainage

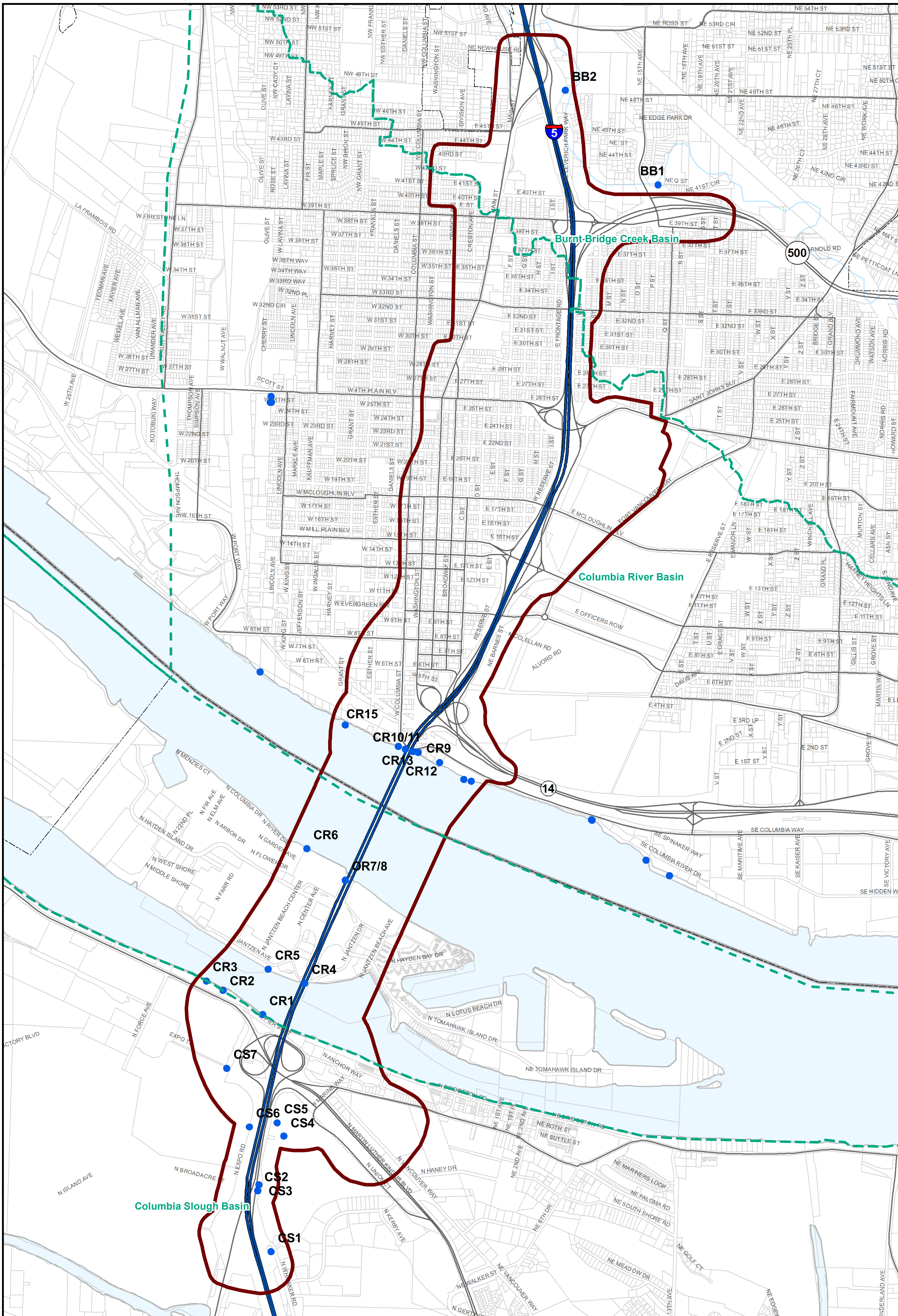
Within the project area, I-5 is elevated on embankments or structures and, in general, the highway drainage systems do not handle runoff from outside the right-of-way.

Exhibit 4-5 illustrates the locations of existing stormwater outfalls within the project area. Most of the runoff from I-5 drains east to Schmeer Slough or Walker Slough and is discharged by outfall to Columbia Slough via a pump station located on Schmeer Road. Both sloughs are in the Peninsula Drainage District No. 2. The only exceptions are:

- The southwest quadrant of the Marine Drive interchange flows into Vanport Wetlands, which is in the Peninsula Drainage District No. 1. A pump station located near the Portland International Raceway discharges flows to Columbia Slough.
- The northwest quadrant of the Marine Drive interchange discharges to North Portland Harbor.

Runoff from the Light Rail Transit (LRT) track between the Delta Park and Expo stations, and from the Expo station and associated parking area discharges to Vanport Wetlands. Runoff from the Delta Park station and adjacent parking areas discharges to Schmeer Slough, while runoff from overflow parking west of N Expo Road drains west to Northern Slough.

There are two stormwater outfalls that drain into the Columbia Slough. On the south side of the Slough, roadway runoff along I-5 from Alberta Street to the Marine Drive off-ramp is treated by a vortex-style separator; it also flows through an engineered wetland prior to discharging to the Slough. On the north side of the Columbia Slough, the Peninsula Drainage District No. 2 pumps water into the Columbia Slough from a series of culverts that collect runoff from I-5 and the area bounded by N Whitaker Road, NE Martin Luther King Boulevard, Marine Drive, and Portland Meadows (BES 2003).



Primary API
Subwatersheds
Outfall

0 1,300 2,600
Feet

Exhibit 4-5: Existing Stormwater Outfall Locations

Columbia River CROSSING

Analysis by J. Koloszar; Analysis Date: 07/23/07; Plot Date: 07/23/07; File Name: BelowGradeAreas_DN079.mxd

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4.4.2 Columbia River and Columbia Slope

4.4.2.1 Hydrology

The Lower Columbia River, which flows from Bonneville Dam at river mile 146 to the mouth of the Columbia River, passes through both the primary and secondary APIs. The lower Columbia River has a total drainage area of 18,000 square miles (EPA 1999). I-5 crosses the Columbia River near river mile 106.5.

The North Portland Harbor, that portion of the Columbia River running south of Hayden Island, also lies within both the primary and secondary API. Hayden Island drains directly into the Columbia River and North Portland Harbor. The east end of the island is located within both the primary and secondary APIs and is highly developed, with large hotels, a shopping center, residential communities, and other commercial activities. The western portion, however, is composed of pasture, woods, and wetlands, and remains undeveloped.

The portion of Clark County that drains directly to the Columbia River is known as the Columbia Slope watershed. This 25-square-mile watershed consists of a narrow band of hillsides between downtown Vancouver and Lacamas Creek. Its northern boundary generally follows Mill Plain Boulevard and hilltops in Camas, Washington. Except for some wetlands, parks, and steep hills, most of the area is urbanized.

Exhibit 4-1 shows the location of the current FEMA-designated 100-year floodplain for the Columbia River and North Portland Harbor.

4.4.2.2 Water Quality

Within both the primary and secondary APIs, the Columbia River is currently on Oregon's 303(d) list because it does not meet water quality standards for the parameters listed in Exhibit 4-6. DEQ does not differentiate between the North Portland Harbor and Columbia River when compiling the 303(d) list; therefore, these listings also apply to the North Portland Harbor.

Exhibit 4-6. Columbia River 303(d) Listings

Waterbody	River Mile	Parameter	Season	List Date
Columbia River	0 to 306.1	Temperature	Year Around	2004
Columbia River	98 to 142	PCB	Year Around	1998
Columbia River	98 to 142	Polynuclear Aromatic Hydrocarbons	Year Around	2002
Columbia River	98 to 142	DDT Metabolite (DDE)	Year Around	1998
Columbia River	98 to 142	Arsenic	Year Around	1998

Source: DEQ, 2007.

The Columbia River within the project area is not on Washington State's 303(d) list for any parameters (Ecology 2007).

In addition to the 303(d) listings, EPA has approved TMDLs for the Columbia River for dioxin and total dissolved gas (DEQ 1991 and 2002).

4.4.2.3 Stormwater

City of Portland data show six outfalls that drain to the Columbia River/North Portland Harbor. Additionally, one outfall within the secondary API drains to the North Portland Harbor (BES 2003).

Clark County data show seven stormwater outfalls located in this area (Clark County 2005). These outfalls drain I-5 and downtown Vancouver. Mapping shows multiple stormwater treatment facilities upstream of the outfalls, but none at the outfalls themselves. There may be additional private outfalls.

On Hayden Island, runoff from I-5 discharges directly to the Columbia River.

Stormwater from the I-5 bridge discharges directly to the river through road-side grates located along the entire span. Runoff from the bridge is not treated prior to release to the river.

South of the SR 500 interchange, runoff from I-5 is discharged to the Columbia River via a 5-foot diameter outfall. A pump station located southeast of the SR 14 interchange discharges runoff from lower-lying portions of the interchange when the Columbia River floods. Within the Columbia Slope watershed, I-5 is generally below-grade of the surrounding areas and the highway drainage system receives runoff from developed areas west of the highway right-of-way. These areas are:

- About 40 acres of downtown Vancouver that flows into the I-5 conveyance system immediately north of the SR 14 interchange.
- Three separate drainage systems serving a combined area of approximately 180 acres, which flows into the I-5 system at Mill Plain Boulevard.
- An area of approximately 35 acres that flows into the I-5 system at 31st Street.

Runoff from neighborhoods east of I-5 and south of 29th Street also flow into the I-5 drainage system. These areas, however, mostly comprise open spaces and other public facilities.

4.4.3 Burnt Bridge Creek

4.4.3.1 Hydrology

Burnt Bridge Creek originates approximately 0.75 mile south of Fourth Plain Road and 0.10 mile south of 162nd Avenue (EnviroData Solutions, Inc. 1998). Burnt Bridge Creek originates in field ditches that drain a large wetland area between NE 112th Avenue and NE 164th Avenue. From its origin, it flows through another large, drained wetland west of NE 86th Avenue and south of E 18th Street. Historically, rain soaked into gravelly soil and made its way into the creek as groundwater seeps and springs (Clark County 2004).

The creek is approximately 12.9 miles in length, and its channel alternates between ditches and natural channels (Clark County 2004). For its last 5 miles, it flows through a small canyon with a narrow floodplain (Clark County 2004). Burnt Bridge Creek discharges to Vancouver Lake, which in turn flows to the Columbia River (Clark County 2004). Except for floodplains, parks, and wetlands, nearly all the basin is urbanized. Approximately two-thirds of the watershed lies within the city of Vancouver; 100 percent of the watershed lies within Clark County.

Currently, some stormwater runoff is routed to the creek through pipes and ditches, but most runoff is discharged into the ground through buried infiltration facilities (Clark County 2004). Many of the creek's tributaries also have been diverted into underground pipes (Clark County 2004).

Within the APIs, Burnt Bridge Creek flows through an undeveloped area south of the BPA Ross Complex. The creek enters a box culvert near the southwestern corner of the BPA complex before crossing under I-5, and daylighting again on the western side of I-5.

Exhibit 4-1 shows the location of Burnt Bridge Creek's FEMA-designated 100-year floodplain.

4.4.3.2 Water Quality

Within the project area, Burnt Bridge Creek is currently on the state's 303(d) list because it does not meet water quality standards for fecal coliform and temperature (Exhibit 4-7).

Exhibit 4-7. Burnt Bridge Creek 303(d) Listings

Waterbody	River Mile	Parameter	List Date
Burnt Bridge Creek	9.6 to 11.1	Fecal Coliform	1998
Burnt Bridge Creek	9.6 to 11.1	Temperature	1998

Source: Ecology, 2007.

Ecology has not approved any TMDLs for Burnt Bridge Creek.

4.4.3.3 Stormwater

A Washington Department of Transportation (WSDOT) outfall survey shows three outfalls from I-5 discharging into Burnt Bridge Creek, one on the eastern side of I-5 and two on the western side of I-5. Other private outfalls are also assumed to exist.

Runoff from I-5 at and north of the SR 500 interchange area is routed to a retention pond east of I-5 and south of the Main Street interchange. Retained runoff usually evaporates or infiltrates, and releases to Burnt Bridge Creek only occur during peak runoff events.

Runoff from SR 500 east of I-5 flows to a detention pond located at NE 15th Avenue before being released to Burnt Bridge Creek.

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5. Long-Term Effects

5.1 How is this section organized?

This section describes the long-term impacts that would be expected from the I-5 CRC alternatives and options. It first describes impacts from the four full alternatives and the No-Build Alternative. These are the five comprehensive alternatives that include specific highway, transit, bicycle, pedestrian and other elements. This discussion focuses on how these alternatives would affect corridor and regional impacts and performance. The section then focuses on impacts that would occur with various design options at the segment level, for example, comparing the impacts of each alignment option in each segment. Finally, the section provides a more comparative and synthesized summary of the impacts associated with the system-level choices. This three-part approach provides a comprehensive description and comparison of (1) the combination of system-level and segment-level choices expressed as five specific alternatives (2) discrete system-level choices, and (3) discrete segment-level choices.

It addresses both direct and indirect long-term impacts.

5.2 Impacts from Full Alternatives

This section describes the impacts from four full build alternatives and No-Build Alternative, which are summarized in Exhibit 5-1. These full alternatives are combinations of highway, river crossing, transit and pedestrian/bicycle alternatives and options covering all of the CRC segments. They represent the range of system-level choices that most affect overall project performance, impacts and costs. The full alternatives are most useful for understanding the regional impacts, performance and total costs associated with the CRC project.

Exhibit 5-1. Summary Comparison of Build Alternatives

Alternative	Hydrology	Water Quality
Replacement with BRT (Alt 2)	32.3 additional acres of impervious surface over land would reduce natural infiltration	39th St. Park and ride within wellhead protection zone; a 26% increase in the dissolved copper load could occur from a gain of impervious surface conveyed to the Columbia Slough; all measured pollutants within the Burnt Bridge Creek watershed would have loads greater than the No-Build Alternative resulting from a gain of 7.9 impervious surface acres conveyed to the Burnt Bridge Creek watershed.
Replacement with LRT (Alt 3)	31.1 additional acres of impervious surface over land would reduce natural infiltration	Impacts would be similar, although slightly less, compared to Alternative 2.

Alternative	Hydrology	Water Quality
Supplemental with BRT (Alt 4)	20.7 additional acres of impervious surface over land would reduce natural infiltration; greater backwater effect from piers vs. Alts 2/3	39th St. park and ride within wellhead protection zone; a 5% increase in the dissolved copper load would occur from a gain of impervious surface conveyed to the Columbia Slough; all measured pollutants within the Burnt Bridge Creek watershed would have loads greater than the No-Build Alternative resulting from a gain of impervious surface conveyed to the Burnt Bridge Creek watershed.
Supplemental with LRT (Alt 5)	19.5 additional acres of impervious surface over land would minimize natural infiltration; greater backwater effect from piers vs. Alts 2/3	Impacts would be similar, although slightly less, compared to Alternative 4.

5.2.1 No-Build Alternative

The existing impervious surface area of project roads and highways is about 205 acres. This is a conservative estimate in that, for comparative purposes, it includes the maximum footprint of roads that would be modified or constructed under the build alternatives. This alternative includes the entire I-5 bridge, whereas the numbers in Exhibit 5-2 do not include bridge surfaces over water for the hydrologic analysis. With the No-Build Alternative there would be none of the CRC-related changes made to the highway and road system, and therefore the CRC related impacts would be avoided. However, background development and other projects, as described in the I-5 CRC Detailed Definition of Alternatives Report would occur. Such development would increase impervious surface area and its related water quality impacts. Potential adverse effects associated with No-Build could include:

- Stormwater runoff from I-5 in the API would continue to flow untreated to the Columbia River and other surface waters.
- With time and increasing traffic and congestion, pollutant loads would increase, and those pollutants known to be harmful to fish, namely dissolved copper, could increase from added start and stop traffic, which increases brake pad wear. Brake pads are a known source for the copper found on roadways.
- The existing I-5 bridge over the Columbia River would continue to be more vulnerable to collapse from a major seismic event compared to a new bridge designed using current seismic standards.
- Escapement of flaking paint (on the bridge) that is known to contain heavy metals.
- Escapement of chemicals and paint associated with repainting and cleaning the bridge.
- Escapement of hazardous materials into the Columbia River associated with high risks of vehicle or ship collisions from bridge congestion and the lift-span.

While traffic and congestion would increase over time with all the project alternatives, the No-Build Alternative would be associated with the worst traffic congestion.

5.2.2 Replacement Crossing with LRT and I-5 Standard Toll (Alternative 3)

5.2.2.1 Hydrology

This section describes potential hydrologic impacts from Alternative 3, which include potential flooding, alterations in peak flows and increased runoff volumes to local receiving waters, and decreased water percolation and groundwater storage.

Except for the Columbia River/North Portland Harbor, this alternative would not have any direct effects within any of the streams within the project area. No watercourses would be crossed other than the Columbia River/North Portland Harbor.

Other than the installation of piers within the Columbia River/North Portland Harbor, and the potential slight encroachment from Southern and Diagonal Marine Drive realignment options, no new or expanded project facilities under this alternative would encroach upon the 100-year floodplain for any stream or river within the affected project area. New roads within the floodplain would either be elevated above the Columbia River floodplain or would avoid floodplains altogether.

The six new piers for the Columbia River crossing are quite large and in a smaller system might have the potential to create a backwater effect that would raise flood elevations. Given the size of the Columbia River relative to the size of the piers and given that this section of the river is tidally influenced; it is extremely unlikely that any backwater effect would be discernable. The project would require a floodplain permit from the local jurisdictions. Modeling studies would be a requirement of this permit and would be conducted in a later phase. If results of the modeling show a backwater effect that exceeds local standards, cut and fill remedies within the floodplain would likely be prescribed.

An increase in impervious surface area typically increases flashiness within receiving waters, and is associated with greater peak flows and increased total runoff volume. Flashiness and impacts from greater peak flows and increased runoff is expected to be negligible within those streams draining the project area. Because the extent of new impervious surface is quite small relative to the size of receiving waterbodies within the project area, and because the project drains almost directly to these major waterbodies that have relatively high flows, there is little need to control the rate of runoff to avoid adverse effects. Stormwater regulations for both Oregon and Washington do not require flow controls for project-generated runoff other than for flows discharged to Burnt Bridge Creek. Impacts from increased runoff in Burnt Bridge Creek would be mitigated by developing a stormwater conveyance and detention system in accordance with standards in place at the time of construction.

Project-generated runoff from a few sections of new or modified roadway that would normally drain to the Columbia River watershed would be conveyed, treated, and discharged to the Columbia Slough. All other runoff generated by the project would be discharged within the watershed that it is generated.

Exhibit 5-2 provides a comparison of total existing, proposed, and additional land-based impervious surface area among the project alternatives. The acreages in this exhibit were generated to provide a comparative estimate of impervious surface as it primarily relates to issues of reduced infiltration. Therefore, roadways over waters are not included in the exhibit acreages. For an assessment of how impervious surface relates to water quality issues, see Section 5.2.2.2 and Exhibit 5-3.

As shown in Exhibit 5-2, Alternative 3 would create slightly less new land-based impervious surface compared to Alternative 2, but would create more new, land-based impervious surface area compared to Alternatives 4 and 5.

Exhibit 5-2. Changes in Land-Based Impervious Surface Area for Build Alternatives

	Alternative 2 (Replacement BRT)			Alternative 3 (Replacement LRT)		
Drainage Areas	**Existing (acres)**	**Proposed (acres)**	**Increase (acres)**			
Columbia Slough	25.4	31.5	6.1	25.4	30.3	4.9
Columbia River	28.9 [a]	30.5 [b]	1.6	28.6 [a]	30.2 [b]	1.6
Columbia Slope	86.1	106.0	19.9	86.1	106.0	19.9
Burnt Bridge Creek	27.2	31.9	4.7	27.2	31.9	4.7
Total	**167.6**	**199.9**	**32.3**	**167.3**	**198.4**	**31.1**
	Alternative 4 (Supplemental BRT)			**Alternative 5 (Supplemental LRT)**		
Columbia Slough	25.4	32.1	6.7	25.4	30.9	5.5
Columbia River	26.5 [a]	28.4 [b]	1.9	26.2 [a]	28.1 [b]	1.9
Columbia Slope	91.4	101.2	9.8	91.4	101.2	9.8
Burnt Bridge Creek	41.9	44.2	2.3	41.9	44.2	2.3
Total	**185.2**	**205.9**	**20.7**	**184.9**	**204.4**	**19.5**

[a] Doesn't include the existing 9.8 acres of existing I-5 bridge sections over water

[b] Doesn't include the proposed 21.4 to 23.2 acres of I-5 bridge sections over water.

[c] The areas include roadway surfaces located beneath bridges.

Current technical literature suggests that stream quality begins to degrade when there is more than 10 percent impervious surface area in a watershed. A watershed that gains a few percentage points of impervious surface area could be vulnerable to some level of degradation (with respect to habitat) if the watershed is close to or above that threshold.

Each of the watersheds within the project area is composed of 10 percent or more impervious surface area; therefore, even though the increase in impervious surface area for each watershed would represent a very small fraction of the total watershed, the literature suggests that this incremental increase could adversely affect stream quality. The size of the drainage areas for the Columbia Slough, Lower Columbia River, and Burnt Bridge Creek are 51 square miles 18,000 square miles, and 1,174 square miles, respectively.

Impervious surfaces do not allow water to percolate into the ground; thereby increasing the amount of runoff. Decreased water percolation also decreases groundwater storage and the beneficial dilution effects from clean water entering the water table.

Groundwater and groundwater storage and movement determine the number of seeps and springs in an area, which are very important in maintaining flows during low flow periods, typically summer. The addition of impervious surfaces often has an effect on this phenomenon by limiting infiltration. The addition of impervious surface is unlikely to measurably affect low flow conditions within the project area. The project area is not within the headwaters of streams and the drainage areas for project area streams are relatively large, which lessens the influence of this phenomenon. Except for Burnt Bridge Creek, flows in project area waters are controlled by tides and dams or pumps.

5.2.2.2 Water Quality

Although it is a required practice of both ODOT and WSDOT to design and build stabilized banks along their highways, increased sedimentation in streams after road construction may occur if slopes are not stabilized as designed. Sedimentation can be increased by two potential pathways: directly from erosion of the finished roadside embankments or from increased streambank erosion as a result of increased peak flows. The project corridor is relatively flat except for the Burnt Bridge Creek area. If worst case circumstances were to occur, this area would be the most susceptible to erosion hazards. This alternative is not expected to substantially increase peak flows and such flows would be managed by stormwater conveyance facilities.

Sediment from highway runoff can contribute to turbidity, but rarely to the clogging of spawning gravels or morphologic changes in a stream. Because metals and other pollutants bind to fine particles, accumulations of road-derived sediments may have elevated levels of contaminants.

Runoff from transportation facilities is typically associated with a suite of pollutants, including suspended sediments, nutrients, PAHs, oils and grease, antifreeze from leaks, cadmium and zinc from tire wear, and copper from wear and tear of brake pads, bearings, metal plating, and engine parts. Fecal coliform, while not a product of roadway surfaces or activities, is known to be conveyed in road runoff. The concentration and load of these pollutants are affected by a number of factors, including traffic volumes, adjacent land uses, air quality, and the frequency and duration of storms. Stormwater management measures would be incorporated into the design of this alternative to minimize the potential adverse impacts that road runoff can have on water quality.

The effect of the pollutants found in runoff depends to a large extent on the condition of the receiving waters. Given the nature of the Columbia Slough, with its slow moving water and identified water quality problems, total suspended solids and other contaminants found in highway runoff would be more of a problem within this stream than in other waterbodies within the project area.

The Columbia Slough is not on the 303d list for any pollutants of particular concern associated with highway runoff. The only pollutant associated with highways that has been regulated through a TMDL on this system is fecal coliform. Stormwater is listed in the TMDL as a comparatively minor source (next to combined sewer overflows) for this pollutant. While highway runoff is “stormwater,” highway runoff is not explicitly called out in the TMDL.

Approximately 32.3 acres of additional impervious surface would be conveyed to the Columbia Slough under this alternative. Much of the runoff generated from this additional impervious surface is currently conveyed to the Columbia River. The proposed stormwater management plan involves conveying this runoff instead to the Columbia Slough. As shown in Exhibit 5-3, for this alternative, the additional runoff from impervious surface area could increase dissolved copper loads by 26 percent compared to the No-Build Alternative. The loads for all other pollutants are expected to decrease since stormwater treatment would be provided where treatment would otherwise not exist.

The Columbia River is not on the 303d list for any pollutants of particular concern that are associated with highway runoff, nor has a TMDL been established for any pollutant associated with highway runoff. The loading rates for all pollutants considered in the analysis presented in Exhibit 5-3 would decrease substantially under Alternative 3 compared to the No-Build Alternative. This reduction is expected because currently untreated stormwater would be treated under the build alternatives.

Burnt Bridge Creek is on the 303d list for fecal coliform. Highway runoff is not identified in the listing as a source for this pollutant. A gain of approximately 7.9 acres of additional impervious surface within the Burnt Bridge Creek watershed is anticipated from this alternative. Because stormwater from the existing road facility in this watershed is currently treated, Alternative 3 does not provide water quality benefits. The loading rates for all pollutants considered in the analysis presented in Exhibit 5-3 would increase by approximately 20 percent under Alternative 3 compared to the No-Build Alternative.

Alternative 3 as well as the other build alternatives would decrease traffic congestion within the project corridor. The reduction of braking would reduce brake pad wear. Copper is a known byproduct of brake pad wear. Therefore, decreasing congestion may potentially reduce the proportionate amount of copper carried by project runoff compared to what would be proportionately carried by the No-Build Alternative.

Exhibit 5-3. Annual Pollutant Loading Comparison of Alternatives

Columbia Slough Basin	No Build	Alternatives 2 and 3[a] (Replacement)[b]	Alternatives 4 and 5[a] (Supplemental)[c]
Treated Impervious Area (acres)	4.3	58.2/57.2	45.8/44.8
Untreated Impervious Area (acres)	34.5	13.9	13.9
Total Impervious Area (acres)	38.8	72.1/71.1	59.7/58.7
TSS (lbs./year)	28,711.9	14,843/14,785	14,124/14,066
Total Phosphorus (lbs./year)	42.7	34.1/33.8	30.4/30.1
Total Copper (lbs./year)	7.1	5.7/5.6	5.1/5.0
Dissolved Copper (lbs./year)	1.9	2.4	2.1/2.0
Total Zinc (lbs./year)	39.0	29.8/29.6	26.7/26.5
Dissolved Zinc (lbs./year)	12.8	14.8/14.6	12.7/12.5
Columbia River	**No Build**	**Alternatives 2 and 3**	**Alternatives 4 and 5**
Treated Impervious Area (acres)	0	19.6	28.2
Untreated Impervious Area (acres)	32.7	0	0
Total Impervious Area (acres)	32.7	19.6	28.2
TSS (lbs./year)	26,977.5	1,136.8	1,635.6
Total Phosphorus (lbs./year)	39.2	5.9	8.5
Total Copper (lbs./year)	6.5	1.0	1.4
Dissolved Copper (lbs./year)	1.6	0.6	0.8
Total Zinc (lbs./year)	36.0	4.9	7.1
Dissolved Zinc (lbs./year)	11.4	3.3	4.8
Columbia Slope Basin	**No Build**	**Alternatives 2 and 3**	**Alternatives 4 and 5**
Treated Impervious Area (acres)	0	86.5	78.2
Untreated Impervious Area (acres)	94.6	23.7	21.5
Total Impervious Area (acres)	94.6	110.2	99.7
TSS (lbs./year)	7,8045.0	24,569.5	22,273.1
Total Phosphorus (lbs./year)	113.5	54.4	49.3
Total Copper (lbs./year)	18.9	9.1	8.2
Dissolved Copper (lbs./year)	4.7	3.8	3.4
Total Zinc (lbs./year)	104.1	47.7	43.2
Dissolved Zinc (lbs./year)	33.1	23.0	20.8
Burnt Bridge Creek Basin	**No Build**	**Alternatives 2 and 3**	**Alternatives 4 and 5**
Treated Impervious Area (acres)	39.4	47.3	46.6
Untreated Impervious Area (acres)	0.0	0.0	0.0
Total Impervious Area (acres)	39.4	47.3	46.6
TSS (lbs./year)	2,285.2	2,743.4	2,702.8
Total Phosphorus (lbs./year)	11.8	14.2	14.0
Total Copper (lbs./year)	2.0	2.4	2.3
Dissolved Copper (lbs./year)	1.2	1.4	1.4
Total Zinc (lbs./year)	9.9	11.8	11.7
Dissolved Zinc (lbs./year)	6.7	8.0	7.9

TOTAL PROJECT AREA	No Build	Alternatives 2 and 3	Alternatives 4 and 5
Treated Impervious Area (acres)	43.7	211.6/210.6	198.8/197.8
Untreated Impervious Area (acres)	161.8	37.6	35.4
Total Impervious Area (acres)	205.5	249.2/248.2	234.2/233.2
TSS (lbs./year)	136,019.6	43,393/43,235	40,735/40,677
Total Phosphorus (lbs./year)	207.3	108.6/108.3	102.1/101.8
Total Copper (lbs./year)	34.5	18.1	17.0
Dissolved Copper (lbs./year)	9.4	8.2	7.7
Total Zinc (lbs./year)	188.9	94.3/94.0	88.6/88.4
Dissolved Zinc (lbs./year)	64.1	49.1/49.0	46.2/46.0

Source: Acreages were derived from the Draft Conceptual Stormwater Design Report. August 2007.

[a] The areas do not include roadway surfaces located beneath bridges.

b. Values separated by a "/" show the difference between Alternative 2 and Alternative 3. A single value is valid for both alternatives in the column

c. Values separated by a "/" show the difference between Alternative 4 and Alternative 5. A single value is valid for both alternatives in the column

This alternative, as well as the other build alternatives, would involve additional roadway area and with it additional winter maintenance activities. Such activities may contribute to water pollution. Highway sanding often results in large quantities of sanding material making its way into adjacent water bodies, with adverse consequences for spawning beds, and occasionally for channel morphology. Chemical anti-icers are a potential concern, but are relatively benign. Calcium magnesium acetate (CMA) is currently being used by ODOT in the Portland area, but magnesium chloride is becoming more common across the state. CMA reduces oxygen in water, but it is used in low quantities. Studies evaluating the effect of CMA use on a small stream found no detectable change in water chemistry (Tanner and Wood 2000). Therefore, impacts from the potential use of CMA within the project area would be expected to be negligible, particularly since the frequency of use of such chemicals is relatively low. Within the project area, there are only about 20 days a year, on average, with minimum temperatures below freezing (OCS 2004). In many cases the duration of freezing temperatures or ambient conditions are such that CMA is not applied. The water quality benefits of increased highway safety could counteract potential adverse impacts from winter maintenance activities: fewer accidents means a lower chance of a spill of toxic materials.

5.2.2.3 Stormwater

A conceptual stormwater conveyance and treatment plan has been proposed for this alternative that would comply with state and local stormwater requirements. Stormwater management and treatment for the interstate roadway would follow the requirements of ODOT and WSDOT. Local roads within Vancouver and Portland would comply with municipal regulations. All new and modified impervious surface areas would be treated in accordance with the protocols set forth by the pertinent jurisdictions. Based on stormwater guidelines, flow control facilities would only be required in the Burnt Bridge Creek watershed. Based on a cursory review of project area soils, topography, land use, and stormwater regulations, the conceptual plan proposes the following:

- An expansion of detention/retention stormwater facilities in the Burnt Bridge Creek watershed.

- Grassy swales (bioswales) located on Hayden Island and near Delta Park to the extent practical, and
- Where bioswales are not practical, stormwater would be conveyed to and treated at the Columbia Boulevard Wastewater Treatment Plant (CBWTP) in Portland.

The data inputs used in the pollutant load analysis are based on the conceptual stormwater management plans prepared for each of the build alternatives.

5.2.3 Replacement Crossing with LRT and No Toll

Impacts from this combination of project options would not differ from those hydrology and water quality impacts described in Section 5.2.2.

5.2.4 Replacement Crossing with BRT and I-5 Standard Toll (Alternative 2)

Refer to Section 5.2.2. As shown in Exhibit 5-2, the total increase in impervious surface is only slightly greater for Alternative 2 compared to Alternative 3. The extent and importance of the hydrology and water quality effects of this alternative are therefore expected to be very similar to those described for Alternative 3.

There is a scarcity of literature available discerning the water quality impacts between BRT and LRT; therefore, the pollutant load analysis presented in Exhibit 5-3 only distinguishes the difference in total impervious area between Alternatives 2 and 3 which is very minor. The pollutant load analysis provided in Section 5.2.2.2 is not sufficiently sensitive to quantify the slight incremental increase in pollutant loading that would be expected from BRT traffic versus LRT traffic. The pollutants associated with BRT versus LRT are described in Section 5.5.2.

5.2.5 Supplemental Crossing with LRT and I-5 Higher Toll (Alternative 5)

5.2.5.1 Hydrology

The overall impact discussion provided in Section 5.2.2.1 also pertains to Alternative 5, with the exception of flooding impacts, the extent of anticipated impervious surface and related effects, and anticipated pollutant loading. The potential for a backwater effect would be slightly greater under this alternative compared to Alternatives 2 and 3. The Supplemental Crossing would involve the placement of more piers in the Columbia River/North Portland Harbor. Although this increases the potential for backwater effects and a potential rise in flood elevation, this potential is still considered extremely low. Even with more piers in the water, a rise in flood elevation is not expected to be discernable.

As shown in Exhibit 5-2, the increase in impervious surface area is expected to be much lower for this alternative compared to Alternatives 2 and 3. Therefore, those issues associated with impervious surface area, including stream flashiness, peak flows, surface infiltration and groundwater storage would be expected to have lesser impact within the project area.

5.2.5.2 Water Quality

The long-term water quality impacts associated with this alternative would be similar to those described in Section 5.2.2.2 with the exception of the smaller amount of total impervious surface generated by this alternative.

Exhibit 5-3 indicates that compared to the other alternatives, pollutant loading under Alternative 5 would be less for all affected watersheds, with the exception of the Columbia River. The pollutant loads expected within the Burnt Bridge Creek watershed would be nearly the same as those calculated for Alternatives 2 and 3, and similar to Alternatives 2 and 3, the loads would be greater compared to the No-Build Alternative.

Like the other build alternatives, the provision of stormwater treatment within a corridor with little to no treatment would provide water quality benefits. This benefit is evident in all watersheds except Burnt Bridge Creek. Also similar to the other build alternatives is that the pollutant load for dissolved copper within the Columbia Slough could go up to 2.0 pounds/year (lbs/yr) compared to 1.9 lbs/yr associated with the No-Build Alternative. This is a much smaller increase (5 percent) compared to the 26 percent increase expected for Alternatives 2 and 3. The load for dissolved copper within the Burnt Bridge Creek watershed would increase from 2.0 lbs/yr to 2.3 lbs/yr, representing a 15 percent increase compared to the No-Build Alternative.

5.2.5.3 Stormwater

Refer to Section 5.2.2.3.

5.2.6 Supplemental Crossing with BRT and I-5 Higher Toll (Alternative 4)

Refer to Sections 5.2.5 and 5.2.2. The additional impervious area associated with Alternative 4 is only slightly greater than that associated with Alternative 5 and substantially less compared to Alternatives 2 and 3. With this slight difference between Alternatives 4 and 5, related impacts are expected to be comparable to those described for Alternative 5. The pollutants associated with LRT versus BRT are described in Section 5.5.2.

5.3 Impacts from Segment-level Options

This section describes and compares the impacts associated with specific highway alignment and interchange options and specific transit alignments and options. They are organized by segment, including:

- Segment A: Delta Park to Mill Plain District
- Segment B: Mill Plain District to North Vancouver

For transit options, Segment A is divided into two sub-segments, each with a discrete set of transit choices:

- Sub-segment A1: Delta Park to South Vancouver
- Sub-segment A2: South Vancouver to Mill Plain District

Impacts from highway options are described separately from impacts from transit options. The purpose of this organization is to present the information according to the choices to be made. Where the traffic and transit choices would have a substantial effect on each other, this is considered. Exhibit 5-4 shows the segments of the primary and secondary APIs.

5.3.1 Segment A: Delta Park to Mill Plain District - Highway Alternatives

5.3.1.1 No-Build

Long-term water quality impacts from congestion, associated with increased wear on brakes, and subsequent increases in harmful pollutant constituents in stormwater would continue. Likewise, the effects of predominantly untreated stormwater would continue to degrade receiving waters.

5.3.1.2 Replacement Crossing

Long-term impacts are directly related to an alignment's potential to create continued erosion hazards, and the infiltration and water quality impacts related to impervious surfaces. Steep slopes are not an issue for the bridge crossing.

Segment A is the only segment that would involve floodplain encroachments. The bridge crossing of the Columbia River would be one encroachment, and the two new Marine Drive realignment options, namely the Southern and Diagonal options, could potentially encroach on the 100-year floodplain of the Columbia Slough. Ground surveys of the FEMA-determined flood elevation for the Slough would be required to conclusively evaluate if and to what degree an encroachment would occur. If an encroachment were to occur, impacts would be offset by a cut and fill balance as required by federal and local law.

5.3.1.3 Supplemental Crossing

A Supplemental Crossing would be associated with a greater overall area of impervious surfaces within Segment A compared to the Replacement Crossing, but with less new impervious area.

The Marine Drive alignments for the Supplemental Crossing would have the same impacts as described for the Replacement Crossing. The effects of impervious surfaces are described in Section 5.2.5.

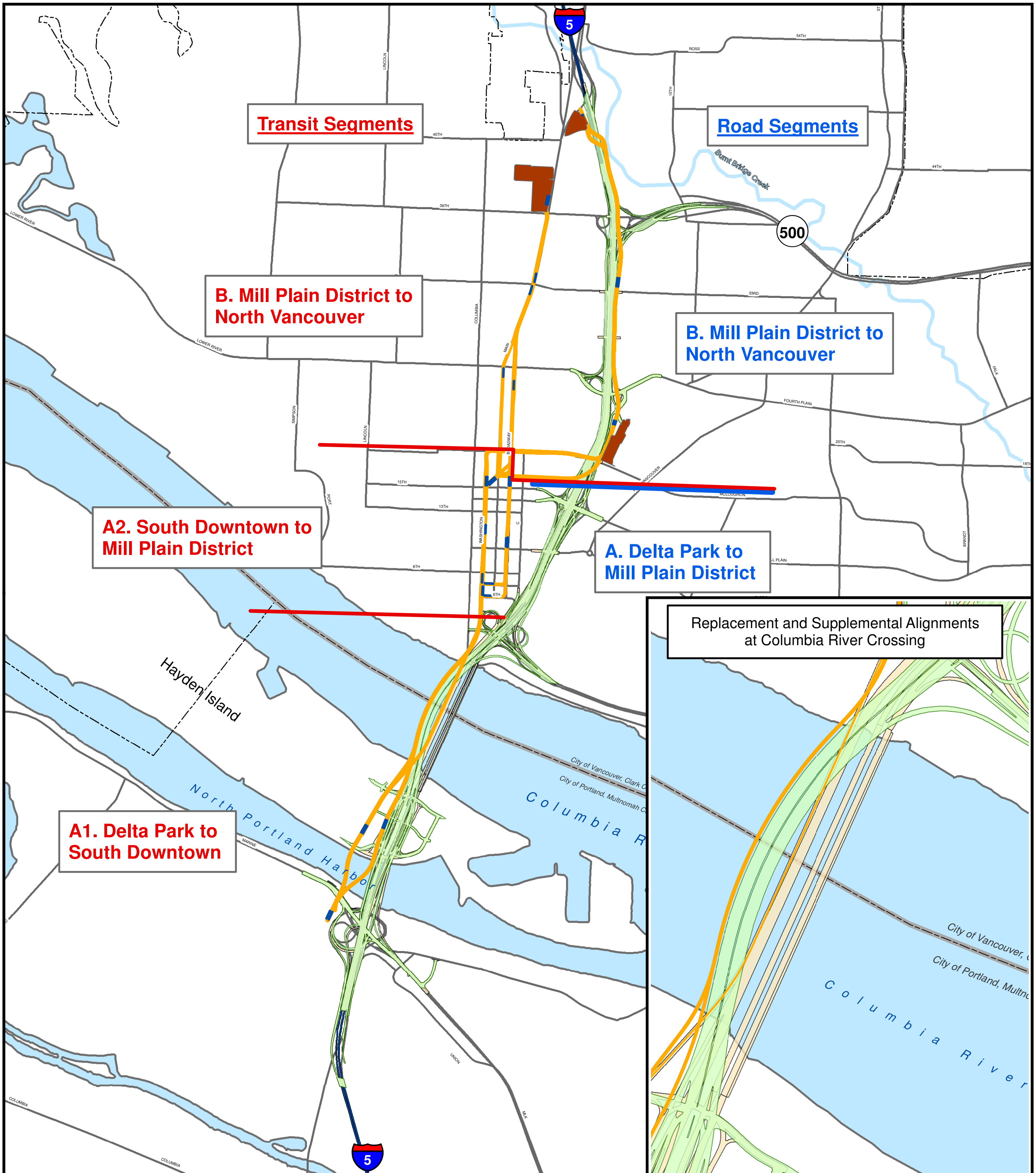
5.3.2 Segment B: Mill Plain District to North Vancouver - Highway Alternatives

5.3.2.1 No-Build

Impacts from the No-Build Alternative described for Segment A (see Section 5.3.1.1) also apply to Segment B.

5.3.2.2 I-5 Western Alignment (with Replacement Bridge)

The differences in long-term water resources impacts among the I-5 alignment options within Segment B would be minor.



Transit Segment Boundaries
Roadway Segment Boundary
Park and Ride
Transit Stop
Transit Alignment Options
Replacement River Crossing
Supplemental River Crossing

0 0.25 0.5
Miles

Exhibit 5-4: Project Area and Alternatives

Analysis by J. Koloszar; Analysis Date: Aug.-2007; Plot Date: Dec.-2007; File Name: JH_014_8x11.mxd

5.3.2.3 I-5 Current Alignment (with Replacement Bridge)

The differences in long-term water resources impacts among the I-5 alignment options in Segment B would be minor.

5.3.2.4 I-5 Current Alignment (with Supplemental Bridge)

The differences in long-term water resources impacts among the I-5 alignment options in Segment B would be minor.

5.3.3 Segment A1: Delta Park to South Vancouver - Transit Alternatives

Alternatives associated with BRT have a slightly greater amount of new impervious surface area within this segment compared to those associated with LRT. Approximately 1 additional acre of new impervious surface would be needed for BRT at the Expo Center station to allow for bus turnaround and passenger transfer to light rail. There are no other differentiating long-term water resources impacts among the various transit alternatives within Segment A1, with the possible exception of potentially more harmful pollutant constituents that may occur in the runoff from BRT options versus LRT options. These differences are described in Section 5.5.2.

5.3.4 Segment A2: South Vancouver to Mill Plain District - Transit Alternatives

There are no significant differentiating long-term water resources impacts among the various transit alternatives within Segment A2, with the possible exception of potentially more harmful pollutant constituents that may occur in the runoff from BRT options versus LRT options. These differences are described in Section 5.5.2.

5.3.5 Segment B: Mill Plain District to North Vancouver - Transit Alternatives

There are negligible differentiating long-term water resources impacts among the various transit alternatives within Segment B, with the possible exception of potentially more harmful pollutant constituents that may occur in the runoff from BRT options versus LRT options (described in Section 5.5.2) and the potential for greater erosion impacts to Burnt Bridge Creek from an I-5 alignment versus a Main Street alignment (described in Section 5.4).

5.4 Impacts from Other Project Elements

5.4.1 Minimum Operable Segment

The Clark College and Mill Plain Minimal Operable Segment (MOS) options are less likely to be as effective at minimizing traffic congestion than the options that continue to Kiggins Bowl Terminus or Lincoln Terminus. Pollutants typically associated with traffic congestion, such as total copper, could therefore be more prevalent within the project corridor.

Impacts specifically associated with additional/modified impervious surface along transportation/transit alignments within the Burnt Bridge Creek watershed that would be realized by other project alternatives and options would not be realized with the Mill Plain MOS Option. These impacts include reduced ground infiltration and increased stormwater runoff. Pollutant loading in the Burnt Bridge Creek watershed would still increase under this option since the Lincoln and Kiggins Bowl Park and Ride lots are part of the option; however; the pollutant loads would be less than those estimated for other alternatives and options.

The Mill Plain MOS option includes four additional park and ride lots comprising approximately 5.7 total acres of new and/or modified impervious surface within the Columbia Slope watershed. This additional acreage would further aggravate impacts related to reduced ground infiltration and increased stormwater runoff. This additional acreage has been added in to the pollutant load model values for the Columbia Slope watershed assuming both treated stormwater and untreated stormwater conditions. Even under worst case conditions (i.e., that all the stormwater from the additional park and ride lots would not be treated), pollutant loads under the No Build Alternative would still be expected to be greater than those for the Mill Plain MOS option under any of the alternatives. Exhibit 5-5 provides of summary of findings for the MOS options.

Exhibit 5-5. Long-Term Effects of MOS Options

	Clark College MOS	Mill Plain MOS
Pollutant Loading Compared to Baseline of Burnt Bridge Creek	Increased, but to a lesser extent than the Kiggins Bowl or Lincoln Terminus alignments	Increased, but to a lesser extent than the Kiggins Bowl or Lincoln Terminus alignments
Pollutant Loading Compared to Baseline of Columbia Slope	Decreased	Decreased, but to a lesser extent than the other terminus alignments

5.4.2 Transit Maintenance Base Options

5.4.2.1 LRT Maintenance Base Options

Ruby Junction Operations Facility on NW Eleven Mile Avenue in Gresham, Oregon is the proposed location for a transit maintenance facility. The facility would be expanded by approximately 10.5 acres. Three of the 15 parcels that would be added to the maintenance facility are located within the 100-year floodplain of Fairview Creek. These three parcels presently contain several buildings and some paved surfaces. Based on drawings prepared in September 2007, it appears that there would be no new buildings constructed within the 100-year floodplain. Therefore, no floodplain encroachments are anticipated. If the floodplain were encroached upon, the project would avoid impacts by balancing cut and fill earthwork within the floodplain. Operational activities such as equipment cleaning and repairs could result in accidental spills or polluted stormwater runoff to Fairview Creek. Mitigation measures would be required to prevent accidents and to store and treat runoff prior to it leaving the site.

5.4.2.2 Even if the No-Build Alternative is chosen and CRC is not built, regional transit services are likely to increase from other projects, and expansion of the vehicle maintenance facilities would likely occur. If one of the build alternatives is chosen for CRC, this project would contribute to the size of that expansion.BRT Maintenance Base Options

The C-TRAN East Vancouver Maintenance Facility is a proposed location for a BRT maintenance facility. The facility would be expanded by approximately 6.7 acres. None of the five parcels that would be added to the maintenance facility are located within a 100-year floodplain. Therefore, no floodplain encroachments are anticipated. Operational activities such as equipment cleaning and repairs could result in accidental spills or polluted stormwater runoff to Burnt Bridge Creek. Mitigation measures would be required to prevent accidents and to store and treat runoff prior to it leaving the site.

5.4.3 River Crossing Type and Capacity: How does the Supplemental 8-lane crossing compare to the Replacement 10-lane crossing?

Based on the impervious surface area and pollutant load comparisons between these crossing options, the Supplemental crossing would have lesser water quality impacts compared to the Replacement crossing. Section 5.2 describes the differences in water resources impacts between these options.

5.4.4 Transit Mode: How does BRT compare to LRT?

The pollutant constituents in runoff from a BRT would be comparable to that from other road vehicles, which includes metals, such as copper from brake-pad wear. LRT has the ability to brake “regeneratively” using electric motors to slow the train, rather than friction braking, which involves the use of brake pads that contain metals such as copper and zinc. Regenerative braking would be used to slow trains during station approaches and when traveling down slopes. In these cases, friction braking would occur only at relatively slow speeds when trains are moving within stations and storage areas, or in case of emergencies or unplanned stops. Regenerative braking emits far fewer brake pad particles (a significant source of copper and other metals) relative to automobiles.

The impervious surface area analysis shows that BRT options would involve slightly more impervious surface area than the LRT options. Therefore, in general, LRT is associated with fewer water resources impacts compared to BRT.

5.4.5 Balance of Transit vs. Highway Investment: Increased Transit System Operations with Aggressive TDM/TSM Measures, and Efficient Transit System Operations with Standard TDM/TSM Measures

These measures have no differentiating effect on the water resources analysis for this project.

5.4.6 Major Transit Alignment: How does the Vancouver alignment compare to the I-5 alignment?

The I-5 transit alignment runs alongside Burnt Bridge Creek for about 1,400 feet and would slightly encroach on its protected riparian buffer area. Slopes within this area are relatively steep compared to the topography of the remainder of the project corridor. Therefore, erosion could be a problem after construction, although it is not likely (for further discussion refer to the Geology and Soils Technical Report). Erosion, in turn, could affect the water quality of Burnt Bridge Creek. Also, if an accident were to occur along this transit alignment during normal operation, given its proximity, the riparian corridor and possibly Burnt Bridge Creek itself could be adversely affected.

This alignment would also involve a greater amount of impervious surface within the Burnt Bridge Creek Watershed compared to a Vancouver alignment. Given that the Vancouver alignment drains directly to the Columbia River, the consequences of the additional impervious surface in the Columbia Slope watershed would be less than that expected by an I-5 transit alignment within the Burnt Bridge Creek watershed.

5.4.7 Tolling: How do the tolling options compare (no toll, standard or higher toll on I-5, toll on both I-5 and I-205)?

The tolling options have no differentiating effect on the water resources analysis for this project.

5.4.8 Transit Project Length: How do the full-length alternatives compare to the shorter length option?

There would be slightly less impervious surface with a shorter length transit option, but any benefits could be negated through more travel by automobile to reach HCT stations.

6. Temporary Effects

6.1 Introduction

For purposes of this discussion, temporary effects are those only likely to occur during construction and those that would eventually cease once construction is completed. In some cases, such as the construction of a bridge crossing, temporary effects may last several years.

6.2 Regional and System-wide Impacts

6.2.1 Impacts Common to All Alternatives

Construction activities involving any of the Build project options can impact surface water quality by inducing increased erosion, by disturbing the bed and banks of water bodies, by the removal of shade vegetation, by the accidental discharge of construction materials and chemicals into the water, and by the pouring of wet concrete for fabricating piers.

In general, new road and transit line (i.e., fixed guideway) construction and improvements would create ground disturbance activities. These types of activities may expose soil to wind, rain, and runoff, thereby inducing erosion. Water bodies receiving sediment-laden runoff may then experience increased turbidity, and may be subjected to excessive sediment deposits.

The installation of piers for any of the bridge options would disturb bed sediments in the Columbia River and North Portland Harbor and create turbidity. Turbidity effects range from changes in the behavior of aquatic animals to physical harm in extreme situations. Excess sedimentation can bury bottom-dwelling organisms, and may clog existing spawning beds.

Disturbance to the riverbanks of the Columbia River and North Portland Harbor would increase the potential for erosion at the water's edge.

There is little to no riparian vegetation that would be removed at the river's edge. Even if it were removed, given the sheer width and volume of the Columbia River, this loss of shading would not be expected to create a discernable increase in water temperature.

Dropped construction materials or demolition debris can physically harm organisms as well as stirring up sediments. Portions of the existing I-5 bridge contain lead-based paints. Significant modification to the existing bridge without proper implementation of BMPs could contaminate surface waters. Accidental chemical spills from construction machinery can be directly toxic.

The construction of piers also requires pouring wet cement to join pier caps elements. This wet cement may accidentally come into contact with the Columbia River/North Portland Harbor. Wet concrete is known to raise water pH when it comes into contact with water.

Exhibit 6-1 provides a summary of the various highway and transit options and the potential acreage of disturbed land during construction. This exhibit does not include in-water or over-water structures. The row identified as “Burnt Bridge Creek” reflects Segment B. All other drainage basins within the project corridor occur within Segment A. As shown in the exhibit, roadway work would require substantially more land disturbance than the transit components of the project. The exhibit also shows that there is little difference among options. While the Supplemental Bridge Crossing is associated with slightly fewer acres of land disturbance related to roadways, overall it would involve about 2.2 percent greater disturbance area compared to the Replacement Bridge Crossing.

Exhibit 6-1. Areas of Potential Disturbance During Construction [a]

Project Drainage Basin	Alternatives 2 and 3 (Replacement, BRT/LRT) (acres)	Alternatives 4 and 5 (Supplemental, BRT/LRT) (acres)
Roadways (subtotal)	**327**	**316**
SEGMENT A		
Columbia Slough Basin	84	77
Columbia River/North Portland Harbor	42	43
Columbia Slope	130	126
SEGMENT B		
Burnt Bridge Creek	71	70
Transit (subtotal) [b]	**38**	**57**
SEGMENT A		
Columbia Slough Basin	1	1
Columbia River/North Portland Harbor	4	4
Columbia Slope	25	22
SEGMENT B		
Burnt Bridge Creek	8	30
TOTAL	**365**	**373**

Source: Kitchin, June 2007. Stormwater: Conceptual Design Draft Technical Report

[a] Values do not include potential construction areas in or over water or additional land outside of the right-of-way that may be used for staging areas.

[b] The differences in area between LRT and BRT options are not significant at this level of analysis.

Temporary groundwater quality impacts may also occur from the construction of roadways or fixed guideways below-grade and close to the water table. A detailed analysis of the depth to water table within the project area has not yet been conducted. A regional groundwater study indicates that the elevation of the water table is relatively constant and consistent with site topography. For instance, the water table within the SR 500 area of the corridor would be further from the surface compared to the water table on Hayden Island. Absent such a detailed analysis, for purposes of this environmental review, any below-grade construction is conservatively assumed to potentially require groundwater pumping.

Depressed road construction could potentially create alterations in groundwater by pumping groundwater to depress it below the road surface elevation. This may create a cone of depression and the potential for groundwater contamination from nearby hazardous materials sites. Exhibits 6-2 and 6-3 illustrate depressed road sections for the alternatives. A review of high ranking potential hazardous materials sites (see Hazardous Materials Technical Report) indicates that there are potential sources of contamination near proposed depressed road sections, except north of SR 500.

The potential sites for a bridge assembly/casting yard are unknown at this time. However, they are likely to be adjacent to the Columbia River, Willamette River, or other water body in the region. The existing conditions on the assembly/casting yard could range from a developed and paved port terminal to a currently undeveloped site. The casting/assembly yard activities may or may not increase stormwater runoff over existing conditions and may or may not increase pollutant loading. Before any site is selected, a thorough, site-specific environmental impact analysis will be conducted. All necessary permits will be secured prior to site development and operations.

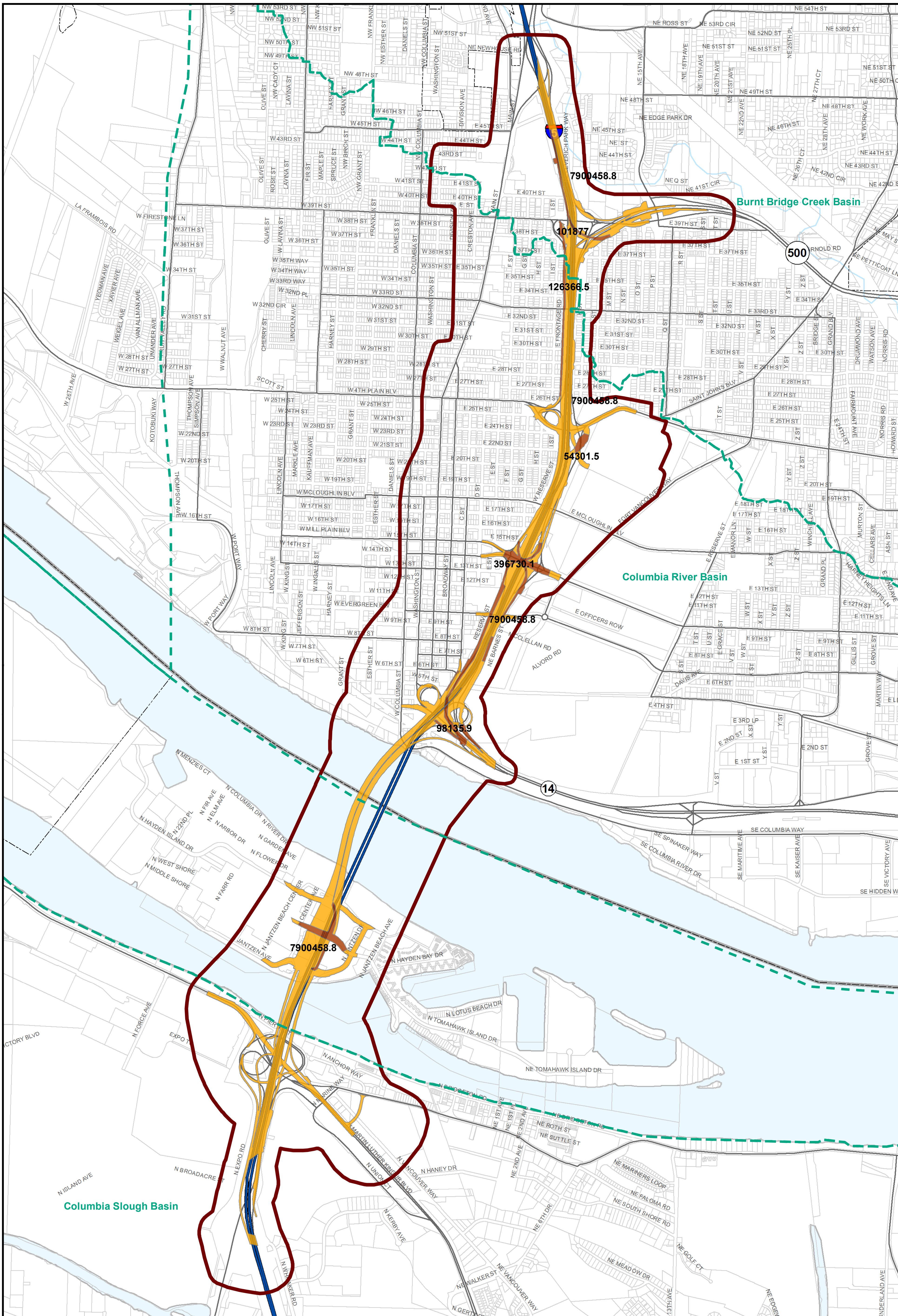
Temporary water quality impact differences among the options are described in the following sections.

6.2.2 Impacts Unique to Transit Alternatives and Options

Slopes within the northern portion of the project above SR 500 are relatively steep compared to the topography of the remainder of the project corridor. The slopes near the Burnt Bridge Creek area increase the potential for erosion during construction and increase the difficulty of erosion and sediment control compared to flatter parts of the project area. A transit alignment along I-5 close to Burnt Bridge Creek would have a greater potential for erosion hazards compared to an alignment along Main Street. In addition, Burnt Bridge Creek would be vulnerable to the potential of accidental spills and the loss of vegetative cover.

There is little difference in temporary impacts between the BRT and LRT transit options. The only difference related to transit type is that there would be a greater area of disturbance related to transit facilities in association with the Supplemental Bridge Crossing (57 acres) compared to the Replacement Bridge Crossing (38 acres).

The area of potential ground disturbance would differ only slightly among the roadway and terminus options. The Lincoln terminus option would result in ground disturbance of 373 acres for the supplemental crossing alternatives, and 384 acres of disturbance for the replacement crossing alternatives. The Kiggins Bowl terminus option would result in ground disturbance of 354 acres for the supplemental crossing alternatives, and 366 acres of disturbance for the replacement crossing alternatives. The MOS options would result in approximately 2 acres less disturbance than the Kiggins Bowl terminus for all build alternatives.



Primary API
Downstream Alignment, Cut/Fill (sq.ft.)
Downstream Alignment, Cut/Fill Below-Grade (sq.ft.)
Subwatersheds

0 1,300 2,600
Feet

Exhibit 6-3: Below-Grade Road Segments for Downstream Replacement Alignment

Columbia River CROSSING

Analysis by J. Koloszar; Analysis Date: 07/23/07; Plot Date: 07/23/07; File Name: BelowGradeAreas_DN079.mxd

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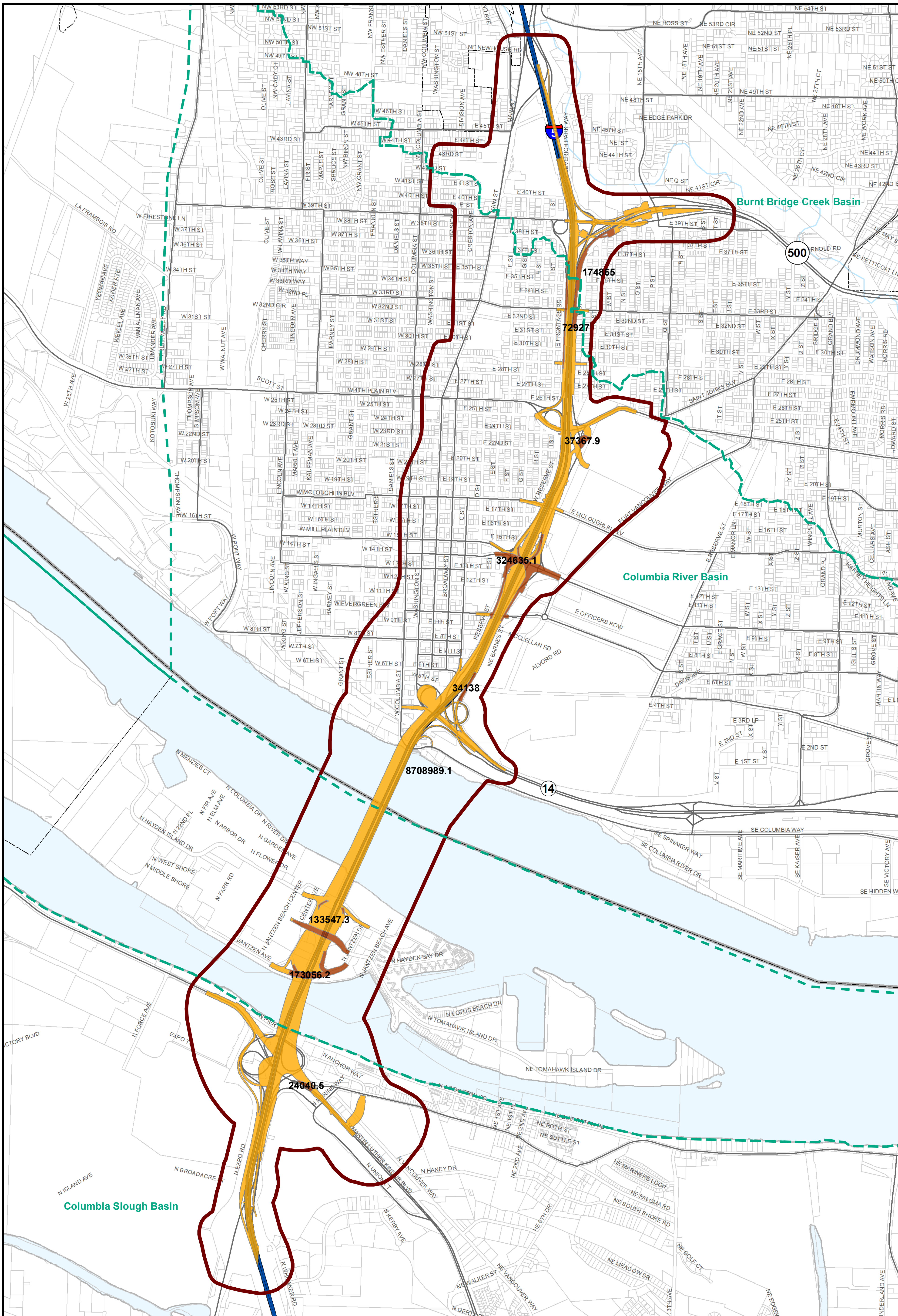

Primary API
Supplemental Alignment, Cut/Fill (sq.ft.)
Supplemental Alignment, Cut/Fill Below-Grade (sq.ft.)
Subwatersheds

0 1,300 2,600
Feet

Exhibit 6-4: Below-Grade Road Segments for Supplemental Alignment

Columbia River CROSSING

Analysis by J. Koloszar; Analysis Date: 07/23/07; Plot Date: 07/23/07; File Name: BelowGradeAreas_DN079.mxd

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In the northern part of the project area the Kiggins Bowl terminus runs alongside Burnt Bridge Creek for about 1,400 feet and would slightly encroach on its protected buffer area. Construction of this alignment would have a higher potential for erosion or releases of hazardous materials that could affect the creek's water quality.

6.2.3 Impacts Unique to Highway Alternatives and Options

The Supplemental Bridge option would involve the greatest overall construction disturbance area (roads and transit combined), and the Replacement Bridge option would involve the greatest construction disturbance area when considering roads only. These comparisons do not consider the bridge span itself.

When considering the construction of the bridge crossing(s), the option with the longest construction duration makes it more statistically probable that a spill may occur. The longer construction duration, in general, is likely to be associated with a longer time that the Columbia River and North Portland Harbor would be exposed to turbidity and its effects. It is possible; however, that construction staging may actually increase the concentration of turbidity. Therefore, without further information on bridge construction, it is not possible to conclude which option would have greater overall water quality impacts. The Supplemental Bridge option would have the largest extent of in-water disturbance area. This option would involve more in-water work related to the construction and deconstruction of bridge piers and decking.

As shown in Exhibit 6-4, overall, there is little difference among the options regarding total area of depressed roadway. The Supplemental Bridge option is associated with the greatest potential for temporary groundwater quality impacts. This option has the most total acreage of depressed road sections (Exhibit 6-3).

Exhibit 6-4. Comparison Summary of Depressed Road Acreages

Drainage Basin	Replacement Bridge (acres)	Supplemental Bridge (acres)
Columbia Slough	Segment A - 0	Segment A – 0.67
	Segment B - 0	Segment B – 0
Columbia River	Segment A - 17.45	Segment A – 16.44
	Segment B - 4.15	Segment B – 6.55
Burnt Bridge Creek	Segment A - 0	Segment A – 0
	Segment B – 5.24	Segment B – 5.69
Totals	**26.84**	**29.34**

6.3 Segments A and B Comparison

Temporary impacts to water quality from construction within Segment A would be substantially greater than those in Segment B, even though slopes in Segment B are more conducive to erosion hazards. As shown in Exhibit 6-1, the total acres of disturbed area from construction in Segment A are substantially greater than those in Segment B. In addition, only Segment A involves in-water work, therefore the risks to water quality are much greater.

7. Mitigation for Long-Term Effects

7.1 Introduction

Mitigation measures to avoid or reduce the impact to water resources have been considered during the development of the project alternatives and options. Earlier designs would have involved extending road improvements to include a Burnt Bridge Creek crossing. Direct impacts to rivers and streams have been minimized to limiting the project to one crossing, the Columbia River/North Portland Harbor. There are many mitigation measures contained in state and local regulations that are designed to avoid and minimize the long-term impacts associated with road construction. Regulations are in place to control the runoff generated from land development projects. Both ODOT and WSDOT have guidance measures for providing stormwater management for highways and both Portland and Vancouver have stormwater management requirements. Therefore, most of the mitigation measures identified in the following sections are measures required by law and the project would not be constructed until all pertinent jurisdictions are satisfied with the measures enumerated in required plans.

7.2 Mitigation Common to All Build Alternatives

7.2.1 Hydrology Mitigation Measures

Build alternatives would involve new bridge piers within the Columbia River, with Alternatives 4 and 5 involving more piers. The potential long-term impact of a rise in the flood elevation would be addressed in a later design phase by conducting a flood-rise analysis. Such an analysis is a regulatory requirement. If flood-rise exceeds that allowed, the rise would be mitigated through floodplain excavation (cut/fill balance) activities.

The build alternatives are associated with an increase in impervious surface area, which may reduce land infiltration. Although there are no regulations that address this potential impact, mitigation techniques that reduce the extent of impervious surface to the extent practical will be investigated.

7.2.2 Water Quality Mitigation Measures

Additional impervious surface area would induce additional project-generated runoff. Pollutants carried in the runoff could adversely affect receiving waters. Stormwater regulations require that total dissolved sediments be reduced by treating stormwater prior to its discharge to receiving waters. A stormwater collection and treatment system will be developed in final design. Until then, the project team has prepared a conceptual design in order to evaluate general feasibility and water quality effects associated with the build alternatives. The conceptual design was prepared to meet the requirements of Oregon and Washington Departments of Transportation for those portions of the project along the interstate roadway and with Cities of Portland and Vancouver regulations for those portions of the project along city-managed roads. However, this is just one possible approach of many that will continue to be considered. In addition, following identification of a locally preferred alternative, the project team will prepare a Biological

Assessment and through formal consultation procedures with NMFS and USFWS will further define stormwater treatment requirements.

The conceptual design prepared for DEIS analysis entails gravity pipe drainage systems that would collect and convey runoff from the new bridges, transit guideway, and road improvements. Basic treatment would reduce total suspended solids to the maximum feasible extent before runoff reaches surface waters. Because the transit facilities and roadways will be operated by different agencies with responsibility for maintenance, roadway and transit runoff would likely be directed to different facilities. Specific stormwater management concepts are described in the following subsections.

7.2.2.1 Potential Stormwater Mitigation in Columbia Slough Watershed

The conceptual stormwater management approach used in the DEIS analysis would convey stormwater from the transit guideway and highway bridges and structures on Hayden Island through the collection system to new treatment swales or ponds near Marine Drive, rather than treating it on Hayden Island. The Marine Drive location has fewer space and land use constraints compared to Hayden Island. It would, however, transfer stormwater currently discharging to the Columbia River to the Columbia Slough. This would likely require a design exception. In addition, because the Columbia Slough is a much smaller waterway than the Columbia River, this could contribute to a more noticeable effect on water quality. This conceptual stormwater design would require exceptions from FHWA and ODOT design standards. Other stormwater treatment approaches will continue to be evaluated and considered, including options that would treat runoff on Hayden Island rather than conveying it to the Marine Drive area.

7.2.2.2 Potential Stormwater Mitigation in Columbia River Watershed

The existing stormwater system in this area collects runoff both from I-5 and from about 250 acres of downtown Vancouver. The build alternatives would separate the highway runoff from this system and treat it in several bioinfiltration swales. During high-flow events, water from the highway would reconnect to the existing system and discharge to the Columbia River after a minimum residence time in the swales. Some parts of the highway that will not be reconstructed for this project will remain connected to the existing system and would continue to discharge to the river without treatment.

In the conceptual design used for DEIS analysis, runoff from the high point of the transit bridge over the river to its touchdown point in Vancouver would flow to a swale near SR 14 before discharging to the Columbia River through an existing outfall. In downtown Vancouver, if curbs separate the transit guideway from the existing roadway, engineered water quality treatment devices could treat transit runoff before releasing it to the City stormwater system. Runoff from the Clark College Park and Ride could be treated either by swales or engineered water quality treatment devices, depending on the final layout.

7.2.2.3 Potential Mitigation in Burnt Bridge Creek Watershed

Existing stormwater retention ponds near the Main Street interchange and 15th Avenue and 41st Circle could be expanded under all build alternatives to handle highway and guideway runoff.

8. Mitigation for Temporary Effects

8.1 Introduction

State and local regulations require mitigation measures so that water quality and hydrology impacts associated with road or transit construction are largely avoided or minimized. Construction impacts include potential sedimentation and erosion hazards, stormwater problems, and accidental spills generally associated with land disturbance activities. The project would not be constructed until state, federal, and local agencies approve the proposed impact minimization and mitigation methods.

8.2 Mitigation Common to All Build Alternatives

All the build alternatives have the potential to create short-term impacts during construction related to sedimentation and erosion and accidental spills. DOT guidelines and local rules and regulations require that sedimentation and erosion control plans as well as spill prevention plans be prepared and approved prior to construction. The CRC project will develop plans to control construction-related risks from erosion, sedimentation, or accidental spills. Construction will not begin until these plans are approved by the appropriate agencies. Plans will specifically address spill prevention, in-water construction work, and could include specific water quality targets with penalties if these are not met. There may be special runoff control requirements to address the 303(d) listings of each of the waterways in the project area.

The project will use best management practices to minimize turbidity and release of pollutants during in-water construction in the Columbia River and North Portland Harbor. The project team will prepare applications for dredging and fill activities under Section 404 of the Clean Water Act, administered by the U.S. Army Corps of Engineers, and will seek water quality certification under Section 401 of the Clean Water Act, administered by the Oregon Department of Environmental Quality and Washington State Department of Ecology.

To specifically address concerns related to concrete work and the potential to increase water pH during construction, the spill prevention plans could include requirements for pH monitoring during concrete work with specific obligations of the contractor enumerated if the pH level changes within receiving waters by more than 0.2 pH units.

Short-term, groundwater pumping in depressed road sections may create a cone of depression that increases the risks of contamination from nearby contaminated sites. Sites with existing soil or groundwater contamination near construction areas will be further studied and tested before any groundwater pumping occurs, in order to avoid causing such contamination to spread.

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9. Permits and Approvals

9.1 Federal

9.1.1 NPDES

A Section 402 National Pollutant Discharge Elimination System (NPDES) permit may be needed if a new outfall is developed on Hayden Island that discharges to North Portland Harbor.

Existing NPDES permits addressing stormwater outfalls may need to be amended to address additional stormwater flows generated by the project.

Existing construction NPDES permits held by ODOT and WSDOT may also require modification to address project construction.

In Oregon, NPDES permits are administered through DEQ. In Washington these permits are administered through Ecology. See specific state requirements below.

9.1.2 Section 404/10

A Section 404 and Section 10 permit will be required for in-water work within the Columbia River and North Portland Harbor and for the loss of wetlands.

9.1.3 Flood Control Facilities Disturbance

Federal regulations state that “no improvement shall be passed over, under, or through the walls, levees, improved channels or floodways, nor shall any excavation or construction be permitted within the limits of the project right-of-way, nor shall any change be made in any feature of the works without prior determination by the District Engineer of the Department of the Army or his authorized representative that such improvement, excavation, construction, or alteration will not adversely affect the functioning of the protective facilities. Such improvements or alterations as may be found to be desirable and permissible under the above determination shall be constructed in accordance with standard engineering practice.”

Further, in the COE Flood Control Operations and Maintenance Policies, Regulation 1130-2-530 states, “Projects that protect urban areas or ones where failure would be catastrophic and result in loss of life should be inspected annually.” It also instructs COE personnel to report nonfederal sponsors who are not complying with the regulations.

9.2 State

9.2.1 Water Quality Certification

Section 401 state water quality certification approval will be required in association with the Section 404/10 permit application process. Section 401 requires an applicant for a federal license or Section 404 permit who plans to conduct an activity that may result in a discharge to waters of the state or U.S. to obtain certification that the activity complies with state water quality requirements and standards. Applicants must submit a Section 404 application form to the COE, who then forwards the application to the certifying state agency. The state agency certifies whether the project meets state water quality standards and does not endanger waters of the state/U.S. or wetlands. These certifications are issued by DEQ in Oregon and by Ecology in Washington.

9.2.2 Safe Drinking Water Act Permits

Both Washington and Oregon implement the federal Safe Drinking Water Act (SDWA) within their jurisdictions. For the CRC project, this law would only apply if infiltration basins or underground injection control (UIC) measures were incorporated into the preferred stormwater management design.

9.2.3 Wetland/Waters Removal-Fill Permit

In Washington, a Joint Aquatic Resource Permits Application (JARPA) is submitted to both the COE and Ecology for removal/fill within wetlands or waters. Ecology reviews the permit application for 401 water quality certification.

In Oregon, removal or fill in jurisdictional wetlands or other waters of the state (including some ditches) requires a Removal-Fill permit from the Department of State Lands (DSL). DSL requires a wetland delineation, compensatory mitigation plan, and sediment and erosion control plan, as part of the permit application. A Joint Permit Application is submitted to the DSL and the COE (Portland Regional Office). DEQ reviews the permit application for 401 water quality certification.

9.2.4 Waste Discharge General Permit

In Washington, a state general permit program is administered through Ecology and is applicable to the discharge of pollutants, wastes, and other materials to waters of the state. Permits issued are designed to satisfy the requirements for discharge permits under the Clean Water Act (CWA).

9.2.5 NPDES

WSDOT has an NPDES Construction General Stormwater Permit to cover all WSDOT construction activities disturbing more than 1 acre. Under the conditions of this permit, WSDOT must submit to Ecology a Notice of Intent (NOI) to discharge stormwater associated with construction activities and to meet stormwater pollution prevention requirements.

In Oregon the DEQ issues and enforces NPDES and Water Pollution Control Facility (WPCF) permits. For the CRC project, a permit would be required for: (1) the construction, installation, or operation of any activity that would cause an increase in the discharge of wastes into the waters of the state or would otherwise unlawfully alter the physical, chemical, or biological properties of any waters of the state; (2) an increase in volume or strength of any wastes in excess of the discharges authorized under an existing permit; and (3) the construction or use of any new outlet for the discharge of any wastes into the waters of the state. ODOT has an NPDES General Construction 1200-CA Stormwater Permit to cover ODOT construction activities on sites covering more than 1 acre. This permit requires a Temporary Erosion and Sediment Control Plan (TESCP).

9.3 Local

9.3.1 Vancouver Municipal Code (VMC). 2005. "Stormwater Management." VMC 14.09.

The City of Vancouver implements its own NPDES permit, as issued by Ecology. The City defers to Ecology's Stormwater Management Manual for Western Washington for guidance, but requires stormwater mitigation for any development that increases the impervious area by more than 2,500 square feet.

9.3.2 Vancouver Municipal Code. 2005. "Erosion Control." VMC 14.24.

This code establishes regulations to minimize erosion from land development and land-disturbing activities.

9.3.3 Vancouver Municipal Code. 2005. "Water Resources Protection." VMC 14.26.

This code establishes allowable and prohibited discharges and best management practices (BMPs) for protecting stormwater, surface water, and groundwater quality.

9.3.4 City of Portland Administrative Rule ENB-4.01, Stormwater Management Manual. September 2004.

The City requires stormwater mitigation for any development that increases impervious surface area by more than 500 square feet.

9.3.5 City of Portland Code (CPC). 2004. "Stormwater Management." CPC 33.653. Portland, OR.

The City of Portland code provides for placement of stormwater facilities, and standards and criteria for on-site facilities. The code lists approval criteria to ensure the development of a feasible stormwater system with adequate capacity.

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