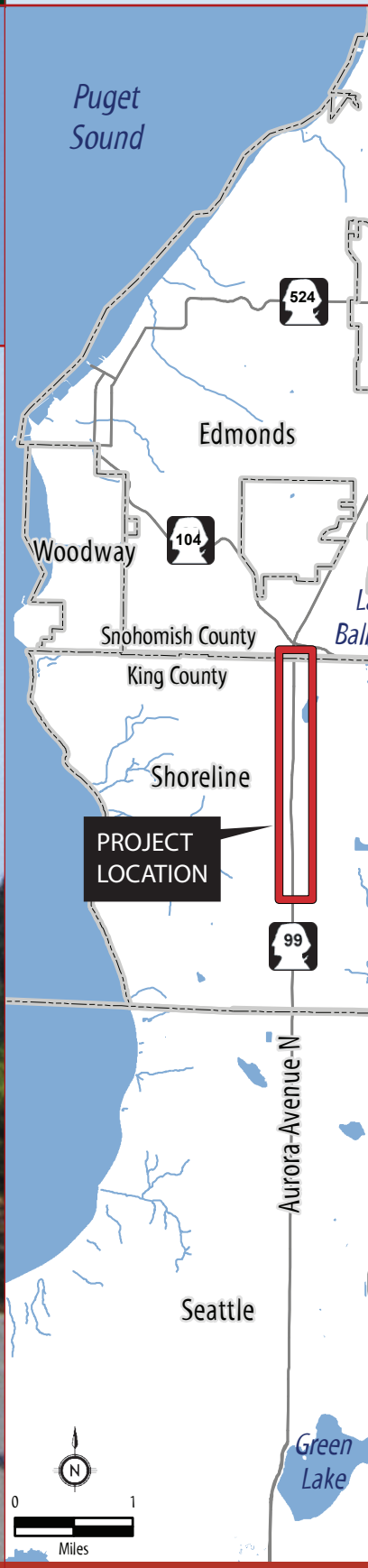
CITY OF SHORELINE

AURORA CORRIDOR

Water Quality/Surface Water
Discipline Report

Aurora Corridor Improvement Project
N 165th Street to N 205th Street



SEPTEMBER 2007

Surface Water Discipline Report

Aurora Corridor Improvement Project: N 165th Street – N 205th Street

Prepared for:

17544 Midvale Avenue N.
Shoreline, WA 98133
Contact: Kris Overleese, P.E.
206/546-0791

Prepared by:

11820 Northup Way, Suite E300
Bellevue, WA 98005
Contact: Andy Wones
425/822-1077

1205 Second Avenue, Suite 200
Seattle, WA 98101
Contact: Amalia Leighton
206/223-0326

September 2007

This document should be cited as:
SvR Design Company and Jones & Stokes. 2007. Surface Water Discipline Report. Aurora Corridor Improvement Project: N 165th Street – N 205th Street. September. (61001.06.) Bellevue, WA. Prepared for City of Shoreline

Table of Contents

Figures

Tables

Appendix

Acronyms and Abbreviations

ADT	Average Daily Traffic
ASTM	American Society for Testing and Materials
BAT	Business Access and Transit
bgs	below ground surface
BMP	Best Management Practice
CAA	Clean Air Act
City	City of Shoreline
CTR	Commute Trip Reduction
DPS	Distinct Population Segment
Ecology	Washington State Department of Ecology
EDR	Environmental Data Resources
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
F	Fahrenheit
FGTS	Freight and Goods Transportation System
GIS	Geographic Information System
GMA	Growth Management Act
HAC	High accident corridor
HAL	High Accident Location
I	Interstate
KCSWDM	King County Surface Water Design Manual
KCTRS	King County Runoff Time Series
LID	Low Impact Development
LOS	level of service
N	North
NCHRP	National Cooperative Highway Research Program
NEPA	National Environmental Policy Act
NHS	National Highway System

NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NRCS	National Resource Conservation Service
OHWM	Ordinary High Water Mark
PAL	Pedestrian Accident Location
PHS	Priority Habitat Species
Project	Aurora Corridor Improvement Project
PSRC	Puget Sound Regional Council
RCW	Revised Code of Washington
RTP	Regional Transportation Plan
SBUH	Santa Barbra Urban Hydrology
SEPA	Washington State Environmental Policy Act
SMC	Shoreline Municipal Code
SMP	Shoreline Master Program
SR	State Route
TDA	Threshold Discharge Area
TEA-21	Transportation Equity Act for the 21st Century
TMDL	Total Maximum Daily Load
USFWS	U.S. Fish and Wildlife Service
V/C	volume to capacity ratio
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WRIA	Water Resource Inventory Area
WSDOT	Washington State Department of Transportation

Glossary

Average Daily Traffic (ADT)	Average number of vehicles that travel on a roadway on typical day.
Bioretention	The removal of stormwater runoff pollutants using the chemical, biological, and physical properties afforded by a natural terrestrial community of plants, microbes, and soil. The typical bioretention system is set in a depressional area and consists of plantings, mulch, and an amended planting soil layer underlain with more freely draining granular material.
Business Access and Transit (BAT) Lane	Right-side lane that serves exclusively for bus travel and for right-turn access in and out of driveways located along the corridor.
Best Management Practices (BMPs)	Innovative and improved environmental protection tools, practices, and methods that have been determined to be the most effective, practical means of avoiding or reducing environmental impacts.
Conveyance	A mechanism for transporting water from one point to another, including pipes, ditches, and channels
Distinct Population Segment (DPS)	A designation used by the U.S. Fish and Wildlife Service to identify unique species or populations that are threatened or endangered.
Evolutionarily Significant Unit (ESU)	A designation used by NOAA Fisheries for certain local salmon populations or runs that are treated as individual species under the Endangered Species Act.
Flood Hazard Area	Areas designated by the Federal Emergency Management Agency based on their risk for flooding as indicated by statistical analyses of river flow and rainfall; long-term historical data of flooding; floodplain topographic surveys; and hydrologic and hydraulic analyses.
Floodplain	The total area subject to inundation by a flood, including the flood fringe and floodway.
Flow Control	Facilities designed to either hold water for a considerable length of time and then release it by evaporation, plant transpiration, and/or infiltration into the ground, or to hold runoff for a short period of time, and then release it to the conveyance system at a controlled rate.
High Accident Corridor (HAC)	A highway corridor one mile or greater in length where a 5-year analysis of collision history indicates that the section has higher than average collision and severity factors.
High Accident Location (HAL)	A highway section typically less than 0.25 mile in length where a 2-year analysis of collision history indicates that the section has a significantly higher than average collision and severity rate.
Highway of Statewide Significance	Highways identified by the Washington State Transportation Commission that provide significant statewide travel and economic linkages.
Hydrologic	Pertaining to the study of water and its interaction with the environment. Hydrologic effects may include changes in stream flow, flooding, or channel capacity, backwatering at culverts, or other characteristics.
Impervious surface	A hard surface area that either prevents or retards the entry of water into the soil mantle as occurs under natural conditions (prior to development), and from which water runs off at an increased rate of flow or in increased volumes.
Level of Service (LOS)	Primary measurement used to determine the operating quality of a roadway segment or intersection.

Low Impact Development (LID)	An approach to stormwater management that uses the natural processes of vegetated areas to infiltrate, filter, store, evaporate, and detain runoff close to its source.
Multimodal Transportation	Multimodal transportation refers to multiple choices for travel, including driving alone, carpooling, walking, biking, or riding transit.
National Highway System	Federally identified highways that are most important to interstate travel and national defense, connect other modes of transportation, and are essential for international commerce
National Pollutant Discharge and Elimination System (NPDES)	The federal program under Section 402 of the Clean Water Act for issuing, monitoring, and enforcing permits, and imposing and enforcing pretreatment requirements for discharges of pollutants from point sources to tidal waters, lakes, wetlands, rivers, streams, or other water courses.
Ordinary High Water Mark (OHWM)	The elevation marking the highest water level that is maintained for a sufficient time to leave evidence upon the landscape, such as a clear, natural line impressed on the bank, changes in soil character, or the presence of litter and debris. Generally, it is the point where the natural vegetation changes from predominately aquatic to upland species.
Pedestrian Accident Location (PAL)	A highway section typically less than 0.25 mile in length where a 6-year analysis of collision history indicates that the section has had four pedestrian accidents in a 0.1 mile segment.
Phase I Study	A historical view of a suspected contaminated site consisting of a regulatory database search, historical file reviews, and site reconnaissance.
Phase II Study	A field investigation to collect and analyze soil and groundwater samples, for purposes of defining the extent of contamination and pollutant migration pathways at a contaminated site.
Pollutant loading	The quantity of a pollutant that discharges to a given point in a drainage area (for example, to a stream) over a set period of time (for example, pounds of phosphorus discharged to Mercer Slough per year).
Regional Transportation Plan (RTP)	Provides the long-range strategy for future investments in the central Puget Sound region's transportation system
Runoff	Rainwater or snowmelt that leaves an area as a surface drainage.
Threshold Discharge Area (TDA)	The entire project area is divided into areas based on drainage. Each area with a discrete stormwater discharge location is defined as a TDA, and stormwater control facilities are located and sized to control drainage in each TDA.
Total Maximum Daily Load (TMDL)	A calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources. A TMDL (also known as a Water Cleanup Plan) is the sum of allowable loads of a single pollutant from all contributing point sources and nonpoint sources.
Water Quality	Term used to describe the chemical, physical, and biological characteristics of water, usually with respect to its suitability for a particular purpose.
Water Resource Inventory Area (WRIA)	A geographic area within which water drains to a particular river, stream, or receiving water body, identified and numbered by the state of Washington (defined in WAC 173-500).
Wetland Hydrology	The condition where water is present during a portion (between 5 and 12.5%) of the annual growing season.

Chapter 1. Introduction

This chapter introduces the proposed project, explains why water quality/surface water is analyzed in the environmental process, and summarizes key findings presented in this report.

What is the purpose of this report?

The City of Shoreline (City) proposes to construct the Aurora Corridor Improvement Project, N 165th Street to N 205th Street (Project), which will improve a 2-mile-long segment of State Route (SR) 99, named Aurora Avenue North (N) within the City. This Project must be developed in compliance with the National Environmental Policy Act (NEPA) and the Washington State Environmental Policy Act (SEPA).

This water quality/surface water discipline report was prepared in general accordance with Section 430 of the Washington State Department of Transportation (WSDOT) Environmental Procedures Manual (WSDOT 2007). This report is intended to provide information required for NEPA and SEPA documentation and water quality related permits, certificates, and approvals. This report provides the data necessary to recognize and assess water quality impacts of the proposed project. The existing surface waters and water quality conditions are described, and the effects of the Project on surface waters and water quality are described.

Where is the Project located?

The Project is located within the city limits of the City of Shoreline on Aurora Avenue N between N 165th Street and N 205th Street (See Figure 1, *Project Vicinity*).

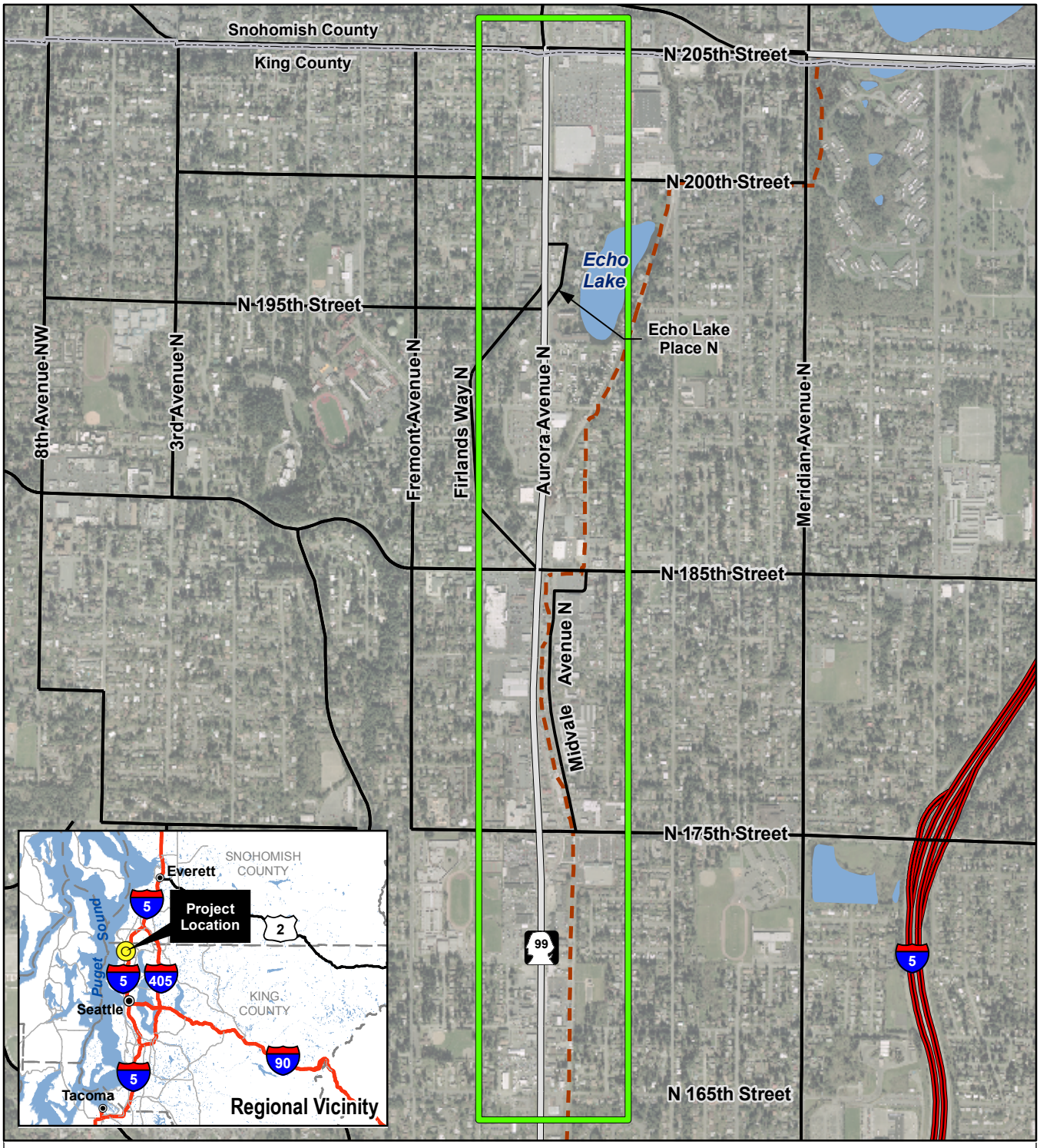
What are the existing characteristics of the Aurora Avenue corridor?

Aurora Avenue N is a major north/south urban highway that serves both local and regional traffic within the City of Shoreline (see Figure 1, *Project Vicinity*). It is a key regional vehicular, transit, and truck corridor within the greater area of Puget Sound and serves as the City's primary arterial roadway, running approximately parallel to Interstate (I)-5 with connections at N 145th Street, N 175th Street, and N 205th Street. Development along the corridor is predominantly commercial, mixed with some multi-family housing. Echo Lake is located approximately 200 feet to the east of the roadway, north of N 192nd Street. The Interurban Trail, currently under construction, runs roughly parallel to Aurora Avenue N, to the east in the project corridor. Aurora Avenue N has two general-purpose lanes in each direction and a center two-way-left-turn lane, with shoulder and sidewalk of varying width located sporadically along the corridor, no curb or gutter, and little landscaping.

Under existing conditions, Average Daily Traffic (ADT) on the roadway is 33,000 to 39,000 vehicles per day. A steady level of pedestrian and bicycle travel occurs along and across the roadway, but the corridor is heavily oriented to vehicle travel and is generally not conducive to non-motorized travel. WSDOT has designated several areas of Aurora Avenue N between N 165th Street and N 205th Street with adverse safety ratings, which are described in Chapter 2. The corridor is served heavily by public transit provided by King County Metro, with additional service at the north end of the corridor provided by Community Transit.

Average Daily Traffic (ADT)

ADT represents the average number of vehicles that travel on a roadway on typical day. Under existing conditions, ADT on Aurora Avenue N is 33,000 to 39,000 vehicles per day.



Sources: City of Shoreline (2006); Jones & Stokes (2007)

City Boundary
Project Area
Interstate
State Route
Arterial
Interurban Trail

N

Feet

0 1,000 2,000

Figure 1. Project Vicinity
Aurora Corridor Improvement Project
September 2007

Why improve Aurora Avenue N?

The purpose of the Aurora Corridor Improvement Project, N 165th Street to N 205th Street, is to improve safety, circulation, and operations for vehicular and non-motorized users of the roadway corridor, to support multi-modal transportation within the corridor, and to support economic stability along the corridor. The Purpose and Need identified for the Project is described further in Chapter 2.

What are the major characteristics of the proposed project?

The Aurora Corridor Improvement Project, N 165th Street to N 205th Street, would include the following elements:

- Business Access and Transit (BAT) lane in each direction;
- two general-purpose lanes in each direction;
- continuous sidewalk, curb, and gutter on each side of the roadway;
- landscaped center median with left-turn and u-turn pockets;
- interconnected, coordinated signal system with transit signal priority;
- improvements to intersections, including proposed new traffic signals at the intersections of Aurora Avenue N with Firlands Way N/N 196th Street and N 182nd Street;
- additional pedestrian crossings at signalized intersections;
- improvements to Midvale Avenue N, between N 175th Street and N 182nd Street;
- improvements to Echo Lake Place, north of N 195th Street;
- new street and sidewalk lighting;
- undergrounding of utilities; and
- stormwater facilities.

Business Access and Transit (BAT) Lane

Right-side lane that serves exclusively for bus travel and for right-turn access in and out of driveways located along the corridor.

In addition to a No Build Alternative, three Build Alternatives, called Alternative A, B and C, respectively, are under consideration. In general, they vary in centerline location, width of median, and presence or absence of an amenity zone between the curb and sidewalk. The three Build Alternatives are described in detail in Chapter 3 of this report.

Why are water quality and surface water considered for this Project?

The City Municipal Code, WSDOT Environmental Procedures Manual, SEPA, and NEPA all specify that water quality and surface waters must be considered for projects with the potential to significantly degrade water quality. Consideration of potential stormwater impacts was also identified as a priority for the project design and environmental documentation in City Resolution 156 (see Chapter 2 for further description).

What are the key points of this report?

Following are the key points of this report:

- Improvements proposed under any of the three Build Alternatives along Aurora Avenue N would reduce impervious surface area; thus, no flow control is required under the City's adopted standards (1998 King County Surface Water Design Manual, amended by the City Municipal Code). Alternatives B and C would result in a greater reduction of impervious surface than Alternative A, due to the inclusion of a planted amenity zone.

- Two options are being considered for installation of stormwater treatment facilities. Option 1 consists of conventional elements that manage water in underground infrastructure, and Option 2 consists of natural elements that manage water in with vegetation and amended soils in addition to conventional elements. Both options will be designed to meet or exceed requirements in the 1998 King County Surface Water Design Manual, as amended by the City. The three major requirements, conveyance, flow control, and water quality measures were evaluated for each option.

- Water quality will be designed to capture and treat 60% of the developed two-year peak flow rate (KCSWDM Section 1.2.8 and 6.2). 80% of the total suspended solids from the stormwater runoff will be removed. For the three Build Alternatives, vaults and filters are required to provide source control for oil due to the high traffic volumes on the roadway.

- The proposed changes under all Build Alternatives would reduce pollutant loading.

- During construction, temporary sediment and erosion control measures would be used to avoid contamination of site runoff with sediment from areas of exposed soil.

Table 1 summarizes the potential surface water effects and mitigation that are identified in this report.

Table 1. Summary of Potential Water Quality/Surface Water Effects and Mitigation

Potential Effects and Mitigation	Alternatives			
	No Build	A	B	C
Potential Operational Effects				
The Project would result in reduction in pollutant loading and reduction in peak flows. No adverse effects to surface water are identified.		X	X	X
Potential Construction Effects				
Increased risk of sediment released to stormwater.		X	X	X
Mitigation: Utilize temporary erosion and sediment control measures during construction. No mitigation needed due to the use of temporary and permanent BMPs.				

Chapter 2. Purpose and Need

This chapter describes the overall purpose of the proposed project and identifies the specific needs that the Project would address.

What is the purpose of the Aurora Corridor Improvement Project?

The purpose of the Aurora Corridor Improvement Project, N 165th Street to N 205th Street, is to improve safety, circulation, and operations for vehicular and non-motorized users of the roadway corridor, to support multi-modal transportation within the corridor, and to support economic stability along the corridor.

How were the needs of the Aurora Avenue corridor identified?

The needs of the Aurora Avenue corridor that would be addressed by this Project were identified through:

- Regional Metropolitan Transportation Plan,
- City Comprehensive Plan, and
- City Multimodal Pre-Design Study.

Regional Metropolitan Transportation Plan

Improvement to Aurora Avenue N between N 165th Street and N 205th Street is identified in *Destination 2030,* which is the regional Metropolitan Transportation Plan that addresses long-range transportation needs of a growing population (PSRC 2001). The plan includes a detailed set of projects and programs that recognize the link between transportation and growth planning. It identifies more than 2,000 specific projects that will improve roads, transit and ferry service, bicycle and pedestrian systems, freight mobility, and traffic management and operations. *Destination 2030* calls for the development of new state and regional funding mechanisms to provide sustained and flexible revenues that support plan strategies, and it outlines a monitoring and review process for ensuring that plans are current and that implementation stays on course.

City Comprehensive Plan

Improving Aurora has been a community goal since the City of Shoreline incorporated in 1995. However, regional and local governments recognized the need for improvements along Aurora Avenue N even before the City's incorporation. Before the City was incorporated, King County initiated a project to provide transit enhancements along Aurora Avenue N. After incorporation, the City requested that the project be postponed until the City could complete its comprehensive planning process to define improvements in the Aurora Avenue N corridor.

The City of Shoreline Comprehensive Plan was first adopted in November 1998 and most recently updated in June 2005. The Plan establishes the City's vision, and establishes Framework Goals intended to guide the City to meet that vision. The City's goals for Aurora Avenue N, as stated in its Comprehensive Plan, are to improve safety for all users on the roadway, to support economic stability along the corridor, and to improve mobility by supporting multimodal transportation services (City of Shoreline 2005a). Assessment of the City's goals and policies, as established in the Comprehensive Plan, is provided in the *Land Use, Plans, and Policies Discipline Report* prepared as part of the environmental analysis for this Project (Jones & Stokes 2007a).

Multimodal Pre-Design Study

In 1998, the City of Shoreline began the 1-year Aurora Corridor Multimodal Pre-Design Study (CH2M Hill 1999). The study included an extensive Community and Agency Involvement Program involving a variety of public and private stakeholders in the plan development. Multiple opportunities for community input were provided, and emphasis was placed on clearly articulating the technical elements of the plan. The Community and Agency Involvement Program included both the community and agencies because both are necessary for consensus building. A key Community and Agency Involvement Program component was the participation of a Citizens' Advisory Task Force, made up of representatives from the business and residential communities and transit users. An Interagency Technical Advisory Committee also included public sector stakeholders. These advisory committees recommended a preferred design concept, described in the following section.

Multimodal Transportation

Multimodal transportation refers to multiple choices for travel, including driving alone, carpooling, walking, biking, or riding transit.

Community and Agency Involvement Program elements included:

- ongoing participation of the Citizens' Advisory Task Force, Interagency Advisory Committee, and Policy Advisory Committee;
- project briefings with City Council and Planning Commission;
- three public open houses;
- open house announcements mailed to 3,000 addresses each time an event was held;
- canvassing by the Citizens' Advisory Task Force;
- meetings with property owners within the study area;
- meetings with community interest groups;
- newsletters distributed to landowners, business owners, and other interested parties; and
- press releases distributed to neighborhood associations, community groups, and local media.

Community Outreach

The City conducted a total of 23 meetings with the Citizens' Advisory Task Force, Interagency Technical Advisory Committee, and the general public. The City also conducted eight City Council briefings and two planning commission presentations. Three open houses were held during the course of the Pre-Design Study. Each meeting was designed to encourage interactive involvement through small group design workshops, informal ballots, prioritization exercises, and comment sheets.

32 Points

The corridor project design concept and the 32 Points (see exhibit on following page) were approved unanimously by the Citizen Advisory Task Force on July 8, 1999, and were adopted unanimously by the City Council as part of Resolution 156 on August 23, 1999. The 32 Points were to be used as guides during implementation and design of Aurora Avenue improvement projects, to ensure that concerns of the community and the vision of the City Council are fully addressed.

The main features of the adopted design concept include the addition of BAT lanes in each direction on the roadway; curbs, gutters, landscaping/street furnishing strip, and sidewalks on both sides; and the creation of a landscaped center median safety lane with left and u-turn pockets. The 32 Points also included recommendation of four new signalized intersections and four new pedestrian-activated signalized crossings along the 3-mile length of Aurora Avenue N within the city limits.

The main features of the adopted design concept include:

- the addition of BAT lanes in each direction on the roadway;
- curbs, gutters, landscaping/street furnishing strip, and sidewalks on both sides; and
- the creation of a landscaped center median safety lane with left and u-turn pockets.

Exhibit. The "32 Points"

1. The maximum number of lanes on an intersection leg shall not exceed eight lanes including turning lanes. Seven lanes is the desired width.
2. Provide ability at intersections for all pedestrians to safely cross (and include median refuge at intersections with pedestrian pushbuttons). New mid-block pedestrian crossings should include pedestrian activated signals. Bus stops and pedestrian crossings will complement each other.
3. Twelve foot sidewalks will be provided on both sides of Aurora the entire length. Consider reducing the initial sidewalk width to mitigate land impacts/acquisitions on existing businesses. Note: a minimum of four feet of a landscaping/street furnishing zone is included in the twelve foot width total above.
4. Utilize more landscaping or colored pavement in sidewalk areas to soften the look. The four foot landscaping/street furnishing strip behind the curb should utilize trees in tree grates/pits (consider a combination tree protector/bike rack), low growing ground cover/shrubs, and could utilize some special paving (or brick) between curb and sidewalk to strengthen the identity of an area.
5. Strive to design the project so that new sidewalks can link to existing recently constructed sidewalks (such as Seattle Restaurant Supply, Drift-on-Inn, Schucks, Hollywood Video, and Easley Cadillac).
6. Re-align the street where possible to avoid property takes.
7. As the final design is developed, work with WSDOT to obtain design approvals for lane width reductions, and look for opportunities to reduce (but not eliminate) the median width both to enable reduction of pavement widths, construction costs, and land impacts/acquisition on existing businesses.
8. Develop median breaks or intersections for business access and U-turns at least every 800-to-1000 feet (these details will be worked out during future design phases and will be based in part on the amount of traffic entering and exiting businesses).
9. Use low growing drought resistant ground-cover and space trees in the median to allow visibility across it.
10. Unify the corridor by adding art, special light fixtures, pavement patterns (and coloring at crosswalks), street furniture, banners, unique bus shelters, etc. to dramatically enhance image and uniqueness of the streetscape and develop it differently than the standard design that has been constructed for most streets.
11. Unify the entire corridor by the use of street trees, lighting, special paving, bus zone design, and other elements to visually connect the corridor along its length.
12. Provide elements in the Interurban/Aurora Junction area, between 175th and 185th that create a safe, pedestrian oriented streetscape. Elements can include special treatments of crossings, linkages to the Interurban Trail, etc.
13. Develop signature gateway designs at 145th and 205th with special interest landscaping, lighting, paving and public art to provide a visual cue to drivers that they have entered a special place.
14. Develop themes that reflect the character and uses of different sections of the street (such as the 150th to 160th area which has a concentration of international businesses, recall the historic significance of the Interurban or other historic elements, and Echo Lake).
15. Utilize the Arts Council and neighborhoods to solicit and select art along the corridor.
16. Strengthen connections to the Interurban Trail through signing and other urban design techniques.
17. Develop a design for closure of Westminster Road between 158th and 155th by developing a southbound right turn lane at 155th Street and converting the existing road section to a driveway entrance to Aurora Square. Also, develop an elevated Interurban trail crossing through "the Triangle" that is integrated with future development of the Triangle (reserve the option to build above Westminster should we not be successful in closing the roadway).
18. Pursue modifying the access to Firlands at 185th, closing Firlands north of 195th, and developing a new signal at 195th.
19. The preferred design shall include:
    - Stormwater management improvements to accompany the project that follow the city's policies;
    - Traffic signal control and coordination technology (including coordination with Seattle and Edmonds SR 99 signal systems);
    - Traffic signal technology to enable transit priority operations;
    - Continuous illumination for traffic safety and pedestrian scale lighting;
    - Undergrounding of overhead utility distribution lines.
20. Traffic signals will include audible elements for the sight-impaired, and wheelchair detection loops for wheelchair users.
21. The City should establish a right-of-way policy to retain or relocate existing businesses along the corridor, including those that do not own the land on which they are located. Consideration should be given to providing financial incentives to those businesses.
22. Work with property and business owners during the preliminary engineering phase to consolidate driveways, share driveways, and potentially to share parking and inter business access across parcel lines. Be creative and sensitive to the parking needs of businesses, including consideration for some potential clustered/shared parking lots (especially if remnant parcels are available).
23. Provide improvements that will not generate an increase in neighborhood spillover traffic.
24. Work with transit agencies to provide increased service and seek capital investments from them to support this project.
25. Develop partnerships with WSDOT and King County/Metro to jointly fund the project.
26. Provide curb bulbs where practical on side streets to reduce pedestrian crossing width and to discourage cut-through traffic.
27. Strengthen and preserve the heritage of the red brick road. If the design impacts the red brick road in its current configuration/location north of 175th, preserve its heritage by relocating it elsewhere.
28. Consider new signalized intersections at 152nd, 165th, 182nd, and 195th.
29. Consider new pedestrian only signalized crossings in the vicinity of 149th, 170th, 180th and 202nd.
30. Sign Ronald Place south of 175th as the route to I-5.
31. Pursue reducing the speed limit to 35 mph where appropriate recognizing the potential impacts of spillover traffic with a lower posted speed.
32. Seek funding to develop a program to assist and encourage businesses to improve their facades.

City of Shoreline (Resolution 156, August 23, 1999)

What are the needs addressed by the Aurora Corridor Improvement Project?

System Linkage

The proposed project would improve regional system linkage by providing additional lane capacity, improved intersection capacity, and improved signal coordination. It would also continue the improvements underway between N 145th Street and N 165th Street, creating a consistent continuous corridor throughout the City.

Aurora Avenue N is a major north/south arterial link that serves both local and regional traffic within the City of Shoreline. It is part of the National Highway System (NHS). The portion of Aurora Avenue N within the City connects SR 104 and SR 523. In addition to serving intra-city traffic, the route serves as a regional link between cities in the Puget Sound region, connecting to the City of Seattle to the south and Snohomish County to the north. It is the significant alternative to I-5 in providing north/south regional linkage. The portion of SR 99 located within the City has also been identified as a Highway of Statewide Significance (Washington State Transportation Commission 1998). Highways of Statewide Significance, identified under the Revised Code of Washington (RCW) 47.06.140, are those facilities deemed to provide and support transportation functions that promote and maintain significant statewide travel and economic linkages. The legislation emphasizes that these significant facilities should be planned from a statewide perspective (WSDOT 2002).

National Highway System

Federally identified highways that are most important to interstate travel and national defense, connect other modes of transportation, and are essential for international commerce.

Highway of Statewide Significance

Highways identified by the Washington State Transportation Commission that provide significant statewide travel and economic linkages.

The timely delivery of goods is extremely important to business operations and economic vitality. Aurora Avenue N is identified by WSDOT as a truck freight route in the statewide Freight and Goods Transportation System (FGTS). It carries more than 5 million tons of freight annually, so is classified as a T-2 tonnage class roadway (WSDOT 2005). It has also been identified as part of the King County Regional Arterial Network, and the Puget Sound Regional Council (PSRC) Metropolitan Transportation and Freight and Goods Systems. Aurora Avenue N also provides a connection between other routes on the FGTS, including Westminster Way/Greenwood Avenue (class T-2), SR 523 (class T-3), N 185th Street (class T-2), and SR 104 (class T-3) (WSDOT 2005).

WSDOT Freight and Goods Transportation System (FGTS) Classifications

Roadways are classified according to the average volume of freight they carry each year:

T-1 > 10 million tons per year

T-2 4 million – 10 million tons per year

T-3 300,000 – 4 million tons per year

T-4 100,000 – 300,000 tons per year

T-5 At least 20,000 tons in 60 days

Aurora Avenue N provides a linkage for commuters and transit to two regional Park and Ride facilities located at N 192nd Street and Aurora Avenue N; and on N 200th Street, two blocks east of Aurora Avenue N.

The City is currently completing improvements to Aurora Avenue N between N 145th Street and N 165th Street, which include similar elements to those proposed for the Project. Improvements include BAT lanes; curbs, gutters, landscaping/utility strip, and sidewalks on both sides; a landscaped center median with left and u-turn pockets, new signalized intersections, pedestrian-activated signalized crossings, undergrounding of utilities, and stormwater facilities.

Capacity

The proposed project would address capacity needs through improvements to intersection geometry and capacity, channelization, signal improvements, and additional lane capacity for business access and transit. By reducing the number of access points according to WSDOT criteria, capacity in the corridor would be improved through the reduction of conflicts and traffic friction.

The capacity of the current facility is inadequate to accommodate projected traffic volumes. The corridor currently supports 33,000 to 39,000 daily vehicle trips. Traffic analysis completed for the Aurora Avenue N corridor assessed level of service (LOS) from now through the future planning year of 2030, under conditions both with and without the proposed project. Over the next 20 years, volumes along the corridor are expected to increase by 1.1% annually.

LOS is the primary measurement used to determine the operating quality of a roadway segment or intersection. LOS is generally measured by the ratio of traffic volume to capacity (V/C) or by the average delay experienced by vehicles on the facility. The quality of traffic operation is graded into one of six LOS designations: A, B, C, D, E, or F. LOS A represents the best range of operating conditions and LOS F represents the worst. LOS on transportation facilities is analyzed and measured according to procedures provided in the Highway Capacity Manual (Transportation Research Board 2000). In an urban corridor such as Aurora Avenue N, LOS at intersections controls the overall LOS of the roadway. LOS for signalized intersections is determined by the average amount of delay experienced by vehicles at the intersection. LOS standards are used

Level of Service (LOS) - Characteristics of Traffic Flow

LOS A	Free flow, little or no restriction on speed or maneuverability caused by the presence of other vehicles.
LOS B	Stable flow, operating speed is beginning to be restricted by other traffic.
LOS C	Stable flow, volume and density levels are beginning to restrict drivers in their maneuverability.
LOS D	Stable flow, speeds and maneuverability closely controlled due to higher volumes.
LOS E	Unstable flow, low speeds, considerable delay, volume at or near capacity, freedom to maneuver is difficult.
LOS F	Forced traffic flow, very low speeds, traffic volumes exceed capacity, long delays with stop and go traffic.

to evaluate the transportation impacts of long-term growth. The Washington State Growth Management Act (RCW 36.70A, 1990) requires that jurisdictions adopt standards by which the minimum acceptable roadway operating conditions are determined and deficiencies may be identified. The City of Shoreline has adopted a standard of LOS E for intersections within the City (City of Shoreline 2005a).

Detailed traffic analysis of Aurora Avenue N is presented in the *Transportation Discipline Report* prepared for this Project. The analysis shows that without improvements, average delay at key signalized intersections along Aurora Avenue N will fall to LOS F. These conditions are considered unacceptable by most drivers and exceed the City's adopted standard of LOS E. A lack of adequate capacity along Aurora Avenue N could cause increased traffic volumes along parallel neighborhood routes.

Regional Transportation Demand

The proposed project would provide additional automobile and transit capacity to help meet the demand that is anticipated to occur in the Aurora Corridor over the next 20 years. The City's design concept for the Aurora Corridor Improvement Project satisfies the following regional policies discussed below:

- Optimize and manage the use of transportation facilities and services.
- Manage travel demand by addressing traffic congestion and environmental objectives.
- Focus transportation investments by supporting transit-and pedestrian-oriented land use patterns.
- Expand transportation capacity by offering greater mobility options.

The PSRC has adopted a Regional Transportation Plan (RTP), the Transportation Element of *Destination 2030* (PSRC 2001). The RTP provides the long-range strategy for future investments in the central Puget Sound region's transportation system. It responds to federal legislative mandates such as the federal Transportation Equity Act for the 21st Century (TEA-21) and the Clean Air Act (CAA); and state mandates such as the Commute Trip Reduction (CTR) Law (RCW 70.94.521-551) and the Growth Management Act (GMA)

Regional Transportation Plan (RTP)

The RTP provides the long-range strategy for future investments in the central Puget Sound region's transportation system.

(RCW 36.70A). It also is intended to respond to regional concerns of pressing transportation problems. The basic building blocks for the RTP are state, city, county, and transit agency plans and policies.

Improvements to Aurora Avenue N through Shoreline are included in the list of capital projects identified by the RTP as critical, and as part of the Metropolitan Transportation System required to satisfy regional needs through 2030.

Modal Interrelationships

The proposed project would enhance mobility and safety for pedestrians by providing continuous sidewalk, curb, and gutter along both sides of the roadway. Additional crosswalks will provide more safe crossings for pedestrians. Pedestrian links would also be provided to the adjacent Interurban Trail.

Bicyclists traveling along Aurora Avenue N would be allowed to travel on the sidewalks or in the BAT lanes, and would also benefit from connections provided to the Interurban Trail.

The Project would also improve transit operations and reliability through the addition of the BAT lanes, providing a lane for bus operation outside the general-purpose traffic flow.

The portion of Aurora Avenue N within the City is heavily automobile-oriented, and lacking in pedestrian or bicycle facilities. Driveway access along the corridor is largely undefined and sidewalk facilities are discontinuous and substandard. The only areas where sidewalks meet City standards are areas along developments that have been built within the last 10 years.

Buses on Aurora Avenue N travel in the general-purpose lanes. When traffic is congested, the buses are likely to be delayed. When buses stop to pick up and drop off passengers, they block traffic in one of the two general-purpose lanes that currently exist in each direction. Bus stops lack safe access, especially for persons with disabilities. The absence of safe, continuous pedestrian facilities can dissuade potential transit patrons from using the bus system. Bicyclists currently have to travel either on shoulders, where they exist, or in the general-purpose traffic lanes.

The Interurban Trail is a pedestrian and bicycle facility that runs roughly parallel to Aurora Avenue N, providing regional connection

The Interurban Trail

The Interurban Trail is a regional pedestrian and bicycle facility that runs roughly parallel to Aurora Avenue N. Construction is currently underway, with completion planned for July 2007. After construction is complete, the Interurban Trail will run throughout the entire City length, between N 145th Street and N 205th Street.

from Everett through Seattle. Construction within the City is currently underway, with completion planned for July 2007. After construction is complete, the Interurban Trail will run throughout the entire City length, between N 145th Street and N 205th Street. In the project area, the trail is located approximately one block east of Aurora Avenue N between N 165th Street and N 192nd Street; runs to the east of Echo Lake; runs east-west along N 200th Street to Meridian Avenue; and then runs north-south on the east side of Meridian Avenue through Ballinger Commons (City of Shoreline 2007). Existing sidewalks are inadequate to provide pedestrian connectivity along Aurora Avenue N and to the Interurban Trail.

Safety

Project elements would improve channelization, separate pedestrians from vehicular traffic, and reduce potential conflicts between vehicles, pedestrians, and bicyclists. The City is working with businesses and property owners to develop appropriate solutions that address access and parking issues, while still maintaining project goals.

WSDOT collects and compiles historical collision data for state highways, including Aurora Avenue N. Several areas of Aurora Avenue N, between N 165th Street and N 205th Street, have been given poor safety designations by WSDOT. WSDOT has identified one High Accident Corridor (HAC), three High Accident Locations (HALs), and two Pedestrian Accident Locations (PALs) on Aurora Avenue N, between N 165th Street and N 205th Street, for the 2007–2009 biennium. Between 2003 and 2005, the average annual collision rate for the entire Aurora Avenue N corridor within Shoreline was calculated to be 5.5 accidents per million vehicle miles traveled. This greatly exceeds the 2003 statewide average for urban principal arterials of 2.6 accidents per million vehicle miles. There is strong public concern for general traffic safety and pedestrian safety along the corridor. Collision history and WSDOT safety designations are discussed in further detail in the *Transportation Discipline Report* prepared as part of the environmental analysis for this Project.

High Accident Corridor (HAC)

A highway corridor one mile or greater in length where a 5-year analysis of collision history indicates that the section has higher than average collision and severity factors.

High Accident Location (HAL)

A highway section typically less than 0.25 mile in length where a 2-year analysis of collision history indicates that the section has a significantly higher than average collision and severity rate.

Pedestrian Accident Location (PAL)

A highway section typically less than 0.25 mile in length where a 6-year analysis of collision history indicates that the section has had four pedestrian accidents in a 0.1 mile segment.

Aurora Avenue N currently lacks adequate access management. Land use along Aurora Avenue N is predominantly commercial/retail. Most of the businesses are freestanding, with defined and undefined individual driveways, or continuous shoulder

access. Numerous driveways, limited curbs and sidewalks, and erratic parking all contribute to a general lack of safe passage for pedestrians, bicyclists, and vehicles. This type of development has resulted in a very high number of individual access points that increase conflict and impact safety along the corridor. In total, there are 154 access points along the 2-mile length within the Project corridor. National Cooperative Highway Research Program (NCHRP) Report 420 indicates that the ideal number of access points is fewer than 30 per mile (Gluck et al. 1999).

Much of the existing business parking along the corridor is directly adjacent to the roadway shoulders and is angled or perpendicular to the street. Many existing parking spaces require motorists to back onto the roadway to exit. Parking within the Aurora Avenue N roadway right-of-way occurs primarily near retail and commercial land uses within the Project area. Several businesses along the roadway between N 165th Street and N 205th Street use the shoulder for parking in areas where there is no curb, effectively blocking pedestrians and people in wheelchairs.

Project elements that would improve safety conditions along Aurora Avenue N include:

- addition of curbs and gutters and focused driveway locations;
- application of driveway width and spacing standards;
- proposed traffic signals and pedestrian crosswalks;
- conversion of the existing two-way left-turn-lane into a median with channelized left-turn and u-turns;
- restriction of driveways to right-turn-in and right-turn-out only;
- elimination of motorists' ability to back onto the roadway to exit; and
- provision of the BAT lanes that would allow traffic to safely enter and exit the roadway with fewer conflicting movements and lower risk of crashes.

Social Demands/Economic Development

The Project would address the need to continue to enhance the movement of people and goods within the SR 99 commercial

The City Comprehensive Plan provides forecasts of job growth within the Aurora Avenue N corridor. This growth depends on a revitalized roadway corridor along all of Aurora Avenue N, including the area between N 165th Street and N 205th Street.

corridor, as identified in the Comprehensive Plan, by improving person and freight mobility; pedestrian, bicycle, and transit linkages; and overall safety for vehicular and non-vehicular travelers.

The City Comprehensive Plan provides forecasts of job growth within the Aurora Avenue N corridor. This growth depends on a revitalized roadway corridor along all of Aurora Avenue N, including the area between N 165th Street and N 205th Street.

The Comprehensive Plan sets forth a vision that concentrated activity centers will develop at several locations along the corridor. These are located between N 175th Street and N 185th Street, and between N 200th Street and N 205th Street (Aurora Village). To support the economic development goals of the Comprehensive Plan, improvements are needed for pedestrian and transit access to and between these locations. The City's objective for Aurora Avenue N is to install improvements that would lead people to the community and its businesses (City of Shoreline 2005a).

What is the legislative context for the Project?

There are three articles of legislation that provide specific direction for the Project. City Resolution 156, City Ordinance 326, and RCW 47.50 are discussed below.

City Resolution 156

Resolution 156 was adopted unanimously by the Shoreline City Council on August 23, 1999, at an open meeting that included opportunities for public testimony. This resolution accepted the recommendation of the CATF for the 3-mile Aurora Avenue N corridor within the city limits; found the recommendation to be in conformance with the City Comprehensive Plan (2005); initiated an amendment to the Capital Improvement Program; and directed staff to pursue environmental analysis for the corridor improvement. Resolution 156 included the 32 Points directive described earlier in this chapter.

City Ordinance 326

Ordinance 326, which consists of revisions to the City's Comprehensive Plan, was passed 5 to 1 by the Shoreline City Council on July 14, 2003. This ordinance amended the text of Land Use Policy LU48 and added a new Transportation Policy 5.1 for the purpose of identifying future right-of-way needs of Aurora Avenue N, between N 172nd Street and N 192nd Street. The ordinance also added a right-of-way map for this area to the Transportation Element. In general, this ordinance identifies any widening that occurs along this segment of the roadway, and resulting right-of-way acquisition needed, as occurring to the east of the existing roadway. SEPA review was completed for Ordinance 326, prior to adoption. The ordinance was not subject to NEPA. However, for the purposes of the NEPA and SEPA evaluation of the Project, the separate Build Alternatives were defined to reflect widening to both the east and the west, so that the potential impacts under the full possible range of build options would be evaluated. If the Recommended Alternative that is ultimately selected requires right-of-way outside of the boundaries defined in the ordinance, Policy T5.1 in the Comprehensive Plan, which specifically defines the boundaries, would need to be amended.

Access Management RCW 47.50

To preserve the safety and operational characteristics of state highways, RCW 47.50 was enacted in 1991, designating all highways in Washington as controlled-access facilities. Aurora Avenue N, part of SR 99, is a class 4 facility according to the WSDOT access control classification system and standards. Within this class, access management measures are identified, such as minimum driveway spacing of 250 feet and installation of medians to mitigate turning, weaving, and crossing conflicts that affect safe travel. Based on the urban environment served by Aurora Avenue N and the high traffic volumes it carries, the street's design is deficient in terms of access management for the preservation of safety and traffic operations. Any improvement to Aurora Avenue N would have to comply with access management standards defined under this law.

Chapter 3. Alternatives

This chapter describes alternatives evaluated for the proposed project.

What alternatives are considered in this discipline report?

This report evaluates the potential effects of a No Build Alternative and three Build Alternatives, which are described in the following sections.

No Build Alternative

Under the No Build Alternative, Aurora Avenue N would remain exactly as it is today. The roadway has two general-purpose lanes in each direction with a center two-way left-turn lane. Shoulder and sidewalk of varying widths are located sporadically along the corridor with intermittent curb and gutter, some drainage ditches, and minimal landscaping. The corridor is served by public transit provided by King County Metro, with additional service at the north end of the corridor provided by Community Transit. Buses on Aurora Avenue N would continue to travel and stop in the general-purpose lanes.

Build Alternatives

The City has proposed three Build Alternatives: Alternative A, Alternative B, and Alternative C. Table 2 provides an overview of

Project features unique in an individual Build Alternative and features common among them.

Figures 2, 3, and 4 present plan views of the three Build Alternatives, respectively. Figure 5 presents more detailed schematic drawings of the proposed roadway configurations under each of the three alternatives. The drawings show one direction of travel of the proposed roadway alternatives, which is typical of both directions.

Table 2. Common and Unique Features of the Aurora Corridor Improvement Project Build Alternatives

Features Common among Build Alternatives A, B, and C	
General-purposes lanes	Project design includes two general-purpose lanes in each direction.
BAT lane	Each Build Alternative would include one Business Access and Transit (BAT) lane in each direction.
Sidewalk	7-foot sidewalks would be constructed along both sides of the corridor.
Curb and Gutter	Curb and gutter would be constructed along both sides of the corridor. Curb ramps would be constructed at all intersections in accordance with ADA requirements.
Underground utilities	Utilities would be placed underground for each of the three Build Alternatives.
Vegetation	Each of the alternatives includes vegetative plantings. Extent and location vary as described below.
Center median	A center median would be added, with left-turn and u-turn pockets (width of the center median varies by alternative, as described below).
Traffic signals	New traffic signals proposed at Aurora Avenue N/N 182nd Street and Aurora Avenue N/Firlands Way N (north of N 195th Street). Signalized intersections will be widened to improve east-west capacity and traffic flow.
Road improvements	Improvements would be made to: - Echo Lake Place (north of N 195th Street), including realignment and a connection to Aurora Avenue N at Firlands Way N; and - Midvale Ave N (N 175th Street – N 183rd Street), including realignment, addition of a center turn lane, curb and gutter, and sidewalk on the east side of the roadway. The new Interurban Trail will serve as the walking path on the west side of the roadway.

Features that vary among Alternatives A, B, and C	Alternative A	Alternative B	Alternative C
Cross Section	Typically 98 feet from back-of-sidewalk to back-of-sidewalk. The cross section will be wider where utility vaults, light/signal poles, and bump outs are located, as described below. This dimension is 12 feet narrower than the cross sections proposed under Alternatives B and C, due to a narrower median (12 feet instead of 16 feet) and the absence of the 4-foot amenity zone on each side of the roadway. The City would also acquire a continuous 3-foot-wide easement behind the sidewalk on each side of the roadway for placement of utilities.	110 feet from back-of-sidewalk to back-of-sidewalk.	
Median Width	Center median would be 12 feet wide.	Center median would be 16 feet wide.	
Amenity Zone	No amenity zone provided. Utility vaults and light/signal poles would be located behind the sidewalks in the 3-foot easement area.	A 4-foot amenity zone would be located between the curb and sidewalk on each side of the street. Utility vaults, light/signal poles, bus stop signs, hydrants, and other pedestrian amenities would be located in this area.	
Bump Outs	Bump outs approximately 4 feet in additional width would be needed at u-turn and left-turn locations to achieve the turning radii needed to accommodate u-turns.	None needed. U-turns would be sufficiently accommodated within the standard roadway width.	
Placement of Alignment	Required widening would be shifted to the east of the existing right-of-way in the vicinity of N 175th Street, N 185th Street, and N 200th Street.	Required widening would be shifted to the east of the existing right-of-way in the vicinity of N 175th Street, N 185th Street, and N 200th Street.	Required widening would be shifted to the west of the existing right-of-way in the vicinity of N 175th Street, N 185th Street, and N 200th Street.
Vegetation	Limited vegetation would be provided in the median.	More vegetation accommodated by wider median. Vegetation could also be planted in areas within the amenity zone.	

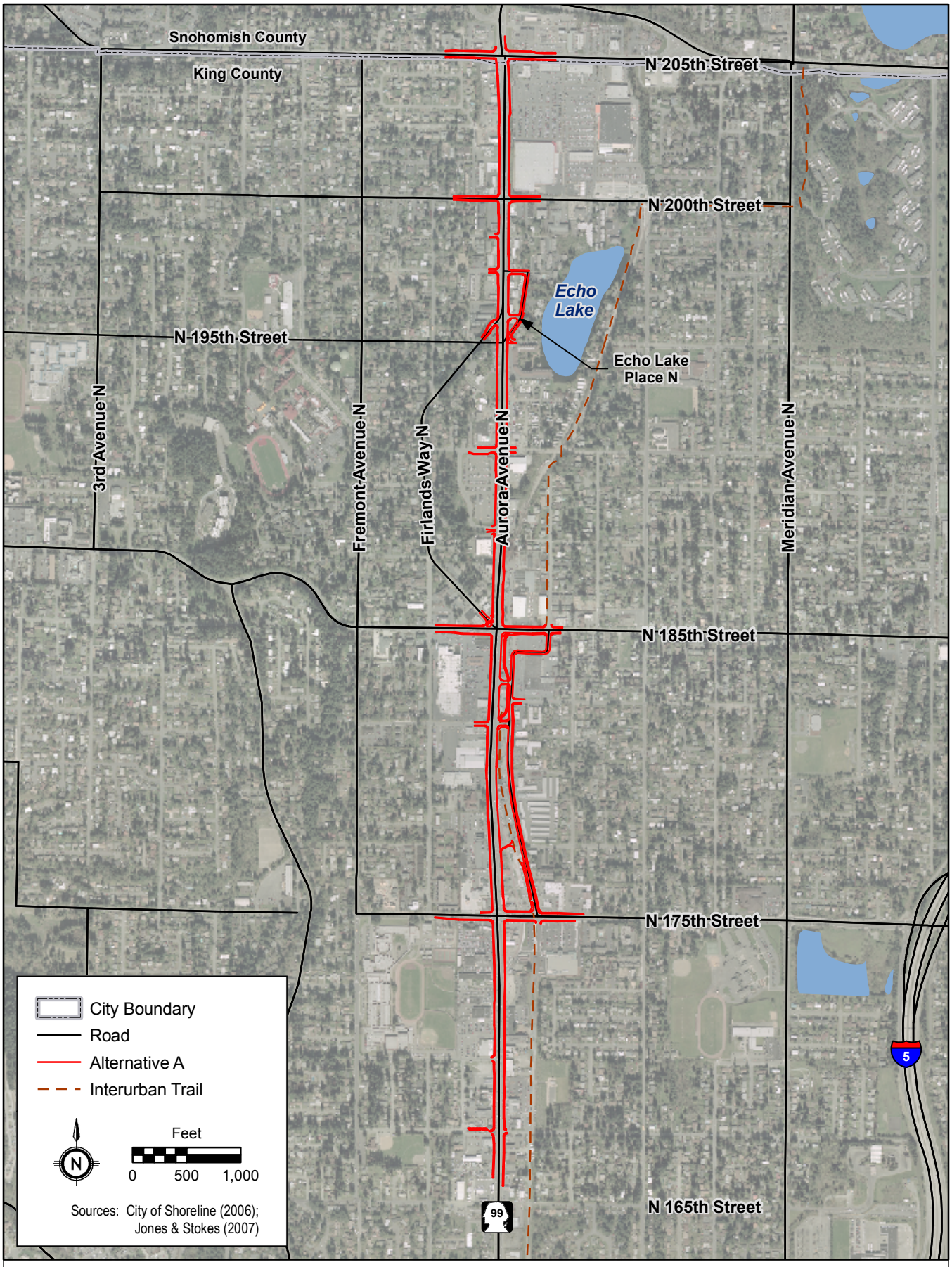


Figure 2. Alternative A
Aurora Corridor Improvement Project
September 2007

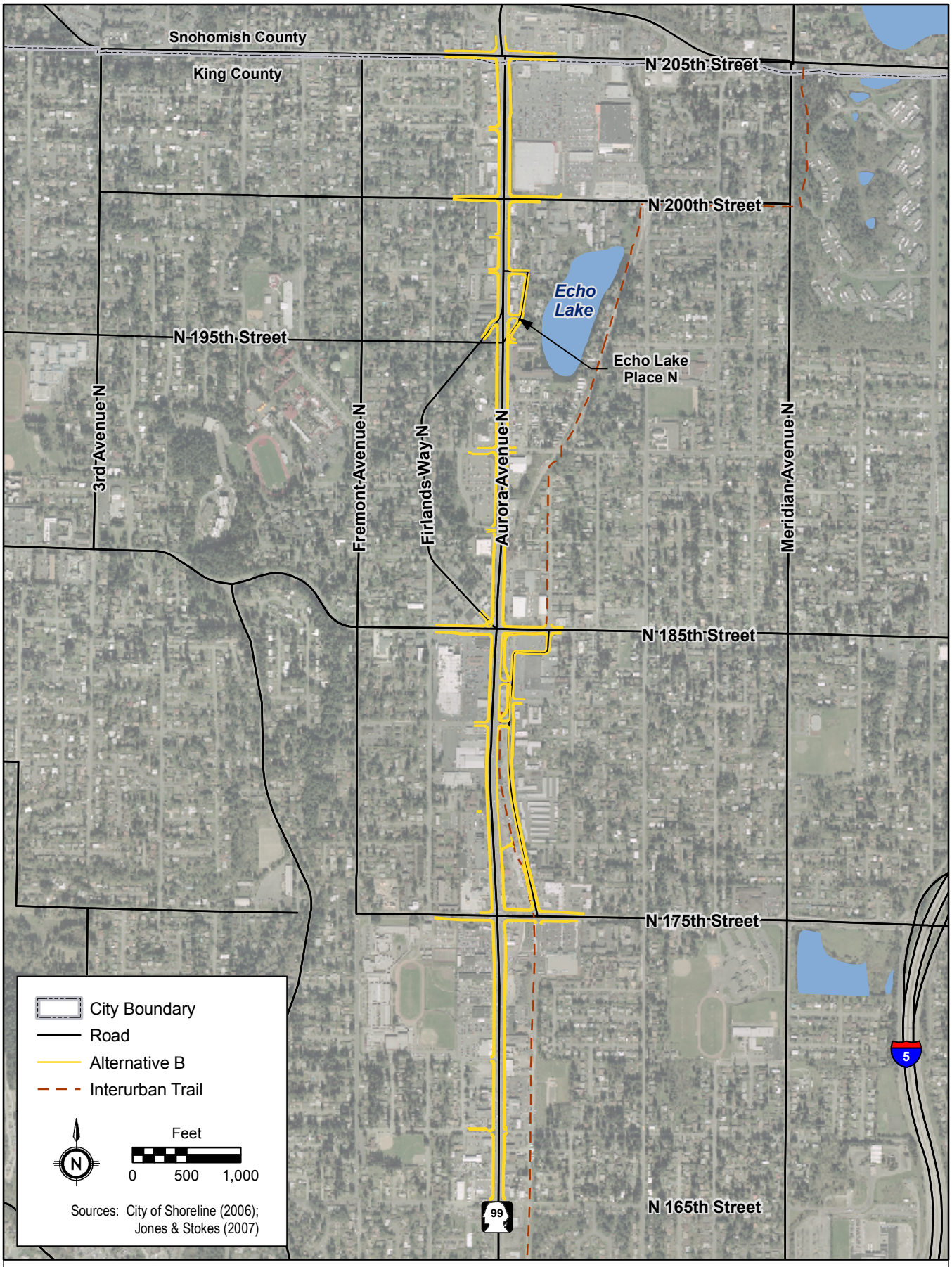


Figure 3. Alternative B
Aurora Corridor Improvement Project
September 2007

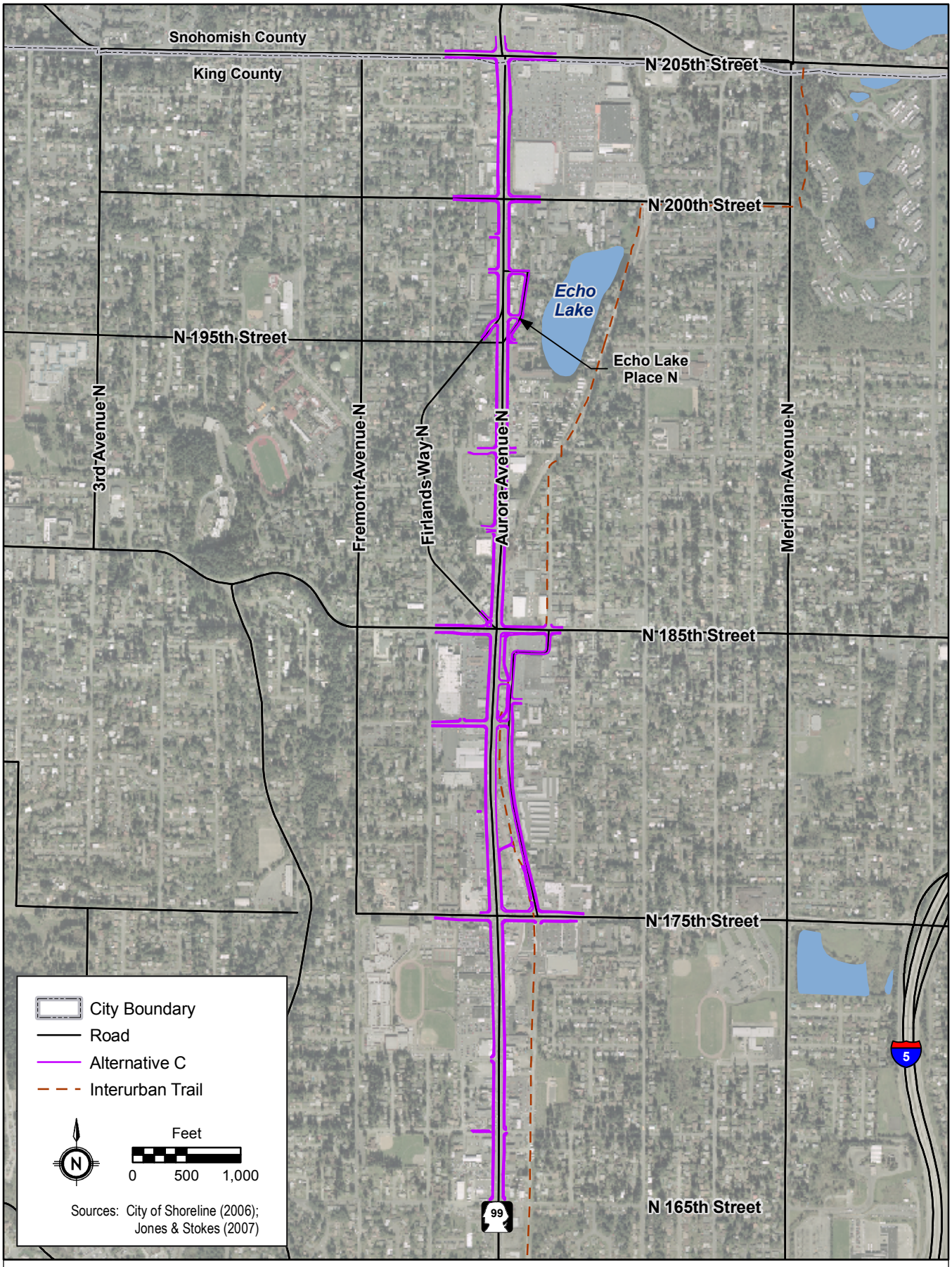
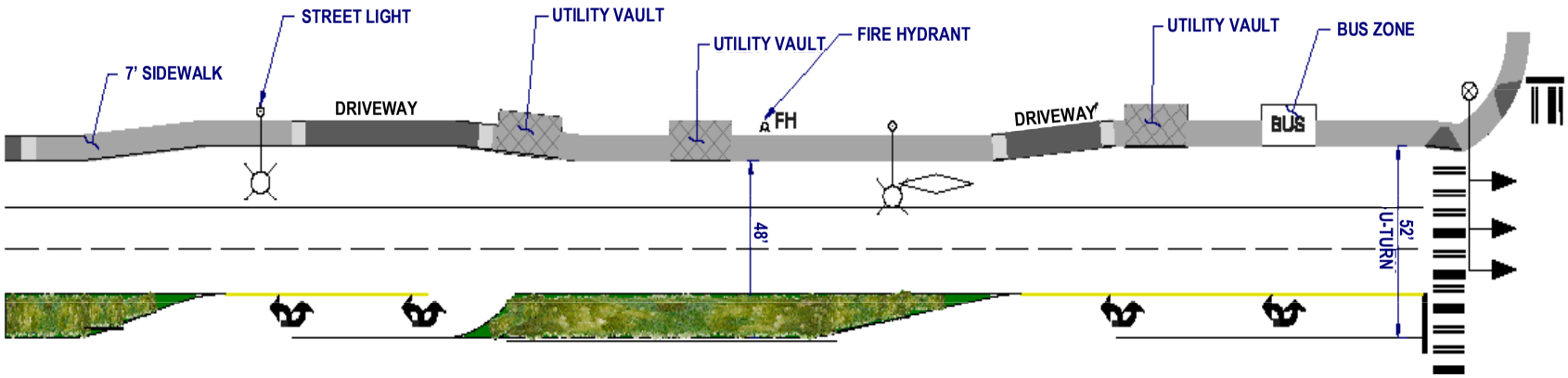


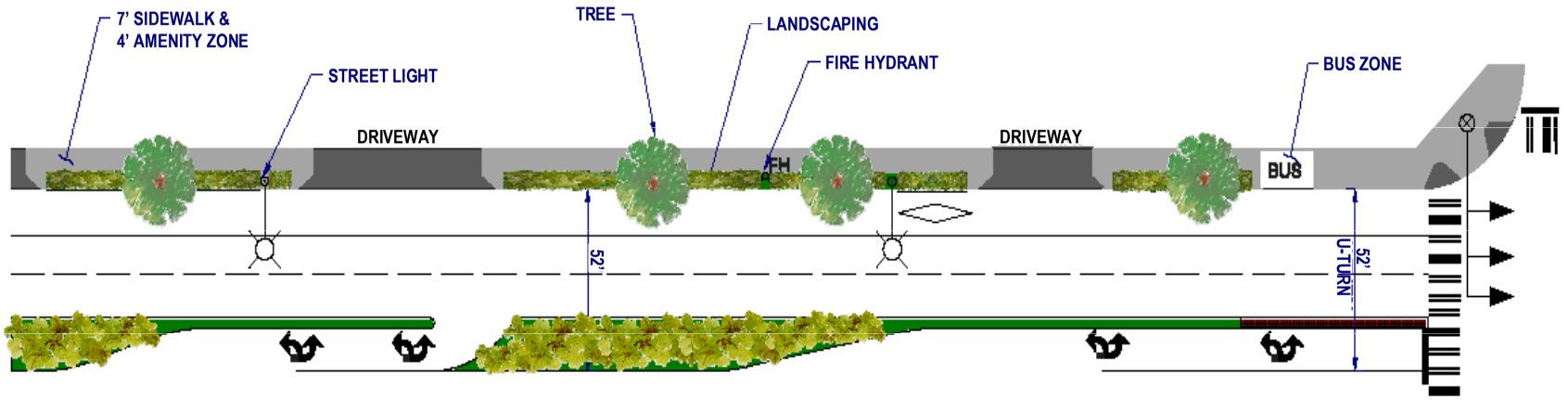
Figure 4. Alternative C
Aurora Corridor Improvement Project
September 2007

Alternative A



Alternatives B and C

Note: Drawing shows one direction of travel of the proposed roadway alternatives, which is typical of both directions



CITY OF SHORELINE AURORA CORRIDOR

Figure 5. Proposed Plan Detail for Build Alternatives
Aurora Corridor Improvement Project
September 2007

What stormwater treatment options are considered for this Project?

This report evaluates two stormwater management options that are being considered for stormwater treatment under the Build Alternatives. Option 1 consists of conventional elements, and Option 2 consists of Low Impact Development (LID) elements in addition to conventional elements. LID is an approach to stormwater management that uses the natural processes of vegetated areas to infiltrate, filter, store, evaporate, and detain runoff close to its source. Both conventional stormwater management and LID can be designed and implemented so that flow control and water quality requirements are met.

Low Impact Development (LID)

An approach to stormwater management that uses the natural processes of vegetated areas to infiltrate, filter, store, evaporate, and detain runoff close to its source.

Both options will be designed to meet requirements in the 1998 King County Surface Water Design Manual (KCSWDM), as amended by the City (Shoreline Municipal Code [SMC] 13.10). The three major requirements, conveyance, flow control, and water quality measures were evaluated for each option.

Conveyance

A mechanism for transporting water from one point to another, including pipes, ditches, and channels.

The conveyance system will be designed to convey the 25-year storm event and the overflow from the 100-year runoff event, to minimize the potential for creating or aggravating severe flooding problems. Portions of Aurora Avenue N that discharge into Boeing Creek will be conveyed to enter the piped watercourse in locations where the City has indicated there is capacity in the adjacent pipe network.

Flow Control

Facilities designed to either hold water for a considerable length of time and then release it by evaporation, plant transpiration, and/or infiltration into the ground, or to hold runoff for a short period of time, and then release it to the conveyance system at a controlled rate.

Since Aurora Avenue N is currently paved and adjacent properties consist of impervious surfaces, construction of any of the three Build Alternatives would result in a net decrease in impervious surfaces; thus, no flow control will be required. The decrease in impervious surface would result in stormwater flows from Alternatives A, B, and C to be less than flows under the No Build Alternative.

Water Quality

Term used to describe the chemical, physical, and biological characteristics of water, usually with respect to its suitability for a particular purpose.

Water quality will be designed to capture and treat 60% of the developed 2-year peak flow rate as per King County standards (KCSWDM Section 1.2.8 and 6.2). For the three Build Alternatives, vaults and filters are required to provide source control for oil due to the high traffic volumes on the roadway.

The proposed Aurora Avenue N improvements are occurring at a time when stormwater management requirements are changing statewide. The City currently uses the 1998 KCSWDM. Ecology is currently reviewing the 2005 KCSWDM to confirm that it meets the requirements of the Phase I and Phase II Western Washington Municipal Stormwater National Pollutant Discharge Elimination System (NPDES) Permit. The 2005 KCSWDM includes many updates to the 1998 KCSWDM Core Requirements and changes many of the thresholds, flow control, and treatment options required. The City Surface Water and Environmental Services Department indicated an objective to use the 2005 KCSWDM as the target requirements considered for Aurora Avenue N. It is assumed that this updated manual will be accepted by Ecology and in turn adopted by the City.

National Pollutant Discharge Elimination System (NPDES)

The federal program under Section 402 of the Clean Water Act for issuing, monitoring, and enforcing permits, and imposing and enforcing pretreatment requirements for discharges of pollutants from point sources to tidal waters, lakes, wetlands, rivers, streams, or other water courses.

In efforts to meet the current standards as well as to protect the existing drainage resources in Shoreline, this Project will target the assumed new stormwater management requirements as a goal when designing the drainage and stormwater management facilities.

The two stormwater management options are described in the following sections.

Stormwater Option 1 – Conventional System

Conventional stormwater management, which is similar to the system that currently exists, would be designed to collect, convey, filter, and detain stormwater using curbs and gutters, concrete catch basins, pipes, wet vaults, in-ground filter systems, and oil-water separators.

The conventional option for all three Build Alternatives will generally be similar. The Project impacts roughly the same area during construction. As part of the Project, stormwater conveyance pipes and catch basins will be replaced and located along curbs and gutters to maximize collection. Per 1998 KCSWDM requirements for conveyance, as amended by the City, the pipes will be sized to convey the 25-year storm event and the overflow from the 100-year runoff event, which will be modeled using the King County continuous modeling program.

Since the Project will remove and replace existing pavement, water quality will be improved to remove total suspended solids that can be collected from the roadway for all Build Alternatives. In addition,

due to the high traffic loads along Aurora Avenue N, oil/water separators will be required at every intersection.

Stormwater Option 2 - LID Combined with Conventional System

An LID stormwater system utilized in conjunction with a conventional conveyance system uses vegetative areas to collect, filter, and detain stormwater conveyed by the conventional system. When LID is coupled with conventional methods listed in Option 1, it often reduces or removes the need for and cost of large-scale conventional stormwater management methods such as detention pipes and vaults. In addition to mimicking the natural process for stormwater management, LID stormwater elements can improve the aesthetics of the Project area by increasing vegetative areas.

Because no amenity zone is proposed for Alternative A, opportunities to locate LID elements along the roadway are limited. There may be opportunities to locate bioretention within the planted medians (see Figure 5). The bioretention areas located in the medians would overflow into underground pipes that will manage high-flow storms and convey water off the roadway.

Bioretention

The removal of stormwater runoff pollutants using the chemical, biological, and physical properties afforded by a natural terrestrial community of plants, microbes, and soil. The typical bioretention system is set in a depressional area and consists of plantings, mulch, and an amended planting soil layer underlain with more freely draining granular material.

Since Alternative B and C have similar cross sections (see Figure 5), there are similar opportunities to incorporate LID elements (coupled with conventional stormwater management) to provide stormwater treatment for total suspended solids. The amenity zone proposed along both Alternatives B and C can provide opportunities to combine aesthetic landscaping and a safety buffer zone with stormwater management and treatment. Stormwater planters and tree filters can be located in the amenity zone and collect water as it flows along the curb line. During repeat and large storm events, the stormwater would overflow into an under-drain system that would move the water into the conveyance pipe network.

In addition, there are opportunities under all Build Alternatives to include permeable pavements, including porous concrete and asphalt, as well as permeable pavers along the sidewalks, driveways, and at bus stops. These surface treatments can reduce the quantity, and slow the velocity, of water entering Aurora Avenue N stormwater management system from adjacent right-of-ways and private property.

If trees are planted within the amenity zones (Alternative B or C only), or along the side streets, tree filters treatments and stormwater planter LID elements could be incorporated as the design of the street progresses.

In addition, oil/water separators will be required at every intersection due to traffic volumes along Aurora Avenue N, regardless of the amount of roadway conveyed to LID elements incorporated along the corridor.

When will the Recommended Alternative be selected?

The Recommended Alternative will be selected after all of the environmental analysis has been completed for the No Build Alternative and three Build Alternatives. The discipline reports that summarize the environmental analysis will be available for public review after they are finalized.

The boundaries of the three Build Alternatives encompass the maximum possible footprint of the Project. The Recommended Alternative ultimately selected for the Project may combine different elements from the different Build Alternatives. However, no part of the Project will occur outside of the study area analyzed in this report. The Recommended Alternative will include the final conceptual stormwater design, which will consist of either Option 1 or Option 2 of the stormwater concepts assessed in this report.

Chapter 4. Affected Environment

This chapter describes existing regulations and conditions of the environment as they relate to surface water/water quality.

What is the study area for surface waters?

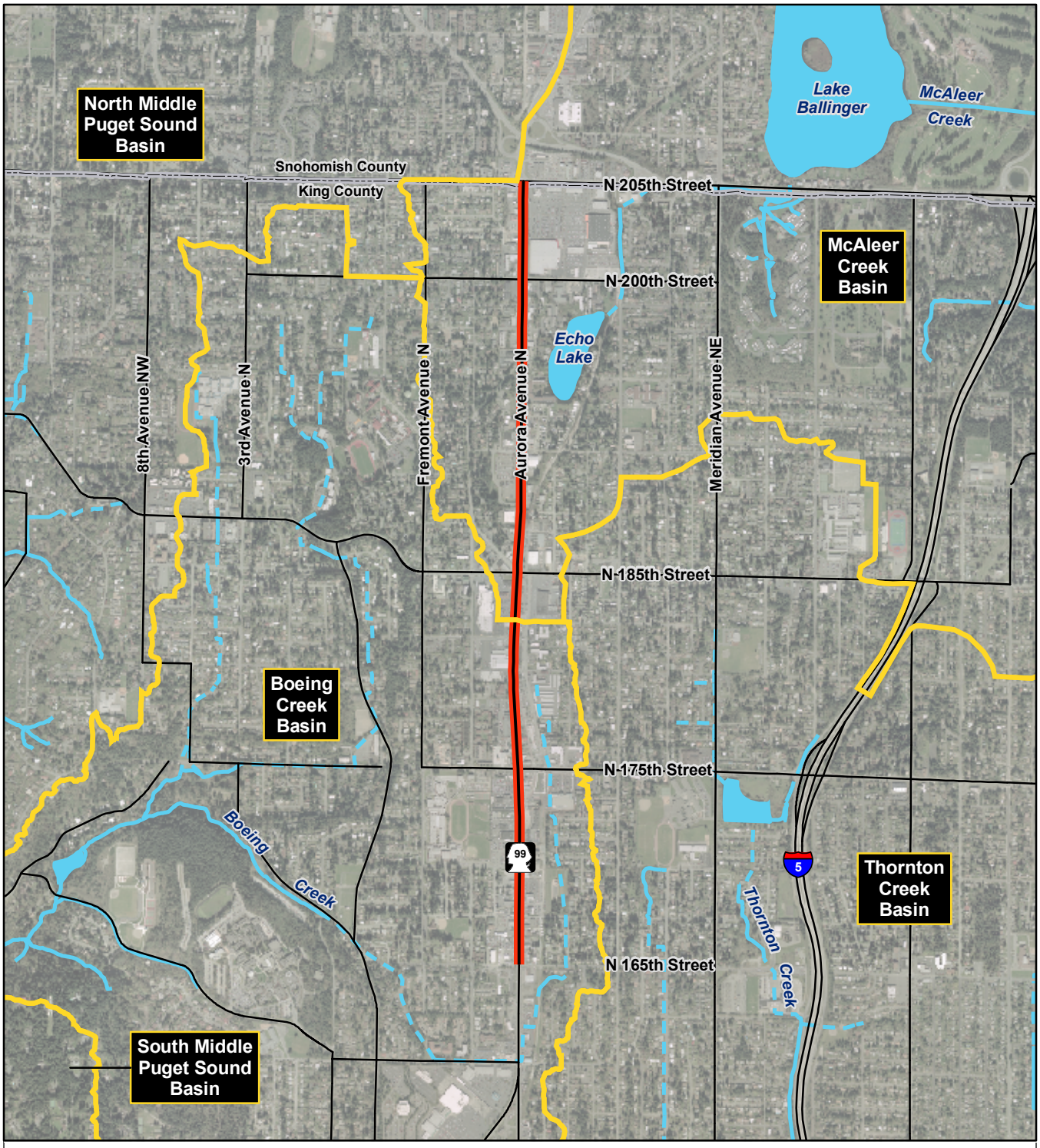
In order to include the potential effects of construction and of changes to the stormwater system, the study area has been defined as all areas within 75 feet of the project footprint, as well as the lakes and streams that receive stormwater discharges from the Project. Surface waters included in the study area include Boeing Creek, McAleer Creek, Echo Lake, and Lake Ballinger (see Figure 6). In the general vicinity of Aurora Avenue N, Boeing and McAleer Creeks flow through piped network systems. Within the study area, the area that would be potentially altered by the Project (i.e., the project footprint that is subject to ground disturbance, paving, or installation of new features) is referred to in this report as the Project area.

Study Area

All areas within 75 feet of the project footprint, as well as the lakes and streams that receive stormwater discharges from the Project.

Project Area

Within the study area, the area that would be potentially altered by the Project, i.e. the project footprint, subject to ground disturbance, paving, or installation of new features.



Sources: City of Shoreline (2006); Jones & Stokes (2007)

- City Boundary
- Project
- Road
- Open Water Course
- Piped Water Course
- Water Body
- Surface Water Basin

N

Feet

0 1,000 2,000

Figure 6. Surface Water Features
Aurora Corridor Improvement Project
September 2007

What are the general features of the Project area?

The study area is almost entirely developed with commercial businesses on either side of Aurora Avenue N. Approximately 97% of the study area is impervious surface area under existing conditions. Only small isolated areas of grass, landscaped trees, and roadside ditches are pervious to stormwater infiltration. Roadways and adjacent impervious areas drain to storm drains along the edges of the existing roadways. Following are the drainage characteristics of the corridor:

- Drainage collected from Aurora Avenue N, between N 165th Street and N 183rd Street, flows down to N 160th Street, where it enters the piped drainage system in Boeing Creek though various points.
- Drainage collected from Aurora Avenue N, between N 183rd Street and just north of N 200th Street, drains to Echo Lake. Water from Echo Lake drains to the northeast and eventually into Lake Ballinger; however, this drainage is not on the surface but is carried in a culvert.
- Drainage from Aurora Avenue N, between just north of N 200th Street and N 205th Street, drains into a stormwater collection system located along N 205th Street, and eventually discharges into Lake Ballinger.

Based on available information, there are no existing stormwater treatment facilities located along Aurora Avenue N between N 165th Street and N 205th Street.

Impervious Surface

A hard surface area that either prevents or retards the entry of water into the soil mantle as occurs under natural conditions (prior to development), and from which water runs off at an increased rate of flow or in increased volumes.

Common impervious surfaces include but are not limited to rooftops, walkways, patios, driveways, parking lots, storage areas, concrete or asphalt paving, gravel roads, and packed earthen materials.

What is the regulatory framework for the Project?

Following is a brief summary of the key regulations and policies that relate to water quality and water quality impacts.

Federal and State Laws

Federal and state law requires stormwater discharges to meet water quality standards. The current water quality standards are detailed in Chapter 173-201A Washington Administrative Code (WAC), Water Quality Standards for Surface Waters of the State of Washington (Ecology 2006), and the federal National Toxic Rule and Human Health Criteria in 40 Code of Federal Regulations Part 131 (*Federal Register* Vol. 57, No. 246, and as updated). The Washington State Department of Ecology (Ecology) Stormwater Management Manual for western Washington (Ecology 2005) provides minimum requirements for all new construction and development. The Manual also includes a list of Best Management Practices (BMPs) to minimize stormwater impacts to water quality and quantity. Because project construction would include greater than 1 acre of ground disturbance and would discharge stormwater to surface waters, the Project will require an NPDES Construction General Permit from Ecology. This permit requires implementation of various BMPs and monitoring activities to minimize construction-related impacts to water quality.

Best Management Practice (BMP)

Innovative and improved environmental protection tools, practices, and methods that have been determined to be the most effective, practical means of avoiding or reducing environmental impacts

Puget Sound Management Plan

The Project lies within Water Resource Inventory Area (WRIA) 8, the Lake Washington/Sammamish/Cedar watershed, which is an area covered by the Puget Sound Management Plan. Developed by the Puget Sound Action Team, a partnership of state agencies and tribal and local governments charged with developing and coordinating conservation programs to protect and restore Puget Sound, the plan mandates the development and implementation of a Surface Water Management Plan. Currently, the City has produced a Surface Water Management Plan (City of Shoreline 2005b).

Water Resource Inventory Area (WRIA)

A geographic area within which water drains into a particular river, stream, or receiving water body, identified and numbered by the state of Washington (defined in WAC 173-500)

Endangered Species Act (ESA)

The waters that form habitat for listed endangered species are protected by the federal Endangered Species Act (ESA). Puget Sound Chinook salmon, which occur downstream of surface waters within the study area, are listed protected species. Resource protection programs include the Salmon Conservation Program within WRIA 8, which aims to enable citizens, scientists, businesses, environmentalists, and governments to cooperate on protection and restoration projects. The National Marine Fisheries Service (NMFS)

issues an ESA Section 4(d) rule adopting regulations necessary to conserve endangered and threatened species. Limit 10 of the 4(d) rule covers routine road maintenance activities and requires new development and redevelopment to comply with specific requirements that protect water quality.

King County Surface Water Design Manual

According to the 1998 KCSWDM (King County 1998) as amended by Shoreline, any new construction projects including 5,000 square feet or more of impervious surface are required to incorporate BMPs into the Project. The KCSWDM establishes minimum project design requirements and provides a list of BMPs that should be implemented to avoid and mitigate water resource impacts from the roadway system.

City Surface Water Master Plan

The City manages surface waters under the guidance of a Surface Water Master Plan (R. W. Beck 2005) and City Comprehensive Plan (City of Shoreline 1995a). The surface water master plan lists the goals and policies that direct surface water management in the City including the following that apply directly to the Project:

- Manage the storm and surface water system through a combination of engineered solutions and the preservation of natural systems in order to provide for public safety, prevent property damage, protect water quality, preserve and enhance fish habitat, and maintain a hydrologic balance.
- Develop surface water facilities that protect water quality, enhance public safety, preserve and enhance habitat, and protect critical areas.
- Manage larger development projects to retrofit existing paved areas with new controls that help alleviate downstream flooding problems.
- Maintain surface water quality as defined by federal and state standards.
- Rehabilitate degraded surface water by reducing nonpoint source pollution, controlling erosion, and improving the stormwater system.

- Adhere to state and federal environmental standards in all City-funded projects.
- Design and construct habitat projects to solve existing habitat problems, but also to provide additional benefits to the extent possible that meet goals, policies, and community needs expressed for flood protection and surface water quality.

City of Shoreline Comprehensive Plan

The City of Shoreline Comprehensive Plan was prepared consistent with the requirements of the GMA. The comprehensive plan provides plans and policies to protect various components of the natural environment, including water quality (City of Shoreline 2005a).

City of Shoreline Critical Areas Ordinances

The City of Shoreline Critical Areas Ordinances, SMC 20.80, includes provisions to protect the following areas:

- Geologic Hazard Areas
- Fish and Wildlife Habitat Conservation Areas
- Wetlands
- Flood Hazard Areas
- Aquifer Recharge Areas
- Streams

The last update to the City's critical areas regulations was approved on February 2, 2006.

No floodplains, aquifer recharge areas, or habitat conservation areas have been identified in the study area. The potential effects of the Project on applicable critical areas are evaluated in the *Wetlands* and *Geology and Soils Discipline Reports* prepared for the Project, in addition to this report.

Shoreline Master Program

The Washington State Shoreline Management Act (RCW 90.58) requires local jurisdictions to develop shoreline master programs (SMPs) for shorelines of the state. Shorelines of the state are defined as streams with mean annual flows of 20 cubic feet per second or greater, lakes 20 acres or greater in size, and all marine shorelines. Shoreline jurisdiction extends inland 200 feet from the ordinary high water mark (OHWM) and any associated wetlands.

Ordinary High Water Mark (OHWM)

The elevation marking the highest water level that is maintained for a sufficient time to leave evidence on the landscape, such as a clear, natural line impressed on the bank, changes in soil character, or the presence of litter and debris. Generally, it is the point where the natural vegetation changes from predominately aquatic to upland species.

SMPs must contain goals and policies related to shoreline uses, conservation, economic development, public access, recreation, circulation, and housing. Under GMA, a local jurisdiction's shoreline goals and policies are included as an element of the comprehensive plan, and the remaining portions are considered part of the jurisdiction's development regulations.

After incorporating in 1995, the City adopted the King County SMP. The City adopted a Shoreline Master Program Element as part of the 1998 Comprehensive Plan. Although the City's SMP is largely consistent with the King County SMP, it does not qualify to be part of the City's SMP until it has been reviewed by Ecology. In the interim, the City continues to apply the 1995 King County SMP.

No shorelines, as defined under the Shoreline Management Act, are located within the study area; thus, evaluation of the SMP is not needed for the Project.

How was information collected?

Information on existing conditions was collected from state and local agency web sites and databases, and from publications describing existing conditions in the area. Information sources are cited in this document and listed in the References section.

In addition to providing Creek Basin Characterization Reports for both Boeing Creek and McAleer Creek, the City also provided the Surface Water Master Plan. These resources contained information about stormwater management along Aurora Avenue N. The City maintains a surface water database of catch basin and pipe network locations. This information has also been combined with geographic information systems (GIS) data for creek basins to indicate discharge locations and receiving water bodies for the stormwater.

Pollutant loading estimates were calculated using methods and loading rates published in Section 430 of the Environmental Procedures Manual (WSDOT 2007).

What surface waters occur in the study area?

There are no natural stream channels within the study area. Portions of the Project are located in two drainage basins, Boeing Creek, which drains to Puget Sound and McAleer Creek, which drains to Lake Washington (Figure 6). The portion of the Project in the McAleer Creek drainage can be further divided into Echo Lake and Ballinger Lake sub-drainages. Drainage from the existing sidewalks and roadways is routed to storm drains along the curbs and shoulders. These storm drains combine with flows from other streets and discharge to Boeing Creek, Echo Lake, and McAleer Creek, as described above.

What is the quality of surface waters in the study area?

King County has records from 1998 and 1999 of high fecal coliform bacterial concentrations in Echo Lake, the closest surface water body to the Project (Ecology 2004) Therefore, Ecology has listed Echo Lake as impaired (Category 5), as required under Section 303d of the federal Clean Water Act. Similarly, the lowest reach of McAleer Creek is also 303d listed as impaired (Category 5) due to fecal coliform bacteria and dissolved oxygen (Ecology 2004).

Ecology issued a Total Maximum Daily Limit (TMDL) ruling for total phosphorus in Lake Ballinger in 1993 (Ecology 1993) Lake Ballinger is located northeast of the study area, but the northern end of the study area and Echo Lake are in the Lake Ballinger drainage basin. The TMDL is based on data collected in 1987 (Ecology 1993). The data used to establish the TMDL are not recent, and may not reflect current conditions. Ecology has prepared a quality assurance project plan (Ecology 2006), and will evaluate the effectiveness of the TMDL in improving water quality in Lake Ballinger in coming years.

Total Maximum Daily Load (TMDL)

A calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources. A TMDL (also known as a Water Cleanup Plan) is the sum of allowable loads of a single pollutant from all contributing point sources and nonpoint sources.

Ecology Water Quality Ratings

Category 1: Meets tested standards for clean waters.

Category 2: Waters of concern.

No Category 3 rating.

Category 4: Polluted waters that do not require a TMDL because pollution problems are being solved in other ways.

Category 5: Polluted waters that require a TMDL.

Although the sources of fecal coliform bacteria and low dissolved oxygen in the McAleer basin have not been determined, these water quality problems are consistent with a high proportion of impervious surface area and use of fertilizers in urban/suburban landscaping leading to nutrient enrichment, and abundant waterfowl (U.S. Geological Survey1995; SMRC 2007. Chapter 5 includes a description of how the Project will result in a reduction in pollutant loading through the reduction in impervious surface area, and the installation of stormwater treatment.

Boeing Creek is not classified under the Washington State 303d list.

Under WAC 173-201A-600, all water bodies in the study area and project vicinity (i.e., those mentioned above) are protected for the following designated uses: salmonid spawning, rearing, and migration; primary contact recreation; domestic, industrial, and agricultural water supply; stock watering; wildlife habitat; harvesting; commerce and navigation; boating; and aesthetic values. Of these uses, these water bodies provide salmonid spawning, rearing, and migration; primary contact recreation; wildlife habitat; and aesthetic values.

What is the significance of aquatic habitat within the study area?

The study area is located within WRIA 8, the Lake Washington/Sammamish/Cedar watershed. A review of the Washington Department of Fish and Wildlife (WDFW) Priority Habitat Species (PHS) database found no priority fish species present in the study area (Jones & Stokes 2007b). There are three fish-bearing streams within the City: McAleer Creek, Boeing Creek, and Thornton Creek (WDFW 2006). All three of these streams support priority fish species down stream of the study area; however, no priority fish species or habitat occurs within the study area. Echo Lake is located within the study area (see Figure 6). Echo Lake drains to Lake Ballinger, located approximately 0.6 mile northeast of Echo Lake. There is no surface flow between these two water bodies, however, with the connecting stream placed in a culvert.

Lake Ballinger, located outside of the study area, is drained by McAleer Creek, which supports fish, including Puget Sound Chinook salmon (*Oncorhynchus tshawytscha*), Puget Sound coho

salmon (*Oncorhynchus kisutch*), Puget Sound steelhead trout (*Oncorhynchus mykiss*), and resident cutthroat trout (*Oncorhynchus clarki*). Two other fish-bearing streams, Boeing Creek and Thornton Creek, occur within the City, although not within the study area. Boeing Creek, located to the west of the study area, supports Puget Sound coho salmon and resident cutthroat trout. Puget Sound Chinook, coho, and sockeye salmon, as well as coastal cutthroat and Puget Sound steelhead trout have been observed in Thornton Creek (Kerwin 2001), which is located to the southeast of the Project and receives no drainage from the study area.

Chinook Salmon

The Puget Sound Chinook salmon evolutionarily significant unit (ESU) was listed as threatened on March 24, 1999 (64 *Federal Register* [FR] 41836). This ESU includes all naturally spawned populations of Chinook salmon from rivers and streams flowing into Puget Sound, including the Strait of Juan de Fuca from the Elwha River eastward, and encompassing rivers and streams flowing into Hood Canal, South Sound, North Sound, and the Strait of Georgia in Washington. Several hatchery stocks are considered part of the listed ESU.

Evolutionarily Significant Unit (ESU)

A designation used by NOAA Fisheries for certain local salmon populations or runs that are treated as individual species under the Endangered Species Act.

Chinook salmon in McAleer Creek are part of the north Lake Washington sub-population that is comprised of wild native stock. Chinook salmon use of McAleer Creek is considered episodic, meaning that the species is present infrequently and may or may not be present or observed during the typical 4- to 5-year lifecycle of the species. In episodic use areas, Chinook salmon that are observed may be strays from another production area (King County 2005).

Coho Salmon

Puget Sound coho salmon are a federal species of concern (National Oceanic and Atmospheric Administration 2007) and a WDFW priority species (WDFW 2007a). Coho salmon in McAleer Creek are part of the Lake Washington/Sammamish Tributaries stock. This is a mixed stock, comprised of both native and hatchery-origin coho that were released in Issaquah Creek between the early 1950s and the early 1970s (WDFW 2007b). Coho salmon in Boeing Creek are hatchery stocks that have been planted in the creek (Trout Unlimited 2007).

Steelhead Trout

The Puget Sound steelhead Distinct Population Segment (DPS) was listed as threatened under ESA on May 11, 2007 by NMFS (72 FR 26722). The Puget Sound steelhead DPS includes all naturally spawned anadromous winter- and summer-run steelhead populations in the river basins of the Strait of Juan de Fuca, Puget Sound, and Hood Canal, Washington, bounded to the west by the Elwha River (inclusive) and to the north by the Nooksack River and Dakota Creek (inclusive), as well as two hatchery stocks.

Distinct Population Segment (DPS)

A designation used by the U.S. Fish and Wildlife Service (USFWS) to identify unique species or populations that are threatened or endangered.

Steelhead trout have been observed in McAleer Creek. Kerwin 2001 mapped the distribution of Steelhead to include McAleer Creek up to I-5.

Resident Cutthroat Trout

Resident cutthroat trout are a WDFW priority species and are a state game fish (WDFW 2007a). Resident cutthroat trout occur in McAleer Creek, Boeing Creek, and Thornton Creek but do not occur within the study area (WDFW 2006).

What is the recreational significance of aquatic areas within the study area?

Echo Lake is the only aquatic feature located within the study area. The shores of Echo Lake contain residential development and residents are expected to use Echo Lake for a number of recreational activities, including swimming and bird watching.

How is stormwater currently managed in the study area?

Stormwater along Aurora Avenue N flows along curb and gutters or along the asphalt shoulders prior to being collected in catch basins along either side of the roadway. Typically these drains include a grate at the street, and a sediment catch basin. A portion of the sediment in stormwater settles out in the catch basin and water and unsettled sediment are conveyed downstream to a discharge location. Discharges from the study area drain to piped courses of Boeing

Creek which discharge into Puget Sound; and piped courses of McAleer Creek that discharge into Echo Lake and Lake Ballinger.

The City street sweeps Aurora Avenue N and routinely cleans out catch basins to remove materials to prevent pollutants from entering surface water bodies.

What are the climate, topography, geology, and soils within the study area?

Climate

The climate of the study area is typical of western Washington with mild temperatures and dry summers; most precipitation falls as rain during the winter season. Based on weather data for north Seattle (the closest data available to Shoreline) monthly average temperatures for Shoreline range from a high of 76 degrees Fahrenheit (F) in July to a low of 33 degrees F in January. Average monthly precipitation is highest in December (6.2 inches), and lowest in July (1.0 inch). Snowfall typically occurs in November through March and monthly average snowfall is greatest in January (1.3 inches) (Western Regional Climate Center 2006).

Topography

The general topography along the Project corridor is as follows:

- N 165th Street – N 185th Street: Aurora Avenue N follows roughly the top of a long flat ridgeline, with a slight elevation gain from south to north and gentle slopes trending downhill to the east and west. At approximately N 185th Street the ridgeline trends away to the north-northwest and Aurora Avenue loses elevation as it enters the Echo Lake drainage basin.

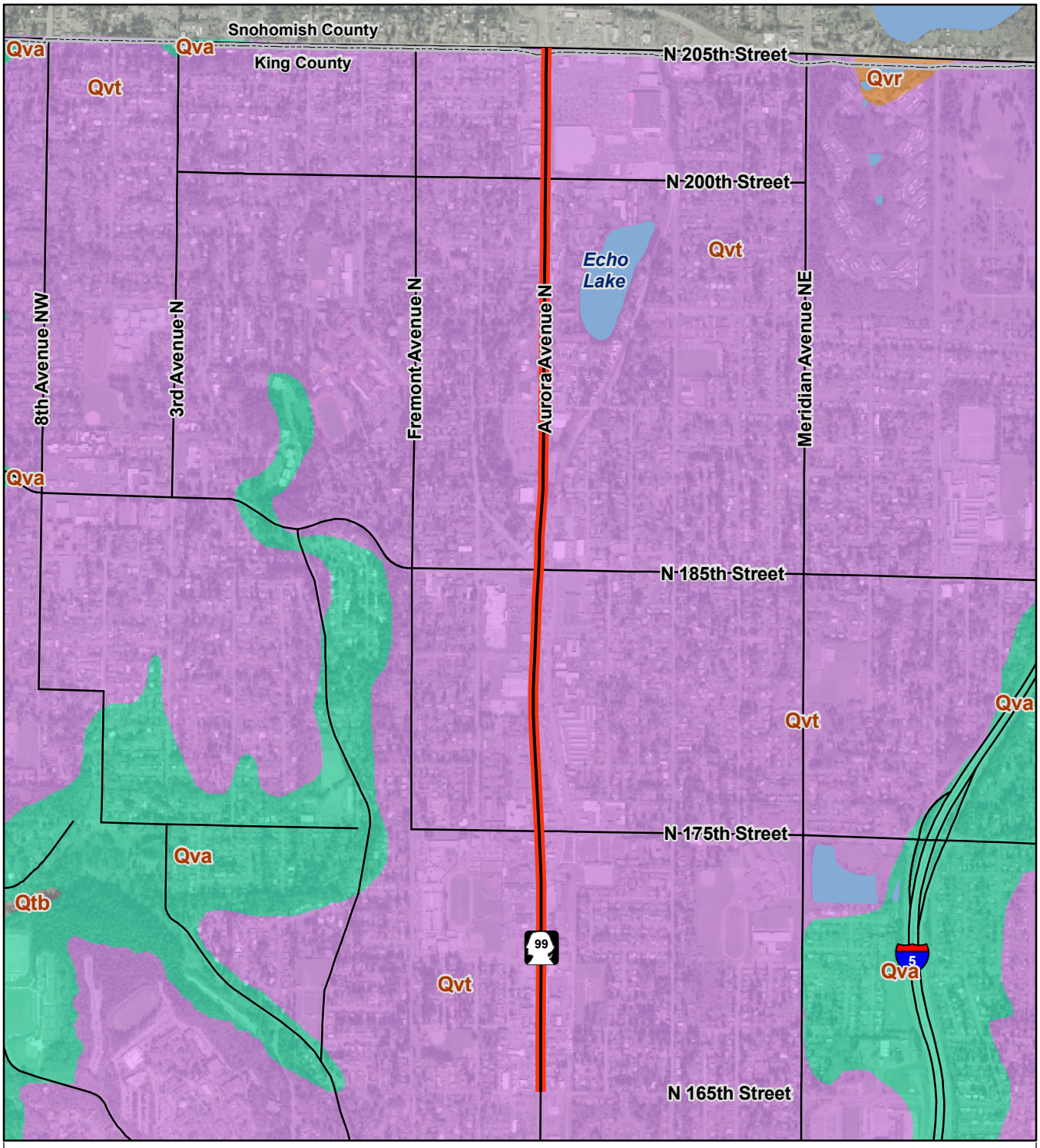
- N 185th Street – N 192nd Street: Aurora Avenue N drops into the Echo Lake basin, with relatively steep slopes trending uphill to both the east and west.

- N 192nd Street – N 205th Street: Aurora Avenue N runs roughly parallel to the adjacent slope with higher elevation to the west and lower elevation to the east. There is also elevation gain going north between N 195th Street and N 198th Street, and

elevation loss from N 198th Street to the Project terminus at N 205th Street.

Geology and Soils

Figure 7 shows the geology and soil characteristics in the study area. The surface geology of the Puget Sound region is largely the result of glacial processes. Massive glaciers advanced south from Canada into the Puget Sound region at least four times during the Pleistocene epoch, between about 1.6 million and 10,000 years ago. The advance and retreat of these glaciers caused deep scouring in some areas and placed thick deposits of sediment in other areas. Human activities have also altered the landscape in the more recent past.



Sources: City of Shoreline (2006); Jones & Stokes (2007)

City Boundary
Project
Road

Surface Geology

Qva (advance outwash)
Qvr (recessional outwash)
Qvt (glacial till)

N

Feet

0 1,000 2,000

AURORA CORRIDOR

Figure 7. Surface Geology
Aurora Corridor Improvement Project
September 2007

The study area is located in the glacial till geological unit (Qvt), which is also known as hardpan. Glacial till consists of an unsorted, crudely stratified mix of very dense silt, sand, gravel, cobbles, and boulders deposited at the base of a glacier.

Because glacial till was overridden by the depositing glacier, it is highly compacted and therefore is relatively impermeable to water. Specific soil data for overlying soils is not available because the Project lies within an area for which specific soil series have not been mapped by the National Resource Conservation Service (NRCS) (NRCS 2007); however, a mixture of native soils and fill are assumed to occur within the study area. Soil boring data collected for specific projects within the City support this assumption and also indicate that in some areas till is present at the soil surface (Shannon and Wilson 1990; AESI 1999). This is likely due to past excavation and/or erosion. In areas where the native soil or fill that overlies till is permeable, it is possible that groundwater may be perched in the upper soil layer, unable to permeate the till.

The weight of the overlying glacier, estimated to be more than 3,000 feet thick during the last ice age, compacted the till, causing it to become very dense and to resemble a rock-like material. Except for minor erosion, cuts in till are usually stable. Because of its high density and the wide range of sediment sizes that compose it, till is often difficult to excavate; likewise it can be difficult to place as fill in wet conditions due to its silt content.

What wetlands or other waters of the U.S. are located within the study area?

No wetlands were found in the study area (Jones & Stokes 2007c). The study area is characterized by paved roadway, paved or gravel shoulders, fill slopes adjacent to the road, and paved driveways into adjacent commercial businesses.

Investigation was conducted at an unpaved area to the east of the northbound lanes of Aurora Avenue N, just south of N 192nd Street. The area was chosen because of its low-lying landscape position and undeveloped character.

The depression at the toe of the road slope is dominated almost exclusively by Himalayan blackberry (*Rubus armeniacus*) with

scattered patches of Scotch broom (*Cytisus scoparius*). Both the blackberry and the Scotch broom are exotic species typically found in upland areas. Soils in this area appeared to be fill material without characteristics of wetland soil.

There was no evidence of wetland hydrology within this area. Thus, this area did not meet any of the three parameters necessary to be considered a wetland.

Wetland Hydrology

The condition where water is present during a portion (between 5 and 12.5%) of the annual growing season

No streams were found in the study area; however three ditches totaling 401 square feet were found in the study area.

Ditch 1 is approximately 227 square feet in size and is located along the west side of Aurora Avenue N just north of N 192nd Street. It is a shallow depression/slope that drains south into a culvert that carries water southward to Ditch 2. Ditch 2 is approximately 108 square feet in size and is located along the west side of Aurora Avenue N just north of N 192nd Street and south of Ditch 1. It is a shallow depression/slope that drains south into a culvert that carries water to a piped underground stormwater system. Ditch 3 is approximately 66 square feet in size and is located on the southwest corner of Aurora Avenue N and N 205th Street. It is a slope that drains to the north into a catch basin that carries water to an underground piped stormwater system.

Table 3 summarizes the area of each ditch mapped within the study area.

Table 3. Ditches Identified within the Study Area

	Area (square feet)
Ditch 1	227
Ditch 2	108
Ditch 3	66
Total	401

A ditch is defined as an engineered surface water feature excavated out of upland to convey surface water runoff. Ditches are not rated, categorized, or buffered. Ditches can have an OWHM, but are intentionally excavated out of uplands, which differentiates them from streams. Maintained ditches are typically clear of vegetation, while un-maintained ditches may become vegetated over time.

There is currently no method to evaluate functions and values of ditches. However, ditches can provide some water quality improvement if vegetation and small depressions are present. These characteristics can slow stormwater runoff and allow for sediment retention and chemical uptake if vegetation and/or clay soils are present.

Ditches 1 and 2 provide some water quality improvement since vegetation is present in both, and a small depression is present within Ditch 1. During the field investigation, sediment deposits in both ditches and water marks in a small depression of Ditch 1 indicated that the ditches are capable of slowing water and detaining sediment delivered via stormwater runoff. Ditch 3 does not have vegetation or depressions and likely provides very little water quality improvement but rather functions only to drain ponded water rapidly to the stormwater system.

What floodplains or groundwater resources are located within the study area?

Floodplains

There are no floodplains within the study area.

Groundwater

A separate groundwater technical report is not required for this Project because no wellhead protection or aquifer recharge areas are located in the study area (King County 2007), and because the project will not increase the potential for groundwater contamination (Taylor pers. comm.).

Based on review of site cleanup reports the uppermost continuous groundwater zone appears to be deeper than 20 feet below ground surface (bgs). Groundwater was encountered at 21 feet bgs at the 17200 block of Aurora Avenue N (GeoEngineers 2003); no groundwater was encountered in 14-foot-deep underground tank excavations just beyond the southern project boundary at the 16200 block (RZA-AGRA 1991), and no groundwater was encountered in 28-foot-deep soil borings at the 17500 block (Kleinfelder 1993). No indication of the gradient direction in the

continuous groundwater zone was available through the previous studies reviewed for this report.

There are indications that localized lenses of shallow perched groundwater can occur during the rainy season. For example, perched groundwater was encountered at a few feet bgs at an excavation in the 20400 block in December 2001 (SECOR 2002).

Phase I Study

A historical view of a suspected contaminated site consisting of a regulatory database search, historical file reviews, and site reconnaissance

Have any historic spills occurred in the study area?

Jones & Stokes retained Environmental Data Resources (EDR) to provide a review of regulatory database information for facilities within 1 mile of Aurora Avenue N, and completed a Phase I hazardous materials study. Due to the length of the Project corridor, two EDR database searches were completed: one for the southern end, and one for the northern end. The site identifiers in the southern end are preceded by "South" and in the northern portion are preceded by "North" (e.g. "South O85" and "North B8").

EDR's review is generally consistent with the American Society for Testing and Materials (ASTM) Practice E 1527 97, Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process. Pursuant to ASTM guidance, federal and state databases were consulted to determine whether the sites of potential concern would appear on lists of entities that generate, transport, store, or dispose of hazardous materials. Lists of entities that are identified as potentially contaminated and that could possibly adversely impact one or more of the parcels researched were also examined. Federal databases consulted are listed in the *Hazardous Materials Discipline Report* prepared for the Project (Jones & Stokes 2007d).

Phase II Study

A field investigation to collect and analyze soil and groundwater samples, for purposes of defining the extent of contamination and pollutant migration pathways at a contaminated site.

Many current and historical businesses adjacent to Aurora Avenue N released fuel and other hazardous materials at some point in the past. However, with the exception of the sites described below, all of the reported historical spills were either previously cleaned up or are being handled by the property owners with oversight by Ecology. Contaminated soil or groundwater at the following sites has the potential to impact Project construction or to expose the City to regulatory liability:

- Site South-O85, the former Mac-Ray dry cleaner, located at 18419 Aurora Avenue N. This former dry cleaner was close to the roadway. Under Alternative C, the building would be either fully or partially demolished. Soil under the building could contain trace amounts of cleaning solvents released during operation of the dry cleaner. Therefore, if Alternative C is selected, a limited Phase II soil investigation should be conducted under the building before it is demolished.

- Site South O86-O88, former Bill Langeberg gas station. Widening of Aurora Avenue N and N 185th Street, under all three Build Alternatives, could encroach into areas where contaminated soil was previously left in place when the former fuel tanks were removed in 1994. Ecology has indicated they believe residual soil contamination at this site poses a risk to groundwater. Either the current owner or the City should conduct Phase II soil and groundwater investigations, and remediate any identified contamination before site grading begins.

- Site South A5-A7, Former Tune N Lube. The City will acquire this property under all three Build Alternatives. An unknown amount of kerosene-containing soil is known to exist under the site, which could interfere with grading activity for Project construction. The City should alert the construction contractor to the likely soil contamination, and require the contractor to develop a contingency plan to remediate contaminated soil if it is encountered.

- Site South A5-A7, former Joe's ARCO gas station. The City will acquire this property under all three Build alternatives. Ecology files did not include any reports on when, how, or if, this former gas station was cleaned up after it ceased operation. Either the current owner or the City should conduct Phase II soil and groundwater investigations and remediate any identified contamination before site grading begins.

The City will require its construction contractors to have contingency plans to ensure that construction crews can identify suspected contaminated soil and groundwater caused by unreported historical releases and will properly manage contaminated soil they might encounter during construction.

The current 9-1-1 emergency response system used within the City will minimize the potential for future spills along Aurora Avenue N

to impact soil, surface water, or groundwater. In addition, City maintenance crews will continue to be trained in spill prevention and spill response related to their routine maintenance activity along Aurora Avenue N.

Throughout the study area, spills (should they occur on the roadway) would drain toward the nearest storm drain downslope. If not intercepted, the spill would flow to piped water courses that discharge to either Boeing Creek at about the intersection of Innis Arden Avenue and Greenwood Avenue North, Echo Lake at the southern end of the lake, or to Lake Ballinger at the southern end of the lake.

Chapter 5. Potential Effects

This chapter describes potential effects of the Project on water quality/surface water under the No Build and three Build Alternatives.

What methods were used to evaluate potential effects to water quality and surface water?

Water quality and surface water effects were evaluated using the WSDOT "Method 1" for determining pollutant loading, described in Section 430 of the WSDOT Environmental Procedures Manual (WSDOT 2007), in which standard pollutant load rates are multiplied by the area of roadway to calculate the annual pollutant load (described later in this chapter).

The quantity of pollutants that are expected from the Project area under existing conditions was determined, as well as the quantity expected under each of the project alternatives based on the impervious surface area under each condition.

How will the Project affect water quality and surface waters?

Effect on Impervious Surface Area

The Project will result in a small change in impervious surface area. Pervious, impervious, and treated impervious surface areas are shown in Table 4. Because impervious roadway surfaces receive airborne particles from vehicles and vehicle exhaust, roadways are pollution-generating surfaces. Changes in impervious surface area can translate into changes in pollutant loading downstream. In the case of the proposed Build Alternatives, there would be a reduction in impervious surface area that would result in a reduction in pollution generation in the Project area.

Table 4. Pervious and Impervious Surface Areas under No Build and Build Alternatives

		McAleer Creek Drainage Basin	
Alternative	Boeing Creek Drainage Area (Acres)	Echo Lake Drainage Area (Acres)	Lake Ballinger Drainage Area (Acres)
Alternative A			
No Build (100% Impervious) [1, 2]	5.4	14.0	3.0
Impervious Area [3]	5.2	13.4	2.9
Change in Impervious Area Under Alternative A	*-0.2*	*-0.6*	*-0.1*
Pervious Area (3%)	0.2	0.6	0.1
Total Area	5.4	14.0	3.0
Alternatives B and C			
No Build (100% Impervious) [1, 2]	5.8	15.0	3.2
Impervious Area [3]	5.4	13.9	3.0
Change in Impervious Area Under Alternatives B and C	*-0.4*	*-1.1*	*-0.2*
Pervious Area (7%)	0.4	1.1	0.2
Total Area	5.8	15.0	3.2

1. Existing area is determined based on the extent of the Project in each alternative. Alternatives B and C affect a larger area, than Alternative A; therefore the existing area compared to post-project conditions is larger under these alternatives than under Alternative A.

2. Impervious area with a discharge.

3. Impervious area retrofitted for stormwater treatment, with discharge.

Because the changes in impervious surface area proposed are relatively small, the most substantial changes in water quality are

likely to occur as the result of stormwater treatment facilities that are proposed under the Build Alternatives.

Effect on Pollutant Loading

The water quality design flow for the Aurora Corridor Improvement Project was developed to remove 80% of total suspended solids, as required in Section 1.2.81 of the 1998 KCSWDM.

Changes in pollutant loading associated with the project alternatives have been calculated using WSDOT data for suspended solids, copper, and zinc from roadways, and from stormwater treatment facilities designed to WSDOT standards (WSDOT 2006) as specified in Section 430 of the WSDOT environmental procedures manual (WSDOT 2007).

Threshold Discharge Area (TDA)

The entire study area is divided into areas based on drainage. Each area with a discrete stormwater discharge location is defined as a TDA, and stormwater control facilities are located and sized to control drainage in each TDA.

The first step in the pollutant load calculation is to determine the project pervious surface area with discharge, pervious area, and treated impervious area for each threshold discharge area (TDA) (see Table 4). Next, the post-Project areas are determined.

After areas of pollution-generating surfaces have been identified, the areas that are treated for water quality and quantity, and pollutant load under each alternative can be calculated and the changes from existing conditions that would occur can be compared. Using "Method 1" from the WSDOT Environmental Procedures Manual (WSDOT 2007), standard pollutant load rates (mean annual load in pounds per acre) are multiplied by the area of roadway to calculate the annual pollutant load. The pollutant load includes rates for untreated surfaces and for treated surfaces, based on monitoring results from highways in western Washington. The calculated pollutant loads are shown in Appendix A (Table A-1 for Alternative A and Table A-2 for Alternatives B and C). The estimated changes in pollutant loadings are shown in Table 5. Under each of the Build Alternatives, the roadway area would be reduced, and untreated surface area would be replaced with treated. As a result, the annual pollutant load would be reduced in each TDA under all of the Build Alternatives. Due to the slightly greater affected area (i.e., larger area converted to pervious surface) under Alternatives B and C, the reductions in pollutant loading would be slightly greater under these alternatives than under Alternative A. The differences between alternatives would amount to an additional

removal of between 1 and 2% of the pre-project pollutant loads under Alternative B or C than under Alternative A.

Table 5. Calculated Net Changes in Pollutant Loads under No Build Conditions and Alternatives A, B, and C

	TSS	Total Zinc	Dissolved Zinc	Total Copper	Dissolved Copper
NET CHANGE in pollutant loads between pre-project and Alternative A conditions (lbs)	-11,688.50	-18.62	-4.66	-3.08	-0.43
NET CHANGE in pollutant loads between pre-project and Alternative B and C conditions (lbs)	-12,556.50	-20.16	-5.14	-3.35	-0.49
Difference in NET CHANGE in pollutant loads between Alternative A and Alternatives B or C[1]	868	1.54	0.48	0.27	0.06

[1]These values are the amount of additional pollutant removal that would be achieved under Alternative B or C compared to Alternative A.

Effect on Peak Flows

Per the KCSWDM Section 6.2 (King County 1998) water quality design flow must meet one of the following criteria, depending on the model used to predict flow:

- King County Runoff Time Series (KCTRS) model: 60% of the 2-year peak flow rate.
- Santa Barbra Urban Hydrology (SBUH) model: 64% of the 2-year 24-hour precipitation.

The SvR Design Company used the KCRTS model to determine the effect of the Project on peak runoff volume. SVR used the impervious and pervious surface areas in Table 4 in their model and determined that, even with no flow control, the Project would result

in a reduction in peak stormwater runoff. The results of the KCRTS model are shown in Table 6.

Table 6. KCRTS Modeled 100-Year Peak Flows

Condition	Boeing Creek Drainage Area (cfs)	McAleer Creek Drainage Basin	
		Echo Lake Drainage Basin (cfs)	Lake Ballinger Drainage Area (cfs)
Alternative A			
No Build Conditions	6.4	16.5	3.5
Proposed Conditions	6.2	16.1	3.4
Alternatives B and C			
No Build Conditions	6.8	17.7	3.8
Proposed Conditions	6.6	17.0	3.6

Notes: Results provided by SVR (2007) based on areas shown in Table 4. These results assume no flow control under existing or proposed conditions.
cfs = cubic feet per second

Two water quality design flow options that are consistent with the KCSWDM (King County 1998, as amended by the City) have been developed for the Aurora Corridor Improvement Project. Option 1 uses conventional stormwater systems to collect and treat stormwater and Option 2 incorporates natural systems into the design

Stormwater Option 1 – Conventional System

Under Option 1, water quality design flow using conventional systems would be designed for each of the three drainage basins. Preliminary SBUH analysis for pollutant-generating impervious surface indicates that these systems would be located approximately at N 165th Street for the Boeing Creek drainage basin, N 195th Street for the Echo Lake drainage basin, and N 205th Street for the Lake Ballinger drainage basin. Table 7 shows estimated water quality volume and approximate length of detention pipes that would be required to capture the estimated volume, based on an assumption of a 5-foot-diameter pipe.

Table 7. Estimate Water Quality Design Flow for Pollutant-Generating Impervious Surface and Length of 5-foot-Diameter Detention Pipe to Treat the Calculated Volume

		McAleer Creek Drainage Basin	
Stormwater Option 1	Boeing Creek Drainage Area	Echo Lake Drainage Area	Lake Ballinger Drainage Area
SBUH Water Quality Design Flow Volume (cubic feet)	14,629	37,501	7,426
Length of 5-foot Detention Pipe Required to Detain and Treat Water Quality Design Flow (feet)	1,817	4,659	922

Stormwater Option 2 – LID Combined with Conventional System

The SBUH model was also run to determine the design of natural systems that would be required to provide the same level of stormwater treatment as under Option 1. The model used a representative area of road: 100 feet long by 43 feet across (approximately half the pollutant-generating surface, or 4,300 square feet). According to the SBUH model, approximately 366 cubic feet of stormwater storage is needed to treat the water quality design flow that would be required per 4,300 square feet of impervious surface.

Under Option 2 approximately four planters, each at 10 feet long by 4 feet wide, with 4 feet of amended soil and 1 foot of ponding would be required for every 4,300 square feet of impervious surface in order to treat stormwater. Alternative A does not have an amenity zone and the smaller median does not provide enough area to capture and treat the necessary volume of water. Alternatives B and C, with a 4-foot wide amenity zone and the wider median, would have adequate vegetative area to capture the volume of water to meet the requirements for water quality design flow.

Indirect Impacts

Indirect impacts are those that occur later in time, at a distance from the Project. The Project would not result in a change in land use, or stimulate development at a distance from the Project. No development is contingent on the Project, and the Project would not provide access to areas that are not already served by SR 99. Furthermore, since the Project would result in a reduction in pollutant loading from nonpoint sources, and an improvement in

hydrologic conditions by increasing pervious surface area, the long-term effects of the Project would be an improvement in downstream water quality and hydrologic conditions. Therefore, the Project would have no adverse indirect impacts.

How will Project construction affect water quality and surface waters?

Project construction will not affect surface waters. No surface waters cross the Project footprint, and construction will follow the KCSWDM (1998, amended by the City), as guidance for preventing erosion and sediment transport from the construction area. The specific methods for preventing stormwater contamination during construction would be the responsibility of the construction contractor, but would likely include installation of temporary storm drain filters, use of silt fences, and covering exposed soil in areas where soil is excavated, graded, or filled. Because the Project footprint and adjacent lands are generally low gradient and largely paved, erosion control can be achieved through these standard BMP erosion control measures.

The majority of the Project is on relatively flat ground; however, portions of it cross steeper slopes, and in some areas cut and fill may be required. Installation or replacement of utilities and foundations for light standards will also require excavation. The area of grading will be determinable when Project design is complete.

Project staging area locations have yet to be determined. However, if they are located on paved areas, the storm drains downslope will be fitted with drain filters or other appropriate BMPs to prevent contamination of stormwater runoff. If staging areas include un-paved areas (unlikely given the developed condition of the study area), erosion and sediment control BMPs such as silt fencing will be used to prevent runoff contamination. BMPs for staging areas will be described in the project SWPPP as required for the construction NPDES permit.

How would the No Build Alternative affect water quality and surface waters in the study area?

The No Build Alternative would not affect water quality and surface waters in the study area. Existing conditions would be maintained.

Chapter 6. Measures Taken to Avoid or Minimize Project Effects

This chapter identifies mitigation measures intended to avoid or minimize the potential effects described in Chapter 5.

What conservation and mitigation measures are proposed to avoid and/or minimize overall impacts of the Project?

Stormwater treatment facilities will be designed to meet the requirements of SMC Title 20, which specifies consistency with the KCSWDM (King County 1998). This conservation measure will avoid operational adverse impacts of the Project on water quality. The KCSWDM has the following Core Requirements that apply to the Project:

- Discharge at the Natural Locations
- Off-site Analysis
- Conveyance System
- Erosion and Sediment Control
- Maintenance and Operation

- Financial Guarantee
- Oil Control at Intersections

Although the Project would be exempt from flow control and water quality requirements (according to the criteria specified in the KCSWDM [King County 1998] as amended by the City), the Project may provide flow control and water quality treatment if LID elements are included. LID elements are being considered, along with conventional stormwater treatment options because stormwater management is a high priority for the City. This Project will include stormwater treatment in all TDAs.

Since the Project would improve the quality of stormwater discharged from the study area, and reduce the peak flow volume, no surface water mitigation is required.

What conservation or mitigation measures are proposed to avoid and/or minimize construction impacts on water quality?

During construction, temporary sediment and erosion control conservation measures would be used to avoid contamination of site runoff with sediment from areas of exposed soil. These measures could include (but are not limited to) the following:

- Silt fences
- Straw bales
- Covering exposed soil
- Temporary storm drain filter inserts
- Street sweeping

Since the conservation measures listed above would avoid construction-related impacts to water quality, no mitigation measures would be required.

Chapter 7. References

AESI. 1999. Subsurface Exploration and Geotechnical Engineering Report, Shoreline Fire Training and Support building, Shoreline, Washington. Associated Earth Sciences, Inc. Kirkland, WA.

CH2M Hill. 1999. Aurora Corridor Multimodal Pre-Design Study. Prepared for the City of Shoreline.

City of Shoreline. 2007. Interurban Trail Map. Available: <http://cosweb.ci.shoreline.wa.us/uploads/attachments/pwk/2006_GEN.pdf>. Accessed: March 30, 2007.

———. 2005a. Comprehensive Plan. Adopted by Ordinance 388. June 13. Shoreline, WA.

_____. 2005b. Surface Water Management Plan. July 11. Shoreline, WA.

———. 1999. Resolution 156, accepting the recommendation of the Citizens Advisory Task Force. August 23.

Ecology. 2006. Water Quality Standards for the Surface Waters of the State of Washington (Chapter 173-201A WAC). Washington State Department of Ecology, Olympia, WA.

———. 2005. Stormwater Management Manual for Western Washington. Washington State Department of Ecology, Olympia, WA.

GeoEngineers. 2003. Underground Storage Tank Removal Monitoring: Texaco Service Station, 17255 Aurora Avenue North. Prepared for Shell Oil Products, Inc. Prepared by GeoEngineers, Redmond, WA.

Gluck, Jerome, Herbert S. Levinson, and Vergil Stover. 1999. Impacts of Access Management Techniques. National Cooperative Highway Research Program (NCHRP) Report 420. Prepared for the Transportation Research Board. National Research Council. Washington, DC.

Jones & Stokes 2007a. *Land Use, Plans, and Policies. Discipline Report*. Aurora Corridor Improvement Project: N 165th Street – N 205th Street. April. (61001.06.) Bellevue, WA. Prepared for City of Shoreline.

———. 2007b. *Wildlife, Fish, and Vegetation*. Technical Memorandum. Aurora Corridor Improvement Project: N 165th Street – N 205th Street. April. (61001.06.) Bellevue, WA. Prepared for City of Shoreline.

———. 2007c. *Wetlands and Other Waters of the U.S. Discipline Report.* Aurora Corridor Improvement Project: N 165th Street – N 205th Street. April. (61001.06.) Bellevue, WA. Prepared for City of Shoreline.

———. 2007d. *Hazardous Materials Discipline Report.* Aurora Corridor Improvement Project: N 165th Street – N 205th Street. April. (61001.06.) Bellevue, WA. Prepared for City of Shoreline.

Kerwin, J., 2001. Salmon and Steelhead Habitat Limiting Factors Report for the Cedar - Sammamish Basin (Water Resource Inventory Area 8). Washington Conservation Commission. Olympia, WA

King County. 2005. Final Lake Washington/Cedar/Sammamish Watershed (WRIA 8) Chinook salmon conservation plan. King County, WA.

———. 1998. Surface Water Design Manual. King County Department of Natural Resources. Seattle, WA. September.

Kleinfelder. 1993. Site Exploration: Burke Property, Seattle, WA. Prepared for Briar Development Company, Bellingham, WA. Prepared by Kleinfelder, Inc., Bellevue, WA.

National Oceanic and Atmospheric Administration. 2007. Endangered Species Act Status of West coast Salmon and Steelhead. Last revised June 8, 2006. Available http://www.nwr.noaa.gov/ESA-Salmon-Listings/Salmon-Populations/upload/1pgr06-06.pdf Accessed March 22, 2007.

NRCS (Natural Resource Conservation Service). 2007. Web Soil Survey. Available: <http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx>. Accessed February 22, 2007.

PSRC (Puget Sound Regional Council). 2001. *Destination 2030: Metropolitan Transportation Plan for the Central Puget Sound Region.*

RZA-AGRA. 1991. Level II Environmental Site Assessment: 16622 Aurora Avenue North. Prepared for First Interstate Bank. Prepared by RZA-AGRA, Kirkland, WA.

R.W. Beck Associates. 2005. City of Shoreline Surface Water Master Plan. Adopted July 11, 2005. Available: <http://cosweb.ci.shoreline.wa.us/uploads/attachments/pwk/master_plans/SWMP_2005_final.pdf.> Accessed: April 19, 2007.

SECOR. 2002. Hydraulic Hoist Removal Report: Phillips Facility 2603149, 20409 Aurora Avenue North. Prepared for Phillips Petroleum Company. Prepared by SECOR International Inc., Redmond, WA.

Shannon and Wilson, Inc. 1990. Geotechnical Report: Proposed Improvements Aurora Village Shopping Center Seattle, Washington. Shannon and Wilson, Inc. Seattle, WA.

SVR Design Company. 2007. Memorandum #3. Stormwater Modeling Review (Preliminary Drainage Review] Aurora Corridor – Shoreline. To: Jennifer Barnes, PE, Jones & Stokes. From: Amalia Leighton, PE, and Gibson Peters, EIT. SVR Project #06031. April 10.

Taylor, T. 2007. February 5—meeting to discuss Aurora Corridor Improvement Project Environmental Classification Summary, and Discipline Report requirements for the project.

Transportation Research Board. 2000. Highway Capacity Manual. Special Report 209. National Research Council. Washington, D.C.

Trout Unlimited. 2007. Edmonds Laebugten Salmon Chapter, NW Steelhead and Salmon Council of Trout Unlimited. Available http://www.geocities.com/edmonds_laebugten/edmonds2.html accessed March 26, 2006.

Washington State Transportation Commission. 1998. Transportation Commission List of Highways of Statewide Significance. Passed by Resolution 584. Available: <http://www.wsdot.wa.gov/ppsc/hsp/HSSLIST.pdf>.

WDFW (Washington Department of Fish and Wildlife). 2007a. Priority Habitats and Species list. Available http://wdfw.wa.gov/hab/phsvert.htm#fish. Accessed March 22, 2007.

———. 2007b. Salmonid Stock Inventory, WRIA 08 - Lake Washington: Sammamish Tribs Coho. Last updated 2002. Available http://wdfw.wa.gov/webmaps/salmonscape/sasi/full_stock_rpts/3120.pdf Accessed March 26, 2007.

———. 2006. Priority Habitats and Species database. November 1, 2006. Washington Department of Fish and Wildlife, Olympia, Washington.

Western Regional Climate Center. 2006. Seattle Jackson Park, Washington 1961-19866 Monthly Climate Summary. Available: http://www.wrcc.dri.edu/summary/climsmwa.html Accessed: June 2007.

WSDOT (Washington State Department of Transportation). 2007. Environmental Procedures Manual. Publication M31-11. Prepared by the Environmental Services Office. April.

Available: <http://www.wsdot.wa.gov/fasc/EngineeringPublications/Manuals/EPM/EPM.htm>.

———. 2006. Highway Runoff Manual. Available: <http://www.wsdot.wa.gov/Environment/WaterQuality/Runoff/HighwayRunoffManual.htm#2006revision>. Accessed: April 27, 2007.

———. 2005. Freight and Goods Transportation System 2005 Update. Prepared by the Office of Freight Strategy and Policy.

———. 2002. Washington State Highway System Plan: 2003 – 2022. Prepared by the WSDOT Planning Office. February.

Appendix A – Pollutant Loading Calculation Tables

Table A-1. Calculated Pollutant Loads under No Build Conditions and Alternative A

	TSS	Total Zinc	Dissolved Zinc	Total Copper	Dissolved Copper
Load Rates					
Mean annual load from untreated surfaces (lbs/acre)	565	1.1	0.4	0.2	0.053
Mean annual load from treated surfaces (lbs/acre)	45	0.28	0.2	0.065	0.035
Project Total					
Annual effluent load from existing impervious surfaces prior to Project (lbs)	12,656.00	24.64	8.96	4.48	1.19
Annual effluent load from new and existing impervious surfaces after Project (lbs)	967.50	6.02	4.30	1.40	0.75
NET CHANGE in pollutant loads between pre- and post-project conditions (lbs)	-11,688.50	-18.62	-4.66	-3.08	-0.43
TDA BREAKDOWN					
Boeing Creek Drainage Area					
Annual effluent load from existing impervious surfaces prior to Project (lbs)	3,051.00	5.94	2.16	1.08	0.29
Annual effluent load from new and existing impervious surfaces after Project (lbs)	234.00	1.46	1.04	0.34	0.18
Net Change (lbs)	-2,817.00	-4.48	-1.12	-0.74	-0.10
Echo Lake Drainage Area					
Annual effluent load from existing	7,910.00	15.40	5.60	2.80	0.74

	TSS	Total Zinc	Dissolved Zinc	Total Copper	Dissolved Copper
impervious surfaces prior to Project (lbs)					
Annual effluent load from new and existing impervious surfaces after Project (lbs)	603.00	3.75	2.68	0.87	0.47
Net Change (lbs)	-7,307.00	-11.65	-2.92	-1.93	-0.27
Lake Ballinger Drainage Area					
Annual effluent load from existing impervious surfaces prior to Project (lbs)	1,695.00	3.30	1.20	0.60	0.16
Annual effluent load from new and existing impervious surfaces after Project (lbs)	130.50	0.81	0.58	0.19	0.10
Net Change (lbs)	-1,564.50	-2.49	-0.62	-0.41	-0.06

Table A-2. Calculated Pollutant Loads under No Build Conditions and Alternatives B and C

	TSS	Total Zinc	Dissolved Zinc	Total Copper	Dissolved Copper
Load Rates					
Mean annual load from untreated surfaces (lbs/acre)	565	1.1	0.4	0.2	0.053
Mean annual load from treated surfaces (lbs/acre)	45	0.28	0.2	0.065	0.035
Project Total					
Annual effluent load from existing impervious surfaces prior to Project (lbs)	13,560.00	26.40	9.60	4.80	1.27
Annual effluent load from new and existing impervious surfaces after Project (lbs)	1,003.50	6.24	4.46	1.45	0.78
NET CHANGE in pollutant loads between pre- and post-project conditions (lbs)	-12,556.50	-20.16	-5.14	-3.35	-0.49
TDA BREAKDOWN					
Boeing Creek Drainage Area					
Annual effluent load from existing impervious surfaces prior to Project (lbs)	3,277.00	6.38	2.32	1.16	0.31
Annual effluent load from new and existing impervious surfaces after Project (lbs)	243.00	1.51	1.08	0.35	0.19
Net Change (lbs)	-3,034.00	-4.87	-1.24	-0.81	-0.12
Echo Lake Drainage Area					
Annual effluent load from existing impervious surfaces prior to Project (lbs)	8,475.00	16.50	6.00	3.00	0.80

	TSS	Total Zinc	Dissolved Zinc	Total Copper	Dissolved Copper
Annual effluent load from new and existing impervious surfaces after Project (lbs)	625.50	3.89	2.78	0.90	0.49
Net Change (lbs)	-7,849.50	-12.61	-3.22	-2.10	-0.31
Lake Ballinger Drainage Area					
Annual effluent load from existing impervious surfaces prior to Project (lbs)	1,808.00	3.52	1.28	0.64	0.17
Annual effluent load from new and existing impervious surfaces after Project (lbs)	135.00	0.84	0.60	0.20	0.11
Net Change (lbs)	-1,673.00	-2.68	-0.68	-0.45	-0.06