Chapter 4 Affected Environment, Environmental Impacts and Mitigation Measures

Chapter 4 – Affected Environment, Environmental Impacts and Mitigation Measures

4.1 LAND USE

This section describes the existing land use in the study area and assesses the impacts of the Project on land use. It also addresses the consistency of the Project with regional and local comprehensive plans, land use or city codes, and shoreline regulations. The study area for this section includes the Seattle neighborhoods of Mount Baker, Beacon Hill, and Judkins Park located between I-5 and Lake Washington, Mercer Island, and the area of Bellevue between Lake Washington to just east of I-405.

4.1.1 Affected Environment

4.1.1.1 Land Use in the Study Area

Beacon Hill/Mount Baker/Judkins Park - Seattle

There are a mixture of land uses in the Beacon Hill/Mount Baker/Judkins Park area; however, the predominant land use is residential. In the Mount Baker area, there are mostly single family houses. The residential areas in Beacon Hill and Judkins Park contain a mixture of single family and multi-family housing. In Judkins Park, the areas closer to Lake Washington are used primarily for single family housing, and residential areas further away from the lake near 23rd Avenue S and Martin Luther King Junior Way S consist mostly of multi-family housing.

Commercial land use in the Beacon Hill and Mount Baker area is concentrated in a strip along Rainier Avenue S. This commercial area is dominated by convenience businesses such as groceries, drugstores, service stations, dry cleaners, banks, and fast food restaurants. There are also smaller neighborhood commercial land uses in some areas such as along Beacon Avenue S and Golf Drive S near I-5. In the Judkins Park area, commercial land use is also concentrated along Rainier Avenue S, and neighborhood commercial areas are located along 23rd Avenue S and Martin Luther King Junior Way S. In Judkins Park, there are industrial commercial areas near Rainier Avenue S and Boren Avenue S, and between I-5 and Rainier Avenue S.

Washington Middle school is located between 20th Avenue S and 23rd Avenue S. There are a number of recreation areas scattered throughout the Beacon Hill/Mount Baker/Judkins Park area. The majority of parks in this area are developed with facilities such as picnic areas and children's play equipment; however, Colman Park in Mount Baker is a natural park with walking trails through forested areas. Further information on parks near the I-90 corridor is provided in Section 4.14 of this FEIS.

Mercer Island

Mercer Island is served by a small central business district (CBD). The CBD occupies an area of approximately 76 acres with residential, retail, commercial, and office-orientated businesses

scattered throughout. Convenience businesses such as groceries, drugstores, service stations, dry cleaners, and banks dominate the commercial area of the CBD. There are also two other commercial areas on Mercer Island that occupy approximately 24 acres: one is located along the southern side of the I-90 corridor at East Mercer Way and contains several office buildings, including the Mercer Island City Hall; the other is located on the southern end of the island near the intersection of SE 68th Street and Island Crest Way, and includes small offices, a grocery store, and a drugstore (City of Mercer Island 1994).

Single family residential zoning accounts for approximately 90 percent of Mercer Island's land use. On Mercer Island there are 3,675 acres zoned for single family residential development, of which 90 percent is currently developed. Multi-family developments surround the CBD and are also located at the fringe of the other commercial areas. Multi-family housing occupies 86 acres. The most densely developed neighborhoods are located on the northern end of the island. This includes the neighborhoods of East Seattle and First Hill as well as neighborhoods immediately north and south of the I-90 corridor and neighborhoods along the entire length of Island Crest Way. The least densely populated neighborhoods are located along East and West Mercer Way (City of Mercer Island 1994).

Parks, open spaces, and educational facilities are highly valued and consume a large amount of land. Mercer Island has over 475 acres of park and open space lands including small neighborhood parks and trails as well as several larger recreational areas such as Luther Burbank Park and the Park on the Lid, which is located on top of the First Hill Lid. Approximately 117 acres of natural-forested land has been set aside in Pioneer Park and an additional 68 acres of public open spaces are scattered across Mercer Island (City of Mercer Island 1994). Further information on parks near the I-90 corridor is provided in Section 4.14 of this FEIS.

Three elementary schools, one middle school, and a high school are owned and operated by the Mercer Island School District. There are also several private schools at the elementary and secondary education levels. These schools are all located in residential areas of Mercer Island (City of Mercer Island 1994).

Bellevue

In 1996, over half of the Bellevue area was developed for residential purposes, slightly less than 14 percent of land was dedicated to open space and recreational use, approximately 10 percent was undeveloped, and the remainder was divided among commercial, industrial, office, government, and institutional uses. Of the remaining 1,900 acres of undeveloped land that was available in 1996, over 90 percent was planned for residential use and the remaining 10 percent was designated for non-residential uses. It was predicted that further development would likely occur in the area south of I-90 (City of Bellevue 1993).

The area of Bellevue between Lake Washington to just east of I-405 is currently used for a variety of purposes. To the west of I-405 near the I-90 corridor, land use consists predominantly of low- to medium-density single family residences and some multi-family developments. A large portion of land in this area is occupied by Mercer Slough Park, which is used for recreational purposes. There are also some relatively small areas of offices. The area to the east of I-405 is more densely developed compared to the area to the west of I-405. Land use to the

east of I-405 consists of commercial and office uses concentrated in the downtown CBD area north of I-90, other smaller areas of offices and commercial development located south of I-90 along with multi-family residential areas, and some single family residential areas.

4.1.1.2 Land Use Adjacent to the Corridor

Land use adjacent to the I-90 corridor is shown on Figure 4.1-1 and described below.

Beacon Hill/Mount Baker/Judkins Park - Seattle

Land use immediately to the north of the I-90 corridor consists predominantly of industrial/manufacturing, commercial and residential uses. Industrial/manufacturing and commercial land use is located between I-5 and Rainier Avenue S. The area that extends from Rainier Avenue S to near 31st Avenue S is mostly used for multi-family housing, with some commercial and single family housing, and the area from 31st Avenue S to Lake Washington consists predominantly of single family housing.

Land use to the south of the I-90 corridor consists predominantly of residential uses, with some commercial and recreational uses. Commercial land use is located between I-5 and Golf Drive S and on both sides of Rainier Avenue S. Residential land use follows the same pattern south of the I-90 corridor as it does to the north, with predominantly single family housing near Lake Washington and multi-family housing with some single family housing located further away from the lake.

The downtown area of Seattle is located to the west of I-5. A number of parks, such as Dr. Jose Rizal Park, Sturgus Park, Taejon Park, Day Street Park, and Sam Smith Park, are located adjacent to the I-90 corridor.

Mercer Island

On Mercer Island, land use immediately to the north of the I-90 corridor consists predominantly of single family residences, parks such as Luther Burbank Park, and linear greenbelts along I-90. Land use to the south of the corridor is more diverse, consisting of single and multi-family residences, the CBD, a smaller commercial area, and parks and linear green belts.

Bellevue

Land use immediately to the north of the I-90 corridor consists of single and multi-family residences, offices, the CBD, and Mercer Slough Park. Land use immediately to the south consists of single and multi-family residences, offices, a commercial area (Loemanns Plaza and Factoria Square Mall), and Mercer Slough Park. Residential land uses are concentrated along the shore of Lake Washington and the office and commercial land uses are located further east away from the lake.

4.1.1.3 State Legislation and Regulations

Growth Management Act

The Growth Management Act of 1990 (GMA) (Revised Code of Washington [RCW] 36.70A) provides a broad strategy for managing the problems associated with rapid growth and development in Washington State. It established new roles and responsibilities for planning at the local, regional, and state level.

At the local level, the GMA requires that counties and cities prepare comprehensive plans, identify natural resource lands of long-term commercial significance and critical areas such as wetlands, and adopt development regulations in relation to these areas. Subsections 4.1.1.4 and 4.1.1.5 of this section describes the requirements of the local planning instruments that are relevant to the I-90 Project. The requirements of the Shoreline Management Act of 1971 (SMA) are tied to the GMA because the goals and policies of shoreline master programs are considered to be an element of comprehensive plans, and all other parts of the programs are considered to be a component of the local government's GMA development regulations.

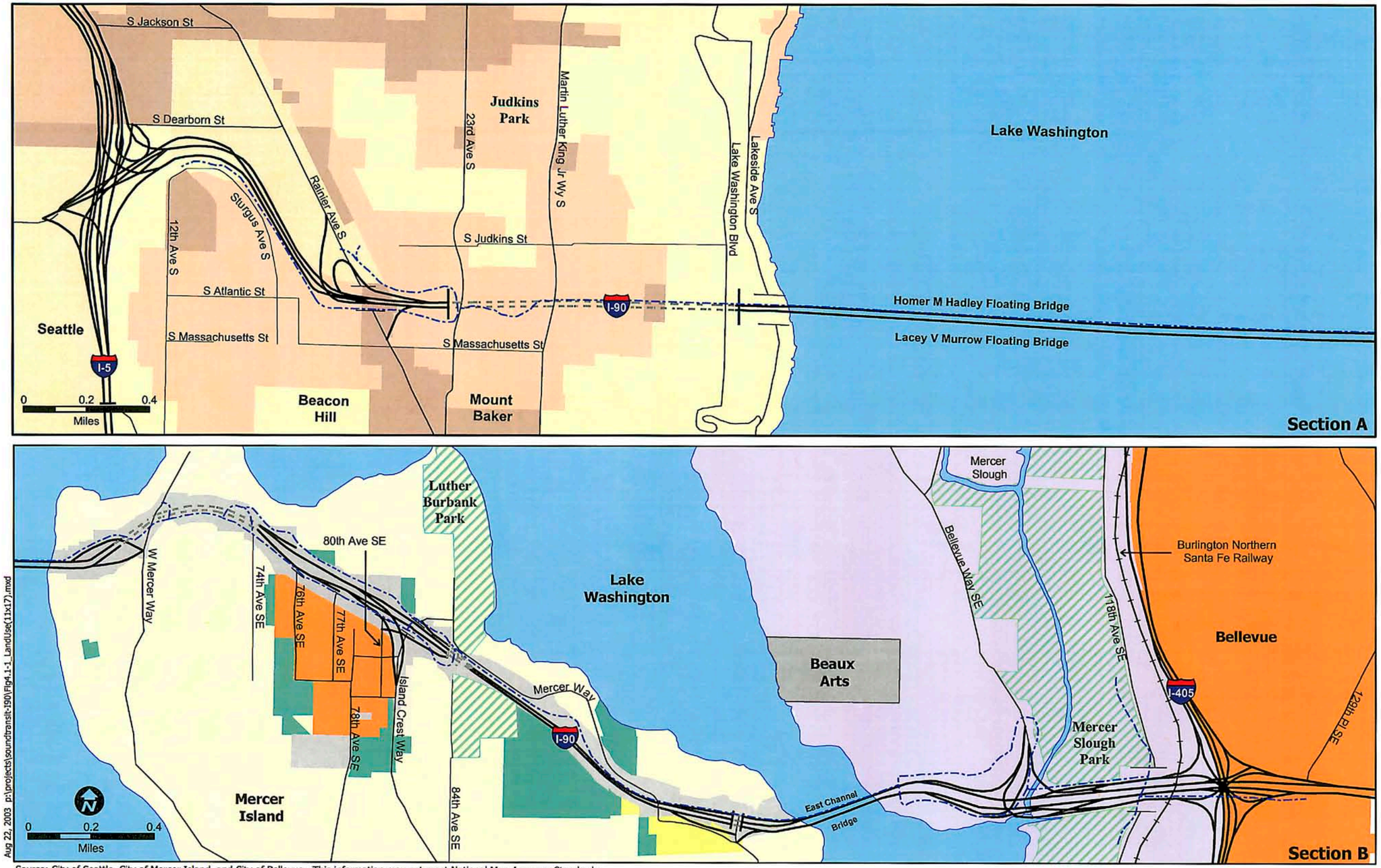
The GMA also establishes a coordinated planning program for regional transportation systems and facilities throughout Washington. The GMA authorizes local governments to form regional transportation planning organizations to develop regional transportation plans and to certify that local comprehensive plans are consistent with such plans and other requirements of the GMA. All transportation projects within the region that have an impact on regional facilities or services must be consistent with the regional transportation plan. I-90 is a facility of statewide significance. Subsection 4.1.1.4 of this section and Section 4.16 of this FEIS detail the requirements set out in the regional transportation plan that applies to the I-90 Project area.

Under the GMA, the state provides technical and financial assistance, mediates disputes between counties and cities, establishes minimum standards to ensure consistency in regional transportation planning, and enforces the GMA through sanctions and a process for identifying and managing natural resources of statewide significance. State agencies must comply with local comprehensive plans adopted under the GMA. Subsections 4.1.1.4 and 4.1.1.5 of this EIS demonstrate the Project's and Sound Transit's compliance with relevant local comprehensive plans.

House Bill 1487

In 1998, the Washington State Legislature passed House Bill (HB) 1487, or the "Level of Service Bill," to enhance the identification and coordinated planning for major transportation facilities identified as "transportation facilities and services of statewide significance." The bill amended the following RCWs in order to do this:

- RCW 47.05 – Priority Programming for Highways
- RCW 47.06 – Statewide Transportation Planning
- RCW 47.80 – Regional Transportation Planning Organizations



Source: City of Seattle, City of Mercer Island, and City of Bellevue. This information may not meet National Map Accuracy Standards.
Land Use Boundaries are approximate only.

U.S. Department of Transportation
Federal Highway Administration
Federal Transit Administration

Sound Transit

Washington State Department of Transportation

City of Seattle
- Manufacturing /Industrial
- Downtown
- Multi-Family
- Neighborhood/Commercial
- Single Family

City of Mercer Island
- Multi-Family
- Commercial
- Commercial Business District
- Single Family Residential
- Linear Green Belts

City of Bellevue
- Single and Multi Family Residential
- Commercial Business District
- Existing Parklands

Figure 4.1-1
Land Use

Transportation facilities and services of statewide significance, including I-90, provide and support transportation functions that promote and maintain significant statewide travel and economic linkages. The bill emphasizes that these significant transportation facilities should be planned from a statewide perspective. Planning includes policy development and the accompanying funding support to represent a broad range of perspectives serving the interests of all citizens in the state who depend on the system both directly or indirectly.

Washington State Commute Trip Reduction Act

In 1991, the state legislature passed the Commute Trip Reduction Act (HB 1671), which requires counties, cities, and towns to implement a commute trip reduction plan for major employers. Each plan must include goals to reduce single-occupant vehicle (SOV) commute trips and vehicle miles traveled (VMT) per employee. Under the legislation, each employer with over 100 employees arriving at work during the 6 AM to 9 AM peak period must prepare a commute trip reduction plan to reduce SOV work trips. Such trips were to be reduced 25 percent by 1999 and are to be reduced 35 percent by the year 2005. Providing commute alternatives is essential to achieving the law's goals.

Shoreline Management Act and Shoreline Master Program Guidelines

The SMA, enacted by the state legislature in 1971 and adopted by public referendum in 1972, establishes policies for regulating significant shorelines in the state. Specifically, the SMA regulates "shorelines," which are defined as lakes (including reservoirs) over 20 acres in size and streams with a mean annual flow over 20 cubic feet per second (cfs).

The SMA also designates specific areas as "shorelines of statewide significance," which include water bodies such as the Pacific Ocean, Hood Canal, lakes and reservoirs over 1,000 acres, rivers on the west side of the Cascades over 1,000 cfs, and rivers on the east side of the Cascades over 200 cfs (RCW 90.58.030). In addition to "shorelines," the SMA regulates certain development on lands immediately adjacent to shorelines, or "shorelands." "Shorelands" or "shoreland areas" are defined in RCW 980.58.030(2)(f) of the SMA as:

> *those lands extending landward for two hundred feet in all directions as measured on a horizontal plane from the ordinary high water mark; floodways and contiguous floodplain areas landward two hundred feet from such floodways; and all wetlands and river deltas associated with the streams, lakes, and tidal waters which are subject to the provisions of this chapter; the same to be designated as to location by the Department of Ecology. Any county or city may determine that portion of a one-hundred-year –flood plain to be included in its master program as long as such portion includes, as a minimum, the floodway and the adjacent land extending landward two hundred feet therefrom.*

Lake Washington is a "shoreline of statewide significance," and the land that extends 200 feet from the ordinary high water mark is the "shoreland area."

Development on shorelands or shoreland areas of Lake Washington (i.e., areas within 200 feet of the shoreline) must be consistent with the policy of the SMA as provided in RCW 90.58.020.

The Washington State Department of Ecology (Ecology) has issued guidance—*Legal Fundamentals of the Shoreline Management Act* (1999)—that discusses the SMA's policy, including Ecology's interpretation of Shorelines Hearings Board and court decisions addressing the SMA policy.

The cities of Seattle, Mercer Island and Bellevue have each developed shoreline master programs that form part of their land use codes or municipal codes and were prepared to be consistent with the Ecology guidelines developed in 1971.

4.1.1.4 Regional Plans and Programs

Sound Move: The 10-Year Regional Transit System Plan – *Adopted May 31, 1996*

Sound Transit's 10-year plan culminates over 7 years of effort by Sound Transit and its predecessor, the Joint Regional Policy Committee. The goal of *Sound Move* (Sound Transit 1996) is to provide the Central Puget Sound region with a cost-effective public transportation system that is an attractive alternative to the SOV.

Sound Move provides a balanced approach to increasing the capacity, utility, and convenience of the existing transit system by offering an integrated package of transportation improvements. Collectively, these improvements will provide a reliable, efficient, and congestion-free travel alternative by adding new high-capacity services and facilities in existing transportation corridors. *Sound Move* includes a regional system of high-occupancy vehicle (HOV) improvements, Regional Express bus routes, community connections including stations and park-and-ride lots, commuter rail, and light rail.

Destination 2030

Destination 2030 (Puget Sound Regional Council 2001) is a transportation action plan for the next 30 years of growth in the central Puget Sound region of Washington State. *Destination 2030* was adopted May 24, 2001, and follows the former document, *Vision 2020* which was adopted in 1990 and updated in 1995 (Puget Sound Regional Council 2001). *Destination 2030* identifies over 2,200 specific projects that have been designed to improve roads, transit, and ferry service. In addition to over 2,000 miles of new and improved regional and state roadways, the plan contains better public transit, incentives for carpools and vanpools, and more than 2,000 miles of new walkways and bikeways to connect communities with transit, shopping areas, and services. In identifying these specific projects, *Destination 2030* reflects a heightened awareness of how land in the region is developed and used and how land use is linked with transportation.

Roadway Improvements

Destination 2030 states that additional capacity and system management enhancements are needed to improve mobility on the central Puget Sound region's highway and regional arterial networks, especially in parts of the region where transit and other alternatives are not as feasible or as effective as they may be elsewhere (Puget Sound Regional Council 2001). The highest roadway priorities are safety, maintenance, and preservation projects, and projects that optimize the use of the existing roadway system. The section of I-90 from I-5 to I-405, is included as one of several projects highlighted for safety, maintenance, and capacity investments.

Regional Transit Improvements

The central Puget Sound region's ambitious, long-range growth management and transportation goals depend heavily on providing more and better public transit services over the next 30 years. A major step towards achieving this goal will be the construction and operation of the Sound Transit regional high capacity transit system (Puget Sound Regional Council 2001). In addition, numerous service changes and facility improvements are planned by local transit operators to provide better local service and support the regional high capacity transit system. The section of I-90 from I-5 to I-405 has been identified as needing transit improvements in the regional Transportation Improvement Plan (TIP) as project #RTA-18.

King County Comprehensive Plan

The *King County Comprehensive Plan* was adopted February 12, 2001 (King County 2001). The plan provides a legal framework for making decisions about land use in unincorporated King County. It does this by establishing policies relating to issues such as transportation, the environment, and community planning that are to be used by public and private agencies, property owners, developers, community groups, and King County staff when making decisions on development proposals, proposed changes in land use and zoning, and public spending on facilities and services, etc.

The environmental and transportation policies of this plan that are relevant to the Project are provided in Appendix G.

4.1.1.5 Local Comprehensive Plans and Zoning Ordinances

RCW 47.01.260 gives the Washington State Department of Transportation full authority to determine the placement of highways. Local jurisdictions do not have the ability to require zoning changes or conditional use permits for state highway projects.

City of Seattle Comprehensive Plan

The *City of Seattle Comprehensive Plan,* which was adopted July 25, 1994 (City of Seattle 1994), was designed to articulate a vision of how Seattle will grow in ways that sustain its citizens' values. The plan is composed of a number of elements that each contain policies and goals for guiding Seattle's growth. The policies and goals of the two elements of this plan that are most relevant to the Project (transportation and environment) are listed in Appendix G.

Land Use Code of the City of Seattle

Zoning

Development in the City of Seattle is governed by the provisions of the *Land Use Code of the City of Seattle*, which was adopted in 1985 (City of Seattle 1985). The *Land Use Code of the City of Seattle* does not specifically identify roads as a land use category but considers them necessary for access to all land use designations and therefore allows them in all zoning districts. Figure 4.1-2 shows the zoning districts adjacent to the I-90 corridor.

Seattle Shoreline Master Program

The *Seattle Shoreline Master Program* is contained in Chapter 23.60 of the *Land Use Code of the City of Seattle*. According to the *Seattle Shoreline Master Program*, the I-90 corridor passes through the Conservancy Recreation (CR) and Urban Residential (UR) Environments of the shoreline. The purpose of the CR Environment is to protect areas for environmentally related purposes such as parks and fishing grounds, and the purpose of the UR Environment is to protect residential areas.

Section 23.60.120 of the *Seattle Shoreline Master Program* provides that:

> *Except as specifically stated, the regulations of this chapter shall not apply to developments legally undertaken in the Shoreline District prior to the adoption of the ordinance codified in this chapter.*

The *Seattle Shoreline Master Program* became effective on December 31, 1987. Construction of the LVM Floating Bridge and tunnel portion of the I-90 corridor commenced in 1984 and 1986, respectively. Therefore, the regulations of the *Seattle Shoreline Master Program* do not apply to the section of the I-90 corridor in the CR and UR Environments.

Regardless of the applicability of Section 23.60.120 to I-90, Sections 23.60.540 and 23.60.546 of the *Seattle Shoreline Master Program* provide that streets and bridges are permitted outright on waterfront and upland lots in the UR Environment. Section 23.60.364 provides that bridges are special uses in the CR Environment and may be authorized as either principal or accessory uses.

Comprehensive Plan of the City of Mercer Island

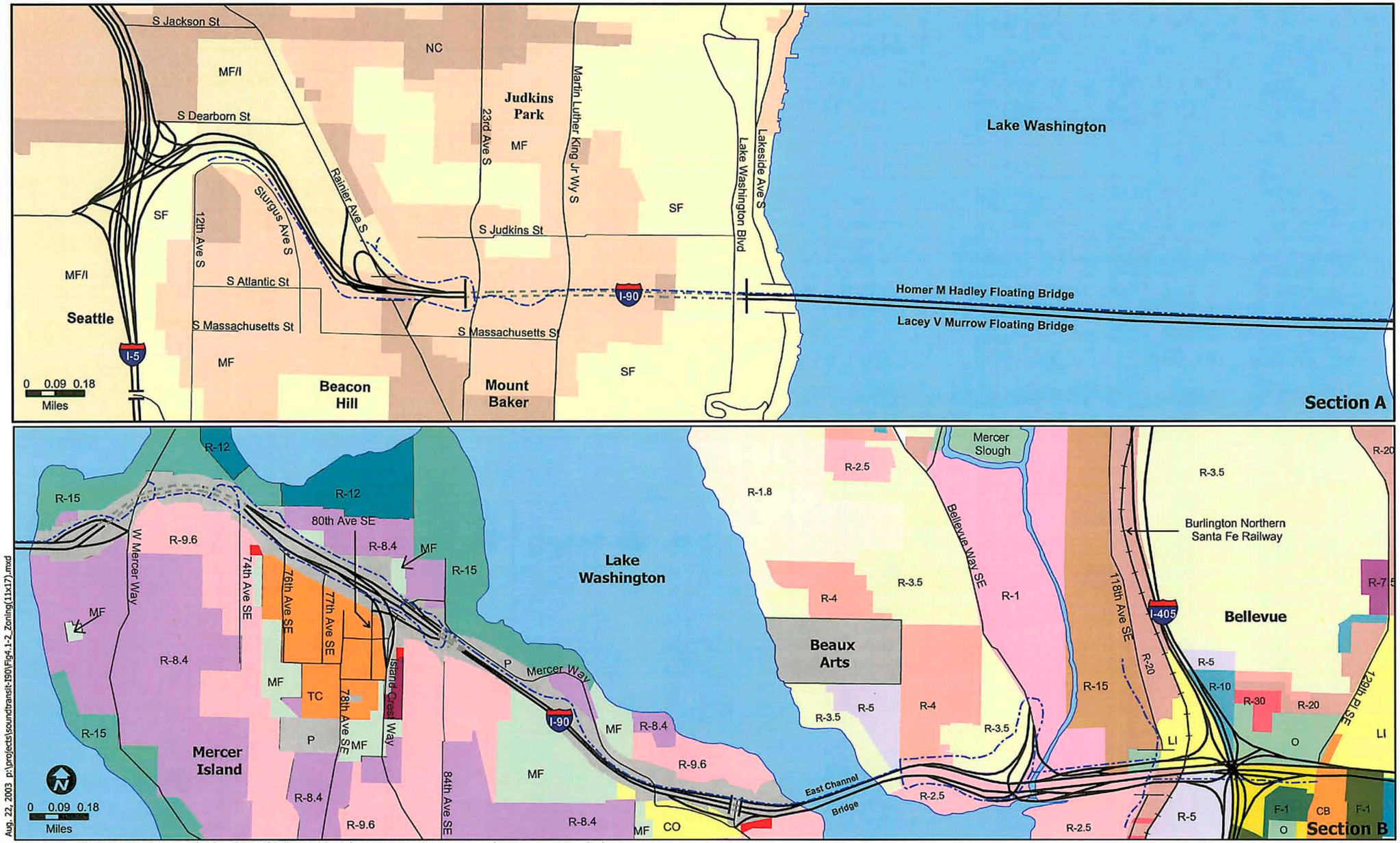
The *Comprehensive Plan of the City of Mercer Island* was adopted in October, 1994 (City of Mercer Island 1994). The issues addressed in the plan relate to how best to revitalize the city's central business district, comply with regional requirements for clean water and transportation, meet local needs for affordable housing, and maintain reliability in public facilities and utilities. The *Comprehensive Plan of the City of Mercer Island* is organized into a number of elements that each contain policies and goals for addressing the above listed issues. The policies and goals of the two elements from this plan that are most relevant to the Project (land use and transportation) are listed in Appendix G along with relevant shoreline policies and goals.

Mercer Island City Code

Zoning

Development within Mercer Island is governed by the provisions of the Mercer Island City Code (MICC) which was adopted in 1981 (City of Mercer Island 1981). Refer to Figure 4.1-2 for zoning adjacent to the I-90 corridor. Section 19.05.010, Title 19 Division 1 Regulations Unified Land Development Code of the MICC provides that:

> *The entire area within the Mercer Island I-90 right-of-way, including but not limited to, the roadway, street overcrossings, lids, open space, recreation areas, linear green belts and the park-and-ride lot area as approved by the city on November 14, 1983, and incorporated into the right-of-way plan approved by*



Source: City of Seattle, City of Mercer Island, and City of Bellevue. This information may not meet National Map Accuracy Standards.
Zoning Boundaries are approximate only.

U.S. Department of Transportation
Federal Highway Administration
Federal Transit Administration

SoundTransit

Washington State Department of Transportation

City of Seattle
- Manufacturing/Industrial (MF/I)
- Downtown (DNTN)
- Multi-Family (MF)
- Neighborhood/Commercial (NC)
- Single Family (SF)
- Major Institution (MI)

City of Mercer Island
- Multi-Family (MF)
- Commercial Office (CO)
- Rural 8.4 acres (R-8.4)
- Rural 9.6 acres (R-9.6)
- Rural 12 acres (R-12)
- Rural 15 acres (R-15)
- Public Institution (PI)
- Town Center (TC)

City of Bellevue
- Rural 3.5 acres (R-3.5)
- Rural 5 acres (R-5)
- Commercial Buildings (CB)
- Downtown (DNTN)
- Farmland (F-1,2,3)
- General Commercial (GC)
- Industrial (I)
- Light Industrial (LI)
- Office (O)
- Rural 1 acres (R-1)
- Rural 1.8 acres (R-1.8)
- Rural 2.5 acres (R-2.5)
- Rural 3.5 acres (R-3.5)
- Rural 4 acres (R-4)
- Rural 5 acres (R-5)
- Rural 7.5 acres (R-7.5)
- Rural 10 acres (R-10)
- Rural 15 acres (R-15)
- Rural 20 acres (R-20)
- Rural 30 acres (R-30)

Figure 4.1-2
Zoning

WSDOT on May 1, 1987, shall be part of the public institution zone. All uses within the I-90 right-of-way shall be maintained as set forth in city-approved I-90 related documents.

Each of the Project alternatives would take place entirely within the existing I-90 right-of-way on Mercer Island and would maintain the existing use of the right-of-way.

Shoreline Management Master Program

The Shoreline Management Master Program is provided in MICC 19.07.080, Title 19 Division 1 Regulations Unified Land Development Code of the MICC. The program exempts only single family residential, bulkheads and utility uses. Any work on I-90 within 200 feet of the water would require a Substantial Development Permit (Scanola 2003).

City of Bellevue Comprehensive Plan

The *City of Bellevue Comprehensive Plan* was adopted on December 6, 1993 (City of Bellevue 1993). The plan contains a number of community goals and policies to direct the orderly and physical development of the city. It serves as a guideline for designating land uses and infrastructure development as well as developing community services. The *City of Bellevue Comprehensive Plan* is organized into a number of elements that each contains policies and goals for guiding development of the city. The policies and goals of the three elements that are most relevant to the Project (transportation, environmental and shoreline) are provided in Appendix G.

Bellevue Land Use Code

Zoning

Development in the City of Bellevue is governed by the provisions of the Bellevue Land Use Code (LUC), which was adopted December 11, 2000 (City of Bellevue 2000). The LUC does not specifically identify roads as a land use category but considers them necessary for access to all land use designations and therefore allows them in all zoning districts. Refer to Figure 4.1-2 for zoning adjacent to the I-90 corridor.

Shoreline Overlay District

The Shoreline Overlay District is provided in Part 20.25E, Chapter 20.25 of the LUC. LUC 20.25E.010 states that the "lake waters, underlying lands and the area 200 feet landward of the ordinary highwater mark, plus associated floodways, floodplains, marshes, bogs, swamps, and river deltas" of Lake Washington, including Mercer Slough upstream to I-405, are located in the Shoreline Overlay District. LUC 20.25E.040 provides that a Substantial Development Permit is required for all development within the Shoreline Overlay District, with the exception of developments listed in LUC 20.25E.050. The Project does not fall into the category of any of the exempt developments listed in LUC 20.25E.050, and therefore a Substantial Development Permit would be required for the Project.

4.1.2 Impacts

Impacts to land use were assessed by reviewing comprehensive plans, land use and city codes, and shoreline regulations of the City of Seattle, City of Mercer Island, City of Bellevue, or King County; reviewing existing environmental documentation relating to the Project; and inspecting land uses within the study area. An adverse impact on land use is considered:

- If there are inconsistencies with a substantial number of the policies and goals set out in the City of Seattle, City of Mercer Island, City of Bellevue, and King County comprehensive plans.
- If there are inconsistencies with the provisions of the City of Seattle, City of Mercer Island, or City of Bellevue land use and city codes.
- If there are inconsistencies with the City of Seattle, City of Mercer Island, or City of Bellevue shoreline regulations.
- If surrounding land owners experience extended interruptions in the ability to carry out their normal land use activities.
- If Project impacts are anticipated such as air, noise, and visual impacts, that negatively affect land use activities.

4.1.2.1 Consistency with Plans and Programs

As described below, the Project is consistent with the relevant policies and goals set out in the City of Seattle, City of Mercer Island, City of Bellevue, and King County comprehensive plans, the land use and city codes, and the shoreline regulations.

King County

The Project would be consistent with the relevant policies set out in the environment element of the *King County Comprehensive Plan*. Dust emissions from construction will be minimized, erosion control measures will be put in place, stormwater runoff will be managed, wetlands will not be removed or altered, and there will be no adverse impacts on fish and wildlife. The Project would also be consistent with the policies set out in the transportation element. The Project would improve the efficiency of transit operations on I-90 between I-5 and I-405, while minimizing air, water, and noise pollution impacts and the disruption of natural surface water drainage in compliance with provisions and requirements of applicable federal, state, and local environmental regulations.

City of Seattle

The Project would be consistent with the relevant policies and goals set out in the environment element of the *City of Seattle Comprehensive Plan*. Mitigation measures would be put in place to minimize the impact of the Project on water quality, and to minimize noise pollution. The Project would also be consistent with the policies set out in the transportation element. The

Project would improve the efficiency of two-way transit operations on I-90 between Seattle and Bellevue and, by improving the efficiency of transit, would likely encourage greater use of transit and reduced reliance on SOVs. Apart from the necessary temporary closure of the I-90 shared-use pathway on the HMH Floating Bridge during construction, the Project would not adversely impact commuters who travel by bicycle. The Project would be implemented in a way that minimizes adverse impacts on the environment.

As detailed earlier in this section, the Project is consistent with the provisions of the *Land Use Code of the City of Seattle* and the *Seattle Shoreline Master Program.*

City of Mercer Island

The Project would be consistent with the relevant policies and goals set out in the land use element of the *Comprehensive Plan of the City of Mercer Island.* The Project would not have any impact on areas of open space, and mitigation measures would be put in place to minimize potential adverse impacts on the natural environment. By ensuring an adequate level of transit service for linking Mercer Island to the rest of the region and implementing mitigation measures that would minimize the impacts of the Project on the environment, the Project would be consistent with the policies set out in the transportation element, except if single-occupant vehicles from Mercer Island were restricted from using the center roadway as set forth in the 1976 Memorandum Agreement and Policy 8.1. By making use of the existing I-90 corridor in shoreline areas and minimizing the impact of the Project on the water quality of Lake Washington, the Project would be consistent with the shoreline policies and goals in the *Comprehensive Plan of the City of Mercer Island.*

As detailed earlier in this section, the Project is consistent with the provisions of the Mercer Island City Code and the Shoreline Management Master Program.

City of Bellevue

The Project would be consistent with the relevant policies and goals set out in the transportation element of the *City of Bellevue Comprehensive Plan.* The Project aims to improve the efficiency of the I-90 corridor for transit/high-occupancy vehicle use, while also retaining the I-90 shared-use pathway on the HMH Floating Bridge for use by commuters who travel by bicycle and minimizing impacts on surrounding neighborhoods. Improving the efficiency of transit would likely encourage greater use of transit and less reliance on SOVs. The Project would be consistent with the relevant policies and goals set out in the environment element. Mitigation measures would be put in place to minimize the impact of the Project on air and water quality, and to minimize noise pollution and soil erosion. There would be no impact on wetlands as a result of the Project. The Project would be consistent with the Shoreline Management Program Element and would be carried out in a way that has minimal impact on the shoreline environment.

As detailed earlier in this section, the Project is consistent with the provisions of the Bellevue Land Use Code and is permitted in the shoreline area upon obtaining a Substantial Development Permit from the City of Bellevue.

4.1.2.2 Construction

Alternative R-1: Existing/No Build

The small-scale roadway modifications or construction activities that would be required to preserve and maintain the corridor would not have an impact on land use in the study area.

Build Alternatives

The construction activities proposed for all the Build Alternatives (including the Preferred Alternative R-8A) would have some minor, temporary impacts on land uses adjacent to the construction areas within the I-90 corridor. Temporary impacts would include dust and noise generation, visual impacts, and access control. These impacts would be greater for Alternatives R-2B Modified, R-5 Modified, and R-8A, compared to Alternative R-5 Restripe because the proposed construction activities are more involved. Major events in Seattle such as professional baseball and basketball games and events in Bellevue such as the Pacific Northwest Arts and Crafts Fair would create additional traffic that would add to congestion caused by construction activities and construction-related traffic. The Project would not result in extended interruptions in the ability of land owners to carry out their normal land use activities.

4.1.2.3 Operation

All Alternatives

No adverse land use impacts are anticipated.

4.1.3 Mitigation Measures

4.1.3.1 Construction

Refer to mitigation measures provided in Chapter 3 - Transportation that would reduce temporary construction impacts.

4.1.3.2 Operation

No mitigation measures are required.

4.2 ENVIRONMENTAL JUSTICE

The environmental justice analysis can be found in Appendix A.

4.3 VISUAL RESOURCES

4.3.1 Affected Environment

This study complies with the guidelines outlined in the WSDOT *Environmental Procedures Manual,* Section 4-9, "Expertise Reports," and Section 5-1-1, "NEPA EIS Outline." Visual quality assessments were conducted in accordance with the United States Department of Transportation (USDOT), Federal Highway Administration (FHWA) *Visual Impact Assessment for Highway Projects* (1980). The Washington State Department of Transportation *Roadside Classification Plan* (1996) was also used for guidance. The I-90 corridor is designated as both a National Scenic Byway by the FHWA National Scenic Byways Program and a Washington State Scenic Byway (the Mountains to Sound Greenway) by the WSDOT Heritage Corridors Program. Refer to Appendix B for details of the visual assessment methodology.

4.3.1.1 Project Area Visual Resources

The Urban Landscape

From 4th Avenue S heading east toward Seattle's Beacon Hill, the roadside character of I-90 can be described as urban. The WSDOT Roadside Character Classification system (WSDOT 1996) defines urban roadside character as follows:

> *The urban landscape is a predominantly built environment. A roadside classified as urban is characterized by elements that mirror the character of adjacent land use. Vegetation is mostly non-native (ornamental) trees, shrubs, groundcover, with remnants of native vegetation. There is a consistent, refined appearance throughout all management zones. Structures are coordinated for visual continuity throughout the corridor. Special attention is given to architectural detail.*

In downtown Seattle, I-90 consists of elevated ramps that intersects with I-5. From the elevated ramps there are views of downtown Seattle to the north; the International District and Beacon Hill to the east; the Industrial District (SODO) and the sports stadiums to the south; and the Puget Sound to west. Likewise, the elevated concrete freeway structures are visible from tall downtown office buildings, the International and Industrial Districts include the sports stadiums, and from points in Beacon Hill including Dr. Jose Rizal Park. The structural elements of the I-90 freeway are well integrated with other built elements such as Seattle's office buildings, roads, Port of Seattle cranes, and sports stadiums.

The Semi-Urban Landscape

From Beacon Hill to the Mount Baker Ridge, the roadside character of I-90 can be described as semi-urban. The WSDOT Roadside Character Classification system (WSDOT 1996) defines semi-urban roadside character as follows:

> *The semi-urban landscape is characterized by intermixed built and natural or naturalized elements, with built elements prevailing. A roadside classified as semi-urban is*

transitional in character. Vegetation is a combination of native and non-native species. Trees and large shrubs are predominant where sufficient right of way is available. Zone 2 may vary from mowed grass to low-maintenance vegetation. Roadside management is used to develop a consistent, informal, moderately-refined appearance in Zone 2. Structures are coordinated for visual continuity throughout the corridor.

From downtown Seattle, I-90 runs through a cut between Beacon Hill and Capitol Hill, then through the Mount Baker Ridge tunnels and lid. Although the neighborhoods of Beacon Hill, Rainier Valley, and Mount Baker are visible in the distance from I-90, foreground views of freeway elements like retaining structures, roadside plantings, and tunnels are dominant in this portion of the Project area. Distant views of I-90 are available from the areas of Beacon Hill, Judkins Park, Rainier Valley, and Mount Baker, including Taejon Park, Sturgus Park, and Judkins Park and Playfield. Views of I-90 from these neighborhoods are often screened by the sensitive siting of the roadway and by freeway design elements such as retaining walls and roadside plantings.

Lake Washington is an expansive area with views oriented toward the sky and horizon lines. On the HMH and LVM floating bridges, the freeway lanes, cars, bridge rails and concrete barriers, and the shared-use pathway are visible in the foreground, middleground, and background. From the bridges, the lake is visible in the middleground and background with Renton and Mount Rainier to south, the downtown Bellevue skyline and SR 520 floating bridge to the north, Mercer Island to the east, and Seattle to the west.

Neighborhoods along the lake in Seattle's Mount Baker neighborhood and Mercer Island also have views of the I-90 bridges. People typically prefer views of open water such as lakes and ocean, and the East Portal View Point on Mount Baker Ridge is a frequently visited for its views of I-90 crossing the lake. Likewise, boats on Lake Washington have views of the HMH and LVM floating bridges. When boats are in proximity to the bridges, a boater might not be able to see past I-90 to the other side of the lake. In this case, the boater's view would be of the lake in front of I-90, the built structure of the bridge, and the open sky above. From farther away, a boater would be able to see over the bridges to the other side of the lake. In either case, the boater would not have a good view of the individual lanes on the bridges.

On Mercer Island, I-90 runs through three areas which can be classified as semiurban landscape types: the First Hill lid, the Central Business District, and the Shorewood/East Mercer neighborhood. Although distant views to the west and east are available along the I-90 corridor, the views from I-90 on within Mercer Island (by design) are inwardly focused. Freeway elements like textured retaining walls, roadside plantings, planted overpasses, and tunnel structures are the dominant views from this portion of the Project area. It is very difficult to see I-90 from many areas on Mercer Island because the roadway is cut into the landscape and buffered by walls and lush roadside plantings. Even the overpass structures that connect neighborhoods divided by the freeway are so densely-planted that it is difficult to reach their edge and look over the side into the freeway corridor. From those points where I-90 is visible, like the Outdoor Sculpture Gallery in the Central Business District, or the Shorewood Apartments in the Shorewood neighborhood, the freeway is seen in the background and often partially screened by foreground elements.

In the area of the I-405/I-90 interchange, there are views of Mercer Slough Park and Bellevue in the distance. Conversely, the I-405/I-90 interchange is visible from Mercer Slough Park and adjacent neighborhoods. The elevated freeway structures are visible from adjacent neighborhoods in the middleground against background views of planted hillsides scattered with office buildings.

4.3.1.2 Visual Resources From Viewpoints

Figure 4.3-1 shows all of the viewpoint locations studied.

Viewpoint 1

Viewpoint 1 represents a neighborhood view from above I-90 at Judkins Park. Park visitors often use the playgrounds and trails or visit with friends under the trees. The visual focus of these activities is usually inward to the park rather than outward toward I-90. However, the duration of views from the park would be relatively long. From Viewpoint 1 the trees, lawn, and trail in Judkins Park are visible in the foreground and middleground. I-90, including its retaining walls and plantings, is visible in the background below the park. In the evening, car lights and glare from the freeway, which is continuously illuminated between I-5 and the Mount Baker Ridge tunnel are visible from this view. The houses and trees in the Rainier/Beacon Hill neighborhoods are visible in the background beyond I-90 from this viewpoint. There are no memorable landscape elements in this view to create a sense of vividness. The freeway does encroach on the natural landscape elements seen in the park to some extent, but because I-90 is in the background and not a focus of the view, there is average visual integrity in the view. Likewise, there is a visual pattern of horizontal layers seen with the park in the foreground and middleground and the freeway and the green Rainier/Beacon Hill neighborhood on the southeast facing ridge in the background that creates an average visual unity.

Viewpoint 2

Viewpoint 2 represents a driver's and passenger's view on the HMH floating bridge looking northeast across the freeway towards Mercer Island. Drivers crossing the bridge are moving at speeds of up to 60 mph and have views of relatively short duration and limited focus. From this viewpoint the freeway lanes, median barrier, and shared-use pathway with railing are visible in the foreground and middleground. In the evening, car lights and glare from the freeway are visible from this view. Lake Washington, Mercer Island, and downtown Bellevue are visible in the background. The contrast in the horizon between the island and the lake is memorable from this view. However, foreground views of I-90 encroach on the natural integration between Mercer Island and Lake Washington, creating only an average sense of intactness. Because the foreground view of I-90 is so dominant, drivers perceive the composition of the view as concerning the relationship between freeway elements rather than between the freeway and the lake, for example. This creates a unified view from Viewpoint 2.

Viewpoint 3

Viewpoint 3 represents a bicyclist's or pedestrian's view from the shared-use pathway on the HMH floating bridge looking east. Bicyclists typically ride at speeds of 10 to 20 mph on the

bridge and pedestrians move more slowly. People who travel on the shared-use pathway have views of longer duration and more focus than drivers crossing the bridge. The freeway railing, concrete barrier, and adjacent freeway lanes with cars and trucks are visible in the foreground and middleground from this view. In the evening, car lights and glare from the freeway are visible from the shared-use pathway. Lake Washington is visible through the freeway railings to the north and Mercer Island and the downtown Bellevue skyline are visible in the background. The contrast between Lake Washington and Mercer Island is more difficult to discern from Viewpoint 3 because bicyclists and pedestrians look through or peer just over the 54-inch high railing to catch glimpses of the lake. Because the foreground views of I-90 are so dominant, they encroach on the natural elements like Lake Washington and the integration between natural and built elements on Mercer Island. Because the foreground view of I-90 is so dominant, bicyclists and pedestrians perceive the composition of the view as concerning the relationship between freeway elements rather than between the freeway and the lake, for example. This creates a unified view from Viewpoint 3.

Viewpoint 4

Viewpoint 4 represents the view from a boat on Lake Washington looking south to the HMH floating bridge (no photo provided). Boaters on Lake Washington can move across the lake quickly or float in one position; therefore the duration and focus of their views vary widely. Because boaters are level with the lake, if they are close to the bridge, they can only see the lake on their side, the bridge, and the sky above. From Viewpoint 4, boaters have views of Mercer Island to the east, Mount Baker to west, and the floating bridge (and often Mount Rainier) to south. In the evening, car lights and glare from the bridges are visible from this view. The contrast between Lake Washington (an open, expansive natural element) and the floating bridge (a horizontal, built element) is memorable in this view. Because the horizontal character of the bridge mimics the horizon line typically seen in views from the lake, there is an average sense of integration and composition between the built structure of the bridge and the natural form of the lake.

Viewpoint 5

Viewpoint 5 represents a driver's and passenger's view from the I-90 center roadway eastbound at 76th Avenue SE in Mercer Island's central business district. Drivers on I-90 are moving at speeds of up to 60 mph in this area and have views of relatively short duration and limited focus. From Viewpoint 5 the freeway lanes, the 77th Avenue SE ramp, trees and other plantings in the center roadway medians, and roadway plantings along the westbound outer roadway are visible in the foreground and middleground. An overpass structure (77th Avenue SE) is visible in the background. In the evening the car lights and glare from the freeway are visible from this view. There are no memorable elements in this view to create a sense of vividness. However, the I-90 architectural design standards have integrated uniform built elements, like the concrete barriers and retaining walls, with natural elements, like uniform roadway plantings, to create a sense of intactness and compositional harmony within the view.

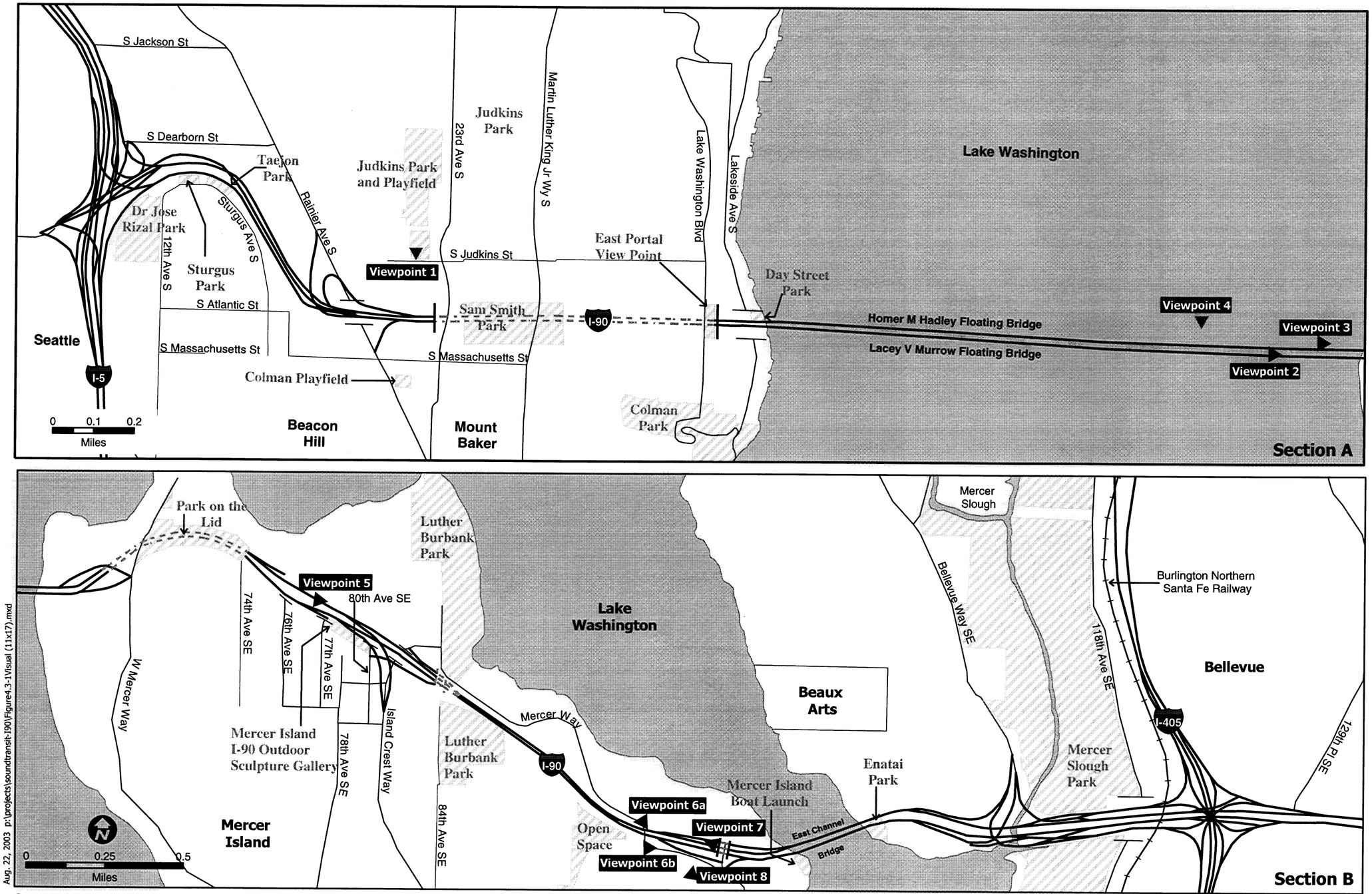


Figure 4.3-1
Viewpoints

Viewpoints 6a and 6b

Viewpoints 6a and 6b represent a driver's and passenger's view looking west from the I-90 center roadway (6a) and I-90 westbound (6b), respectively, at East Mercer Way. Drivers on I-90 are moving at up to 60 mph in this area and have views of relatively short duration and limited focus. In both views, the freeway lanes, concrete barriers, retaining walls, and uniform roadway plantings are visible in the foreground, middleground and background. In addition, the Shorewood Apartment buildings set on ridges adjacent to the freeway are visible in the background from both viewpoints. In the evening the car lights and glare from the freeway are visible from Viewpoints 6a and 6b. There are no memorable elements in these views to create a sense of vividness. However, the I-90 architectural design standards have integrated uniform built elements, like the concrete center dividers and retaining walls, with natural elements, like uniform roadway plantings and existing landforms, to create a sense of intactness and compositional harmony within the view.

Viewpoint 7

Viewpoint 7 represents a pedestrian's view looking west at I-90 from the planter beds on the Shorewood Avenue overpass on Mercer Island. Pedestrians using the overpass typically move slowly and have views with a long duration and specific focus. The freeway lanes, retaining walls, and uniformly-planted center dividers and roadsides are visible in the foreground, middleground, and background from this view. A planted ridge adjacent to the freeway, the Luther Burbank lid, and Mount Baker Ridge in Seattle are also visible in the background of this view. In the evening the car lights and glare from the freeway are visible from this view. There are no memorable elements in this view to create a sense of vividness. However, the I-90 architectural design standards have integrated uniform built elements, like the concrete center dividers and retaining walls, with natural elements, like uniform roadway plantings and existing landforms, to create a sense of intactness and compositional harmony within the view.

Viewpoint 8

Viewpoint 8 represents a resident's view of I-90 looking west from the Shorewood Apartments on E Lexington Way on Mercer Island. Residents of Shorewood Apartments are in a fixed position and, as a result, their views have a long duration and specific focus. The apartment side yard with shrubs and flagpole are visible in the foreground from this view. Beyond this are the eastbound, center and westbound I-90 roadways with the Somerset area of Bellevue in the distance. The uniformly-planted center dividers, roadsides, and overpasses as well as the I-90 retaining walls and ramps are visible in the middleground and background from Viewpoint 8. In the evening, the car lights and glare from the freeway are visible from this view. Because this viewpoint is located on a high point, it has an expansive view of the surrounding area and the freeway creates a striking visual pattern moving through the larger landscape. Like many places along I-90, the architectural design standards have integrated uniform built elements, like the concrete center dividers and retaining walls, with natural elements, like uniform roadway plantings and existing landforms, to create an average sense of intactness and compositional harmony within the view.

4.3.2 Impacts

Assessing Visual Impacts

Assessing the visual impacts that would be caused by the proposed alternatives involves quantifying visual resource change. The vividness, intactness, and unity levels seen from the identified viewpoints were evaluated and rated for the existing and proposed conditions of all alternatives. The methodology and rating sheets are found in Appendix B. Visual simulations were also developed to illustrate the existing and proposed conditions of the alternatives. Simulations of the proposed alternatives were prepared from a variety of viewpoints. The simulations were developed to illustrate the points along I-90 where the Project alternatives would have the most impact. As a result, this report does not include simulations of each viewpoint with every alternative. Table 4.3-1 lists the simulations prepared for this report.

Table 4.3-1
Simulations Prepared

Viewpoint Number	Location	Alternative Views
1	From Judkins Park looking southeast	Simulations not needed, impacts minimal
2	From the I-90 center roadway on the HMH floating bridge looking east	Simulations of Alternatives R-2B, R-5R, R-5M, and R-8A (Figure 4.3-3)
3	From the shared-use pathway on the HMH floating bridge looking east	Simulation of Alternative R-8A (Figure 4.3-4)
4	From Lake Washington looking south toward the HMH floating bridge	Simulations not needed, impacts minimal
5	From I-90 center roadway at 76th Avenue SE eastbound looking east (Level view)	Simulations of Alternatives R-2B and R-8A (Figure 4.3-5)
6	From I-90 at E Mercer Avenue looking west in the center roadway (6a) and west in the westbound outer roadway (6b) (Level view)	Simulations of 6a with Alternative R-2B and of 6b with Alternative R-8A (Figure 4.3-6)
7	From the Shorewood Avenue Overpass on Mercer Island looking west (Superior view)	Views of Alternatives R-2B, R-5R, R-5M, R-8A (Figure 4.3-7)
8	From Shorewood Apartments at East Lexington Way looking northeast (Superior view)	Simulations not needed, impacts minimal

4.3.2.1 Construction

This section discusses the impacts to scenic resources that would be created during the construction of each alternative.

Construction activities would include the relocation of concrete barriers and shorter retaining walls, removal of landscaping, grading and paving in limited areas, restriping the roadway surface, constructing new retaining wall and ramp structures, and widening existing roadways. Construction equipment that could be present during construction includes but is not limited to backhoes, graders, pavers, loaders, and trucks. Construction materials would include concrete, steel, timber asphalt, crushed rock, gravel, and landscaping materials such as topsoil and plantings. Construction impacts are temporary and would not be part of the lasting project operations.

Alternative R-1: Existing/No Build

With Alternative R-1 there would be future small-scale, maintenance and rehabilitation projects that would not have substantial visual impacts.

Alternatives R-2B, R-5 Restripe, R-5 Modified, and R-8A – *Preferred Alternative*

A variety of construction-related impacts would occur as a result of all the proposed Build Alternatives. Visual impacts would include the presence of construction equipment and construction staging areas. Work conducted at night would result in the presence of temporary construction lighting and associated glare. These construction activities would be seen from each viewpoint.

Temporary and intermittent land changes on I-90 and detours on local streets near I-90 ramps would occur. Construction activities would occur for approximately two construction seasons.

4.3.2.2 Operation

Viewpoint 1 (Figure 4.3-2)

Alternative R-1: Existing/No Build

With Alternative R-1 there would be future small-scale, maintenance and rehabilitation projects that would not have substantial visual impacts (Figure 4.3-2).

Alternative R-2B Modified

Alternative R-2B Modified would not change the vividness, intactness, and unity of the views from Judkins Park. Due to sensitive siting and carefully-developed freeway plantings, only portions of I-90 are visible from the park and the conversion of the center roadway to two-way operation would not be discernible from this distance. The alternative would neither increase nor diminish the levels of nighttime light and glare currently seen from this view. In addition, park visitors are more likely to be focused on recreation activities, than views of the freeway in this area. Because the visual changes would be so minimal, a simulated view from Viewpoint 1 was not prepared.

Alternative R-5 Restripe

No modifications of I-90 within the viewshed of Viewpoint 1 would occur with this alternative.

Alternative R-5 Modified

No modifications of I-90 within the viewshed of Viewpoint 1 would occur with this alternative.

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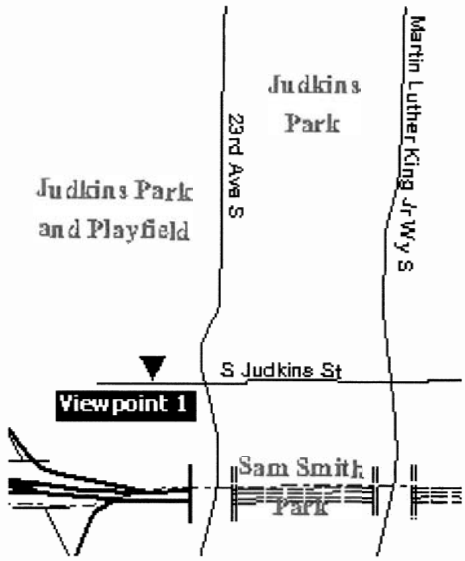

Existing Visual Resources From Judkins Park Looking South

Source: URS Corporation

U.S. Department of Transportation
Federal Highway Administration
Federal Transit Administration

SoundTransit

Washington State Department of Transportation

Figure 4.3-2
Existing Visual Resources
Viewpoint 1

Alternative R-8A

Alternative R-8A would not change the vividness, intactness, and unity of the views from Judkins Park. Due to sensitive siting and carefully developed freeway plantings, only portions of I-90 are visible from the park and the addition of a fifth travel lane to the outer roadways and associated widening would not be discernible from this distance. The alternative would neither increase nor diminish the levels of nighttime light and glare currently seen from this view. In addition, park visitors are more likely to be focused on recreation activities, than views of the freeway in this area.

Viewpoint 2 (Figure 4.3-3)

Alternative R-1: Existing/No Build

With Alternative R-1 there would be future small-scale, maintenance and rehabilitation projects that would not have substantial visual impacts (Figure 4.3-3).

Alternatives R-2B Modified and R-5 Restripe

Alternatives R-2B Modified and R-5 Restripe would not change the vividness, intactness, and unity of the views from Viewpoint 2 (Figure 4.3-3). Existing I-90 elements such as cars, freeway lanes, center dividers, and the shared-use pathway, that dominate a driver's foreground and middleground views on the HMH floating bridge would largely remain the same. The alternatives would neither increase nor diminish the levels of nighttime light and glare currently seen from this view. Views of Lake Washington or Mercer Island in the distance would not be altered by the addition of a median barrier between the center roadway lanes with Alternatives R-2B Modified or R-5 Restripe, or with the addition of a standard WSDOT type "BP" railing on the traffic barrier between the westbound roadway and the shared-use pathway.

Alternatives R-5 Modified and R-8A – Preferred Alternative

Alternatives R-5 Modified and R-8A would not change the vividness, intactness, and unity of the views from Viewpoint 2 (Figure 4.3-3). With both of these alternatives, screening would be added on top of the concrete barrier adjacent to the shared-use pathway. With Alternative R-8A, the median barrier between the westbound and center roadways would be moved south 2 feet. The existing I-90 elements such as cars, freeway lanes, and median barriers that currently dominate a driver's foreground and middleground views on the HMH floating bridge would remain the same with both alternatives. The alternative would neither increase nor diminish the levels of nighttime light and glare currently seen from this viewpoint.

With a standard WSDOT type "BP" railing (Figure 4.3-4, Option "A"), Lake Washington and the profiles of Mercer Island and Bellevue would remain visible in the middleground and background. With higher screening options selected for implementation (Figure 4.3-4, Options "B" and "C"), the view to Mercer Island and Bellevue could be partially obscured, depending on the opacity of the screening material selected for use with these higher railing options.

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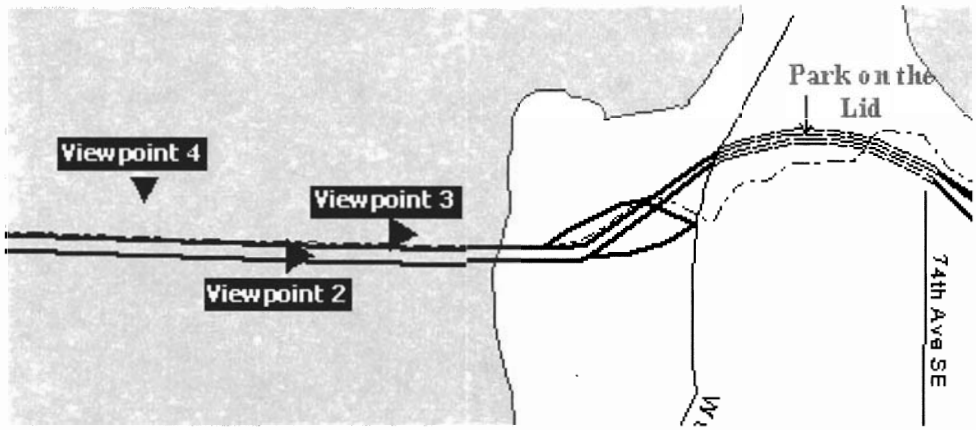

Existing Visual Resources From Homer M. Hadley Floating Bridge Looking East

Source: HNTB

U.S. Department of Transportation
Federal Highway Administration
Federal Transit Administration

Washington State Department of Transportation

SOUNDTRANSIT

Figure 4.3-3 (Sheet 1 of 3)
Existing Visual Resources and Simulation of Alternatives
Viewpoint 2

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Simulation of Alternative R-2B Modified Looking East

Source: HNTB

Simulation of Alternative R-5 Restripe Looking East

Source: HNTB

U.S. Department of Transportation
Federal Highway Administration
Federal Transit Administration

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SOUNDTRANSIT

Figure 4.3-3 (Sheet 2 of 3)
Existing Visual Resources and Simulation of Alternatives
Viewpoint 2

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Simulation of Alternative R-5 Modified Looking East

Source: HNTB

Simulation of Alternative R-8A Looking East

Source: HNTB

U.S. Department of Transportation
Federal Highway Administration
Federal Transit Administration

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Figure 4.3-3 (Sheet 3 of 3)
Existing Visual Resources and Simulation of Alternatives
Viewpoint 2

Viewpoint 3 (Figure 4.3-4)

Alternative R-1: Existing/No Build

With Alternative R-1 there would be future small-scale, maintenance and rehabilitation projects that would not have substantial visual impacts (Figure 4.3-4).

Alternative R-2B Modified

Alternative R-2B Modified would not change the vividness, intactness, and unity of the views from Viewpoint 3. Existing I-90 elements such as the cars, freeway lanes, lane dividers, and the shared-use pathway that dominate a bicyclist's or pedestrian's foreground and middleground views on the HMH floating bridge would remain the same. The alternative would neither increase nor diminish the levels of nighttime light and glare currently seen from this view. The roadway modifications, including a median barrier between the center roadway lanes, would not alter or improve the views of Lake Washington or Mercer Island in the distance, or restrict the bicyclist's or pedestrian's view to the south.

Alternative R-5 Restripe

Alternative R-5 Restripe would not materially change the vividness, intactness, and unity of the views from Viewpoint 3. Existing I-90 elements such as the cars, freeway lanes, lane dividers, and the shared-use pathway that dominate a bicyclist's or pedestrian's foreground and middleground views on the HMH floating bridge would remain the same. The alternative would neither increase nor diminish the levels of nighttime light and glare currently seen from this view. The roadway modifications would not alter or improve the views to the north of Lake Washington or Mercer Island in the distance. The addition of a WSDOT type "BP" railing to the traffic barrier would, to a limited degree, restrict views to the south.

Alternatives R-5 Modified and R-8A

Alternatives R-5 Modified and R-8A would not change the vividness, intactness, and unity of the views from Viewpoint 3 (shared-use pathway users). Additional screening would be added on top of the concrete barrier on the south side of the shared-use pathway (as shown in Options A, B, and C in Figure 4.3-4). Existing I-90 elements such as the shared-use pathway, bridge rails and median barriers, and freeway lanes would remain the dominant structures in the foreground and middleground views from this point. Alternatives R-5 Modified and R-8A would not change northerly views of Lake Washington or easterly views of Mercer Island from the path, however views to the south would be screened by the higher screening options, to a limited degree with Option "A", and to a greater degree with Options "B" and "C". Railing Options B and C would decrease the levels of nighttime light and glare currently seen from this view.

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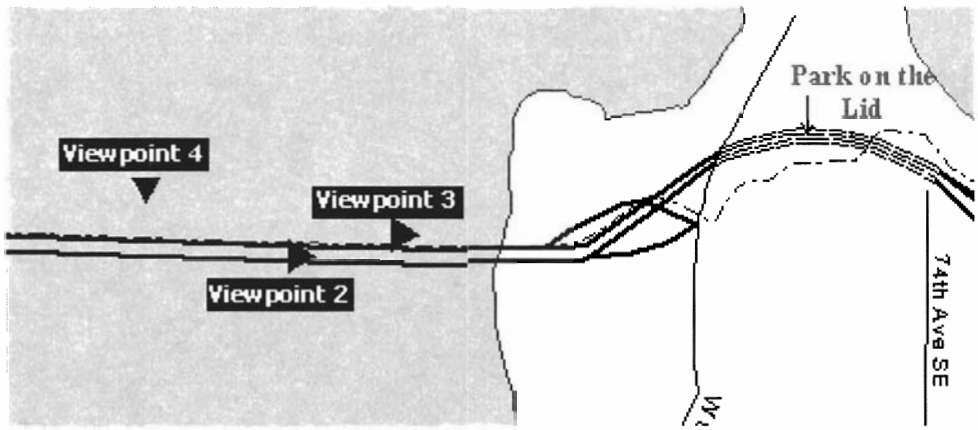

Existing Visual Resources (Alternative R-1) and Alternatives R-2B.
From the Shared-use Pathway on the
Homer M. Hadley Floating Bridge Looking East

U.S. Department of Transportation
Federal Highway Administration
Federal Transit Administration

Washington State Department of Transportation

SOUNDTRANSIT

Figure 4.3-4 (Sheet 1 of 3)
Existing Visual Resources and Simulation of Alternatives
Viewpoint 3

Simulation of Alternatives R-5 Modified and R-8A (Railing Option A)

Source: HNTB

Simulation of Alternatives R-5 Modified and R-8A (Railing Option B)

Source: HNTB

Simulation of Alternatives R-5 Modified and R-8A (Railing Option C)

Source: HNTB

Viewpoint 4

Alternative R-1: Existing/No Build

With Alternative R-1 there would be future small-scale, maintenance and rehabilitation projects that would not have substantial visual impacts.

All Build Alternatives

The changes with the Build Alternatives would not be discernible from a boat on Lake Washington looking south toward the bridge. In addition, the alternatives would neither increase nor diminish the levels of nighttime light and glare currently seen from this view.

Viewpoint 5 (Figure 4.3-5)

Alternative R-1 and R-5 Restripe

With Alternatives R-1 and R-5 Restripe there would be no changes to the center roadway. Future small-scale, maintenance and rehabilitation projects that would not have substantial visual impacts (Figure 4.3-5).

Alternatives R-2B Modified and R-8A – Preferred Alternative

Alternatives R-2B and R-8A would decrease the vividness, intactness, and unity of the view from Viewpoint 5 unless mitigated. The addition of a second center roadway ramp at 77th Ave. SE would increase the amount of built structure and decrease the amount of roadside planting, particularly trees, within the foreground and middleground views from Viewpoint 5, breaking the current visual continuity of the corridor. To compensate for this change, the additional structure would follow established I-90 architectural design standards and remain consistent with existing retaining wall and bridge structures in the corridor. Also, the roadside planting functions of the trees removed for the new ramp would be replaced by plantings consistent with the existing vegetation in the corridor, such as the lower plantings that currently exist along and under the existing ramp bridge structure. Alternative R-2B Modified would increase levels of nighttime light and glare currently seen from this view, in that an opposing traffic stream would be introduced into the center roadway. No change in levels of nighttime light and glare would occur with Alternative R-8A. Similar impacts would occur in the center roadway in the vicinity of 80th Avenue SE, where a new ramp would also be added with Alternatives R-2A Modified and R-8A.

Alternative R-5 Modified

At this specific viewpoint, no changes would occur with Alternative R-5 Modified. In the vicinity of 80th Avenue SE, however, a new transit-only ramp would be constructed. Impacts at that location would be similar to those described for Alternatives R-2B Modified and R-8A.

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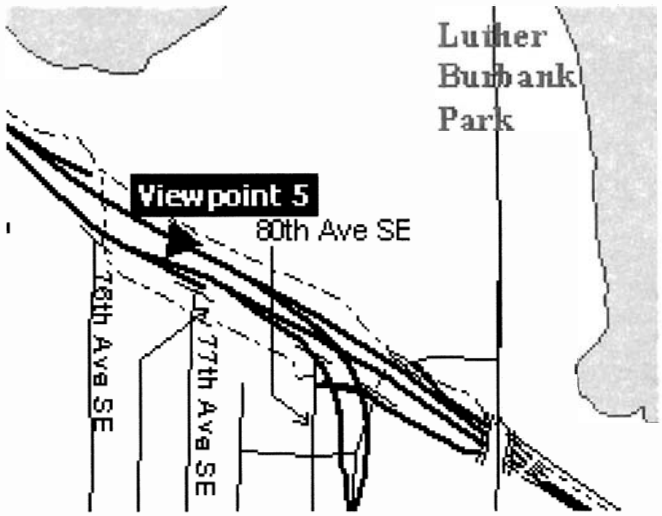

Existing Visual Resources (Alternative R-1) and Alternatives R-5 Restripe and R-5 Modified
From I-90 Eastbound Lanes at
76th Avenue SE in Mercer Island Looking East

Source: HNTB

U.S. Department of Transportation
Federal Highway Administration
Federal Transit Administration

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Washington State Department of Transportation

Figure 4.3-5 (Sheet 1 of 2)
Existing Visual Resources and Simulation of Alternatives
Viewpoint 5

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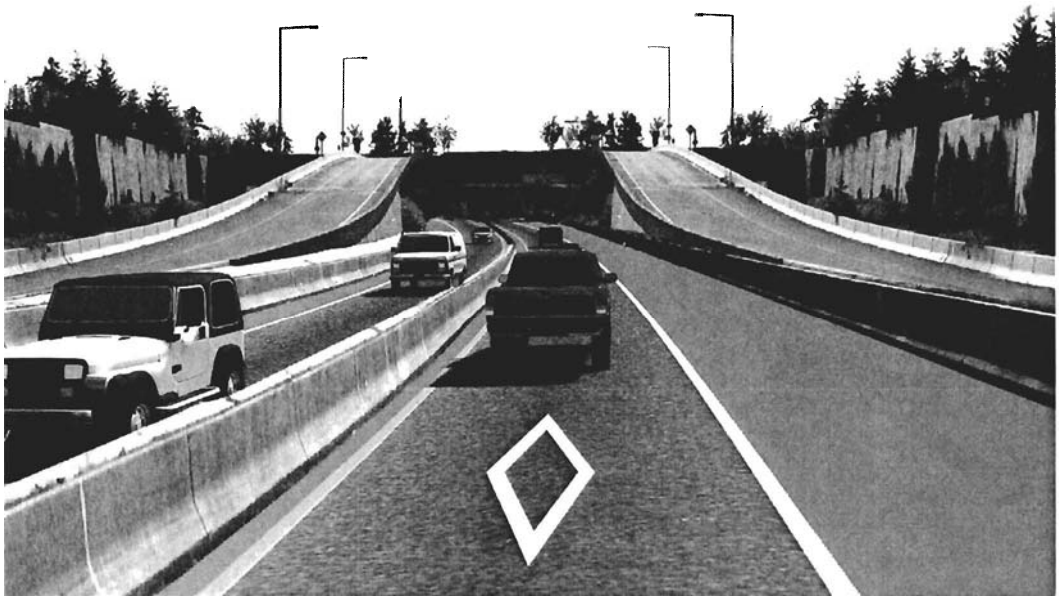

Simulation of Alternative R-2B

Source: HNTB

Simulation of Alternative R-8A

Source: HNTB

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Federal Highway Administration
Federal Transit Administration

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Washington State Department of Transportation

Figure 4.3-5 (Sheet 2 of 2)
Existing Visual Resources and Simulation of Alternatives
Viewpoint 5

Viewpoints 6a and 6b (Figure 4.3-6)

Alternative R-1: Existing/No Build

With Alternative R-1 there would be future small-scale, maintenance and rehabilitation projects that would not have substantial visual impacts (Figure 4.3-6).

Alternative R-2B Modified

Alternative R-2B Modified would not change the vividness, intactness, or unity of the view from Viewpoint 6a. Existing I-90 elements such as cars, freeway lanes, retaining walls, and roadside plantings that dominate a driver's foreground and middleground views from this point on I-90 would largely remain the same with Alternative R-2B Modified. The alternative would increase levels of nighttime light and glare currently seen from this view, in that an opposing traffic stream would be introduced into the center roadway. The addition of a median barrier in the center roadway and roadway widening for two-way operation would increase the amount of freeway roadway paving and decrease the amount of roadside planting seen from Viewpoint 6a. As shown in the simulation (Figure 4.3-6), vegetation would be removed at the outer 4 to 6 feet of the 20-25 foot wide median, where there is currently ground cover and shrubs. Based on the design completed to date, some or all of the existing trees could remain in place, however, impacts to specific trees would not be determined until subsequent and more detailed engineering design is completed.

Alternative R-5 Restripe

Alternative R-5 Restripe would not change the vividness, intactness, and unity of the views from Viewpoints 6a or 6b. The addition of a transit shoulder on the outer roadway and the reduction of lane widths with Alternative R-5 Restripe would not impact the composition or integration of natural and built elements in this view. Existing I-90 elements like cars, freeway lanes, center dividers, the overpass, and roadside plantings, would continue to dominate the driver's foreground and middleground views from this viewpoint. In addition, the alternative would neither increase nor diminish the levels of nighttime light and glare currently seen from this view.

Alternatives R-5 Modified and R-8A – Preferred Alternative

Alternatives R-5 Modified and R-8A would widen the outer roadways by 12 feet at this location. Because the widening would occur largely in the portion of the existing landscaped median where there is currently ground cover and shrubs, the built character of the existing view from Viewpoints 6b would not be materially altered despite the removal of some trees and associated increased views to existing retaining walls (Figure 4.3-6). Existing I-90 elements such as cars, freeway lanes, the median, retaining walls, and roadside plantings, would continue to dominate the driver's foreground and middleground views from Viewpoints 6a and 6b. In addition, the alternative would neither increase nor diminish the levels of nighttime light and glare currently seen from this view. Based on the design completed to date, some existing trees visible from the viewpoint could remain in place, as indicated in the simulation, however, impacts to specific trees would not be determined until subsequent and more detailed engineering design is completed.

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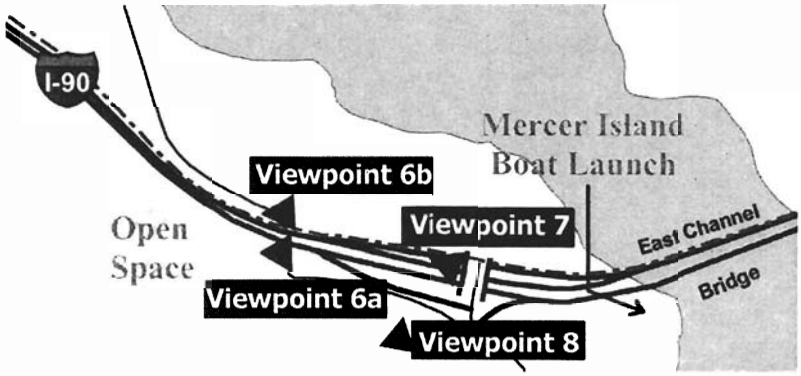

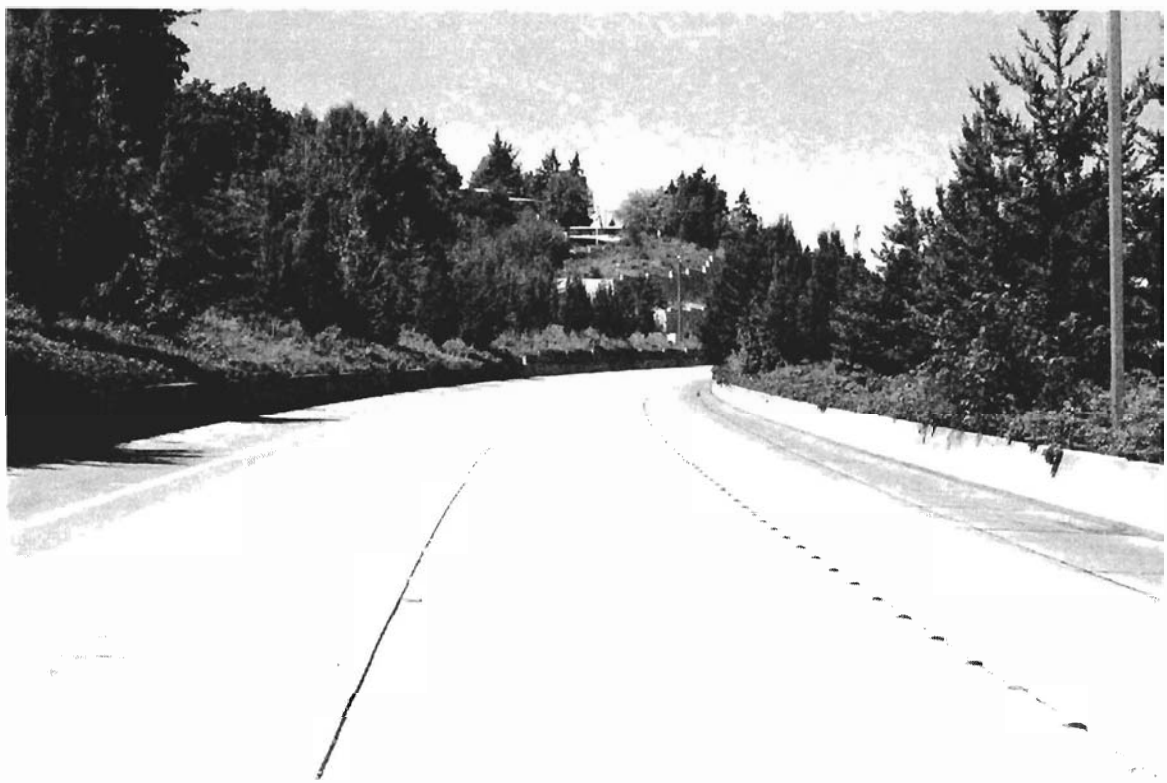

Existing Visual Resources From I-90 Center Roadway Looking Westbound
at E Mercer in Mercer Island

Source: HNTB

U.S. Department of Transportation
Federal Highway Administration
Federal Transit Administration

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Washington State
Department of Transportation

Figure 4.3-6 (Sheet 1 of 4)
Existing Visual Resources and Simulation of Alternatives
Viewpoint 6a

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Simulation of Alternative R-2B Modified

Source: HNTB

U.S. Department of Transportation
Federal Highway Administration
Federal Transit Administration

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Department of Transportation

Figure 4.3-6 (Sheet 2 of 4)
Existing Visual Resources and Simulation of Alternatives
Viewpoint 6a

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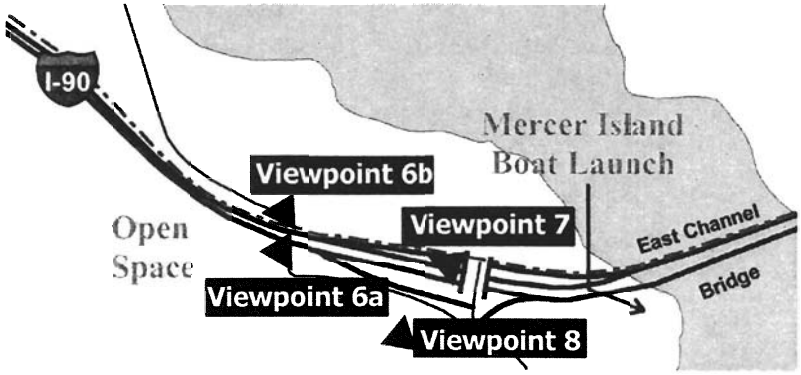
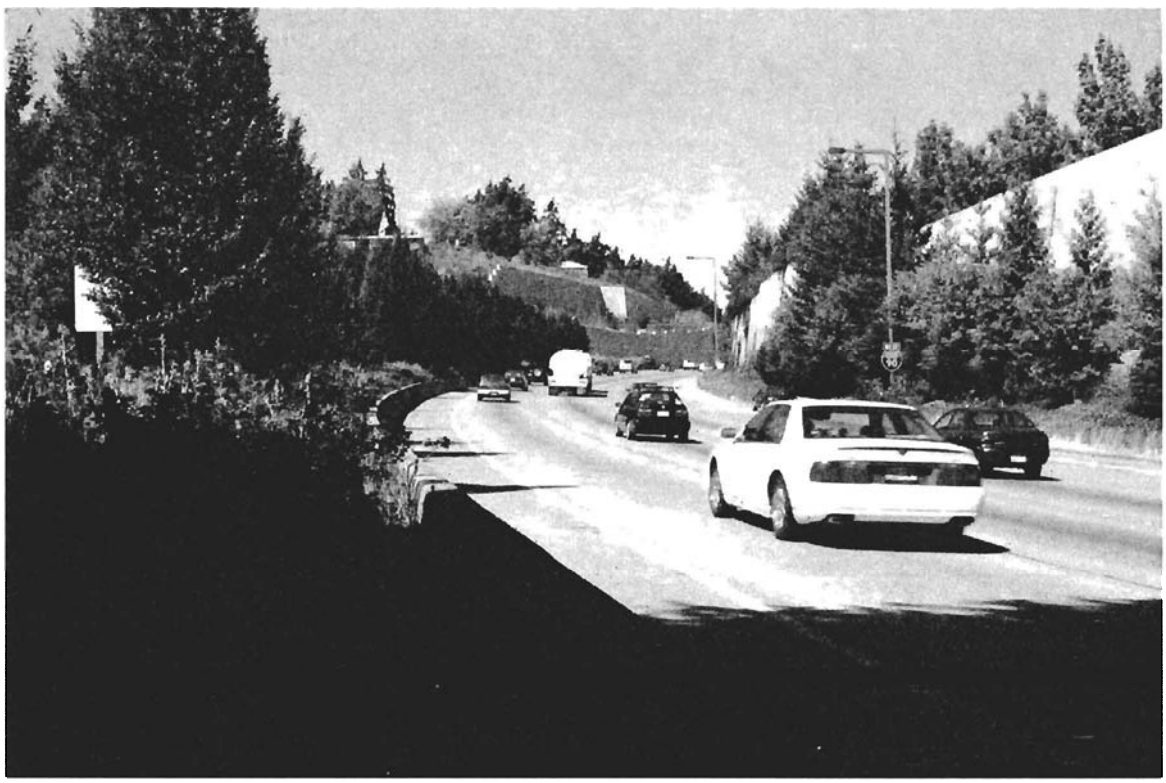




Existing Visual Resources From I-90 Outer Roadway Westbound
at E Mercer in Mercer Island

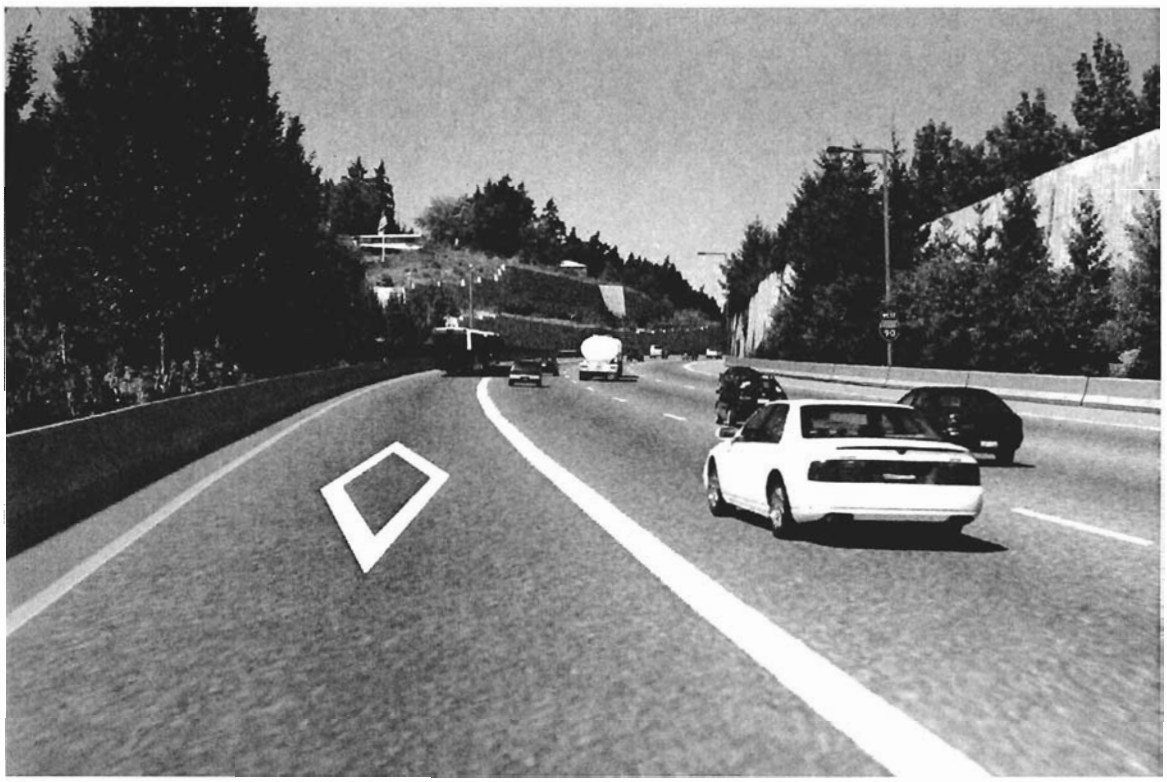
Source: HNTB

U.S. Department of Transportation
Federal Highway Administration
Federal Transit Administration

SoundTransit

Washington State
Department of Transportation

Figure 4.3-6 (Sheet 3 of 4)
Existing Visual Resources and Simulation of Alternatives
Viewpoint 6b



Simulation of Alternative R-8A

Source: HNTB

U.S. Department of Transportation
Federal Highway Administration
Federal Transit Administration
SoundTransit
Washington State Department of Transportation

Figure 4.3-6 (Sheet 4 of 4)
Existing Visual Resources and Simulation of Alternatives
Viewpoint 6b

Viewpoint 7 (Figure 4.3-7)

Alternative R-1: Existing/No Build

With Alternative R-1 there would be future small-scale, maintenance and rehabilitation projects that would not have substantial visual impacts (Figure 4.3-7).

Alternative R-2B Modified

Alternative R-2B Modified would not change the vividness, intactness, or unity of the view from Viewpoint 7. Existing I-90 elements seen from the Shorewood Avenue overpass, such as cars, freeway lanes, retaining walls, and plantings in the medians and along the roadsides would remain the dominant elements in the foreground, middleground, and background of this view with Alternative R-2B Modified. The alternative would neither increase nor diminish the levels of nighttime light and glare currently seen from this view. The addition of a median barrier in the center roadway and widened lanes for two-way operation would only minimally increase the amount of freeway structure and decrease the amount of median planting seen from Viewpoint 7 (Figure 4.3-7).

Alternative R-5 Restripe

Alternative R-5 Restripe would not change the vividness, intactness, and unity of the views from Viewpoint 7. The addition of a transit shoulder on the outer roadway and the reduction of lane widths with Alternative R-5 Restripe would not substantially alter the view from Viewpoint 7 (Figure 4.3-7). Existing I-90 elements such as cars, freeway lanes, the planted median, the overpass, and roadside plantings, would continue to dominate the driver's foreground, middleground, and background views from this viewpoint. In addition, the alternative would neither increase nor diminish the levels of nighttime light and glare currently seen from this view.

Alternative R-5 Modified

The vividness, intactness, and unity of the visual resources in this view would not change with Alternative R-5 Modified. Widening the outer roadways to allow for a transit shoulder with this alternative would not substantially change the built character of the view from this point (Figure 4.3-7). Existing I-90 elements such as cars, freeway lanes, the planted median, overpass, and roadside planting would continue to dominate the driver's foreground and middleground views from Viewpoint 7. In addition, the alternative would neither increase nor diminish the levels of nighttime light and glare currently seen from this view.

Alternative R-8A – Preferred Alternative

Widening the outer roadways to allow for an HOV lane with Alternative R-8A would not substantially change the view from Viewpoint 7 (Figure 4.3-7). Existing I-90 elements such as cars, freeway lanes, the planted median, overpass, and roadside plantings would continue to dominate the driver's foreground and middleground views under this viewpoint. In addition, the alternative would neither increase nor diminish the levels of nighttime light and glare currently seen from this view. There are no proposed changes with Alternative R-8A that would alter the vividness, intactness, or unity of this view.

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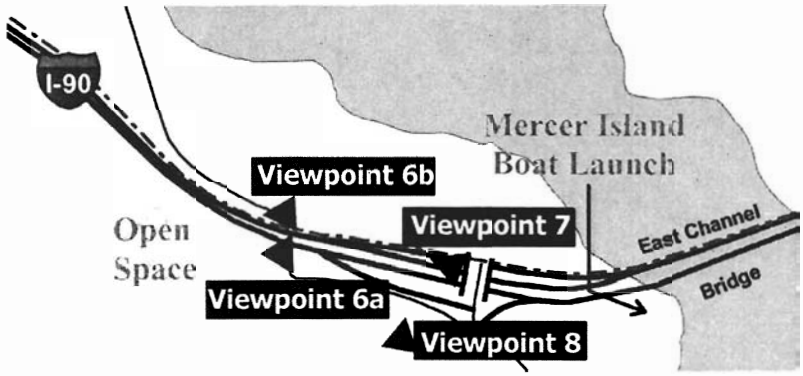

Existing Visual Resources From Shorewood Drive Overpass
Looking West Down to I-90 in Mercer Island

Source: HNTB

U.S. Department of Transportation
Federal Highway Administration
Federal Transit Administration

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Department of Transportation

Figure 4.3-7 (Sheet 1 of 3)
Existing Visual Resources and Simulation of Alternatives
Viewpoint 7

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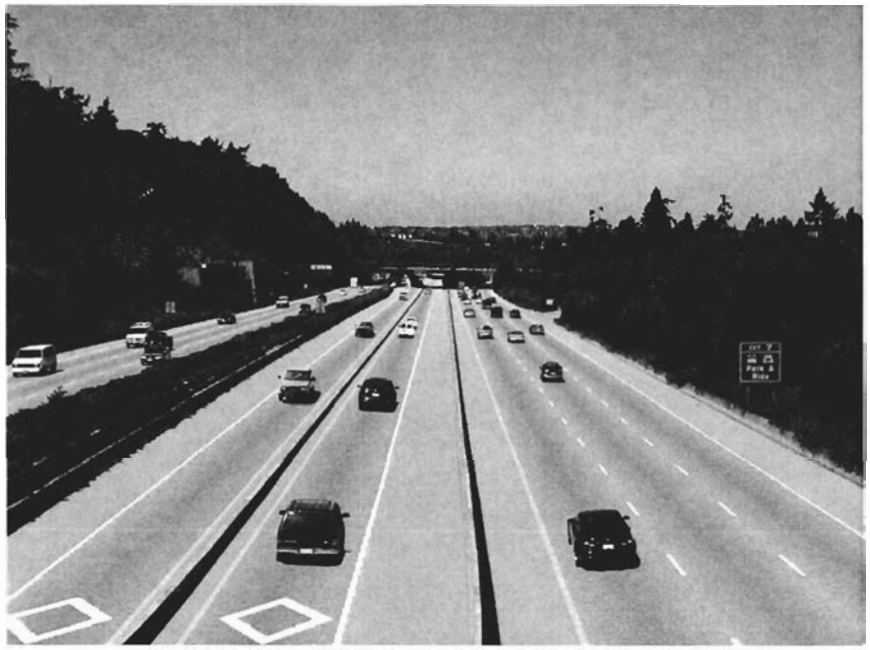

Simulation of Alternative R-2B Modified

Source: HNTB

Simulation of Alternative R-5 Restripe

Source: HNTB

U.S. Department of Transportation
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Figure 4.3-7 (Sheet 2 of 3)
Existing Visual Resources and Simulation of Alternatives
Viewpoint 7

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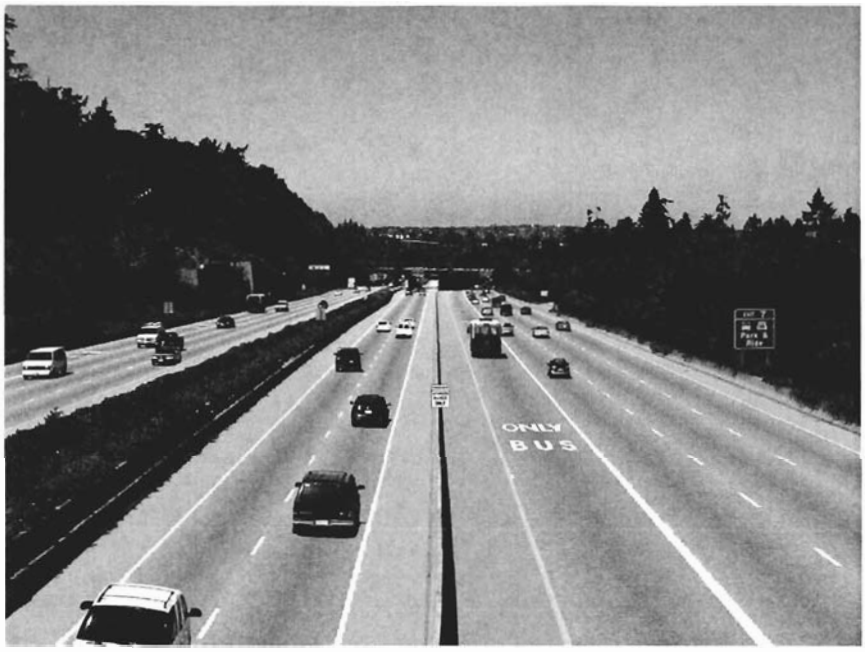
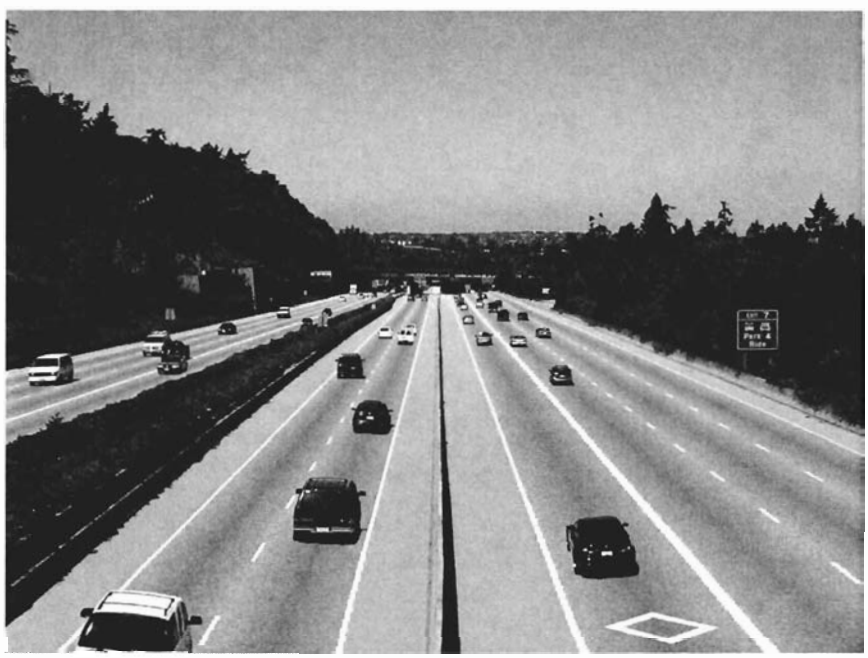


Simulation of Alternative R-5 Modified

Source: HNTB



Simulation of Alternative R-8A

Source: HNTB

U.S. Department of Transportation
Federal Highway Administration
Federal Transit Administration

SoundTransit

Washington State Department of Transportation

Figure 4.3-7 (Sheet 3 of 3)
Existing Visual Resources and Simulation of Alternatives
Viewpoint 7

Viewpoint 8 (Figure 4.3-8)

Alternative R-1: Existing/No Build

With Alternative R-1 there would be future small-scale, maintenance and rehabilitation projects that would not have substantial visual impacts (Figure 4.3-8).

All Build Alternatives

The Build Alternatives would not change the vividness, intactness, or unity of the view from Viewpoint 8. Existing I-90 elements seen from the Shorewood Apartments, such as cars, freeway lanes, retaining walls, and plantings in the medians and along the roadsides would remain visible in the middleground and background. The alternatives would neither increase nor diminish the levels of nighttime light and glare currently seen from this view. The roadway modifications would only minimally increase the amount of freeway structure and decrease the amount of median planting seen from Viewpoint 8, although the number of trees in the medians between the outer and center roadways would be decreased with Alternatives R-2B Modified, R-5 Modified, or R-8A. Based on the design completed to date, many of the existing trees visible from this viewpoint could remain in place, however, impacts to specific trees would not be determined until subsequent and more detailed engineering design is completed. In addition, because this view is of the larger landscape to the east, I-90 is not the major focus of this view.

4.3.3 Mitigation

4.3.3.1 Construction

VIS-1. Construction would be scheduled so that night lighting would be kept to a minimum; however, night construction would be required with all Build Alternatives to minimize impacts to roadway users.

4.3.3.2 Operation

VIS-2. Vegetation, including trees, would be preserved or restored wherever possible after construction. Mitigation areas for vegetation that cannot be preserved or restored would consist of additional plantings to enhance existing landscaped areas within the I-90 corridor between I-5 and I-405.

VIS-3. *I-90 Architectural Design Standards* (WSDOT, Revised Edition, December 1986) would be followed for all visual elements including walls and bridge structures, exposed concrete texture and color, lighting, and signing.

VIS 4. Restoration of roadside functions such as guidance and navigation, screening, and roadway buffering would be done in accordance with the WSDOT *Roadside Manual* where these functions would be affected by the Project.

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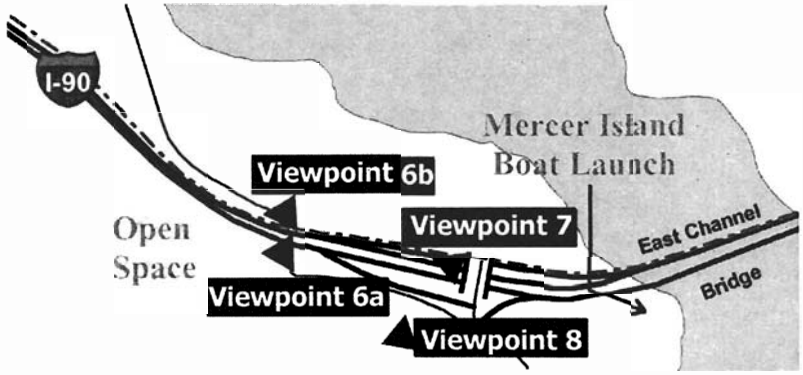


Existing Visual Resources From Shorewood Apartments in Mercer Island
Looking Northeast to I-90

Source: HNTB

U.S. Department of Transportation
Federal Highway Administration
Federal Transit Administration

Washington State
Department of Transportation

SOUNDTRANSIT

Figure 4.3-8
Existing Visual Resources
Viewpoint 8

4.4 AIR QUALITY

In response to comments received on the DEIS, a qualitative analysis of PM_{10} conformity has been included as Section 4.4.2.4.

4.4.1 Affected Environment

4.4.1.1 Local Air Quality

The area potentially affected by the Project overlaps with three different EPA designated air quality regions. The entire area included within the political boundaries of King County has been designated as "maintenance" for ozone. The King County Carbon Monoxide Maintenance area extends eastward from the county's western border, encompassing approximately one-third of the county. The Seattle/Duwamish Particulate Matter Maintenance Area follows the Duwamish River northward from Tukwila to I-90 and east to I-5. The study area falls entirely within the areas designated as in "maintenance" with the NAAQS (Table 4.4-1) for CO and ozone and in "attainment" for NO_x and SO_2. A small portion of the Project has the potential to affect five intersections located within the northwestern boundary of the Seattle-Duwamish PM_{10} maintenance area. Because the Project extends into regions designated as in maintenance for three criteria pollutants and federal funds are sought for a portion of the costs, the Project is subject to transportation conformity. All transportation projects seeking federal funding are included in the regional Transportation Improvement Program and must conform to the State Implementation Plan.

Table 4.4-1
National Ambient Air Quality Standards

Pollutant	Averaging Period	NAAQS
CO	1-hour	35 ppm
	8-hour	9 ppm
NO_2	Annual	0.053 ppm
PM_{10}	24-hour	150 µg/m3
	Annual	50 µg/m3
SO_2	3-hour	0.50 ppm
	24-hour	0.14 ppm
	Annual	0.03 ppm
O_3	1-hour	0.12 ppm
Pb	Quarterly	1.5 µg/m3

Note:
ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter

Source: USEPA

CO, NO_x, SO_2 and PM_{10} are monitored on a regular basis in the study area and there have been no measured violations of the national ambient air quality standards from 1996 through 2001 (PSCAA 2003). Ozone concentrations in excess of the one-hour and eight-hour federal standards were measured in 1998; however, the frequency of these ozone exceedances did not constitute a violation of the federal standards.

Motor vehicles are dominant sources of criteria pollutants. Based on the 1998 emission levels obtained from Puget Sound Clean Air Agency (PSCAA), automobiles contribute about 57 percent of the CO and 60 percent of the NO_x released to the atmosphere in the Puget Sound region.

Despite the population growth the region has experienced in recent years, ambient CO levels have been declining over the last two decades. Reduced emissions from mobile sources due to increasingly stringent state motor vehicle inspection and maintenance programs, cleaner burning fuels and technological/engineering improvements to engine performance have been the key factors behind the decrease. The second highest 1-hour CO concentrations from 1999 through 2002 measured at the intersection of 4th Avenue and Pike Street (monitor #53-033-0077) were 15.6, 5.2, 4.8, and 4.8 ppm, respectively. The second highest 8-hour CO concentrations during the same time period were 3.9, 3.7, 3.3 and 3.4 ppm, respectively.

Mobile source emissions contribute to the formation of ground level ozone. The ozone monitor nearest the Seattle region of the project area is in the Beacon Hill neighborhood (monitor ID# 530330080). Maximum 1-hour ozone concentrations at this location have been stable from 1997 through 2001. The 1999, 2000, 2001 and 2002 maximum 1-hour averages were 0.058 ppm, 0.059 ppm, 0.058 ppm and 0.053, respectively. The maximum 8-hour average ozone concentrations for 1999 through 2002 were 0.040, 0.049, 0.045 and 0.046 ppm, respectively.

4.4.1.2 Local Climate

The topography of the Puget Sound region is characterized by low rolling hills intermingled with a complex maze of waterways linked to the Pacific Ocean though the sound. The region has a mild climate with a preponderance of clouds and rain during the winter, while the summer season may be quite dry with a substantial number of sunny days. The average daily high temperature for the region is 59.8°F and the average daily low temperature is 44.8°F. Average annual precipitation is 37.18 inches. November is the wettest month with an average 5.77 inches of precipitation. The study area lies within a convergence zone caused by the typical offshore (westerly) airflow and the Olympic Mountains. It is common for a narrow band of clouds and rain to remain in the area while neighboring locales remain dry, sometimes sunny.

4.4.2 Impacts

4.4.2.1 Construction

Air quality impacts due to the construction of the Build Alternatives are likely to be small in both magnitude and duration. It would be difficult to calculate the air quality impacts from the construction of the various alternatives due to the lack of specific data: however, the actual construction activities associated with the Build Alternatives are relatively minor. The construction activities for all of the Build Alternatives would involve roadway restriping and/or minor roadway widening. The construction of all Build Alternatives would require the use of scrapers, graders, pavers, loaders, haul trucks and other miscellaneous equipment. The federal transportation conformity regulations {40 CFR 193.123(c)(5)} does not require an air quality modeling analysis for the emissions from roadway construction activities unless construction will continue for a period of time greater than five years.

During construction, the immediate impacts on air quality would be due primarily to particulate matter (or fugitive dust emissions) from earth-moving activities and tailpipe emissions of CO, NO_x, SO_2, VOC and PM_{10} from construction vehicles/equipment. Ambient pollutant concentrations would vary substantially over different phases of construction, depending on the level of activity, specific operations and prevailing meteorological conditions.

Construction activities have the potential to cause secondary increases of CO and other pollutants emitted by automobiles by disrupting the normal flow of traffic. These secondary emissions increases would be a result of the longer traffic queue lengths due to the closed or restricted travel lanes. Traffic flow may also be rerouted to other roadways with lower capacities, thus causing temporary increases in pollutant emissions in locations that normally have minimal traffic impacts.

The alternative that requires the least amount of construction activity would have the least impact on air quality. Conversely, the alternative requiring the greatest amount of construction activity would have the potential for the largest air quality impact. A more detailed analysis of each build alternative is not warranted and would be difficult due to the dynamic nature of construction activities. Qualitatively, the differences in the ambient air impacts from construction activities among Build Alternatives are minor. Since Alternative R-1 does not require any construction other than routine maintenance activities, it would have no impact on air quality. Alternative R-8A is likely to require the greatest amount of construction and, therefore has the potential to affect air quality to the largest extent.

4.4.2.2 Operation

Air quality impacts were calculated for all affected intersections within the study area as specified in 40 CFR 93.123 (a). Three operational years were examined; the base year (2000), the year of opening (2005), and the design year (2025).

None of the intersections examined in this air quality impact analysis had a modeled exceedance of the 1-hour or 8-hour CO standards during any of the three study years. The air quality throughout the study area, assessed as ambient CO levels, improved from the baseline year (2000) through the 2025 design year, even though traffic volumes increased. This was a result of lower vehicle CO emission rates. Because the modeled CO concentrations associated with all of the three study years and alternatives were well below the NAAQS, no adverse health effects are expected due to this Project.

The CAL3QHC model was set up to predict short-term pollution episodes by calculating the maximum 1-hour and 8-hour average CO concentrations. All intersections in this analysis were modeled as described in the Synchro traffic model input/output report provided by Mirai Associates. The traffic modeling was performed for both peak AM and PM hours. 8-hour traffic counts were estimated from peak 1-hour volumes by applying an adjustment factor of 0.825 and 0.771 for Seattle and Bellevue intersections, respectively. These adjustment factors were provided by Mirai Associates and were calculated by dividing the average traffic volume for the hours of 12:00 PM through 7:00 PM by the peak hour traffic volume. Ten intersections were averaged to obtain the factor for Seattle and seven intersections were averaged in the Bellevue area.

All of the CO concentrations presented in this section include 1-hour and 8-hour background levels obtained from an EPA Aerometric Information Retrieval System (AIRS) monitor located at 4th Avenue and Pike Street, Seattle, WA. The monitor (ID #53-033-0077) had 4,971 valid hours of data in 2001. The maximum 1-hour CO concentration measured in 2001 was 4.6 ppm and the maximum 8-hour concentration was 3.2 ppm. The arithmetic mean CO concentration was 0.93 ppm. After consultation with PSCAA (Paul Carr - Air Resource Specialist, 2002), conservative background CO levels of 1.7 and 1.6 ppm (2001- 90th percentile values) were determined to be appropriate for the 1-hour and 8-hour averaging periods, respectively.

Alternatives R-1 (Existing/No Build), R-5 Restripe and R-5 Modified

None of the intersections modeled with Alternatives R-1, R-5 Restripe or R-5 Modified had a modeled exceedance of the 1-hour or 8-hour CO standards during any of the three study years. The maximum CO concentrations for this alternative are summarized in Table 4.4-2.

Table 4.4-2
Summary of Air Quality Impacts
Alternatives R-1 (No Build), R-5 Restripe and R-5 Modified

Intersection	Modeled CO Concentrations (ppm)[1,2]					
	2000		2005		2025	
	1-hr	8-hr	1-hr	8-hr	1-hr	8-hr
James St & 7th Ave					4.10	2.90
James St & 6th Ave					5.30	3.30
S Jackson St & 2nd Ave	8.80	5.50	6.00	3.90	4.30	3.00
4th Ave S & Airport Way S					5.50	3.40
I-90 Ramps & 4th Ave S	14.20	8.80				
S Royal Brougham Way & 4th Ave S			8.20	5.20	5.50	3.50
S Royal Brougham Way & 1st Ave S	11.3	7.00	8.90	5.50	5.50	3.70
S Jackson St & 14th Ave S	14.0	7.70	9.80	5.60	6.10	3.40
S Dearborn St & Rainier Ave S	13.6	7.70	8.40	5.20	5.20	3.40
S Hill St & 23rd Ave S	13.2	7.70	8.40	5.20	5.60	3.60
MLK Jr. Way S & Rainier Ave S	13.0	7.30	8.20	5.00	6.00	3.90
Atlantic St & 4th Ave S			8.50	5.20		
Atlantic St & 1st Ave S			9.20	5.50	6.30	4.00
Bellevue Way SE & 112th Ave SE	16.9	8.10	10.7	5.30	6.20	3.50

[1] CO concentrations are reported in parts per million (ppm).
[2] Background CO levels of 1.7 ppm (1-hour) and 1.6 ppm (8-hour) are included in these concentrations.

Source: URS Corporation

The maximum 1-hour and 8-hour CO concentrations for the Seattle area intersections during the 2005 study year were 9.8 ppm and 5.6 ppm, respectively. The maximum CO concentrations were calculated at the intersection of S Jackson Street and 14th Avenue S. The maximum 1-hour and 8-hour CO concentrations for the Seattle area intersections during the 2025 study year were 6.3 ppm and 4.0 ppm, respectively. The maximum CO concentrations were calculated at the intersection of Atlantic Street and 1st Avenue S. With this alternative the air quality in the study area, assessed as ambient CO levels, improved from the baseline year (2000), to the year of opening (2005) and through the 2025 design year, even though traffic volumes increased. This was the result of lower vehicle CO emission rates.

Alternative R-2B Modified

None of the intersections modeled with Alternative R-2B Modified had a modeled exceedance of the 1-hour or 8-hour CO standards during any of the three study years. The maximum CO concentrations for this alternative are summarized in Table 4.4-3.

Table 4.4-3
Summary of Air Quality Impacts – Alternative R-2B Modified

Intersection	Modeled CO Concentrations (ppm)[1,2]							
	2000		2005				2025	
	Base Year		R-2B Mod. 2+		R-2B Mod. 3+		R-2B 3+	
	1-hr	8-hr	1-hr	8-hr	1-hr	8-hr	1-hr	8-hr
James St & 7th Ave							4.10	3.10
James St & 6th Ave							5.30	3.30
S Jackson St & 2nd Ave S	8.80	5.50	6.00	4.00	5.70	3.70	4.30	3.00
4th Ave S & Airport Way S							5.40	3.50
S Dearborn ST & 5th Ave S			6.90	4.60			4.50	3.00
I-90 Ramps & 4th Ave S	14.2	8.80						
S Royal Brougham Way & 4th Ave S			8.20	5.20			5.50	3.50
S Royal Brougham Way & 1st Ave S	11.3	7.00	8.90	5.50			5.60	3.70
S Jackson St & 14th Ave S	14.0	7.70	9.80	5.70	9.80	5.70	6.10	3.40
S Dearborn St & Rainier Ave S	13.6	7.70	8.40	5.20	8.40	5.20	5.20	3.40
S Hill St & 23rd Ave S	13.2	7.70	8.40	5.20	8.40	5.20	5.60	3.60
MLK Jr. Way S & Rainier Ave S	13.0	7.30	8.20	5.10	8.30	5.10	5.90	3.70
Atlantic St & 4th Ave S			8.40	5.50				
Atlantic St & 1st Ave S			9.20	5.00	8.90	5.30	6.30	4.00
Bellevue Way SE & 112th Ave SE	16.9	8.10	10.8	5.30	10.6	5.20	6.30	3.50

[1] CO concentrations are reported in parts per million (ppm).
[2] Background CO levels of 1.7 ppm (1-hour) and 1.6 ppm (8-hour) are included in these concentrations.

Source: URS Corporation

The maximum 1-hour and 8-hour CO concentrations for the Seattle area intersections during the 2005 study year were identical for both HOV 2+ (HOV lanes with 2+ occupants per vehicle) and HOV 3+ (HOV lanes with 3+ occupants per vehicle) versions of the alternative and were 9.8 ppm and 5.7 ppm, respectively. The maximum CO concentrations were calculated at the intersection of S Jackson Street and 14th Avenue S. The maximum 1-hour and 8-hour CO concentrations for the Seattle area intersections during the 2025 study year 6.3 ppm and 4.0 ppm, respectively. The maximum CO concentrations were calculated at the intersection of Atlantic Street and 1st Avenue S. The air quality in the study area, assessed as ambient CO levels, improved from the baseline year (2000), to the year of opening (2005), through the 2025 study year, even though traffic volumes increased. This was the result of lower vehicle CO emission rates.

Alternative R-8A

None of the intersections modeled with Alternative R-8A had a modeled exceedance of the 1-hour or 8-hour CO standards during any of the three study years. The maximum CO concentrations for this alternative are summarized in Table 4.4-4.

Table 4.4-4
Summary of Air Quality Impacts – Alternative R-8A

Intersection	Modeled CO Concentrations (ppm)[1,2]							
	2000		2005		2025			
	Base Year		R-8A		R-8A 2+		R-8A 3+	
	1-hr	8-hr	1-hr	8-hr	1-hr	8-hr	1-hr	8-hr
James St & 7th Ave					4.30	3.10	4.00	3.00
James St & 6th Ave							5.10	3.20
S Jackson St & 2nd Ave S	8.80	5.50	6.20	4.10	4.50	3.00	4.20	3.20
4th Ave S & Airport Way S					6.30	3.50	5.30	3.20
S Dearborn St & 5th Ave S			8.00	5.10				
I-90 Ramps & 4th Ave S	14.2	8.80						
S Royal Brougham Way & 4th Ave S			8.30	5.20	6.30	3.50		
S Royal Brougham Way & 1st Ave S	11.3	7.00	8.90	5.50	6.00	3.70	5.50	3.70
S Jackson St & 14th Ave S	14.0	7.70	9.80	5.70	6.10	3.40	5.90	3.30
S Dearborn St & Rainier Ave S	13.6	7.70	8.40	5.20	5.30	3.40	5.20	3.40
S Hill St & 23rd Ave S	13.2	7.70	8.40	5.20	5.60	3.60	5.60	3.60
MLK Jr. Way S & Rainier Ave S	13.0	7.30	8.40	5.20	5.90	3.70	5.90	3.70
S Atlantic St & 1st Ave S			9.20	5.50	6.40	4.00	6.60	4.10
Bellevue Way SE & 112th Ave SE	16.9	8.10	10.8	5.40	6.20	3.50	6.10	3.50

[1] CO concentrations are reported in parts per million (ppm).
[2] Background CO levels of 1.7 ppm (1-hour) and 1.6 ppm (8-hour) are included in these concentrations.

Source: URS Corporation

The maximum 1-hour and 8-hour CO concentrations for the Seattle area intersections during the 2005 study year were 9.8 ppm and 5.7 ppm, respectively. The maximum CO concentrations were calculated at the intersection of S Jackson Street and 14th Avenue S. The maximum 1-hour and 8-hour CO concentrations for the Seattle area intersections during the 2025 study year were calculated for the HOV 2+ version at 6.4 ppm and 4.0 ppm, respectively. The CO concentrations were calculated at the intersection of Atlantic Street & 1st Avenue S. The HOV 3+ version was 6.6 ppm and 4.1 ppm for the intersection. The air quality in the study area, assessed as ambient CO levels, improved from the baseline year (2000), to the year of opening (2005), through the 2025 study year, even though traffic volumes increased. This was the result of lower vehicle CO emission rates.

4.4.2.3 Comparative Analysis

None of the alternatives included in this study had an intersection with a modeled CO concentration that exceeded the 1-hour or 8-hour NAAQS during operation. To compare the air quality impacts among the alternatives, the same intersections across all alternatives and study years were modeled. Six intersections were common throughout all alternatives and study years. Five were located in the Seattle region of the study area and one was located in the Bellevue region. There were no intersections from the Mercer Island region of the study area. The common intersections were:

- S Jackson Street & 2nd Avenue S
- S Jackson Street & 14th Avenue S
- S Dearborn Street & Rainier Avenue S
- S Hill Street & 23rd Avenue S

- MLK Jr Way S & Rainier Avenue S
- Bellevue Way SE & 112th Avenue SE

A side by side comparison of 1-hour and 8-hour CO concentrations at the six intersections for each alternative is presented in Tables 4.4-5 and 4.4-6. Carbon monoxide concentrations for the 2005 year of opening are shown in Table 4.4-5 and CO concentrations for 2025 design year are presented in Table 4.4-6.

The CO concentrations vary little among the alternatives in the Seattle region of the study area for the 2005 study year. In fact, the intersections of S Dearborn Street/Rainier Avenue S and S Hill Street/23rd Avenue S have identical modeled CO concentrations for all alternatives. The CO concentrations for the five Seattle intersections were averaged for each alternative in order to provide another method of comparison. As shown in Table 4.4-5, both the 1-hour and 8-hour alternative specific average CO concentrations varied by only 0.1 ppm. The highest and lowest 1-hour and 8-hour CO concentrations at the only Bellevue intersection modeled were separated by only 0.2 ppm. Because these differences among CO concentrations are so small, it must be concluded that the impacts to air quality at these intersections would be relatively equal among all alternatives for the 2005 study year.

Table 4.4-5
Comparative Impacts for the 2005 Study Year

2005	Modeled CO Concentrations (ppm)[1,2]									
	R-1		R-2B 2+		R-2B 3+		R-5 3+		R-8A 2+	
Intersection	1-hr	8-hr	1-hr	8-hr	1-hr	8-hr	1-hr	8-hr	1-hr	8-hr
S Jackson St & 2nd Ave S	6.00	3.90	6.00	4.00	5.70	3.70	6.00	3.90	6.20	4.10
S Jackson St & 14th Ave S	9.80	5.60	9.80	5.70	9.80	5.70	9.80	5.60	9.80	5.70
S Dearborn St & Rainier Ave S	8.40	5.20	8.40	5.20	8.40	5.20	8.40	5.20	8.40	5.20
S Hill St & 23rd Ave S	8.40	5.20	8.40	5.20	8.40	5.20	8.40	5.20	8.40	5.20
MLK Jr Way S & Rainier Ave S	8.20	5.00	8.20	5.10	8.30	5.10	8.20	5.00	8.40	5.20
Average - Common Intersections (Seattle)	**8.2**	**5.0**	**8.2**	**5.0**	**8.1**	**5.0**	**8.2**	**5.0**	**8.2**	**5.1**
Bellevue Way SE & 112th Ave SE	10.7	5.30	10.8	5.30	10.6	5.20	10.7	5.30	10.8	5.40

[1] CO concentrations are reported in parts per million (ppm).
[2] Background CO levels of 1.7 ppm (1-hour) and 1.6 ppm (8-hour) are included in these concentrations.
[3] Alternatives R-5 Restripe and R-5 Modified are identical to Alternative R-1 (No Build).

Source: URS Corporation

The average carbon monoxide concentrations for the 2025 study year (Table 4.4-6), while lower in magnitude than the 2005 concentrations, exhibit a similar trend. The intersections of S Dearborn St/Rainier Ave S and S Hill St/23rd Ave S have identical modeled CO concentrations for all alternatives, as was calculated for the 2005 study year. Again the CO concentrations for the five Seattle intersections were averaged for each alternative. For the 2025 study year, all 1-hour alternative specific average CO concentrations were equal. The 8-hour concentration varied by only 0.1 ppm. The only Bellevue intersection modeled returned a 1-hour CO concentration range of 0.2 ppm and the 8-hour concentrations were equivalent. Because these differences among CO concentrations were so minute, it must be concluded that the impacts to air quality at these intersections would be relatively equal among all alternatives for the 2025 study year.

Table 4.4-6
Comparative Impacts for the 2025 Study Year

2025	Modeled CO Concentrations (ppm)[1,2]									
	R-1		R-2B 3+		R-5 3+		R-8A 2+		R-8A 3+	
Intersection	1-hr	8-hr	1-hr	8-hr	1-hr	8-hr	1-hr	8-hr	1-hr	8-hr
S Jackson St & 2nd Ave S	4.30	3.30	4.20	3.20	4.30	3.30	4.30	3.00	4.20	3.20
S Jackson St & 14th Ave S	6.10	3.40	6.10	3.40	6.10	3.40	6.10	3.40	5.90	3.30
S Dearborn St & Rainier Ave S	5.20	3.40	5.20	3.40	5.20	3.40	5.20	3.40	5.20	3.40
S Hill St & 23rd Ave S	5.60	3.60	5.60	3.60	5.60	3.60	5.60	3.60	5.60	3.60
MLK Jr Way S & Rainier Ave S	6.00	3.90	5.90	3.70	6.00	3.90	5.90	3.70	5.90	3.70
Bellevue Way SE & 112th Ave SE	5.70	3.30	5.80	3.30	5.70	3.30	5.80	3.30	5.70	3.30
Average - Common Intersections (Seattle)	**5.4**	**3.5**	**5.4**	**3.5**	**5.4**	**3.5**	**5.4**	**3.4**	**5.4**	**3.4**

[1] CO concentrations are reported in parts per million (ppm).
[2] Background CO levels of 1.7 ppm (1-hour) and 1.6 ppm (8-hour) are included in these concentrations.
[3] Alternative R-5 is identical to Alternative R-1 (No Build).

Source: URS Corporation

The CO concentrations at intersections common among all alternatives could not provide any distinction with respect to air quality impacts; therefore, the total number of intersections with LOS designations of D or lower were compared among the alternatives. LOS ratings are indicative of the efficiency of an intersection. LOS designations of A, B and C are considered indicative of efficiently operating intersections with small delay times and short queue lengths. LOS ratings of D, E and F are associated with poorly operating intersections where delay times and queue lengths can be extensive. It is therefore reasonable to assume that the alternative that produces the lowest number of intersections with LOS ratings of D or lower would have a lower impact on air quality. A summary of the total number of intersections in the Seattle area with LOS designations of D or lower is presented in Table 4.4-7.

Since Alternative R-2B 3+, R-8A 2+ and R-8A 3+ would create the fewest D or lower LOS rated intersections (17) in the Seattle region; these alternatives are likely to have the least impact to air quality. Alternative R-2B 2+ would produce the greatest number of LOS D or lower rated intersections in the Seattle area and, therefore may have a greater impact on air quality. All Mercer Island intersections included in this study would have LOS ratings of C or above. The Bellevue Way SE/112th Avenue SE intersection would have an LOS rating of F for all alternatives and study years. Again, it is important to note that this conclusion is qualitative in nature.

Table 4.4-7
Comparison of LOS D or Lower Intersections in the Seattle Area

	Number of Intersections with An LOS of D or Lower					
Study Year	R-1	R-2B 2+	R-2B 3+	R-5[b]	R-8A 2+	R-8A 3+
2005	8	9	5	8	7	7[c]
2025	11	12[a]	12	11	10	10

[a] Alternative R-2B 2+ would not be an option in 2025; minimum HOV capacity would be 3+, so R-2B 3+ LOS designations are used.
[b] Alternatives R-5 Restripe and R-5 Modified would be identical to Alternative R-1 (No Build).
[c] Alternative R-8A 3+ would not exist in 2005, minimum HOV capacity would be 2+, so R-8A 2+ LOS designations are used.
Source: URS Corporation

4.4.2.4 PM_{10} Conformity – Qualitative Analysis

Five of the intersections that may be affected by the Project are located in the Seattle-Duwamish PM_{10} maintenance area, however, the Project is not expected to cause a violation of the NAAQS for PM_{10}. The intersections, which are located along the northwestern corner of PM_{10} maintenance area, are:

- I-90 Ramps & 4th Ave S,
- S Royal Brougham Way & 4th Ave S,
- S Royal Brougham Way & 1st Ave S,
- S Atlantic St & 4th Ave S, and
- S Atlantic St & 1st Ave S.

The ambient PM_{10} concentrations within the maintenance area have been steady since 1998. There have been no violations of the PM_{10} NAAQS in the previous 10 years and the 24-hour and annual concentrations have been well below the federal standards. The PM_{10} monitor located at 4752 East Marginal Way South is nearest to the five intersections, within the maintenance area. The maximum 24-hour PM_{10} concentrations measured at that location during 1999, 2000, 2001 and 2002 were 53, 73, 73 and 71 μg/m3, respectively. These ambient concentrations were well below the 150 $\mu g/m^3$ standard. The annual averages during the same time period were 25, 27, 24 and 23 $\mu g/m^3$, respectively. These ambient concentrations were also well below the 50 $\mu g/m^3$ standard. Ambient PM_{10} data were obtained from the US EPA AIRData web site.

None of the alternatives under consideration for this project are likely to cause a PM_{10} concentration above the NAAQS at any of the five intersections within the Seattle-Duwamish maintenance area. This is because the potential changes in traffic patterns associated with the Project are relatively minor; light duty gasoline vehicles are not major PM_{10} emitters; the five intersections are located on the edge of the maintenance area; recent ambient PM_{10} concentrations have been far below the NAAQS; and the current air quality and traffic volume trends have been moving in opposite directions.

The potential changes in traffic patterns associated with the Project are relatively minor. The various alternatives distribute the traffic differently among the Seattle area intersections, however, the total number of vehicles under each of the alternatives remain similar. The combined traffic volume for the I-90 Ramp/4th Avenue S, S Royal Brougham Way/ 4th Avenue S, and S Royal Brougham Way/1st Avenue S intersections was 12,040 vehicles per hour in 2000. The combined traffic volume for these three intersections in 2025 under Alternative R-1 is projected to increase 13 percent to 1,604 vehicles per hour. The greatest increase in traffic volume from the base year to the design year would occur at the intersection of South Royal Brougham Way/1st Avenue S under Alternative R-8A 2+. Year 2000 peak hour traffic volumes at the intersection were 3,810 vehicles per hour. Under Alternative R-8A 2+ the peak hour traffic volume is projected to increase 39 percent to 5310 vehicles per hour.

While PM_{10} is a pollutant emitted from automobiles, CO is the pollutant of concern at urban intersections as the emission of CO is maximized at idle. While PM_{10} emissions from diesel-fueled vehicles, especially heavy-duty tucks, are a serious air quality concern, light-duty gasoline

vehicles are not large PM_{10} sources and the Project is not expected to cause an increase in the number of diesel engine vehicles at any of the five intersections.

The five intersections are located just within the northern and western corner of the Seattle-Duwamish PM_{10} maintenance area. Any increase in PM_{10} emissions from these intersections is unlikely to affect receptors in the PM_{10} maintenance area. The winds have a southerly component approximately 45 percent of the time. Emissions from these five intersections are more likely be transported either northward away from the maintenance area, or to the southeast, across the northeastern corner of the maintenance area.

Ambient PM_{10} concentrations have been steady, at approximately 50 percent of the NAAQS over the last four to five years, even though traffic has continued to increase. Given the low ambient levels, it is improbable that slight alterations to the traffic flow at a few intersections would cause a violation of the NAAQS for PM_{10}.

Based on the recent air quality and traffic volume trends in the Seattle-Duwamish maintenance area, even the highest projected traffic volume increase associated with the project (S Royal Brougham/1st Avenue S, Alternative R-8A 2+) would not cause a violation of the PM_{10} NAAQS. A comparison between the maximum 24-hour PM_{10} concentrations at 4752 East Marginal Way S and the average daily traffic volumes for the sections of East Marginal Way S and 1st Avenue S surrounding that PM_{10} monitoring site (obtained from the Seattle Department of Transportation) indicates that there is no strong correlation between the two parameters. The traffic volumes for East Marginal Way S and 1st Avenue S were summed for each of the years, 1996 through 2001 and compared with the maximum measured ambient PM_{10} concentrations. The highest 24-hour PM_{10} concentration coincided with the year (1997) that had the lowest measured traffic volumes. This suggests mobile sources may not be the only contributor to ambient PM_{10} concentrations at this location. From 1997 to 1998, traffic volumes increased slightly, while PM_{10} concentrations decreased slightly. Traffic volumes increased 35 percent, from 57,800 vehicles per day in 1997, to 77,900 vehicles per day in 2001. During the same time period the maximum 24-hour PM_{10} concentration dropped 47 percent from 137 to 73 $\mu g/m^3$.

4.4.2.5 Statement of Project Conformity

Transportation plans programs and projects that are funded under title 23 U.S.C or the Federal transit Act (49 U.S.C. 1601) must conform with section 176(c) of the Clean Air Act. As such, the I-90 corridor improvement project, administered jointly by Sound Transit and Washington Department of Transportation, must comply with the project-level conformity criteria described 40 CFR 93.100 Subpart A – Conformity to State or Federal Implementation Plans of Transportation Plans, Programs, and Projects Developed, Funded or Approved Under Title 23 U.S.C or the Federal Transit Act, and with WAC Chapter 173-420. The regional metropolitan planning organization (MPO) must also include the project in a conforming plan (MTP) and Transportation Improvement Plan (TIP).

As per 40 CFR Chapter 93, the following criteria must be met when determining project conformity.

1. *(93.110) The conformity determination must be based on the latest planning assumptions.*

   Improvements to the I-90 corridor, from I-5 to I-405, are specified in the list of projects highlighted for safety, maintenance and capacity investments within the Puget Sound Region. PSRC's primary planning document, *Destination 2030* was adopted on May 24, 2001 and replaces Vision 2020, which was adopted in 1990 (amended in 1993 and 1995).

   The *Destination 2030* plan is based on the most recent planning assumptions and establishes a regional growth management strategy. The *Destination 2030* plan considers the current and future estimates of population, employment, travel, transit ridership and congestion.

   The air quality impact analysis was conducted in order to evaluate the I-90 project's impact on regional CO levels. Intersections were selected for CO hot-spot analysis based on the LOS and peak traffic volumes. The most recent versions of the EPA approved models MOBILE6 and CAL3QHC were used in the analysis. Because of a constantly shifting timeline, the air quality analysis was completed prior to the federal requirement specifying the use 2030 as the design year for the Project. Therefore, CO concentrations were calculated assuming 2025 as the design year for the hot spot analysis. The FHWA recognized that the project should be "grandfathered" out of the use of 2030 as the design year and authorized the use of 2025 as the design year for the FEIS.[1]

   Carbon monoxide background concentrations were chosen based on measurements obtained from a nearby AIRS station. The use of the CO background concentrations was approved by PSRC and PSCAA.

   A qualitative analysis was performed in order to address potential PM_{10} impacts from the Project as specified in 40 CFR 93.123(b)(4).

2. *(93.111) The conformity determination must be based on the latest emission estimation model available.*

   Vehicle fleet emissions were calculated using the most recent release of the EPA motor vehicle emissions model (MOBILE6). Specific inputs to the model were coordinated with WADOE and PSRC.

[1] See Appendix F for a letter from Sound Transit dated June 26, 2003 indicating concurrence by FHWA.

3. *(93.112) The MPO must make the conformity determination according to the consultation procedures of this rule and the implementation plan revision required by Section 51.396.*

   The PSRC has completed the conformity determination for the I-90 corridor (Two-Way Transit Facility) project. The project is listed in the Regional TIP as I.D. # RTA-18.

4. *(93.113) The transportation plan, TIP, or FHWA/FTA project which is not from a conforming plan and TIP must provide for the timely implementation of TCMs from the applicable implementation plan.*

   The project is listed in regional TIP; therefore this requirement is not applicable.

5. *(93.114) There must be a currently conforming transportation plan and a currently conforming TIP at the time of project approval.*

   The current conforming MTP is *Destination 2030* and the project is in the conforming regional TIP as I.D. # RTA-18.

6. *(93.115) The project must come from a conforming transportation plan and program.*

   The project is in the current conforming MTP (*Destination 2030*) and the project is in the conforming regional TIP as I.D. # RTA-18.

7. *(93.116) The FHWAFTA project must not cause or contribute to any new localized CO or PM_{10} violations or increase the frequency or severity of any existing CO and PM_{10} violations in CO and PM_{10} nonattainment and maintenance areas.*

   The majority of the project area is in attainment for PM_{10}; however, the project is located in the Puget Sound CO maintenance area. None of the intersections included in the air quality impact analysis were found to have a modeled exceedance of the 1-hour or 8-hour CO standards during any study year. Therefore, the project will not create any new regional violations or contribute to the frequency or severity of any existing violations of the NAAQS for CO.

8. *(93.117) The FHWA/FTA project must comply with PM10 control measures in the applicable implementation plan.*

   The Project will conform to all requirements to limit PM_{10} emissions from construction activities and normal operation of the Project as contained in the Seattle, Washington PM-10 Attainment/Maintenance Plan (66 FR 14492).

4.4.3 Mitigation

4.4.3.1 Construction

Controls used to mitigate the air quality impacts from construction activities would be similar for all Build Alternatives. The pollutant of primary concern, and the easiest to mitigate is particulate matter, because it would have the potential to be emitted in the greatest quantity. The construction sites would also be a source of CO, NO_x, SO2, and VOC emissions. These pollutants would be more difficult to control, but would have lower emission rates. Several of the actions that could be taken to mitigate impacts to air quality would alleviate the emissions of several pollutants. PSCAA requires "best available control measures" be used to mitigate fugitive dust emissions. The implementation of control measures is the responsibility of the construction contractor and will be included in their project specifications.

The following controls would be implemented to mitigate air quality impacts where applicable to the specific construction location and activity and are applicable to all Build Alternatives:

- **AQ-1.** Restrict construction activities to specific periods of the day when traffic volumes are at a minimum, which would reduce the emissions from increased traffic congestion and the public's exposure to primarily emitted pollutants. If permitted, construction activities may be limited to nighttime hours.

- **AQ-2.** If feasible, restrict construction activities on hot days when region is at risk for ozone exceedances.

- **AQ-3.** Stage construction among separate or related projects to minimize overall traffic congestion.

- **AQ-4.** Route transport vehicles to minimize the impacts to traffic flow.

- **AQ–5.** Make maintaining HOV lane operation during construction a priority.

- **AQ-6.** Control dust emissions by using measures such as spraying water or other dust suppressant on bare surfaces and covering any soils that may need to be transported to, from, and within the construction area.

- **AQ-7.** Maintain adequate freeboard on trucks when transporting soil/materials.

- **AQ-8.** Cover soil/materials during transport to minimize wind-borne particulate emissions.

- **AQ-9.** Minimize the size of the construction area, cover exposed soil and re-vegetate disrupted areas as soon as possible.

- **AQ-10.** Use newer construction equipment and maintain all equipment in good mechanical condition to minimize exhaust emissions.

- **AQ-11.** Use emission reduction retrofit equipment for on/off road vehicles and equipment (Diesel Solutions Program).

- **AQ-12.** If feasible, replace regular diesel fuel usage with bio-diesel or use alternative fuel vehicles/equipment.

- **AQ-13.** Construct wind barriers to reduce wind velocity over exposed earth.

- **AQ-14.** Restrict the speed of construction vehicles when operating in areas of exposed earth.

- **AQ-15.** Use wheel washers to remove mud from construction vehicles prior to exiting site (reduce the potential emissions from re-entrained particulate matter).

- **AQ-16.** Clean road surfaces regularly to reduce re-entrained particulate matter.

- **AQ-17.** Locate construction equipment away from sensitive populations and building air intakes. Locate truck/equipment staging zones to minimize impacts to the public, especially the elderly and the very young.

- **AQ-18.** Limit construction vehicle idling to a maximum of 5 minutes.

- **AQ-19.** Encourage construction workers to car pool or use other forms of mass transportation.

4.4.3.2 Operation

No operation mitigation measures are required.

4.5 NOISE

4.5.1 Affected Environment

4.5.1.1 Sound Background and Characteristics

Characteristics of Sound

Sound is created when objects vibrate, resulting in a minute variation in surrounding atmospheric pressure called sound pressure. The human response to sound depends on the magnitude of a sound as a function of its frequency and time pattern (USEPA 1974). Magnitude describes the physical sound in the air. The range of magnitude from the faintest to the loudest sounds that humans can hear is so large that sound pressure is expressed on a logarithmic scale in units called decibels (dB). Magnitudes of typical sounds are presented in Table 4.5-1.

Table 4.5-1
Sound Pressure Levels of Representative Sounds and Noises

Source	Decibels	Description
Large rocket engine (nearby)	180	
Jet takeoff (nearby)	150	
Pneumatic riveter	130	
Jet takeoff (60 meters)	120	Pain threshold
Construction noise (3 meters)	110	
Subway train	100	
Heavy truck (15 meters), and Niagara Falls	90	Constant exposure endangers hearing
Average factory	80	
Busy traffic	70	
Normal conversation (1 meter)	60	
Quiet office	50	Quiet
Library	40	
Soft whisper (5 meters)	30	Very quiet
Rustling leaves	20	
Normal breathing	10	Barely audible
Hearing threshold	0	

Source: Tipler 1976

Noise is defined as unwanted sound. Environmental noise is composed of many frequencies, such as high and low pitch. The human ear does not respond to all frequencies. The commonly used frequency weighting for environmental noise is A-weighted decibels (dBA), which approximates how an average person hears sounds.

Because of the logarithmic decibel scale, a doubling of the number of noise sources, such as the number of automobiles and trucks on a roadway, increases traffic sound levels by 3 dBA. Thus, a noise source emitting a sound level of 60 dBA combined with another noise source of 60 dBA results in a combined sound level of 63 dBA, not 120 dBA. An increase of 26 percent in traffic volumes would increase traffic sound levels by 1 dBA.

Loudness, compared to physical sound measurement, refers to how people subjectively judge a sound and varies from person to person. Table 4.5-2 summarizes how increases in sound levels correlate with perceived loudness. Studies have shown that an increase of 3 dBA, such as from a doubling of traffic volumes, would be barely detectable by the human ear (FHWA 1995). A listener often judges an increase of 5 dBA to be readily noticeable and an increase of 10 dBA to be twice as loud. Although the sound levels in Table 4.5-2 are not regulatory criteria, they are useful to evaluate potential noise impacts.

Table 4.5-2
Decibel Changes and Loudness

Sound Level Change, dBA	Relative Loudness
0 to 2	Imperceptible
3	Barely Perceptible Change
5	Readily Perceptible Change
10	Twice as Loud
20	Four Times as Loud

Source: FHWA 1995

Vehicular noise is a combination of sounds from vehicle engine, exhaust, and tires. Traffic sound levels depend on vehicle volume, speed, percentage of trucks, topography, vegetation, and distance from the roadway to the receptor. Generally, an increase in volume, speed, or percentage of trucks increases traffic sound levels. Traffic noise is not usually a serious problem for people who live more than approximately 500 feet from heavily traveled freeways or more than 100 to 200 feet from lightly traveled roads (FHWA 1995).

Sound levels decrease with distance from the noise source. For a roadway, sound levels will decrease 3 dBA over hard ground (concrete or pavement) or 4.5 dBA over soft ground (grass) for every doubling of distance between the source and the receptor. For a point source such as stationary construction equipment, sound levels will decrease between 6 and 7.5 dBA for every doubling of distance from the source.

Noise Descriptors

The common descriptor for measuring and predicting environmental noise is the equivalent sound level (L_{eq}). The L_{eq} can be considered a measure of the average noise level during a specified period of time. It is defined as the constant level that, over a given period of time, transmits to the receiver the same amount of acoustical energy as the actual time-varying sound. For example, two sounds, one of which contains twice as much energy but lasts only half as long, would have the same L_{eq} noise levels. L_{eq} places more emphasis on occasional high noise levels than general background noise levels. L_{eq} measured or predicted over a one-hour period is the hourly L_{eq} or $L_{eq}(h)$, which is recommended by the FHWA and WSDOT for highway noise analyses.

Effects of Noise

Environmental noise can affect human health and welfare. According to a U.S. Environmental Protection Agency (EPA) study, average sound levels in an urban environment are not hazardous to human hearing (USEPA 1974). The primary effect of noise on people in urban locations is

annoyance resulting in interference with sleep, thought, and conversation. Prolonged exposure to very high levels of noise can cause hearing loss. Even under the most extreme conditions, however, traffic sound rarely approaches the level that could cause hearing damage.

4.5.1.2 Noise Regulations and Guidelines

Noise regulations and agency guidelines provide a basis for evaluating potential noise impacts and mitigation measures for the proposed alternatives. Noise regulations and guidelines for federally funded highway projects in Washington are established by FHWA and WSDOT. The FHWA has established a two-part test to evaluate traffic noise impacts (23 CFR §772.5(g)). The FHWA defines traffic noise impacts as occurring when one of the following conditions exist:

- Predicted traffic noise levels approach or exceed the noise abatement criteria (see Table 4.5-3), or
- Predicted traffic noise levels substantially exceed the existing noise levels.

In Washington, WSDOT defines "approach" to be 1 dBA below the FHWA noise abatement criteria in Table 4.5-3. WSDOT also defines "substantially exceed" as a 10 dBA increase over existing noise levels, as long as the predicted design year traffic noise level is a minimum of 50 dBA (WSDOT 2002).

The FHWA noise abatement criteria specify exterior $L_{eq}(h)$ noise levels for various land activity categories, as presented in Table 4.5-3. For residences, parks, schools, churches, and similar areas, the noise abatement criterion is 67 dBA. Because WSDOT defines "approach" to be within 1 dBA of these criteria, noise impacts at residences would occur if predicted traffic noise levels would be 66 dBA or higher.

Table 4.5-3
FHWA Noise Abatement Criteria

Activity Category	$L_{eq}(h)$ (dBA)	Description of Activity Category
A	57 (exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67 (exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.
C	72 (exterior)	Developed lands, properties, or activities not included in Categories A or B above.
D	-	Undeveloped lands.
E	52 (interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

Source: 23 CFR Part 772

Most local jurisdictions have noise ordinances that limit noise levels at the property lines of neighboring properties. Seattle, Mercer Island, and Bellevue have noise ordinances that would apply to construction noise under the proposed Project, but not to traffic noise on I-90. Most local noise ordinances have adopted the Washington State Department of Ecology noise regulations, with some variations. Each local jurisdiction enforces its own noise regulations, or has the authority to enforce Ecology's noise regulations if it has no noise code. Ecology does not

enforce its regulations where a local noise ordinance is in effect. These local noise regulations provide that no person or entity shall cause or permit noise to intrude into the property of another person if the noise exceeds the maximum permissible noise levels. Ecology's maximum permissible noise levels are presented in Table 4.5-4.

Table 4.5-4
Maximum Permissible Environmental Noise Levels (dBA)

	EDNA of Receiving Property			
EDNA of Noise Source	Daytime Class A (Residential)	Nighttime Class A (Residential)1	Class B (Commercial)	Class C (Industrial)
Class A (Residential)	55	45	57	60
Class B (Commercial)	57	47	60	65
Class C (Industrial)	60	50	65	70

1 Ecology regulations provide that the maximum permissible noise levels are reduced by 10 dBA for Class A EDNAs (residential) receiving properties between 10 p.m. and 7 a.m. Nighttime hours may vary in local noise codes.

Source: WAC Chapter 173-60

The environmental designation for noise abatement (EDNA) of a property considers its usage or zoning designation. The Class A EDNA is defined as lands where humans reside and sleep, such as residences, campgrounds, and hospitals. The Class B EDNA includes commercial, retail, offices, schools, and churches. The Class C EDNA includes industrial, agricultural, and silvicultural uses.

The maximum permissible noise levels in Table 4.5-4 depend on the land uses of both the source of noise and receiving property, and on the time of day. Highway construction within WSDOT right-of-way generally is considered a Class B EDNA or commercial source. According to Table 4.5-4, the maximum permissible noise levels from roadway construction along I-90 (Class B source) would be 47 dBA during nighttime at neighboring residences (Class A receiving property).

Short-term exceedances are allowed above the maximum permissible noise levels. The noise levels in Table 4.5-4 may be exceeded in any one-hour period by 5 dBA for a total of 15 minutes, 10 dBA for five minutes, or 15 dBA for 1.5 minutes. The noise levels in Table 4.5-4 are maximum noise levels, and are not L_{eq} noise levels. Sounds from motor vehicles on public roads are exempt from the property-line regulations in Table 4.5-4, although the WSDOT and FHWA traffic noise abatement criteria still would apply.

The City of Seattle has adopted similar maximum permissible sound levels (Seattle Municipal Code, Chapter 25.08). In Seattle, the 10-dBA nighttime reduction at residential receiving properties applies between 10 PM and 7 PM on weekdays and between 10 PM and 9 AM on weekends. The City of Bellevue also has adopted maximum permissible environmental noise levels similar to the Ecology regulations (Bellevue Municipal Code, Chapter 9.18). The City of Mercer Island regulates noise as a nuisance, and has not established property-line standards (Mercer Island Municipal Code, Chapter 8.24).

Construction noise under the proposed project must meet the local noise regulations. Daytime construction noise generally is exempt or at higher allowable noise limits, depending on the local jurisdiction. Nighttime construction noise must meet the noise limits in Table 4.5-4 for

residential receiving properties. The Ecology noise regulations define nighttime as 10 PM to 7AM, but local jurisdictions often have different definitions of nighttime. Noise variances from local noise ordinances may be required for construction activities during nighttime hours.

Construction activities in Seattle generally have higher allowable noise limits between 7 AM and 10 PM on weekdays and between 9 AM and 10 PM on weekends, but must meet the lower noise limits in Table 4.5-4 during nighttime hours. The property-line standards in Seattle may be exceeded in daytime by 25 dBA for large equipment such as dozers and drills, by 20 dBA for portable equipment such as chainsaws and powered handtools, and by 15 dBA for maintenance equipment such as lawn mowers. Noise from impact equipment such as jackhammers and pile drivers may not exceed a continuous one-hour L_{eq} of 90 dBA between 8 AM and 5 PM on weekdays and 9 AM and 5 PM on weekends (SMC Chapter 25.08).

Construction noise in Bellevue is exempt between 7 AM and 6 PM on weekdays and between 9 AM and 6 PM on Saturdays. On Sundays, legal holidays and non-exempt hours, construction noise is prohibited unless authorized by the City (Bellevue Municipal Code Chapter 9.18). In Mercer Island, construction noise is considered a nuisance between 10 PM and 7 AM on weekdays and between 10 PM and 9 AM on weekends and holidays (Mercer Island Municipal Code, Chapter 8.24).

4.5.1.3 Affected Environment

The Project would be located within developed urban areas of the cities of Seattle, Mercer Island, and Bellevue. The dominant land use along the I-90 corridor in the Project area is residential at urban densities. Residential densities generally are higher in Seattle and relatively lower in Mercer Island and Bellevue. Neighborhood businesses and shopping areas are located along Rainier Avenue S in Seattle and south of I-90 in Mercer Island. Several parks, greenbelts, and churches are located near I-90. Land use and parklands are discussed in detail in the 4.1 Land Use and 4.14 Parklands sections of this FEIS.

The terrain along I-90 is hilly. In Seattle, I-90 runs along the base of Beacon Hill, across the Rainier valley, and through a tunnel under the Mount Baker Ridge. On Mercer Island, I-90 runs through a cut with retaining walls up to 30 feet high along both sides of the roadway. Most of the adjacent receptors lie at elevations either above or below I-90, at elevation differences of 10 to 40 feet. Many noise receptors receive considerable shielding of traffic noise from intervening terrain.

The I-90 corridor in the Project area includes existing noise abatement measures that were constructed as part of the previous I-90 expansion project. These noise abatement measures include noise walls (or barriers) and retaining walls corridor wide, and lids located in Seattle and Mercer Island. Because of the existing noise walls and lids, traffic sound levels at many areas adjacent to I-90 are below FHWA noise criteria.

Sound levels were measured to describe the existing environment and to identify noise sources in the Project area. A sound level meter measured L_{eq} sound levels during 20-minute sampling periods consistent with FHWA and WSDOT noise measurement procedures. Table 4.5-5 presents the L_{eq} sound measurements along I-90. Figure 4.5-1 shows the locations of the noise

measurements, along with the additional receptor locations evaluated for project impacts and mitigation.

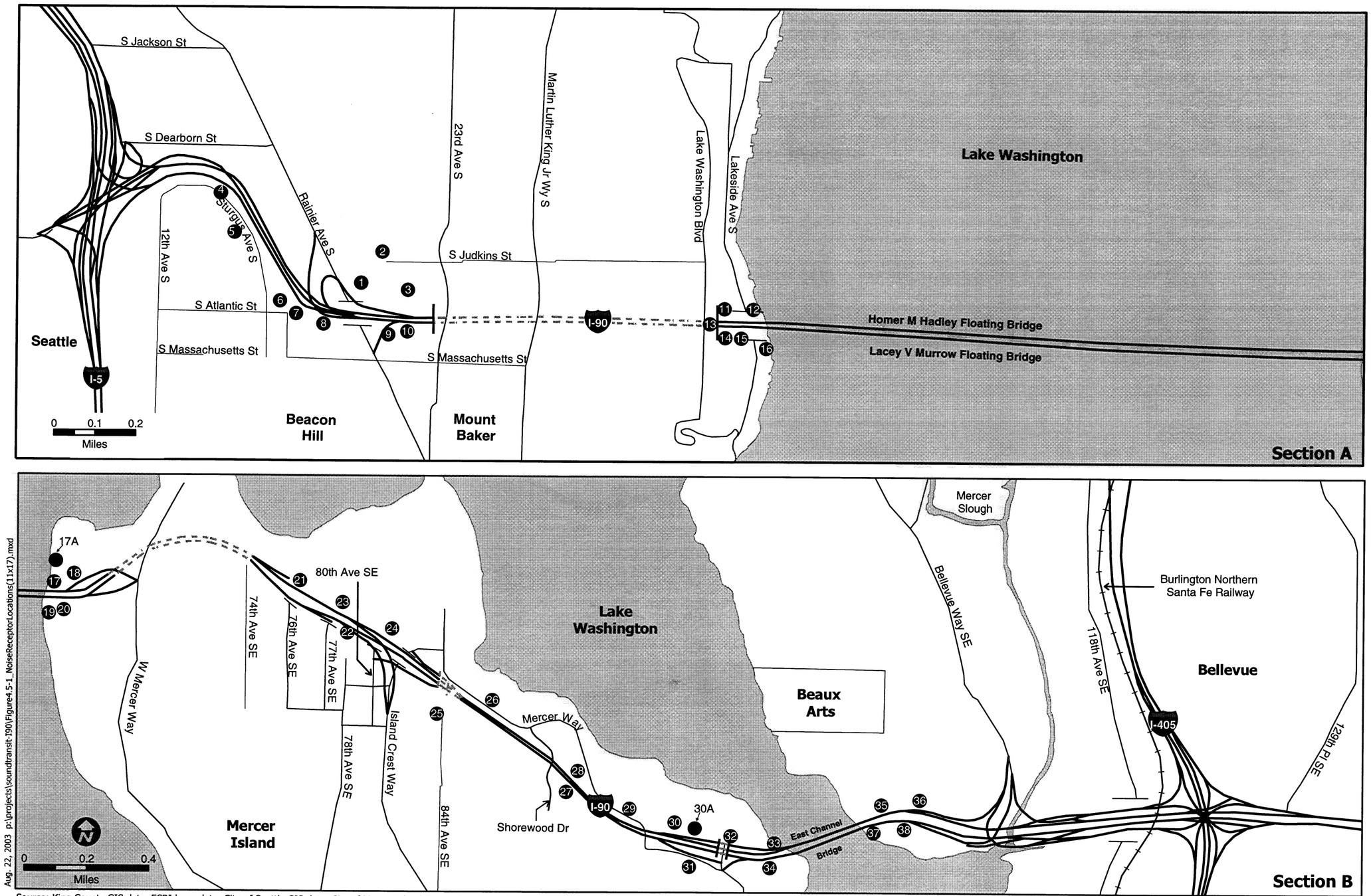
Table 4.5-5
Sound Measurements Along I-90

Receptor Number	Location	Represents	Time	Measured L_{eq} (dBA)
Corwin Curves				
1	1126 Hiawatha Place S	Single family residences	2:15 PM	57
2	20th Avenue S & S Judkins Street	Single family residences	2:00 PM	63
3	Judkins Park and Playfield	Park	1:30 PM	62
6	1364 Sturgus Avenue S	Single family residences	3:25 PM	65
8	1525 18th Avenue S	Single- and multi-family residences	3:00 PM	63
Leschi				
11	35th Avenue S & S Irving Street	Single family residences	10:58 AM	**61**
13	1383 Lake Washington Blvd S	Single family residences	10:18 AM	**65**
15	1400 35th Avenue S	Single-family residences	12:00 PM	**68**
16	1424 Lakeside Drive	Single-family residences	11:25 AM	**68**
Mercer West Shoreline				
17	2227 60th Avenue SE	Single-family residences	3:10 PM	64
17A	2053 Faben Drive	Single-family residences	12:53 PM	62
Mercer Cut				
24	2500 81st Avenue SE Mercer Isle Apartments	Multi-family apartments	1:50 PM	65
27	Shorewood Apartments Block 3202	Multi-family apartments	12:25 PM	63
28	3235 90th Place SE	Single-family residences	3:45 PM	**70**
30	3508 SE 35th Street	Single-family residences	11:45 AM	**66**
30A	3434 97th Avenue SE	Single-family residences	12:12 PM	**63**
Bellevue				
36	3255 111th Avenue SE	Single-family residences	10:05 AM	**69**
37	Enatai Park	Park	9:06 AM	63
38	11003 SE Lake Road	Single-family residences	10:50 AM	65

Note: Boldface indicates noise level approaches (within 1 dBA) or exceeds FHWA Noise Abatement Criteria of 67 dBA for residences and parks.

Source: URS Corporation, Krause 2003

Measurement locations were selected where traffic sound from I-90 was dominant or where noise impacts could occur with the alternatives. Additional measurements were taken in response to public comments on the DEIS and are responded to individually in Volume II of the FEIS – Responses to Comments. The dominant source of sound in the Project area was vehicular traffic on I-90. The measured L_{eq} sound levels ranged from 57 to 70 dBA (Table 4.5-5). The measured sound levels at Receptors 15, 16, 28, 30, and 36 approached or exceeded the FHWA noise abatement criterion of 67 dBA, which indicates an existing noise impact at those five locations under FHWA and WSDOT policies.



Aug. 22, 2003 p:\projects\soundtransit-I90\Figure4.5-1_NoiseReceptorLocations(11x17).mxd

Source: King County GIS data, ESRI base data, City of Seattle GIS data, City of Mercer Island Base data. This information may not meet National Map Accuracy Standards.

U.S. Department of Transportation
Federal Highway Administration
Federal Transit Administration

SOUNDTRANSIT

Washington State Department of Transportation

Legend

Roadway Tunnel

Noise Receptor Locations

Figure 4.5-1
Noise Receptor Locations

The noise-monitoring program also included two 24-hour sound measurements along I-90. Site LT-1 was on the north side of I-90 in the Shorewood area of Mercer Island, at the end of 90th Place SE. Site LT-2 was on the south side of I-90 in the Leschi area of Seattle, at the end of 35th Avenue S. Each sound measurement was conducted over a two-day period, for a total of 48 hours at each location.

The 24-hour sound measurements show that the worst traffic noise levels along I-90 occur in the morning. The highest sound measurements were around 7:00 AM at both 24-hour monitoring sites. At Site LT-1 in Shorewood, the highest traffic sound levels were during the 7:00 to 7:30 AM period. At Site LT-2 in Leschi, the highest traffic sound levels were during the 6:30 to 7:30 AM period.

4.5.2 Impacts

4.5.2.1 Construction

Site preparation and construction activities would intermittently generate sound during the construction period, which is anticipated to start by the year 2005. Construction noise sources would include earthmovers, generators, trucks, and impact equipment. On-site construction noise would be audible at times at off-site locations, and possibly result in complaints about noise at nearby residences and businesses. Potential construction impacts would be most noticeable at locations near construction activities and during nighttime construction if proposed. Any construction noise impacts would be considered temporary or short-term impacts and would be reduced with the mitigation measures to be included in the proposed Project.

Highway construction activities would include moving shoulder barriers, removing landscaping, grading and paving in limited areas, restriping the roadway surface, and adding permanent extensions to existing roadway structures. Alternatives R-2B Modified, R-5 Modified, and R-8A would involve demolition of concrete retaining walls, barriers, pavement, and other structural elements. I-90 would be the primary haul route, which would reduce construction truck noise on local streets. Pile driving would be minimal or not occur, and blasting would be unlikely with the alternatives. Maximum sound levels of construction equipment would be similar to the typical construction equipment noise levels presented in Table 4.5-6.

Table 4.5-6
Construction Equipment Noise Ranges

Equipment	Examples	Noise Level at 50 feet (dBA)
Earth moving	Compacters, loaders, backhoes, tractors, graders, pavers	73-96
Materials handling	Concrete mixers and pumps, cranes, derricks	74-88
Stationary	Pumps, compressors, generators	69-87
Hauling	Trucks	83-94
Impact equipment	Pile drivers	95-106
Impact tools	Jackhammers, rock drills, pneumatic wrenches	81-98

Source: USEPA 1971

Construction noise would be intermittent. The construction sound levels in Table 4.5-6 are for individual equipment operating separately and do not represent L_{eq} sound levels over any particular period. Average L_{eq} sound levels during construction would depend on what type of equipment is present, the number of pieces of equipment, how often the equipment operates, location within the construction area, and distance to noise receptors.

Assuming no pile driving, sound levels from construction equipment while operating would range from 69 to 98 dBA at 50 feet. Construction noise at receptors farther away would decrease at a rate of approximately 6 dBA per doubling of distance from the source. Extrapolating from Table 4.5-6, sound levels from construction equipment would range from 57 to 86 dBA at 200 feet from the piece of equipment. Construction noise from louder construction equipment such as impact tools would be greater at times than background traffic sound levels.

To minimize impacts on traffic, construction activities could occur at night when traffic volumes on I-90 are lower. Nighttime construction noise could interfere with sleep of adjacent residents; however, and could exceed local noise regulations. If proposed, nighttime construction work would be required either to meet lower noise limits in the local noise ordinances or to obtain a nighttime construction noise variance from the appropriate local jurisdictions.

Under Alternative R-1, No Build, construction impacts would not occur. Alternatives R-2B Modified, R-5 Modified, and R-8A would include demolition of concrete retaining walls, barriers, pavement, and other structural elements. Alternative R-5 Restripe would result in relatively lower construction noise impacts.

Construction noise would be reduced with reasonable measures, such as restrictions on nighttime construction noise, mufflers on engines, and turning off equipment during periods of nonuse. Construction activities would be required to comply with the applicable construction noise provisions of the Seattle, Mercer Island, and Bellevue noise ordinances, and any potential noncomplying nighttime construction activity could require a variance from those ordinances. With the construction noise mitigation measures to be included with the proposed Project, daytime construction noise impacts would be low. An unavoidable adverse impact could occur during potential times of nighttime construction activities near residential areas, if the impacts could not be mitigated.

4.5.2.2 Operation

Traffic sound levels during operation of the alternatives have been predicted with the Traffic Noise Model (TNM), Version 2.0, which is FHWA's new computer program for highway traffic noise prediction and analysis (FHWA 1998). Traffic sound levels depend primarily on the number of automobiles and trucks, speeds, noise emission levels of individual vehicles, and distance of receptors from the roadway. TNM also considers effects of intervening barriers, topography, vegetation, pavement type, grades, intersections, and atmospheric conditions. The noise model does not include noises from sources other than traffic.

The traffic noise modeling techniques and assumptions are consistent with the noise assessment procedures of the FHWA (1995) and WSDOT (2002). The design-year traffic volumes on I-90

were determined by projecting from the transportation forecast model for the region, rather than applying a growth factor to the existing traffic counts (HNTB, 2002).

The percentage of trucks greatly influences traffic sound levels, because trucks operate more loudly than other vehicles and have a higher engine/exhaust source of noise. The TNM defines medium trucks as cargo vehicles with two axles and six wheels, and heavy trucks as cargo vehicles with three or more axles. The assumed vehicle mix for the general-purpose lanes in the outer roadways and associated ramps with all alternatives is 95 percent automobiles, 2 percent medium trucks, 2 percent heavy trucks, and 1 percent buses. The assumed vehicle mix for the center roadway is 98 percent automobiles and 2 percent buses with all alternatives. With Alternative R-8A, the outer HOV lanes would operate at 99 percent automobiles and 1 percent buses.

During peak volume periods, traffic on I-90 would operate at speeds below the posted speed limit because of capacity constraints. To provide a realistic comparison of the alternatives, traffic data were analyzed to determine the traffic conditions that would yield the worst hourly noise conditions under WSDOT guidelines. Because the 24-hour sound measurements indicate that the worst hourly sound levels along I-90 occur in the morning, traffic volumes were gathered at 15-minute intervals before and after the AM peak periods. Different combinations of volumes and speeds were modeled, which determined that the worst hourly sound levels would occur at operational speeds of 38–50 mph in the I-90 outer roadways. Assuming an operational speed of 50 mph in the outer roadways at peak-hour volumes would ensure that the traffic conditions would yield the worst hourly sound levels.

The speed for all vehicles in the general-purpose lanes of the outer roadways with all alternatives was assumed to be 50 mph, based on the analysis of worst hourly noise conditions. The speed of traffic in the I-90 center roadway would be 55 mph for Alternative R-2B Modified and 60 mph for Alternatives R-1, R-5, and R-8A. With Alternative R-8A, the outer HOV lanes would operate at 55 mph. The speeds on ramps would be the posted speed limits of 35 to 40 mph.

Accuracy of the TNM model runs was confirmed by modeling L_{eq} sound levels at the measurement sites based on concurrent traffic volumes counted during sound measurements, and then comparing the sound levels modeled on the actual traffic counts with the corresponding measured sound levels. Modeled results were within 2 dBA of the corresponding sound measurements, which is considered satisfactory agreement under WSDOT policies (WSDOT 2002).

Table 4.5-7 presents the predicted 2025 traffic L_{eq} sound levels with the proposed alternatives at noise receptors along I-90. Noise receptors are existing and proposed land uses, such as residences, hospitals, parks, hotels, schools, and historic areas, that could be affected by construction and operation of the proposed Project. Noise receptors were identified by field investigations, aerial photographs, review of plans and policies, and public comment. These noise receptors are analysis sites that are representative of land uses based on similar distances to the roadway, traffic volumes and operating conditions, terrain, and potential for noise abatement. The shared-use pathway on the HMH floating bridge is not a noise receptor, but is included in Table 4.5-7 for information purposes. The locations of the noise receptors are shown in Figure 4.5-1.

Table 4.5-7
Predicted L_{eq} (dBA) Traffic Sound Levels Along I-90

No.	Location	2005 Existing	2025 R-1	2025 R-2B Mod.	2025 R-5 Restripe	2025 R-5 Modified	2025 R-8A
Corwin Curves							
1	Hiawatha Place S 6 single family residences	59	59	59	59	59	59
2	S Judkins Street 8 single family residences	**66**	**67**	**66**	**67**	**67**	**67**
3	Judkins Park and Playfield (no residences)	62	63	63	63	63	63
4	Taejon Park (artworks) (no residences)	60	61	61	61	61	61
5	Sturgus Avenue S 21 single family residences	64	64	64	64	64	64
6	Sturgus Avenue S 1 single family residence	65	**66**	65	**66**	**66**	**66**
7	17th Avenue S 11 single family residences	61	62	62	62	62	62
8	18th Avenue S 10 single family residences	64	64	64	64	64	64
9	Play area S Atlantic Street (no residences)	65	65	65	65	65	65
10	S Atlantic Street 3 single family residences	63	64	64	64	64	64
Leschi							
11	S Irving Street 5 single family residences	**66**	**66**	**65**	**66**	**67**	**68**
12	Lakeside Avenue S 4 single family residences	64	64	64	64	64	65
13	Lake Washington Blvd S 16 single family residences	**68**	**67**	**67**	**68**	**68**	**69**
14	35th Avenue S 11 single family residences	**72**	**72**	**72**	**72**	**72**	**73**
15	35th Avenue S 4 single family residences	**67**	**67**	**67**	**67**	**67**	**68**
16	Lakeside Avenue S 13 single family residences	**66**	**66**	**66**	**66**	**66**	**67**
Floating Bridge							
	Shared Use Pathway mid-floating bridge (no residences)	**82**	**82**	**81**	**81**	**82**	**83**
Mercer West Shoreline							
17	60th Avenue SE 5 single family residences	64	64	64	65	65	65
17A	Faben Drive 6 single family residences	63	63	63	64	63	64
18	61st Avenue SE 4 single family residences	62	62	62	63	62	63
19	60th Avenue SE 7 single family residences	63	63	63	63	63	64
20	SE 24th Street 8 single family residences	62	62	62	62	62	63

Table 4.5-7 (Continued)
Predicted Leq (dBA) Traffic Sound Levels Along I-90

No.	Location	2005 Existing	2025 R-1	2025 R-2B Mod.	2025 R-5 Restripe	2025 R-5 Modified	2025 R-8A
Mercer Cut							
21	76th Avenue SE 3 single family residences	62	63	63	63	62	63
22	Outdoor Sculpture Gallery Parklands (no residences)	64	64	64	64	64	65
23	77th Avenue SE 6 single family residences	60	60	60	60	60	61
24	81st Avenue SE Mercer Isle Apartments	63	64	64	64	64	64
25	84th Avenue SE 5 single family residences	60	60	60	60	61	61
26	North Mercer Way 8 single family residences	62	63	63	63	63	63
27	Shorewood Apartments	63	64	64	63	64	64
28	90th Place SE 8 single family residences	**69**	**69**	**69**	**69**	**69**	**69**
29	Covenant Shores Multi-family residences	59	60	60	60	60	60
30	96th Avenue SE 1 single family residence	65	65	**66**	**66**	**66**	**66**
30A	97th Avenue SE 2 single family residences	64	65	65	65	65	65
31	Mercer Island City Hall Commercial	63	64	64	64	64	64
32	El Dorado Drive 4 single family residences	64	65	65	65	65	65
33	Waterfront north of I-90 4 single family residences	61	61	61	61	61	62
34	Herzl-Ner Tamid Conservation Congregation	64	64	64	64	64	64
Bellevue Way SE							
35	108th Avenue SE 9 single family residences	63	64	63	64	64	64
36	111th Avenue SE 15 single family residences	**69**	**69**	**69**	**69**	**69**	**70**
37	Enatai Park Parkland (no residences)	61	61	61	61	61	62
38	SE Lake Road 7 single family residences	65	65	65	65	65	65

Note: Boldface indicates level approaches (within 1 dBA) or exceeds FHWA Noise Abatement Criteria of 67 dBA for residences and parklands, and 72 dBA for commercial areas.

Source: Krause 2003

The traffic sound levels in Table 4.5-7 were predicted for exterior locations outside the noise receptors. In comparison, interior sound levels would range 15 to 25 dBA less than the exterior sound levels in Table 4.5-7. The amount of interior noise reduction at individual receptors depends on building construction, type of windows, and whether windows are open.

Predicted Existing Conditions

Traffic sound levels for the Existing Conditions were predicted with the same computer modeling techniques as for the 2025 alternatives, based on 2005 traffic volumes. These predicted existing sound levels were based on similar peak-hour traffic volumes, percentage of trucks, and operating speeds. Predicting L_{eq} sound levels under the Existing Conditions provides a baseline for comparison of impacts, particularly at receptors without sound level measurements.

Sound levels at the majority of receptors along I-90 would not approach or exceed the FHWA noise abatement criterion of 67 dBA for residential areas. Traffic sound levels are less than FHWA criteria because of terrain shielding, several lids and tunnels, bridge structures, and the series of existing noise barriers and retaining walls along I-90. Existing sound levels would approach or exceed FHWA criteria along South Judkins Street (Receptor 2), at several locations in Leschi (Receptors 11, 13, 14, 15, and 16), north of the Mercer cut (Receptor 28), and north of I-90 in Bellevue (Receptor 36).

Predicted 2005 and 2025 Sound Levels

At receptors with sound measurements, the measured sound levels (Table 4.5-5) differ from the predicted Existing Conditions sound levels (Table 4.5-7). Measured sound levels often include local traffic and non-traffic noise, whereas predicted existing sound levels include only traffic sound on I-90. In addition, the traffic conditions during sound measurements were not the same as the worst-case traffic conditions assumed for the predicted existing sound levels.

Alternative R-1: Existing/No Build

Alternative R-1 represents future traffic conditions on I-90 without the proposed Project. Alternative R-1 includes the existing I-90 roadway alignment and number of lanes, but with traffic volumes in the design year, and describes the future sound levels likely to be reached in the same area if no highway improvements would be undertaken with the proposed Project. The operation of the center roadway, however, would change from HOV 2+ (HOV lanes with 2+ occupants per vehicle) to HOV 3+ (HOV lanes with 3+ occupants per vehicle) with Alternative R-1 in 2025.

Design-year sound levels would approach or exceed FHWA criteria along S Judkins Street (Receptor 2), at the base of Beacon Hill (Receptor 6), at several locations in Leschi (Receptors 11, 13, 14, 15, and 16), north of the Mercer cut (Receptor 28), and north of I-90 in Bellevue (Receptor 36).

Compared with the predicted Existing Conditions, 2025 sound levels with Alternative R-1 would increase by 1 dBA or less at all receptors analyzed. This increase in future traffic sound levels without the Project would result from the growth in peak-hour traffic volumes from 2005 to 2025 on I-90. The increase in future traffic sound levels would be low because capacity constraints on I-90 would result in a relatively small increase in peak-hour volumes. An increase of 1 dBA in traffic sound levels with Alternative R-1 would not be perceptible (Table 4.5-2).

Alternative R-2B Modified

With Alternative R-2B Modified, design-year sound levels would approach or exceed FHWA criteria along S Judkins Street (Receptor 2), at several locations in Leschi (Receptors 13, 14, 15, and 16), north of the Mercer cut (Receptors 28 and 30), and north of I-90 in Bellevue (Receptor 36). Potential noise walls have been analyzed as mitigation at these locations and are evaluated in Section 4.5.3.

Compared with the predicted Existing Conditions, 2025 sound levels with Alternative R-2B Modified would increase by 1 dBA or less at all receptors analyzed. The increase in future traffic sound levels with Alternative R-2B Modified would be low because of the small increase in traffic volumes. An increase of 1 dBA in traffic sound levels with Alternative R-2B Modified would not be perceptible (Table 4.5-2).

Alternative R-5 Restripe

With Alternative R-5 Restripe, the reversible operations of the center roadway would be maintained while the outer roadways would be restriped to create 14-foot-wide outside shoulders for buses. Design-year traffic volumes and speeds with Alternative R-5 Restripe were assumed to be the same as with Alternative R-1. Future traffic sound levels with Alternative R-5 Restripe would increase by 1 dBA or less at all receptors analyzed, when compared with the predicted Existing Conditions. Any changes in sound levels with Alternative R-5 Restripe would not be perceptible (Table 4.5-2). Potential noise walls have been analyzed as mitigation at receptors with predicted noise impacts, and are evaluated in Section 4.5.3.

Alternative R-5 Modified

With Alternative R-5 Modified, the reversible operations of the center roadway would be maintained while the outer roadways would be restriped and have barriers relocated to create transit shoulders for buses. Design-year traffic volumes and speeds with Alternative R-5 Modified were assumed to be the same as with Alternative R-1. Future traffic sound levels with Alternative R-5 Modified would increase by 1 dBA or less at all receptors analyzed, when compared with the predicted Existing Conditions. Any changes in sound levels with Alternative R-5 Modified would not be perceptible (Table 4.5-2). Potential noise walls have been analyzed as mitigation at receptors with predicted noise impacts, and are evaluated in Section 4.5.3.

Alternative R-8A – Preferred Alternative

With Alternative R-8A, design-year sound levels would approach or exceed FHWA criteria along S Judkins Street (Receptor 2), the base of Beacon Hill (Receptor 6), at several locations in Leschi (Receptors 11, 13, 14, 15, and 16), north of the Mercer cut (Receptors 28 and 30), and north of I-90 in Bellevue (Receptor 36). Potential noise walls have been analyzed as mitigation at these locations and are evaluated in Section 4.5.3.

Compared with the predicted Existing Conditions, 2025 sound levels with Alternative R-8A would increase by 2 dBA or less at all receptors analyzed. The increase in future traffic sound levels with Alternative R-8A would be low because of the small increase in traffic volumes. An increase of 1 to 2 dBA in traffic sound levels with Alternative R-8A would not be perceptible (Table 4.5-2). Design-year traffic sound levels with Alternative R-8A would be the highest of all

Build Alternatives (by 1 dBA or less), because peak-hour volumes in the outer roadways would be higher with the addition of HOV lanes.

Alternative R-8A would shift a small volume of traffic (less than 1 percent) away from the existing SR 520 to I-90. Although a small amount of traffic would be shifted away, SR 520 would continue to operate at capacity during the peak hours. The operation of SR 520 at peak-hour capacity would result in similar peak-hour traffic noise levels with or without this projected shift of traffic. This shift in traffic to I-90 from SR 520 also would result in a very small net increase on I-405 (through downtown Bellevue) and on I-5 (through downtown Seattle), which would result in a negligible increase in traffic noise levels. In comparison, Alternatives R-1, R-2B, R-5 Restripe, and R-5 Modified would not measurably shift any traffic from SR 520 to I-90.

With Alternative R-8A, trucks carrying flammable cargo may be prohibited on I-90, some of which would be diverted to SR 520. The shift of trucks from I-90 to SR 520 would increase the number of trucks on I-405 by less than 1 percent, which would result in a negligible increase on truck noise on I-405. Few trucks would be shifted from I-90 to I-5. The potential impacts of diverting trucks carrying flammable cargo would not occur under Alternatives R-1, R-2B, R-5 Restripe, or R-5 Modified.

Impacts at Individual Receptors

Beacon Hill, Rainier Avenue, and Judkins Neighborhoods (Corwin Curves)

The Beacon Hill/Mount Baker/Judkins Park area of Seattle is predominantly residential, with a mixture of single family and multi-family units at relatively high urban densities. Neighborhood businesses are located along Rainier Avenue S on both sides of I-90. The area west of Rainier Avenue S and north of I-90 is a mixture of light industrial and commercial uses, without any residences or areas of frequent outdoor use that are noise sensitive. Existing noise walls along I-90 are located north of I-90 at Judkins Park and along most of the south side of I-90. The existing I-90 lid from the west portal of the Mount Baker Ridge tunnel to 23rd Avenue S eliminated much of the traffic sound in the Judkins neighborhood and around the Coleman School.

The Judkins neighborhood is located north of I-90 and east of Rainier Avenue S. The area of the Judkins neighborhood along the I-90 corridor includes the Judkins Park and Playfield, and a mixture of single family and multi-family residences along S Judkins Street, 20th Avenue S, and Hiawatha Place S. The single family residences along Hiawatha Place S experience relatively low sound levels because of the considerable shielding provided by terrain. The measured and predicted sound levels at the south end of Hiawatha Place S (Receptor 1) would range from 57 to 59 dBA, which is well below the FHWA noise abatement criterion of 67 dBA for residential areas.

Several single family and multi-family residences, including recently constructed condominiums, are located along S Judkins Street and 20th Avenue S. These residences overlook I-90 and have a direct view to the I-90 and Rainier Avenue S interchange. They are located approximately 50 feet above I-90 and 500 feet from the roadway, and receive only partial shielding of I-90 traffic sound from the existing noise wall north of I-90. The predicted L_{eq} traffic sound levels for

the design year at S Judkins Street (Receptor 2) for all alternatives would be 66 to 67 dBA, which would be considered a traffic noise impact. Sound levels are lower at the Judkins Park and Playfield, which receives shielding of noise from the existing noise wall. The measured and predicted traffic sound levels at the park (Receptor 3) for all Build Alternatives would be 63 dBA.

The base of the northeast slope of Beacon Hill is an area of single family and multi-family residences, which includes some recent infill residential development. Residences and Taejon Park are located along Sturgus Avenue S. Because these residences and the park are located behind the existing noise wall on the south side of I-90, the predicted L_{eq} traffic sound levels would range from 60 to 61 dBA (Receptor 4) and 64 dBA (Receptor 5).

Sound levels are higher to the south, in the residences along Sturgus Avenue S and north of S Atlantic Street. This area is a mixture of single family, two-plex, three-plex, and four-plex residences at high urban densities. These residences are elevated above I-90 and have direct view to I-90 to the east. The existing noise wall south of the I-90 off ramp to Rainier Avenue S provides partial shielding of I-90 traffic sound. The predicted L_{eq} traffic sound levels for the design year at Receptor 6 would range from 65 to 66 dBA. Traffic noise impacts would occur with Alternatives R-1, R-5 Restripe, R-5 Modified, and R-8A at Receptor 6.

Sound levels are lower at residences to the east along 17th and 18th Avenues S. These residences are shielded by the existing noise wall and terrain. The measured and predicted L_{eq} traffic sound levels for the design year at Receptors 7 and 8 for all alternatives would range from 61 to 64 dBA, which is not considered a traffic noise impact.

The area east of Rainier Avenue S and south of I-90 includes single family residences, the Atlantic Street Center, and a small play area. Currently, this area is shielded from traffic sound by a large noise wall south of I-90 and a smaller noise wall along the I-90 on ramp from northbound Rainier Avenue S. The predicted L_{eq} traffic sound level for the design year at Receptors 9 and 10 for all alternatives would range from 64 to 65 dBA, which is not considered a traffic noise impact.

Leschi

The I-90 corridor runs through the Leschi area of Seattle, which is located east of the Mount Baker Ridge tunnel along Lake Washington. Noise receptors along I-90 are single family residences and several parks. Residences along the shoreline are below the I-90 bridge highrise, while residences on the eastern slopes of the Mount Baker Ridge are above I-90. Recently, several residences have been constructed along Lake Washington Boulevard S on top of the eastern portal. Most residences have expansive views of Lake Washington and the Cascade Mountains. The Day Street Park is on the shoreline underneath the I-90 bridge, and the East Portal Viewpoint is above I-90 on top of the eastern portal to the Mount Baker Ridge tunnel.

The measured and predicted sound levels at many Leschi residences adjacent to I-90 (Receptors 11, 13, 14, 15, and 16) approach or exceed the FHWA criteria. At those receptors, predicted traffic sound levels would range from 66 to 73 dBA. The Leschi section of the I-90 corridor currently does not have any existing noise barriers, although the tunnel and the bridge structure do provide some noise shielding. The three separate highrise approaches to the floating bridges

do not provide as much noise shielding to waterfront receptors underneath as would a solid bridge structure. Adjacent receptors that are elevated above I-90 have a direct view to the roadway and higher sound levels.

Floating Bridge

A shared-use pathway is located on the north side of the HMH floating bridge. This pathway extends along the length of the Project area. Because it is a transportation facility, the shared-use pathway is not considered a noise receptor and the FHWA noise abatement criteria in Table 4.5-3 are not applicable. To compare the relative noise impacts among alternatives, a noise analysis site is located at approximately the mid-channel location of the floating bridge, in the middle of the 10-foot-wide pathway. The predicted L_{eq} traffic sound levels at the shared-use pathway would range from 82 to 83 dBA for the alternatives. The highest L_{eq} levels would occur with Alternative R-8A because of its relatively higher volumes and closer distance of the nearest traffic lane to the pathway.

Mercer Island West Shoreline

The Mercer Island west shoreline is west of the First Hill lid and overlooks Lake Washington. The noise receptors are single family residences at elevations of 10 to 50 feet below the I-90 bridge approach. The existing noise wall south of I-90 along the eastbound off ramp and the retaining wall along the north side of the westbound on ramp provide noise abatement at receptors on both sides of I-90. The existing First Hill lid eliminates I-90 traffic noise at residences east of 63rd Avenue SE. These existing walls, lid, terrain, and the bridge structure provide noise shielding in the Mercer Island west shoreline area. Residences along the shoreline, such as Receptor 17A along Faben Drive, would be exposed to traffic noise from the HMH floating bridge that would be audible but below applicable criteria. The measured and predicted design-year sound levels for all Alternatives would range from 62 to 65 dBA, which would not approach or exceed the FHWA noise abatement criteria of 67 dBA for residential areas. Traffic noise impacts would not occur in the Mercer Island west shoreline area.

Mercer Island CBD and Shorewood Areas

Land uses in the Mercer Island CBD and Shorewood areas are single family residential, multi-family residential, and commercial. Most residential areas are single family residences at low to medium urban densities, while some areas are large apartment complexes such as the Shorewood Apartments south of I-90. Businesses and offices are located south of I-90 in the Mercer Island central business district (CBD) and in the vicinity of the Mercer Island City Hall.

On Mercer Island, I-90 runs through a cut with retaining walls up to 30 feet high along both sides of the roadway. These retaining walls and existing noise walls provide noise abatement at most adjacent receptors along the I-90 corridor in Mercer Island.

The existing First Hill lid eliminates I-90 traffic noise at residential and commercial areas west of 74th Avenue SE. East of the First Hill lid and north of I-90 are single family and multi-family residences. South of I-90 is the Mercer Island CBD and the Outdoor Sculpture Gallery. Receptors on both sides of I-90 are shielded from I-90 traffic noise by the existing retaining/noise walls. The predicted L_{eq} traffic sound levels at Receptors 21, 22, 23, and 24 would be below the FHWA criteria and would range from 60 to 65 dBA.

South of I-90 and west of 84th Avenue SE are several new residences along SE 29th Street. Because they receive noise shielding from terrain and from the Luther Burbank Park lid over I-90, the predicted L_{eq} traffic sound levels at Receptor 25 would range from 60 to 61 dBA. On the north side of I-90 east of the Burbank Park lid, the single family residences are at elevations below I-90 and are behind an existing noise wall. The predicted L_{eq} traffic sound levels at Receptor 26 would range from 62 to 63 dBA.

The Shorewood Apartments are a large multi-family complex south of I-90 along Shorewood Drive. The apartments are elevated above I-90 but receive shielding from the existing I-90 noise/retaining walls. The measured and predicted L_{eq} traffic sound levels at Shorewood (Receptor 27) would range from 63 to 64 dBA, which is not considered a noise impact. Sound levels north of I-90 across from Shorewood, however, are higher. The measured and predicted L_{eq} traffic sound levels at the 90th Place SE street end (Receptor 28) would range from 69 to 70 dBA, which is considered a noise impact. The sound levels would be relatively high because the existing noise walls do not extend in front of Receptor 28.

The Covenant Shores complex is located north of I-90 along Fortune Drive, and is protected by an existing noise wall. The predicted L_{eq} traffic sound levels at Covenant Shores (Receptor 29) for all alternatives would range from 59 to 60 dBA. Sound levels are higher at the single family residence at the street end of 96th Avenue SE (Receptor 30). Because the existing retaining wall provides partial shielding of noise, the measured and predicted L_{eq} traffic sound levels at Receptor 30 for all alternatives would range from 65 to 66 dBA, which is considered a noise impact under Alternatives R-2B, R-5 Restripe, R-5 Modified, and R-8A. At Receptor 30A on street end of 97th Avenue SE, the measured and predicted traffic L_{eq} levels of 63 to 65 dBA would not approach or exceed the FHWA noise abatement criteria of 67 dBA for residential areas.

The Mercer Island City Hall and several office buildings are located south of I-90 farther east. City Hall is behind a large retaining wall, and the predicted L_{eq} traffic sound levels at Receptor 31 would range from 63 to 64 dBA. Single family residences north of I-90 are located along El Dorado Drive north of the East Mercer Way interchange. The predicted L_{eq} traffic sound levels at El Dorado Drive (Receptor 32) for all alternatives would be 65 dBA, which is not considered a noise impact.

Single family residences (Receptor 33) and the Herzl-Ner Tamid Conservation Congregation (Receptor 34) are located along the Lake Washington waterfront on the east side of Mercer Island. Shoreline areas are located approximately 40 feet below I-90 and receive noise shielding from the East Channel bridge structure. The existing noise wall along the south side of I-90 provides noise abatement at the synagogue. The predicted L_{eq} traffic sound level at Receptors 33 and 34 would be below the FHWA criteria and would range from 61 to 64 dBA.

Bellevue

In the Project area within the City of Bellevue, land use is single family residential on both sides of the I-90 corridor between Lake Washington and the Bellevue Way SE interchange. Residences and Enatai Park along the Lake Washington shoreline adjacent to the bridge are located approximately 40 to 60 feet below the East Channel bridge and receive noise shielding from the bridge structure. Residences immediately east of the bridge are shielded by the existing

noise walls that are located both north and south of I-90 immediately east of the bridge. Residences would be exposed to traffic noise from the East Channel bridge that would be audible but below applicable criteria.

Sound levels at residences and Enatai Park below the bridge would be relatively low. The predicted L_{eq} traffic sound level at residences on the north side of the bridge (Receptor 35) and the park on the south side of the bridge (Receptor 37) would be below FHWA criteria. Residences south of I-90 are at elevations below the roadway, where noise levels are shielded by terrain and the existing noise/retaining wall south of the I-90 eastbound off ramp. The predicted L_{eq} traffic sound level at residences south of I-90 along SE Lake Road (Receptor 38) would be 65 dBA, which is not considered a noise impact.

Sound levels would be higher, however, at receptors north of I-90 that are elevated above the roadway. The single family residences in the first row along SE 34th Street, that are represented by Receptor 36, are approximately 10 to 25 feet above I-90 and have a direct view to the roadway. Design-year sound levels at Receptor 36 and other first-row receptors along SE 34th Street between 109th and 112th Avenues SE would exceed the FHWA criteria, which would require consideration of noise mitigation at this location.

4.5.3 Mitigation Measures

Noise Barrier Analysis

At noise receptors with predicted traffic noise impacts, FHWA and WSDOT require consideration of traffic noise abatement measures. Roadway projects must identify noise abatement measures that are both feasible and reasonable and that are likely to be incorporated in the project. Feasibility is primarily an engineering determination of whether a desired level of sound reduction could be achieved at a particular receptor. Reasonableness is a more subjective criterion based on the practicality of an abatement measure. Reasonableness considers a number of factors, including cost, amount of noise reduction, future traffic noise levels, aesthetics, safety, and public concerns. Noise barriers are analyzed in this section; other long-term noise abatement measures are evaluated in Section 4.5.3.2.

Construction of noise barriers could reduce long-term traffic sound levels along I-90. The amount of sound reduction is determined by the height and length of a barrier, its location relative to the noise source and receiver, and topography of the project site. To be effective, a barrier must block the "line of sight" between the highest point of a noise source, such as a truck's exhaust stack, and the receptor. The barrier must be long to prevent sounds from passing around the ends, have no openings such as driveway access connections, and be dense enough so that noise would not be transmitted through it. Noise barriers usually are either walls or earth berms. Berms require a wide space, whereas walls can fit into many locations.

Noise barriers are intended to reduce traffic sound at receivers within several hundred feet of a roadway. At distances greater than several hundred feet from I-90 to a receiver, noise barriers would be less effective. Sound levels at those distances, without barriers, are already low. Several studies have shown that barriers do not show substantial noise reductions at distances of approximately 500 feet or greater (Caltrans 2002).

Potential noise barriers were evaluated with the TNM at noise receptors where predicted future traffic sound levels for the alternatives would approach or exceed the noise abatement criteria in Table 4.5-3. The noise barrier analyses were conducted consistent with FHWA and WSDOT procedures for evaluating the feasibility and reasonableness of noise barriers (FHWA 1995 and WSDOT 2002). The feasibility and reasonableness of potential noise barriers has been determined for each location, considering the site-specific topography, intervening terrain, distance between roadway and receptors, roadway configuration, and projected traffic volumes and speeds.

Barrier Feasibility

The feasibility of a noise barrier is a technical consideration of whether a barrier could be built that effectively reduces traffic noise levels. Barrier feasibility considers access requirements, topography, other noise sources, safety, drainage, aesthetics, and effectiveness. Key assumptions for the barrier feasibility analysis include the following:

- A majority of the first row receivers must receive at least a 5 dBA insertion loss, and at least one receiver must have at least a 7 dBA reduction. "Majority" is defined as 60 percent of the first-row residents and 55 percent of all other residents where property lines are within 500 feet of the right-of-way (WSDOT 2002).

- Noise barriers were evaluated within the proposed I-90 right-of-way. Berms were not evaluated because of the limited amount of space available within the proposed right-of-way.

- The height of the proposed noise walls is the actual height above the terrain at the base of the wall, not the effective height above the adjacent roadway surface.

Table 4.5-8 presents the analyses of potential noise barriers with the proposed Project.

Table 4.5-8
Noise Barrier Feasibility for Sound Transit I-90 Project

Noise Receptor	Barrier Description	Height	Maximum Noise Reduction	First Row 5-dBA reduction	Other Considerations	Recommendation
Judkins North Barrier						
R2	North of I-90 along WB off ramp	50 feet	4 dBA	--	--	Not feasible
Beacon Hill Barrier						
R6	South of I-90 along EB off ramp	24 feet	7 dBA	81%	Potential impacts on views and on nearby trail	Feasible noise reduction
Leschi Portal Barrier						
R13	On portal above tunnel, on edge of East Portal Viewpoint park	10 feet	8 dBA	83%	Adverse impacts on East Portal Viewpoint park	Not feasible, because of park impacts
Leschi North Barrier						
R11	North side of I-90, next to tunnel entrance	30 feet	7 dBA	100%	Must be built on bridge structure.	Feasible noise reduction, although structurally infeasible
Leschi South Barrier						
R14, R15	South side of I-90, next to tunnel entrance	24 feet	9 dBA	100%	Portions must be built on bridge structure	Feasible noise reduction for R14 and R15, although structurally infeasible
R16	Extended for R16	30 feet	2 dBA	0%	Extension must be built on bridge structure	Not feasible for R16
North Shorewood Barrier						
R28	North of I-90, at 90th Place street end	24 feet	8 dBA	67%	--	Feasible
North Mercer Barrier						
R30	North of I-90, at 96th and 97th Avenues	34 feet	7 dBA	100%	--	Feasible
Bellevue North Barrier						
R36	North of I-90 along WB on ramp	21 feet	8 dBA	63%	--	Feasible

Note: WB = westbound, EB = eastbound

Source: Krause 2002

Barrier Reasonableness

Once a potential noise wall is found to be feasible, the next step is to determine its reasonableness. Reasonableness is a more subjective criterion based on the practicality of a noise abatement measure. An evaluation of noise barrier reasonableness considers noise benefits, costs, community desires, type of development, and other factors.

WSDOT's allowed cost per benefited residence ranges from $15,500 to $27,500, the allowed costs increasing with higher noise levels. The mitigation costs allowed per residence are shown in Table 4.5-9.

Table 4.5-9
WSDOT Mitigation Cost Allowances

Design-Year Traffic Noise Decibel Level	Allowed Cost per Household	Equivalent Wall Surface Area per Household
66 dBA or lower	$15,500	65.0 sq. meters (700 sq. ft)
67 dBA	$17,000	71.5 sq. meters (770 sq. ft)
68 dBA	$18,500	77.7 sq. meters (837 sq. ft)
69 dBA	$20,000	84.0 sq. meters (905 sq. ft)
70 dBA	$21,500	90.5 sq. meters (973 sq. ft)
71 dBA	$23,000	96.7 sq. meters (1041 sq. ft)
72 dBA	$24,500	103.0 sq. meters (1109 sq. ft)
73 dBA	$26,000	109.2 sq. meters (1176 sq. ft)
74 dBA	$27,500	115.5 sq. meters (1244 sq. ft)

Source: WSDOT 2002. The allowed cost per household are in year 1996 dollars, based on the $22.10 per square foot constructed cost.

In Washington, a benefited residence is defined as one receiving a 3-dBA reduction within 500 feet of the right-of-way. The mitigation costs for each benefited residence are added together, and the sum is the total mitigation allowance for a potential barrier. The total mitigation allowance then is compared with the construction cost of the proposed barrier. If the total mitigation allowance exceeds the construction cost, then the potential noise barrier is considered reasonable. Table 4.5-10 compares the mitigation and construction costs of potential noise barriers that were found feasible in the previous section.

Evaluation of Individual Noise Barriers

Judkins North Barrier. Receptor 2 and other residences along S Judkins Street are approximately 50 feet above I-90 and at least 500 feet from the edge of the roadway. The design-year L_{eq} sound levels at Receptor 2 would range from 66 to 67 dBA for all alternatives. A potential noise barrier was evaluated along the north side of I-90 and the westbound off ramp. A sound reduction of 7 dBA could not be achieved at Receptor 2 because of its height above and distance from I-90, and the existing noise wall north of I-90. A noise barrier at this location would not be feasible under FHWA-approved WSDOT guidelines.

Table 4.5-10
Reasonableness of Potential Noise Barriers

Proposed Noise Barrier	Alternative R-2B Modified	Alternative R-5 Restripe	Alternative R-5 Modified	Alternative R-8A – *Preferred Alt.*
Beacon Hill Barrier				
Height of Barrier (ft)	--	24 feet	24 feet	24 feet
Construction Cost ($68.33/sq. ft.)	--	$820,000	$820,000	$820,000
Number of Residences Benefited	--	19	19	19
Mitigation Cost Allowance per Residence	--	$15,500	$15,500	$15,500
Total Mitigation Allowance	--	$295,000	$295,000	$295,000
Recommendation	No impacts	Not reasonable	Not reasonable	Not reasonable
Leschi North Barrier				
Height of Barrier (ft)	--	30 feet	30 feet	30 feet
Construction Cost ($22.10/sq. ft.)	--	$1,305,000	$1,305,000	$1,305,000
Number of Residences Benefited	--	12	12	12
Mitigation Cost Allowance per Residence	--	$15,500	$15,500	$15,500-17,000
Total Mitigation Allowance	--	$186,000	$186,000	$189,000
Recommendation	No impacts	Not reasonable	Not reasonable	Not reasonable
Leschi South Barrier				
Height of Barrier (ft)	24 feet	24 feet	24 feet	24 feet
Construction Cost ($22.10/sq. ft.)	$357,000	$357,000	$357,000	$357,000
Number of Residences Benefited	14	14	14	14
Mitigation Cost Allowance per Residence	$15,500-24,500	$15,500-24,500	$15,500-24,500	$15,500-26,000
Total Mitigation Allowance	$248,500	$248,500	$248,500	$263,500
Recommendation	Not reasonable	Not reasonable	Not reasonable	Not reasonable
North Shorewood Barrier				
Height of Barrier (ft)	24 feet	24 feet	24 feet	24 feet
Construction Cost ($22.10/sq. ft.)	$398,700	$398,700	$398,700	$398,700
Number of Residences Benefited	4	4	4	4
Mitigation Cost Allowance per Residence	$15,500-21,500	$15,500-21,500	$15,500-23,000	$15,500-23,000

Table 4.5-10 (Continued)
Reasonableness of Potential Noise Barriers

Proposed Noise Barrier	Alternative R-2B Modified	Alternative R-5 Restripe	Alternative R-5 Modified	Alternative R-8A – *Preferred Alt.*
Total Mitigation Allowance	$80,000	$77,000	$77,000	$81,500
Recommendation	Not reasonable	Not reasonable	Not reasonable	Not reasonable
North Mercer Barrier				
Height of Barrier (ft)	34 feet	34 feet	34 feet	34 feet
Construction Cost ($22.10/sq. ft.)	$638,000	$638,000	$638,000	$638,000
Number of Residences Benefited	4	4	4	4
Mitigation Cost Allowance per Residence	$15,500	$15,500	$15,500	$15,500
Total Mitigation Allowance	$62,000	$62,000	$62,000	$62,000
Recommendation	Not reasonable	Not reasonable	Not reasonable	Not reasonable
Bellevue North Barrier				
Height of Barrier (ft)	21 feet	21 feet	21 feet	21 feet
Construction Cost ($22.10/sq. ft.)	$417,000	$417,000	$417,000	$417,000
Number of Residences Benefited	14	14	14	14
Mitigation Cost Allowance per Residence	$15,500-$23,000	$15,500-$23,000	$15,500-$23,000	$15,500-$24,500
Total Mitigation Allowance	$250,000	$250,000	$250,000	$257,500
Recommendation	Not Reasonable	Not Reasonable	Not Reasonable	Not Reasonable

Beacon Hill Barrier. The predicted L_{eq} traffic sound levels for the design year at Receptor 6 would range from 65 to 66 dBA, resulting in traffic noise impacts with Alternatives R-1, R-5 Restripe and Modified, and R-8A. The residences along Sturgus Avenue S and S Atlantic Street are a mixture of single family residences, duplexes, and small apartment buildings at high urban densities. These residences have a view to the eastern portion of I-90, and the existing noise barrier south of I-90 provides partial shielding of traffic noise. A noise barrier was evaluated just behind the existing noise/retaining wall along the eastbound off ramp, at approximately the same base elevation as the nearby paved trail. Because a sound reduction of 7 dBA could be achieved at Receptor 6, the proposed wall would be provide a feasible noise reduction.

The potential noise wall could be built on top of the existing retaining wall or replace the existing retaining wall, either of which may not be feasible and reasonable from an engineering basis. The structural feasibility and construction requirements of the proposed noise wall were evaluated by WSDOT. The existing retaining wall was designed and built to capacity and would not support additional loads imposed by the noise wall. Any potential noise wall on top of the existing retaining wall would have to be extended below the existing wall elevations to avoid overloading the existing wall. Construction of the noise wall at this location would require expensive techniques such as drilled shafts and large beams. Construction of the noise wall would cost approximately $820,000, which would exceed the mitigation allowance for the proposed noise wall. The proposed noise wall would not be economically reasonable.

The potential 24-foot wall could block views from many of the residences and could result in adverse visual impacts. The proposed wall also could interfere with the operation of the multi-use trail immediately behind the wall. Because of the potential adverse impacts on views and the trail and because wall construction costs would exceed the mitigation allowance, this noise wall would not be considered feasible and reasonable.

Leschi Portal Barrier. Receptor 13 and other first-row residences along Lake Washington Boulevard S are above the eastern portal to the Mount Baker tunnel and have a direct view to I-90. The predicted L_{eq} traffic sound levels at Receptor 13 for all alternatives would range from 67 to 69 dBA , which would exceed the FHWA noise abatement criterion of 67 dBA for residences. A potential noise wall was evaluated running north-south on the east side of Lake Washington Boulevard S within the East Portal Viewpoint park. Although a continuous 10-foot wall would provide an 8-dBA reduction at Receptor 13, it would adversely affect the park. The East Portal Viewpoint was created specifically for viewing the I-90 floating bridges. Construction of a noise barrier within the park would require acquisition of parkland, inhibit public access to the park, and interfere with the park's specific purpose of providing views. Because of its potential adverse impacts on parkland, the proposed barrier would not be considered feasible.

Leschi North Barrier. Receptor 11 is a single family residence north of I-90, with a view to the bridge approach and floating bridges. The predicted L_{eq} traffic sound levels at Receptor 11 would range from 65 to 68 dBA for the alternatives. A potential noise wall was evaluated along the north side of the westbound bridge approach, from the entrance to the tunnel eastward over Lake Washington. Two houses are the first row of receptors along S Irving Street, which are 5 to 30 feet above and 270 feet from I-90. A noise wall 30 feet high would provide a minimum 7-dBA reduction, but would have to be relatively high and long to be feasible because of the distance and elevation of the receptors and the partial shielding already provided by the tunnel and bridge structure. Although the proposed noise wall would be feasible under WSDOT noise policies, it likely would not be feasible from an engineering perspective because the existing bridge structure could not support its weight. A large noise wall also would result in aesthetic impacts in a residential neighborhood where views are desirable and valuable. The proposed wall would not be economically reasonable, however, because its construction costs would exceed its total mitigation allowance for the benefited receptors. A noise wall at this location would not be considered feasible and reasonable under FHWA-approved WSDOT guidelines.

Leschi South Barrier. Receptors 14, 15, and 16 are single family residences south of I-90, all of which have design-year L_{eq} traffic sound levels predicted to approach or exceed the FHWA noise abatement criteria. A potential noise wall was evaluated along the south side of the eastbound bridge approach, from the entrance to the tunnel eastward over Lake Washington. The first row of receptors along 35th Avenue S consists of two residences (R14 and R15), which are located between 0 and 20 feet above I-90. A noise wall 24 feet high would provide a minimum 7-dBA reduction, but the wall would have to be relatively high and long to be feasible because of the elevation of the receptors and the partial shielding already provided by the tunnel and bridge structure. Extending the wall for Receptor 16, however, would not provide a 7-dBA noise reduction at R16 and this extension would not be feasible.

Although the proposed noise wall would be feasible under WSDOT noise policies, it likely would not be feasible from an engineering perspective because the existing bridge structure could not support its weight. A large noise wall also would result in aesthetic impacts in a residential neighborhood where views are desirable. The proposed wall would not be economically reasonable because its construction costs would exceed its total mitigation allowance for the benefited receptors. A noise wall at this location would not be considered reasonable under FHWA-approved WSDOT guidelines.

Shorewood North Barrier. Receptor 28 is a single family residence north of I-90 at the 90th Place SE street end. The measured and predicted L_{eq} traffic sound levels at Receptor 28 would exceed the FHWA noise abatement criteria, because the existing noise walls do not extend fully in front of Receptor 28. A noise wall was evaluated behind the existing retaining wall along the north of I-90. A noise wall 24 feet high would provide a feasible reduction at Receptor 28. The proposed noise wall would be relatively high because of the partial shielding provided by the existing retaining walls and because Receptor 28 is approximately 45 feet in elevation above I-90. The proposed wall, however, would not be economically reasonable because its construction costs would exceed its total mitigation allowance for the benefited receptors. A noise wall at this location would not be considered reasonable under FHWA-approved WSDOT guidelines.

North Mercer Barrier. Receptor 30 is a single family residence north of I-90 at the street end of 96th Avenue SE. The existing noise/retaining wall provides partial shielding of traffic noise, but the existing and future noise levels would approach or exceed the FHWA criteria. A noise wall was evaluated just behind the existing noise/retaining wall along the north of the westbound East Mercer Way on ramp. Its base would be at approximately the same elevation as the adjacent paved trail. A noise wall 34 feet high would provide a minimum 7-dBA reduction at Receptor R30, but the wall would have to be high to be feasible because of the shielding already provided by the existing wall. This potential noise wall could also provide a 6-dBA reduction at Receptor 30A. The proposed wall would not be economically reasonable because its construction costs would exceed its total mitigation allowance for the benefited receptors. A noise wall at this location would not be considered reasonable under FHWA-approved WSDOT guidelines.

Bellevue North Barrier. Receptor 36 and other first-row receptors along SE 34th Street are elevated above I-90 by 10 to 25 feet. The design-year L_{eq} sound levels at Receptor 36 would range from 69 to 70 dBA for the alternatives without mitigation. A potential noise wall was evaluated along the north side of the I-90 westbound on ramp from Bellevue Way SE. Because the receptors are elevated above the roadway, a relatively high noise wall would be required to achieve at least a 7-dBA reduction. A wall height of 21 feet would provide an 8-dBA reduction at one location and at least a 5-dBA reduction at the majority of the first-row receptors, which would be considered feasible. The proposed wall would not be economically reasonable because its construction costs would exceed its total mitigation allowance for the benefited receptors. A noise wall at this location would not be considered reasonable under FHWA-approved WSDOT guidelines.

4.5.3.1 Construction

Construction activities with the proposed Project would include the construction industry's best management practices to reduce construction noise at nearby receptors along I-90. Construction activities would comply with local construction noise regulations. Construction mitigation would be incorporated into construction plans and contractor specifications in the construction contract. The following construction noise mitigation measures are recommended for all Build Alternatives.

NOI–1. Engines of construction equipment would be equipped with adequate mufflers, intake silencers, or engine enclosures.

NOI-2. The quietest equipment available would be used.

NOI-3. Construction equipment would be turned off during prolonged periods of nonuse.

NOI-4. Contractors would be required to maintain all equipment and train their equipment operators.

NOI-5. Stationary equipment would be located away from receiving properties where feasible.

NOI-6. Where stationary equipment must be located close to residences, temporary noise barriers or curtains would be constructed around the equipment to decrease noise levels at the nearby sensitive receptors.

The Project could include nighttime construction activities to minimize traffic impacts. The Project would limit noisier construction activities when possible to between 7 AM to 10 PM to reduce construction noise during sensitive nighttime hours, but not all activities would allow this. Potential nighttime construction would be required either to meet lower noise limits in the local noise ordinances or to obtain nighttime construction noise variances from the cities of Seattle, Mercer Island, and Bellevue. If nighttime construction activity were proposed with the Project, each local agency would be contacted to determine local noise code requirements and to consider specific mitigation measures.

Noise variances from local noise ordinances may be required for construction activities during nighttime hours. A variance could consider the type of work, location, equipment expected to be used, hours of operation, and total number of nights required. Sound Transit would obtain any required noise variance from each local jurisdiction.

4.5.3.2 Operation

A variety of mitigation measures could be effective at reducing traffic noise impacts. Noise barriers have been evaluated and discussed previously. The following discussion evaluates other traffic noise mitigation measures. None have been found to be reasonable and feasible for the Project.

Traffic sound levels could be reduced with traffic-control devices, signs for prohibition of certain vehicle types (such as motorcycles and heavy trucks), time-use restrictions, and reduced speed limits. Because the percentage of heavy trucks on I-90 would be approximately 2 percent, restrictions of heavy trucks would provide minimal noise benefit. Operating speeds on I-90 would be less than posted speed limits because of capacity constraints. The operating speeds during peak-volume periods would be 50 mph or lower, which is below the current posted speed limit of 60 mph. Prohibition of heavy trucks, time-use restrictions, and reduced speed limits, however, provide minimal noise reductions and would be unreasonable for an interstate highway.

Acquisition of adjacent properties affected by traffic noise impacts could eliminate noise impacts at those receptors. Property rights also could be acquired for construction of noise barriers.

Receptors adjacent to the I-90 corridor are developed residential and commercial properties in the urban area of Seattle. Acquisition of property would be unreasonable because developed properties would be expensive to acquire for the purpose of noise mitigation, and because acquisition would result in adverse impacts by displacing residences.

Buffer zones are undeveloped open spaces that border a highway. Buffer zones could be created by purchasing undeveloped land to prevent future noise receptors from being built adjacent to I-90. No undeveloped land exists adjacent to I-90 where noise mitigation is under consideration. Because most properties adjacent to the I-90 corridor already are developed as residential and commercial areas, creation of buffer zones would not be feasible.

The proposed vertical and horizontal alignments are the only alignments determined to meet the purpose and need for the Project. Changes in the vertical and horizontal alignments are beyond the scope of the project. Other design alternatives would not to be feasible because of high cost and impacts on traffic operation. The evaluation and selection of alternative alignments are discussed in Chapter 2 – Alternatives Considered, of this FEIS.