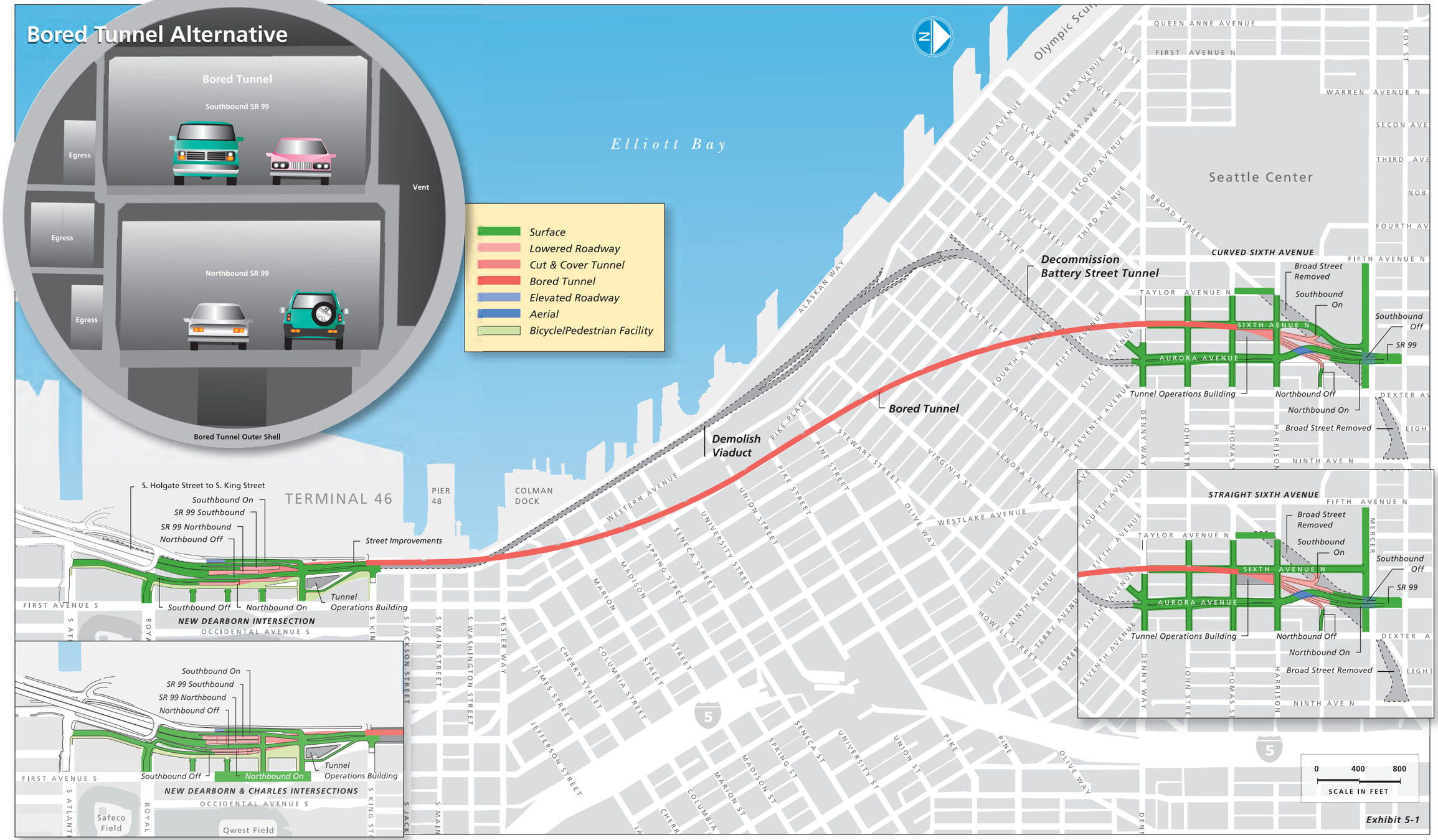

Bored Tunnel Alternative
Bored Tunnel
Southbound SR 99
Egress
Vent
Egress
Northbound SR 99
Egress
Bored Tunnel Outer Shell
Surface
Lowered Roadway
Cut & Cover Tunnel
Bored Tunnel
Elevated Roadway
Aerial
Bicycle/Pedestrian Facility
Elliott Bay
Olympic Scu
QUEEN ANNE AVENUE
FIRST AVENUE N
WARREN AVENUE N
SECON AVE
THIRD AVE
NOB
FOURTH AV
FIFTH AVENUE N
ROY ST
BAY ST
EAGLE ST
WESTERN AVENUE
ELLIOTT AVENUE
CLAY ST
CEDAR ST
FIRST AVE
SECOND AVENUE
THIRD AVENUE
BROAD STREET
VINE STREET
WALL STREET
Seattle Center
CURVED SIXTH AVENUE
Decommission
Battery Street Tunnel
Broad Street
Removed
Southbound
On
Southbound
Off
SR 99
TAYLOR AVENUE N
SIXTH AVENUE N
AURORA AVENUE
Tunnel Operations Building
Northbound Off
Northbound On
Broad Street Removed
DEXTER AV
EIGH
NINTH AVE N
ALASKAN WAY
BELL STREET
FOURTH AVENUE
FIFTH AVENUE
SIXTH AVENUE
SEVENTH AVENUE
BLANCHARD STREET
LENORA STREET
DENNY WAY
JOHN STR
THOMAS ST
HARRISON
Bored Tunnel
Demolish
Viaduct
PIKE PLACE
PINE STREET
STEWART STREET
VIRGINIA ST
PIKE STREET
UNION STREET
OLIVE WAY
WESTLAKE AVENUE
WESTERN AVENUE
SENECA STREET
UNIVERSITY STREET
SPRING STREET
MADISON
MARION
EIGHTH AVENUE
NINTH AVENUE
HOWELL STREET
TERRY AVENU
BOREM
TERMINAL 46
PIER 48
COLMAN DOCK
S. Holgate Street to S. King Street
Southbound On
SR 99 Southbound
SR 99 Northbound
Northbound Off
Street Improvements
Southbound Off
Northbound On
Tunnel Operations Building
FIRST AVENUE S
NEW DEARBORN INTERSECTION
OCCIDENTAL AVENUE S
S ATLANTIC
ROYAL
S KING ST
S JACKSON STREET
S MAIN STREET
S WASHINGTON STREET
YESLER WAY
JAMES STREET
CHERRY STREET
COLUMBIA STREET
JEFFERSON STREET
Southbound On
SR 99 Southbound
SR 99 Northbound
Northbound Off
Southbound Off
Northbound On
Tunnel
Operations Building
NEW DEARBORN & CHARLES INTERSECTIONS
Safeco
Field
Qwest Field
STRAIGHT SIXTH AVENUE
Broad Street
Removed
Southbound
On
Southbound
Off
SR 99
Tunnel Operations Building
Northbound Off
Northbound On
Broad Street Removed
MERCER
0
400
800
SCALE IN FEET
Exhibit 5-1

CHAPTER 5 - BORED TUNNEL ALTERNATIVE

What's in Chapter 5?

This chapter describes the components of the Bored Tunnel Alternative and identifies direct and indirect long-term project effects. Potential mitigation measures are discussed in Question 32. Indirect effects are discussed under the resources where they occur in Questions 12-28, and indirect effects are summarized in Question 29.

1 How would the Bored Tunnel Alternative replace SR 99 and the viaduct?

The Bored Tunnel Alternative would replace State Route 99 (SR 99) between S. Royal Brougham Way and Roy Street, as shown in Exhibit 5-1. The tunnel would have two lanes in each direction.

The completed S. Holgate Street to S. King Street Viaduct Replacement Project would end near S. Royal Brougham Way with the SR 99 roadway at-grade. Beginning at S. Royal Brougham Way, the Bored Tunnel Alternative would continue replacing SR 99 with a side-by-side, surface roadway that would transition to a cut-and-cover tunnel section. At approximately S. King Street, SR 99 would become a stacked bored tunnel, with two southbound travel lanes on the top and two northbound travel lanes on the bottom.

The bored tunnel would continue under Alaskan Way S. to approximately S. Washington Street, where it would curve slightly away from the waterfront and then travel under First Avenue beginning at approximately University Street. At Stewart Street, it would travel in a northern direction under Belltown. The tunnel would be about 215 feet below ground level at its deepest point near Virginia Street. At Denny Way the bored tunnel would travel under Sixth Avenue N., where it would transition to a short cut-and-cover tunnel section near Thomas Street and become a side-by-side surface roadway at about Harrison Street. This alignment for the bored tunnel was developed to provide safe curves and grades, minimize construction effects, and avoid existing underground facilities and foundations.

The project includes removing the existing viaduct and closing and filling the Battery Street Tunnel after the new bored tunnel is completed.

There are three primary components of the Bored Tunnel Alternative: the south portal area, the bored tunnel, and the north portal area. Each of these areas is discussed in more detail below.

South Portal Area

Full northbound and southbound access to and from SR 99 would be provided in the south portal area between S. Royal Brougham Way and S. King Street. The northbound on-ramp to and southbound off-ramp from SR 99 would be built near S. Royal Brougham Way and would intersect with the East Frontage Road as shown in Exhibit 5-2.

The southbound on-ramp to and northbound off-ramp from SR 99 would feed directly into a reconfigured Alaskan Way S. The northbound off-ramp would have a general-purpose lane and a transit-only lane to accommodate transit coming from south or West Seattle. The reconfigured Alaskan Way S. would have three lanes in each direction up to S. King Street. A new trail, called the City Side Trail, would replace the existing Waterfront Bicycle/Pedestrian Facility on the east side of Alaskan Way S. as shown in Exhibit 5-2.

Two options are being considered for new cross streets that would be built to intersect with Alaskan Way S. north of S. Royal Brougham Way:

- **New Dearborn Intersection –** Alaskan Way S. would have one new intersection and cross street at S. Dearborn Street. The cross street would have sidewalks on both sides.
- **New Dearborn and Charles Intersections –** Alaskan Way S. would have two new intersections and cross streets at S. Charles Street and S. Dearborn Street. The cross streets would have sidewalks on both sides.

The frontage road east of SR 99 would be widened slightly at S. Atlantic Street to accommodate truck turning movements and a new right-turn pocket would be added between S. Atlantic Street and S. Royal Brougham Way. Railroad Way S. would be replaced by a new one-lane roadway where traffic could travel northbound between S. Dearborn Street and Alaskan Way S.

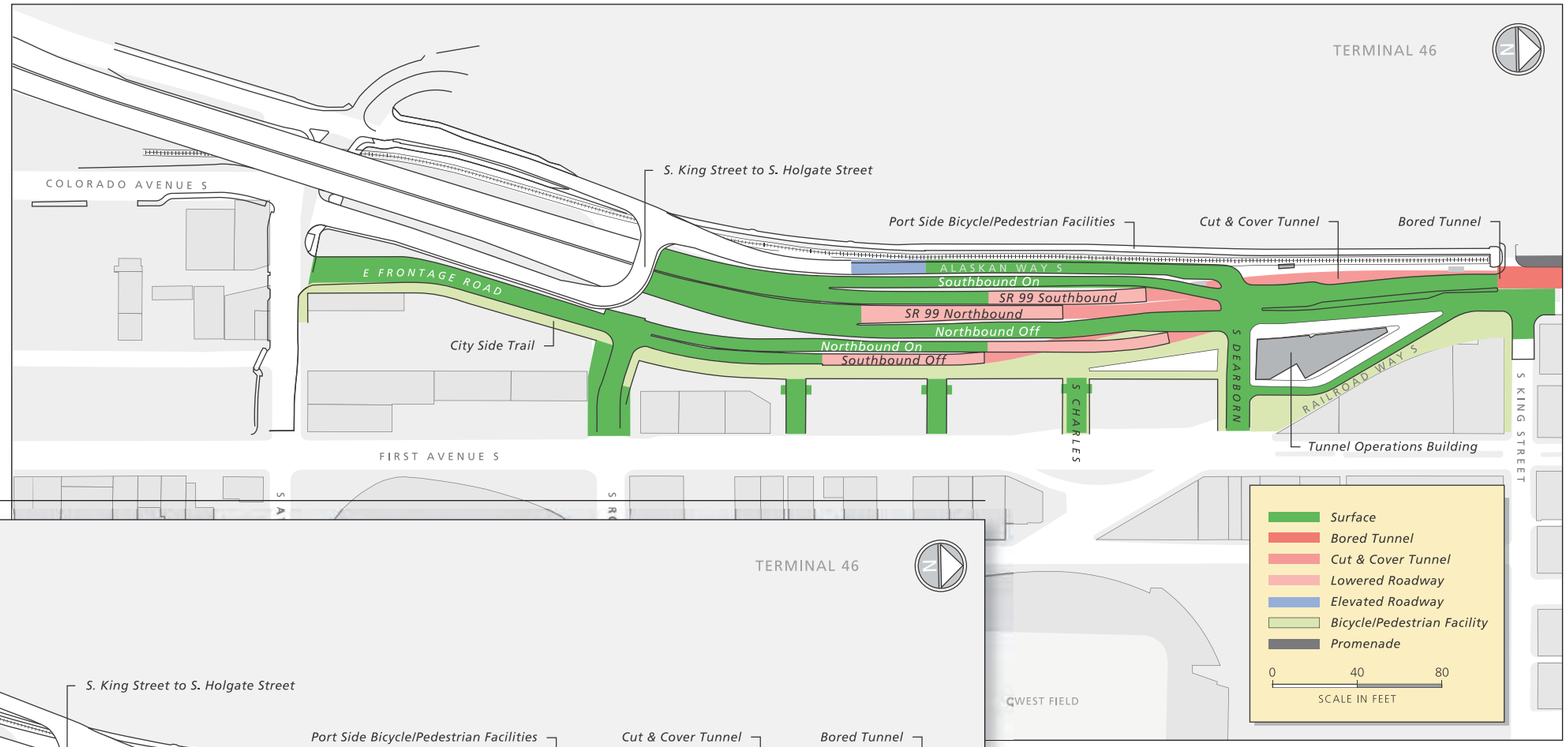
A tunnel operations building would be constructed in the block bounded by S. Dearborn Street, Alaskan Way S., and the new Railroad Way S. access road. A conceptual drawing of the building is provided in Exhibit 5-3. Part of the building would be constructed underground. The remaining portion of the building is expected to be approximately 65 feet tall with vent stacks extending up to 30 feet above the roof.

Bored Tunnel

The bored tunnel would have two lanes in each direction. Southbound lanes would be located on the top portion of the tunnel, and the northbound lanes would be located on the bottom. Travel lanes would be approximately 11 feet wide, with a 2-foot-wide shoulder on one side and a 6-foot-wide shoulder on the other side. The 6-foot shoulder would help with emergency vehicle access and provide some space for disabled vehicles to stop. In most places, the Bored Tunnel Alternative would be built to meet current Washington State Department of Transportation (WSDOT) roadway design standards; however, in some areas deviations will be required. For example, the bored tunnel is being designed with 11-foot wide lanes, a 2-foot wide shoulder on one side, and a 6-foot shoulder on the other side. A WSDOT highway facility of this type typically would be designed with

South Portal Options

New Dearborn Intersection



New Dearborn & Charles Intersections

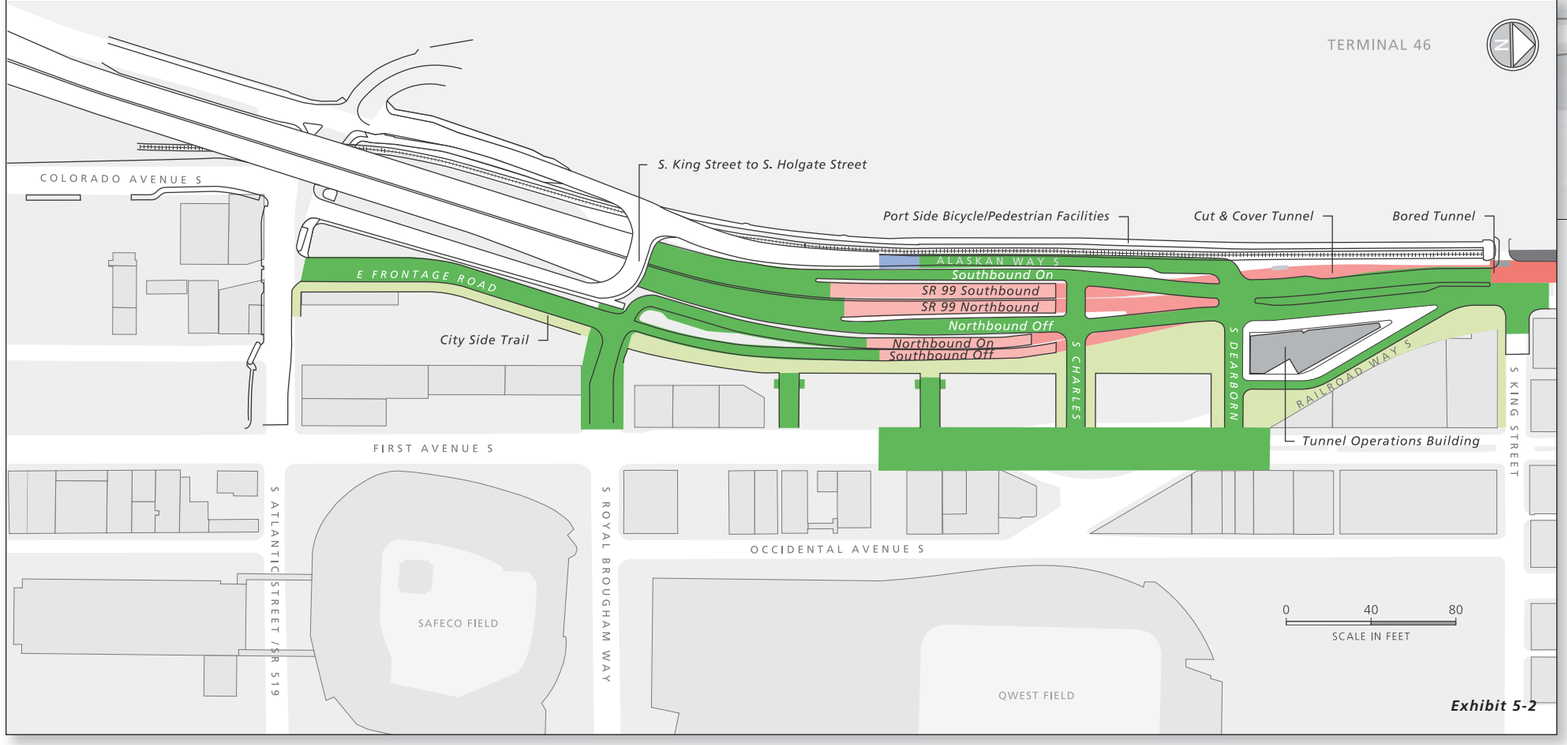


Exhibit 5-2

Conceptual Drawing of the South Portal Tunnel Operations Building

Exhibit 5-3

12-foot-wide lanes and a 4-foot shoulder on one side and a 10-foot shoulder on the other side. For the bored tunnel, this deviation is required to minimize the diameter of the bored tunnel. All deviations will be approved by WSDOT and Federal Highway Administration (FHWA) to ensure that the roadway is built to be a safe facility for travelers.

The 6-foot shoulder would provide access to emergency tunnel exits, which would be provided at least every 650 feet. In an emergency, travelers would walk along the shoulders to reach a doorway into a secure waiting area, called a refuge area, located between the tunnel's levels. Staircases inside the refuge area would provide access to a walkway which would run the length of the tunnel and would be located between the roadway levels. Signs would point travelers to the nearest exit, where they would either wait for assistance or walk out of the tunnel. Refuge areas would contain emergency telephones. People who are unable to use the stairs to exit the tunnel could wait in the enclosed, protected refuge areas for assisted rescue. Refuge areas and the pathways to the refuge areas will meet Americans with Disabilities Act requirements.

The tunnel would be equipped with ventilation, a fire detection and suppression system, and drainage. Video cameras would provide real-time information to the operators at WSDOT's 24-hour tunnel control center and allow them to respond quickly to changing conditions and emergencies. The tunnel control center would be incorporated into one of the tunnel operations buildings at either the south or north tunnel portal.

North Portal Area

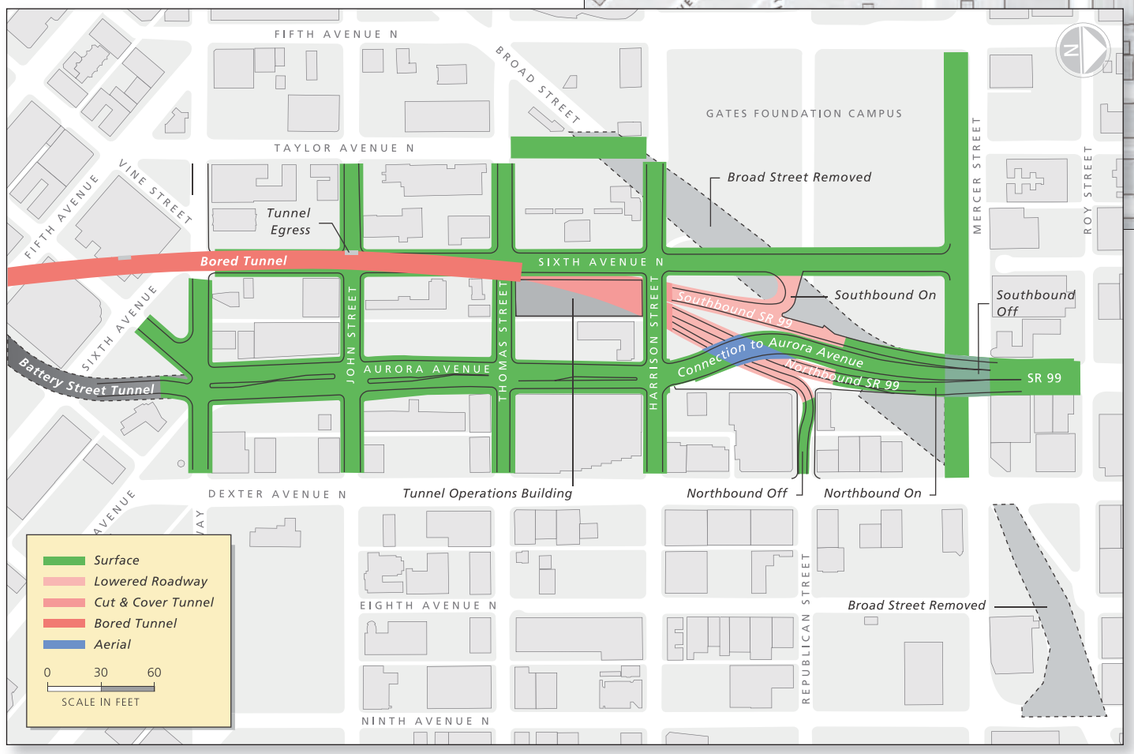
Full northbound and southbound access to and from SR 99 would be provided near Harrison and Republican Streets. The existing SR 99 on- and off-ramps provided at Denny Way would be closed and replaced by the ramps near Harrison Street that would connect to Aurora Avenue.

Northbound access from SR 99 and southbound access to SR 99 would be provided via new ramps at Republican Street. The northbound off-ramp to Republican Street would be provided on the east side of SR 99 and routed to an intersection at Dexter Avenue N. Drivers would access the southbound on-ramp via a new connection with Sixth Avenue N. at Republican Street on the west side of SR 99. Access to SR 99 would continue to be available at Roy Street as it is today.

Because of the new SR 99 portal and ramp locations, surface streets would be reconfigured and improved in the north portal area. Aurora Avenue would be built to grade level between Denny Way and John Street. John, Thomas, and Harrison Streets would be connected across Aurora Avenue with signalized intersections at Denny Way and John, Thomas, and Harrison Streets. This rebuilt section of Aurora Avenue would connect to SR 99 via the ramps at Harrison Street. The roadway would have two general-purpose lanes in each direction, turn pockets, and right-side transit lanes. In the southbound direction, a

North Portal Options

Straight Sixth Avenue



Curved Sixth Avenue

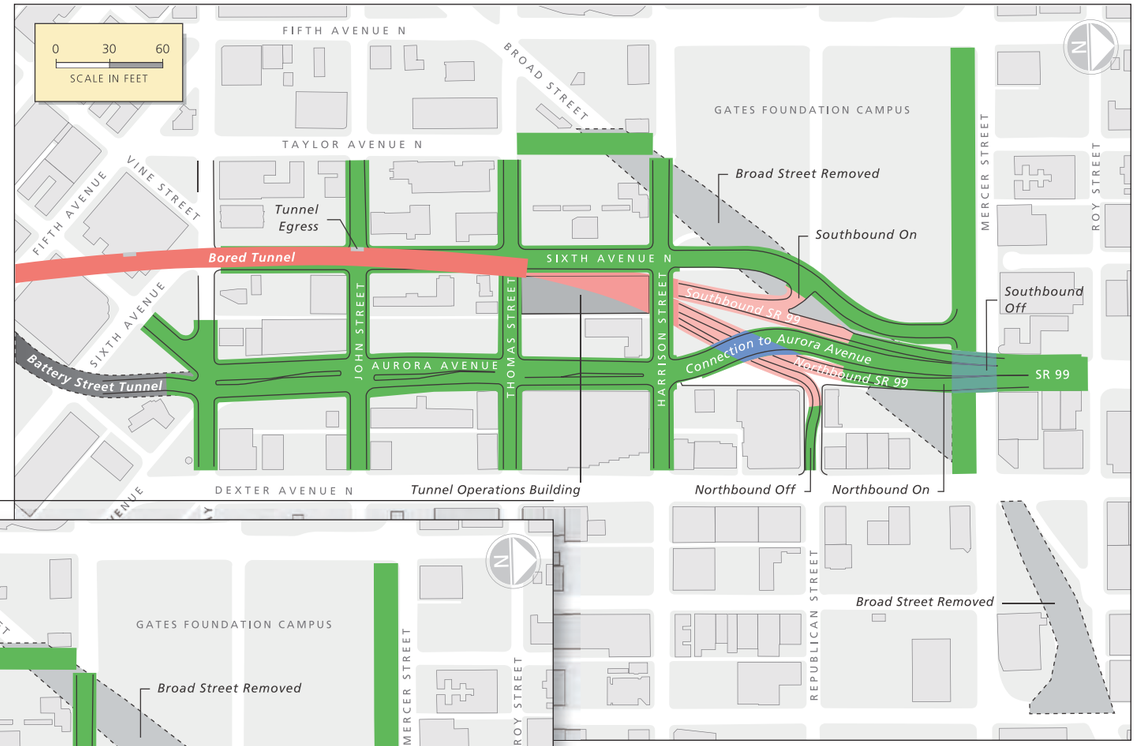


Exhibit 5-4

Which option is preferred in each portal area?

The New Dearborn Intersection is the preferred option in the south portal area.

Curved Sixth Avenue is the preferred option in the north portal area.

transit-only lane would be provided between Harrison Street and Denny Way that would continue to Wall Street and Third Avenue. In the northbound direction, a transit-only lane would be provided on Battery Street between Third Avenue and Denny Way. The northbound transit-only lane would continue north of Denny Way to John Street.

John Street would be built with one lane in each direction, a center turn lane, and bike lanes and sidewalks on each side of the roadway. Thomas Street would be built with one lane in each direction, a center turn lane, and sidewalks. Harrison Street would be built with two lanes in each direction and sidewalks.

Mercer Street would become a two-way street and would be widened from Dexter Avenue N. to Fifth Avenue N. The rebuilt Mercer Street would have three lanes in each direction with left-hand turn pockets. Broad Street would be closed and filled between Ninth Avenue N. and Taylor Avenue N. to allow the street grid to be connected.

Two options are being considered for Sixth Avenue N. and the southbound on-ramp, as shown in Exhibit 5-4:

- **The Curved Sixth Avenue** option proposes to build a new roadway that would extend Sixth Avenue N. in a curved formation between Harrison and Mercer Streets. The new roadway would have a signalized intersection at the southbound on-ramp.

- **The Straight Sixth Avenue** option proposes to build a new roadway that would extend Sixth Avenue N. from Harrison Street to Mercer Street in a typical grid formation. The new roadway would have signalized intersections at the southbound on-ramp and Mercer Street.

As part of the north portal, a tunnel operations building would be constructed between Thomas and Harrison Streets on the east side of Sixth Avenue N. Part of the building would be constructed underground. The remaining portion of the building is expected to be approximately 65 feet tall with vent stacks extending up to 30 feet above the roof. The building would be similar to the conceptual drawing shown in Exhibit 5-3.

2 How would the SR 99 lane configuration and access points change?

The Bored Tunnel Alternative would change the access points, lane configuration, and alignment of SR 99 between S. Royal Brougham Way and Mercer Street. Currently, this section of SR 99 provides two lanes in each direction for through traffic, as shown in Exhibit 5-5. Additional lanes in the south, central, and north sections collect and distribute traffic to destinations near the stadiums and Pioneer Square, the central downtown area, and the Seattle Center/South Lake Union area.

The Bored Tunnel Alternative would replace SR 99 between S. Royal Brougham Way and Roy Street with a new roadway that would have two lanes in each direction. As described in Exhibit 5-6, connections to and from downtown and other destinations would be provided access at the south and north portals of the proposed tunnel.

SR 99 Lane Configuration

Existing Viaduct | *Bored Tunnel*

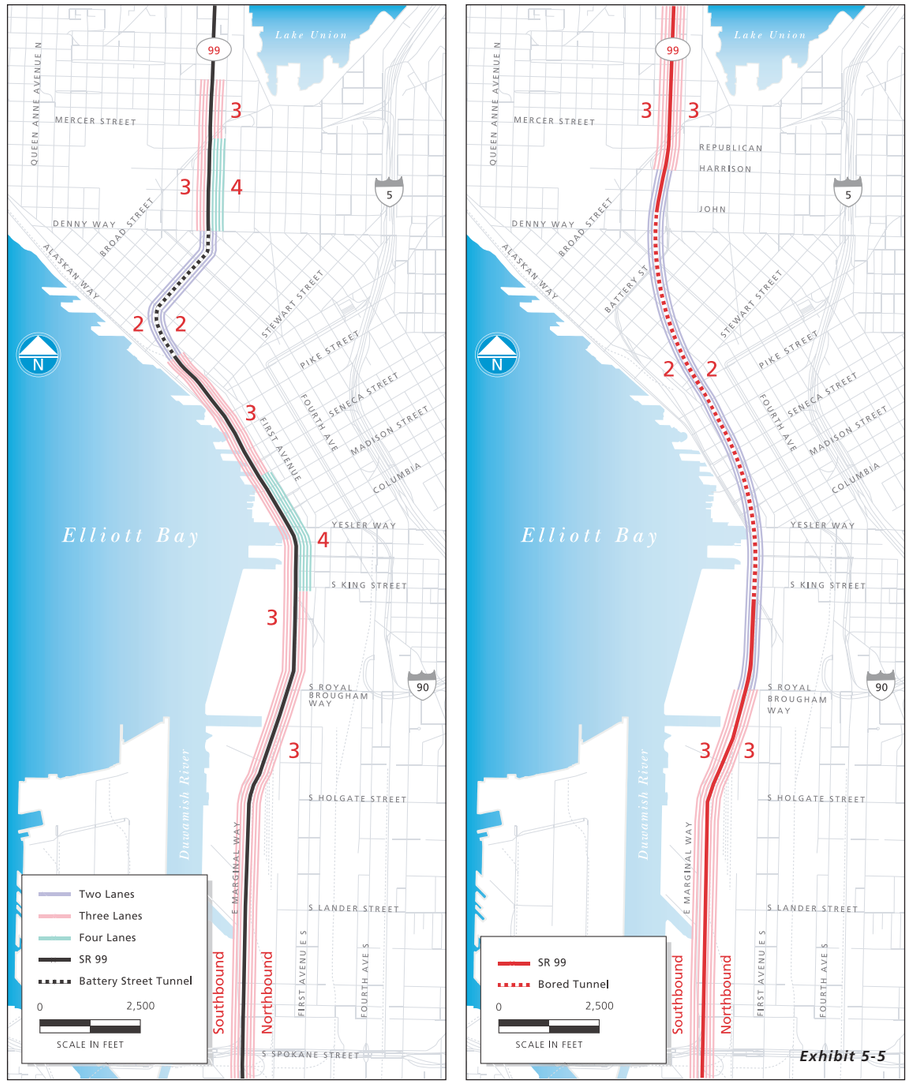


Exhibit 5-5

Exhibit 5-6
SR 99 Lane and Ramp Connections

CONNECTIONS	RAMP CONNECTIONS	
To/From	**Existing**	**Bored Tunnel Alternative**
Stadium Area	A northbound on-ramp and southbound off-ramp currently provide access to First Avenue S. near Railroad Way S. In addition, a northbound off-ramp & southbound on-ramp would be provided to Alaskan Way S. just south of S. King Street as part of the S. Holgate Street to S. King Street Viaduct Replacement Project.	The Bored Tunnel Alternative would replace the existing ramps to First Avenue S. with a northbound on-ramp and southbound off-ramp at Alaskan Way S. near S. Royal Brougham Way The ramps provided to Alaskan Way S. would be widened. The southbound on-ramp would be widened from one lane to two and the northbound off-ramp would be widened from one lane to include two general purpose lanes and a transit only lane.
Downtown Seattle	A northbound off-ramp is located at Seneca Street and a southbound on-ramp is located at Columbia Street.	The Columbia & Seneca Street ramps would be removed. Access to and from downtown from the south would be provided by the northbound off-ramp & southbound on-ramp to Alaskan Way S. just south of S. King Street.
Elliott & Western Corridor	SR 99 connections are provided by a northbound off-ramp at Western Avenue, a southbound on-ramp at Elliott Avenue, a northbound on-ramp near Battery Street, & a southbound off-ramp at Battery Street.	The existing ramps would not be replaced. Instead, drivers heading to or from SR 99 and northwest Seattle (including Ballard, Interbay, and Magnolia) could access SR 99 via Mercer Street and new ramps at Republican Street, or drivers could connect to SR 99 by traveling on Alaskan Way.
South Lake Union	Access is provided by a northbound on-ramp & southbound off-ramp at Denny Way, a northbound off-ramp at Mercer Street, a southbound off-ramp at Broad Street, and several side street connections.	Existing ramps to Denny Way and the southbound off-ramp to Broad Street would be replaced with ramps that provide access to Aurora Avenue near Harrison Street. A southbound on-ramp and northbound off-ramp at Republican Street would replace street connections between John and Mercer Streets and the northbound off-ramp to Mercer Street.

3 What conditions were modeled and what assumptions were made for the traffic analysis?

Several conditions were modeled to understand the effects of the Bored Tunnel Alternative. In this chapter, the following conditions are discussed to understand how the Bored Tunnel Alternative would operate and how it would compare to other scenarios, such as a No Build Alternative (Viaduct Closed). To understand and compare alternatives, the following conditions were modeled:

- **2015 Viaduct Closed –** This represents the No Build Alternative. For this project, the No Build Alternative assumes that the viaduct would be closed in 2015 between the First Avenue S. ramps and the Battery Street Tunnel ramps. However, it is unknown when the viaduct would close because it isn't deteriorating at a constant rate and earthquakes can't be predicted.

- **2015 Existing Viaduct –** This describes projected traffic conditions in 2015 if the existing viaduct were in place. The 2015 Existing Viaduct is the scenario used to assess changes associated with the Bored Tunnel Alternative, because it represents conditions that are similar to the existing facility.

- **2015 Bored Tunnel –** This shows forecasted traffic conditions in 2015 with the Bored Tunnel Alternative.

- **2030 Viaduct Closed –** This also represents the No Build Alternative, although as described for the 2015 Viaduct Closed, closure of the viaduct can't be accurately predicted. This scenario assesses 2030 traffic conditions if the viaduct were closed in 2030 between the First Avenue S. ramps and the Battery Street Tunnel ramps.

- **2030 Bored Tunnel –** This shows forecasted traffic conditions in 2030 with the Bored Tunnel Alternative.

For this environmental analysis, we provide data for the 2015 and 2030 Viaduct Closed; however, the analysis focuses on comparing the transportation network for the 2015 Bored Tunnel with the 2015 Existing Viaduct. The 2015 Existing Viaduct assumes that the existing viaduct (with the new S. Holgate Street to S. King Street Viaduct Replacement Project) would continue to be part of the transportation network between S. King Street and Denny Way in the year 2015. In this Supplemental Draft Environmental Impact Statement (EIS), traffic conditions with the 2015 Bored Tunnel are compared to the 2015 Existing Viaduct so we can understand how traffic operations are expected to change with the new tunnel and without most of the other elements of the Alaskan Way Viaduct and Seawall Replacement Program that would be completed later. This demonstrates that the Bored Tunnel Alternative has value as an independent project. We also compare the 2015 Bored Tunnel with conditions in 2030 (the design year) to understand how it would operate with future traffic demands.

The traffic analysis conducted for all alternatives assumes that improvements associated with the S. Holgate Street to S. King Street Replacement Project would be constructed by the time improvements associated with the Bored Tunnel Alternative would be completed. Specifically, the analysis for the Bored Tunnel Alternative assumes that a northbound off-ramp to SR 99 and a southbound on-ramp from SR 99 would be built connecting to Alaskan Way just south of S. King Street, and the aerial structure over the railroad tracks between Colorado Avenue S. and E. Marginal Way would be in place. These improvements are also assumed to be in place and operational for the 2015 Existing Viaduct.

In addition, the traffic analysis discussed in this chapter assumes that SR 99 would continue to operate without tolls as it does today. WSDOT has discussed publicly the possibility that the replacement SR 99 facility would be a tolled facility. Chapter 9 of this Supplemental Draft EIS presents a quantitative discussion of transportation and other permanent effects if the Bored Tunnel Alternative were tolled. It also qualitatively discusses the effects of tolling for the Cut-and-Cover Tunnel and Elevated Structure Alternatives.

4 Would regional travel patterns change?

Traffic Volumes throughout the Transportation Network

To evaluate the effects of changing the lane configuration, access points, and alignment of SR 99, traffic volumes were analyzed throughout the transportation system located in the study area. The analysis captured combined traffic volumes on Interstate 5 (I-5), SR 99, and local streets at

Appendix C, Transportation Discipline Report

Assumptions made for the traffic analysis provided in this Supplemental Draft EIS are provided in *Appendix C*, Section 2.3.

What is the traffic study area for this project?

The traffic study area for this project is roughly bordered by I-5 to the east, Elliott Bay to the west, S. Spokane Street to the south, and Valley Street to the north. This area includes I-5, SR 99, the Spokane Street Viaduct, SR 519, and many city streets.

Does the information presented in this chapter assume a toll would be charged to use the Bored Tunnel?

The analysis presented in this chapter does not assume a toll for the Bored Tunnel Alternative. Chapter 9 discusses effects if the build alternatives were tolled.

specific locations called screenlines. The results of the screenline analysis at three locations in the study area are shown in Exhibit 5-7.

Exhibit 5-7
Vehicle Volumes at Screenlines

	2015 Viaduct Closed	2015 Existing Viaduct	2015 Bored Tunnel	2030 Viaduct Closed	2030 Bored Tunnel
South Screenline – South of S. King Street					
AM	32,440	36,670	36,150	34,090	37,540
PM	37,640	42,730	42,110	39,430	43,640
Daily	**490,200**	**543,300**	**536,500**	**515,900**	**561,400**
Central Screenline – North of Seneca Street					
AM	28,420	33,250	32,790	29,720	33,970
PM	31,790	37,270	36,710	33,060	37,810
Daily	**428,000**	**483,100**	**477,700**	**447,500**	**496,600**
North Screenline – North of Thomas Street					
AM	35,910	39,500	39,050	37,370	40,440
PM	39,920	43,130	43,460	42,290	46,070
Daily	**505,600**	**544,700**	**550,200**	**535,500**	**582,300**

Findings of the Screenline Analysis

- For all screenlines assessed, the 2015 Existing Viaduct and the 2015 Bored Tunnel carry about the same amount of traffic, which demonstrates that the Bored Tunnel Alternative would accommodate a similar number of vehicles compared to the viaduct even though the lane configuration and access points would change. As shown in Exhibit 5-7, daily vehicle volumes for the 2015 Bored Tunnel are expected to be within about 1 percent of vehicle volumes for the 2015 Existing Viaduct.

- In most cases, traffic volumes are expected to increase between 2015 and 2030. These traffic volume increases are related to expected population growth in the study area and region.

- With the Viaduct Closed (No Build Alternative), daily traffic volumes are projected to decrease substantially across the all three screenlines as compared to the Bored Tunnel in 2015 and 2030. This is likely because trips are expected to redistribute, and traffic volumes would be lower because of reduced roadway capacity through the central waterfront.

Person Throughput at Screenlines

In addition to vehicle throughput, total person throughput was evaluated to determine the number of people traveling through the study area, as shown in Exhibit 5-8.

Exhibit 5-8
Person Throughput at Screenlines

	2015 Viaduct Closed	2015 Existing Viaduct	2015 Bored Tunnel	2030 Viaduct Closed	2030 Bored Tunnel
South Screenline – South of S. King Street					
AM	49,950	55,120	54,250	61,370	65,420
PM	61,110	67,860	66,800	73,480	79,080
Daily	**718,300**	**788,800**	**777,400**	**821,900**	**883,500**
Central Screenline – North of Seneca Street					
AM	46,970	53,080	52,350	53,670	60,560
PM	54,900	62,430	61,550	61,920	70,070
Daily	**658,600**	**734,400**	**725,300**	**727,800**	**805,300**
North Screenline – North of Thomas Street					
AM	55,440	59,330	58,790	63,020	67,550
PM	65,200	69,140	69,760	74,890	80,400
Daily	**747,200**	**794,600**	**803,700**	**840,100**	**902,800**

Exhibit 5-8 shows that overall person throughput for the 2015 Existing Viaduct and 2015 Bored Tunnel is comparable. The 2015 Bored Tunnel is expected to have a daily total person throughput that is about 1 to 2 percent less than the 2015 Existing Viaduct across the south and central screenlines and about 1 percent more than the 2015 Existing Viaduct across the north screenline. With the Viaduct Closed, daily person throughput is expected to decline across all three screenlines as compared to the Existing Viaduct or Bored Tunnel due to reduced roadway capacity through the central waterfront.

Vehicle Miles Traveled

Vehicle miles traveled (VMT) measures how many miles vehicles travel on a roadway network. Exhibit 5-9 shows VMT for the downtown Seattle Center City area as well as the broader four-county region.

Exhibit 5-9
Vehicle Miles Traveled

	2015 Viaduct Closed	2015 Existing Viaduct	2015 Bored Tunnel	2030 Viaduct Closed	2030 Bored Tunnel
Seattle Center City					
AM	392,500	433,100	427,000	413,000	443,800
PM	490,700	537,500	530,600	521,400	557,400
Daily	**2,239,500**	**2,432,700**	**2,406,700**	**2,371,400**	**2,533,900**
Four-County Region					
AM	17,963,800	18,028,300	18,020,100	20,452,500	20,292,700
PM	21,183,700	21,233,700	21,227,300	24,263,200	24,008,900
Daily	**96,982,500**	**97,233,000**	**97,213,100**	**110,820,300**	**109,718,600**

The data in Exhibit 5-9 show that VMT within the four-county Puget Sound region are about equal for the 2015 Existing Viaduct, 2015 Viaduct Closed, and 2015 Bored Tunnel. These results suggest that various SR 99 scenarios have little effect on trips across the broad four-county region. However, changes are more noticeable at the local level, as evidenced by the Seattle Center City results. The Seattle Center City results indicate that daily VMT for the 2015 Bored Tunnel is slightly less (just over 1 percent) than the 2015 Existing Viaduct. For the 2015 Viaduct Closed, daily VMT is expected to be reduced by about 9 percent. This reduction is likely due to a disincentive of trip making caused by increased traffic and congestion on city streets since roughly 100,000 daily trips on SR 99 would need to be accommodated by local street capacity, I-5, transit, or biking and walking.

Vehicle Hours Traveled

Vehicle hours traveled (VHT) indicates the total number of hours traveled on the roadway network. Exhibit 5-10 shows VHT for the downtown Seattle Center City area as well as the broader four-county region.

Exhibit 5-10
Vehicle Hours Traveled

	2015 Viaduct Closed	2015 Existing Viaduct	2015 Bored Tunnel	2030 Viaduct Closed	2030 Bored Tunnel
Seattle Center City					
AM	18,200	16,800	17,200	20,300	18,700
PM	26,500	23,800	24,500	33,600	30,700
Daily	**91,800**	**87,200**	**88,500**	**107,400**	**101,400**
Four-County Region					
AM	745,400	747,200	747,600	1,107,200	1,104,500
PM	860,700	858,100	858,900	1,236,400	1,232,700
Daily	**3,312,500**	**3,311,300**	**3,312,900**	**4,436,100**	**4,428,000**

Appendix C, Transportation Discipline Report

Screenline volumes and analysis is discussed in *Appendix C*, Sections 5.1.5 and 5.1.6.

VMT, VHT, and VHD are discussed in *Appendix C*, Sections 5.1.1, 5.1.2, and 5.1.3.

What is the 2015 Existing Viaduct?

The 2015 Existing Viaduct is used to show what conditions would be like in 2015 just before the existing viaduct is closed and traffic moves to the new tunnel. The 2015 Existing Viaduct assumes that the S. Holgate to S. King Street Viaduct Replacement Project is completed and the new southbound on-ramp and northbound off-ramp at Alaskan Way S. near S. King Street are open.

What area does Seattle Center City refer to?

The area defined as Seattle Center City is roughly bounded by S. Royal Brougham Way in the south, just north of Mercer Street to the north, Broadway to the east, and Elliott Bay to the west.

What are VMT, VHT, and VHD?

- Vehicle miles traveled (VMT) measures how many miles vehicles travel on the roadway network.
- Vehicle hours traveled (VHT) indicates the total number of hours travelers spend on the roadway network.
- Vehicle hours delay (VHD) measures the number of hours that travelers spend traveling on roadways at less than optimum speeds. VHD is often used as an indicator of congestion.

What is the AM peak hour and the PM peak hour?

The AM and PM peak hours occur when traffic is heaviest during the morning and evening commutes. For SR 99, the AM peak hour is from 8:00 a.m. to 9:00 a.m. The PM peak hour is from 5:00 p.m. to 6:00 p.m. Traffic conditions during these peak travel times were modeled to understand traffic conditions and effects when traffic is heaviest on a typical day.

VHT in the four-county region are about the same for the 2015 Existing Viaduct, 2015 Viaduct Closed, and 2015 Bored Tunnel. However, for the Seattle Center City area, daily VHT for the 2015 Bored Tunnel is slightly higher than the 2015 Existing Viaduct (about 1.5 percent higher) and about 5 percent higher for the 2015 Viaduct Closed. For the 2015 Viaduct Closed scenario, the measurable increases in daily VHT over the 2015 Existing Viaduct and Bored Tunnel in 2015 and 2030 are likely due to increased congestion levels brought about by closing the viaduct.

Vehicle Hours of Delay

Vehicle hours delay (VHD) measures the number of hours that travelers spend traveling on roadways at less than optimum speeds. VHD is often used as an indicator of congestion. Exhibit 5-11 shows VHD for the Seattle Center City area as well as the broader four-county region.

Exhibit 5-11
Vehicle Hours of Delay

	2015 Viaduct Closed	2015 Existing Viaduct	2015 Bored Tunnel	2030 Viaduct Closed	2030 Bored Tunnel
Seattle Center City					
AM	7,100	5,300	5,700	8,600	6,700
PM	12,400	9,100	9,900	18,500	15,200
Daily	**30,000**	**22,700**	**24,300**	**41,300**	**33,300**
Four-County Region					
AM	252,700	253,500	254,000	537,900	533,100
PM	274,800	271,700	272,600	553,800	549,900
Daily	**682,600**	**678,200**	**679,700**	**1,385,800**	**1,374,900**

As shown in Exhibit 5-11, vehicle delay in the four-county region is expected to grow at a faster rate than in the Seattle Center City area. This reflects that a higher number of new trips destined to and from downtown are expected to be accommodated by transit in the future as compared to new trips within the four-county region. Daily vehicle delay for the Seattle Center City area is expected to increase by about 7 percent for the 2015 Bored Tunnel compared to the 2015 Existing Viaduct. This expected change in VHD within the transportation system is likely due to changes in access proposed with the Bored Tunnel Alternative. As a result of these access changes, specifically the removal of the Elliott and Western and Columbia and Seneca ramps, more vehicles are expected to use city streets for a longer portion of their trip than they would using the existing viaduct. This increase is likely because the Elliott and Western and Columbia and Seneca ramps would not be provided, resulting in increased vehicle volumes on city streets. Daily vehicle delay for the 2015 Viaduct Closed would increase substantially, by about 32 percent in the Seattle Center City area as compared to the 2015 Existing Viaduct, due to increased congestion levels brought about by closing the viaduct.

5 How would traffic conditions on SR 99 change?

Travel Patterns

Currently, during the AM peak period, SR 99 experiences higher traffic volumes heading toward downtown. During the PM peak period, this pattern changes as a higher volume of traffic leaves the downtown area. This overall traffic pattern is expected to continue with the Bored Tunnel Alternative.

The Bored Tunnel Alternative would change the access points, lane configuration, and alignment of SR 99 between S. Atlantic Street and Roy Street. The following changes are expected to alter travel patterns:

- The midtown ramps at Columbia and Seneca Streets would be removed. Drivers would be able to enter and exit downtown by using the Alaskan Way S. ramps located just south of S. King Street.

- The Elliott and Western Avenue ramps would be removed. Since about one-third of viaduct traffic currently uses the Elliott Avenue off-ramp or the Western Avenue on-ramp, removing these ramps would change traffic patterns for these drivers. The Elliott and Western Avenue ramps mostly serve northwest Seattle neighborhoods, including Interbay, Ballard, and Magnolia. Drivers traveling from these areas could make their trip by
(1) traveling on Mercer Street to the SR 99 ramp at Sixth Avenue N. and Republican Street, or
(2) traveling on Elliott Avenue and Alaskan Way to SR 99 ramps at Alaskan Way S. and S. Royal Brougham Way. These routes are shown in Exhibit 5-12.

SR 99 Access to Northwest Seattle
Northbound and Southbound

Exhibit 5-12

- Connections to and from SR 99 north of Denny Way would change. The Denny Way ramps would be replaced with access to Aurora Avenue N. via ramps at Harrison Street. The multiple access points provided to and from SR 99 via side street connections between John and Mercer Streets

would be replaced with a single access point at Republican Street.

Average SR 99 Speeds

As shown in Exhibits 5-13 and 5-14, traffic operations during peak hours on the SR 99 mainline are expected to be similar or slightly improved for the 2015 Bored Tunnel in comparison to the 2015 Existing Viaduct. Traffic operations on SR 99 are expected to improve with the Bored Tunnel Alternative because of changes made to SR 99 access points and roadway design improvements. Increased levels of congestion expected for the 2015 Existing Viaduct are primarily due to merging and weaving friction associated with existing access points and geometric constraints such as narrow lanes, limited sight distance, and limited distances for ramp acceleration and deceleration.

Ramp connections for the Bored Tunnel Alternative would result in fewer weaving motions, particularly in the midtown area, and where feasible, ramps would be built to meet current design standards, which would improve safety and overall traffic flow and operations. By 2030, traffic speeds and operations during peak hours with the Bored Tunnel Alternative are expected to degrade slightly compared to 2015 conditions due to increased traffic volumes from population and employment growth.

Travel Times

Travel times for key routes during the AM and PM peak hours are shown in Exhibit 5-15 and key findings are discussed below.

General Travel Time Findings

- Projected travel times for the routes investigated generally would not vary noticeably between the 2015 Existing Viaduct and the 2015 Bored Tunnel, with the majority of the times expected to be within 1 to 2 minutes of each other. Some larger travel changes may occur for specific routes, as shown in Exhibit 5-15 and described below, but such increases or decreases would likely remain within 3 to 4 minutes.

Travel Speeds AM Peak

2015 Existing Viaduct | *2015 Bored Tunnel* | *2030 Bored Tunnel*

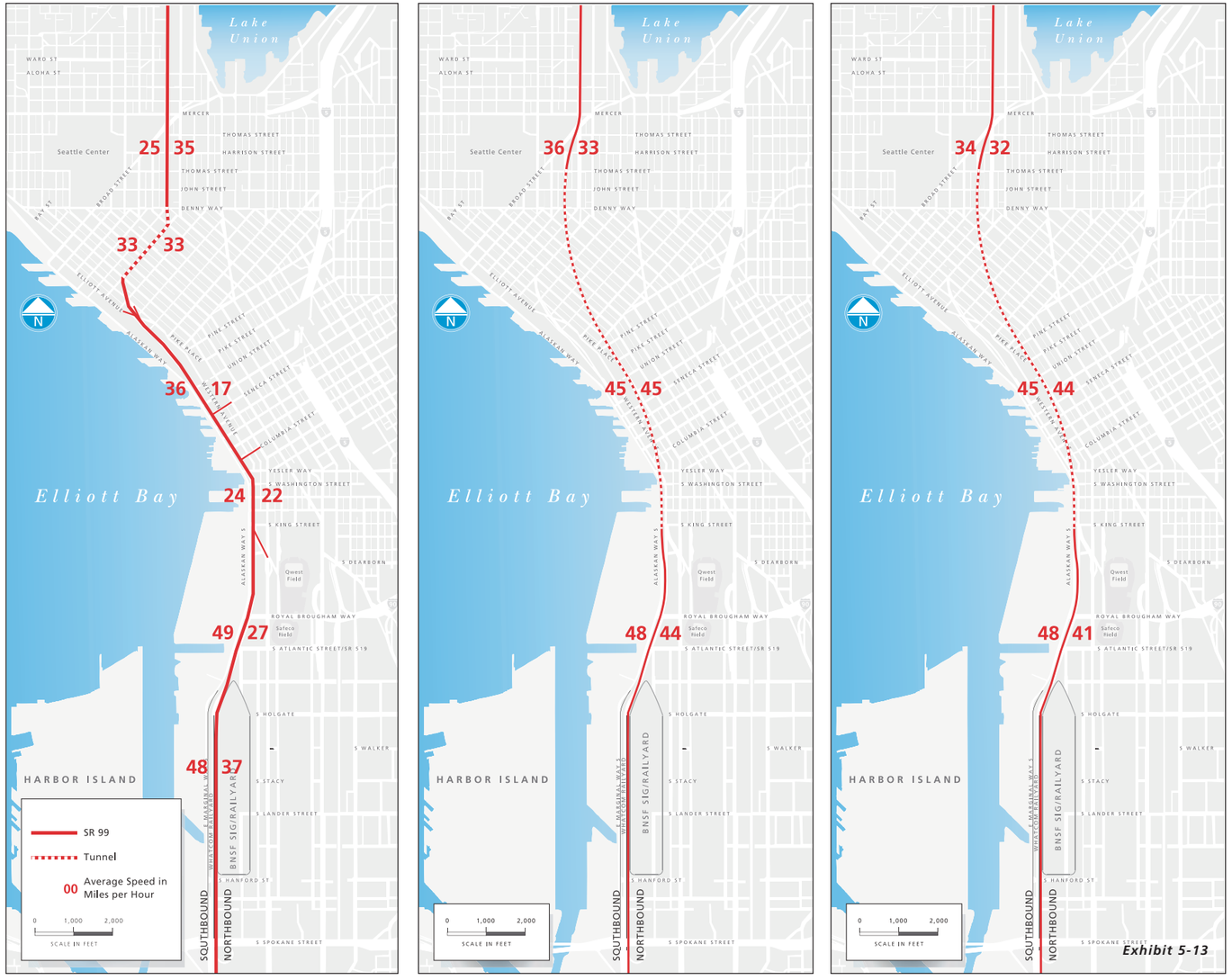


Exhibit 5-13

- As expected, for most trips, travel times would increase between 2015 and 2030 for the Bored Tunnel Alternative due to growth in traffic demand resulting from population and employment increases.

- The 2015 Viaduct Closed scenario is expected to result in substantially slower speeds and higher travel times as compared to the other alternatives. As an example, the Woodland Park to S. Spokane Street route is projected to experience a substantial increase in travel times compared to the 2015 Existing Viaduct. In the PM peak hour, northbound trips are projected to increase by approximately 29 minutes and southbound trips are projected to increase by approximately 28 minutes.

Travel Time Findings for Specific Trips

West Seattle Trips – In the AM peak hour, travel times for people heading from West Seattle to downtown are expected to increase by about 3 minutes with the 2015 Bored Tunnel as compared to the 2015 Existing Viaduct. If the New Dearborn and Charles Intersection option were selected, this travel time would increase by about 4 minutes. This increased travel time is due to the fact that people coming from West Seattle during the morning commute would enter downtown farther south than they would with Seneca off-ramp included in the 2015 Existing Viaduct. During the PM peak hour, travel times for southbound trips leaving downtown heading to West Seattle are expected to decrease by about 4 minutes with the 2015 Bored Tunnel as compared to the 2015 Existing Viaduct. Travel times are expected to improve with the 2015 Bored Tunnel because merging and weaving conflicts on the SR 99 mainline would be reduced, improving mainline operations. Also, with the Bored Tunnel Alternative, these trips would not need to pass through the highly congested First Avenue/Columbia Street intersection to enter SR 99 as they would with the 2015 Existing Viaduct.

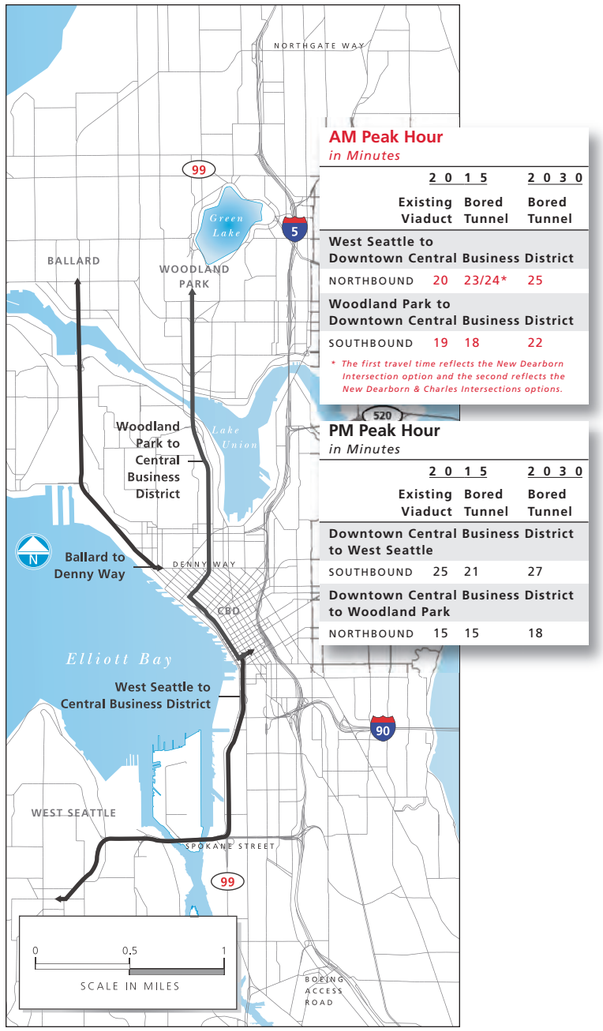
North Seattle Trips To and From Downtown – Trips heading to downtown from north Seattle during the

Travel Speeds PM Peak

2015 Existing Viaduct | *2015 Bored Tunnel* | *2030 Bored Tunnel*

Exhibit 5-14

Bored Tunnel Alternative Travel Time Comparison



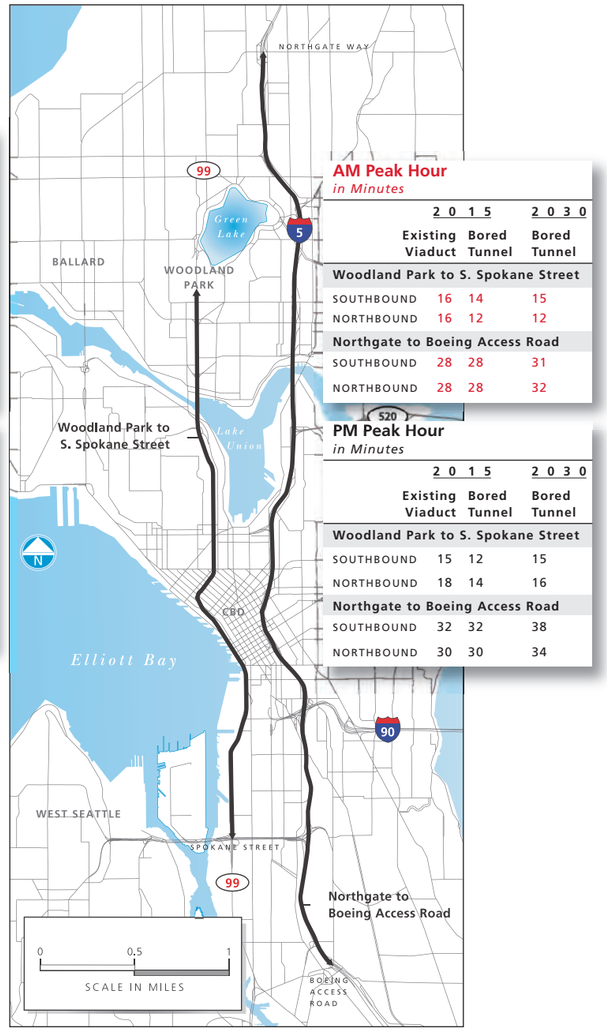
AM Peak Hour
in Minutes

	2015 Existing Viaduct	2015 Bored Tunnel	2030 Bored Tunnel
West Seattle to Downtown Central Business District			
NORTHBOUND	20	23/24*	25
Woodland Park to Downtown Central Business District			
SOUTHBOUND	19	18	22

* The first travel time reflects the New Dearborn Intersection option and the second reflects the New Dearborn & Charles Intersections options.

PM Peak Hour
in Minutes

	2015 Existing Viaduct	2015 Bored Tunnel	2030 Bored Tunnel
Downtown Central Business District to West Seattle			
SOUTHBOUND	25	21	27
Downtown Central Business District to Woodland Park			
NORTHBOUND	15	15	18

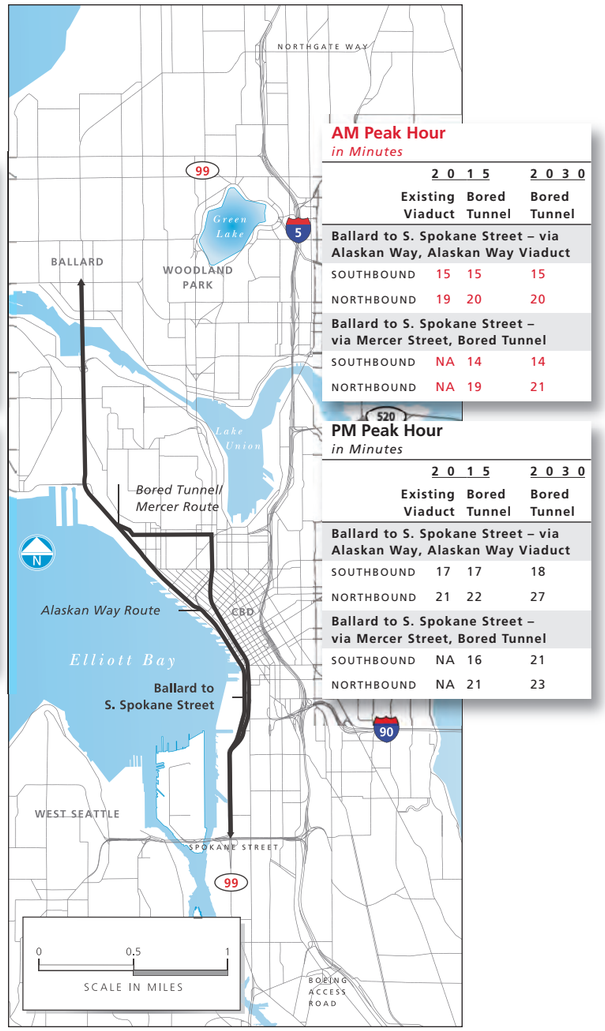


AM Peak Hour
in Minutes

	2015 Existing Viaduct	2015 Bored Tunnel	2030 Bored Tunnel
Woodland Park to S. Spokane Street			
SOUTHBOUND	16	14	15
NORTHBOUND	16	12	12
Northgate to Boeing Access Road			
SOUTHBOUND	28	28	31
NORTHBOUND	28	28	32

PM Peak Hour
in Minutes

	2015 Existing Viaduct	2015 Bored Tunnel	2030 Bored Tunnel
Woodland Park to S. Spokane Street			
SOUTHBOUND	15	12	15
NORTHBOUND	18	14	16
Northgate to Boeing Access Road			
SOUTHBOUND	32	32	38
NORTHBOUND	30	30	34

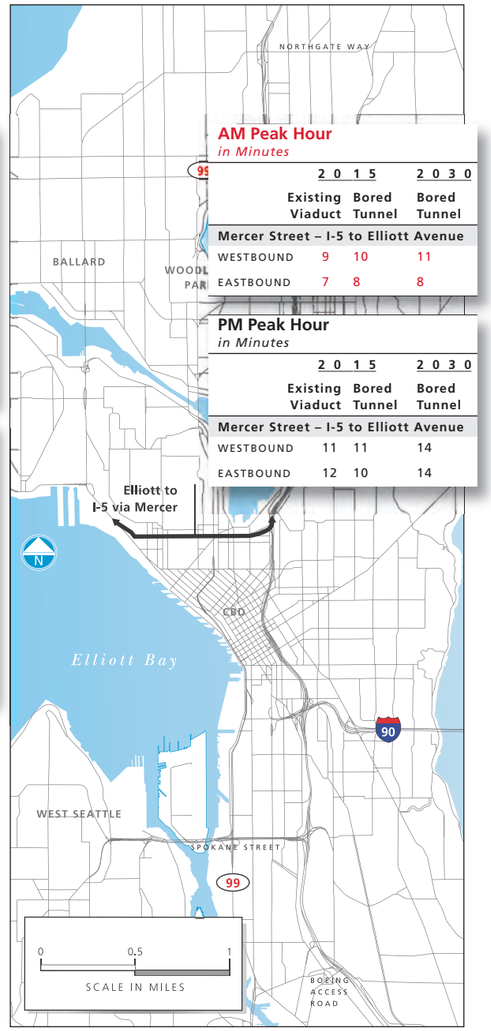


AM Peak Hour
in Minutes

	2015 Existing Viaduct	2015 Bored Tunnel	2030 Bored Tunnel
Ballard to S. Spokane Street – via Alaskan Way, Alaskan Way Viaduct			
SOUTHBOUND	15	15	15
NORTHBOUND	19	20	20
Ballard to S. Spokane Street – via Mercer Street, Bored Tunnel			
SOUTHBOUND	NA	14	14
NORTHBOUND	NA	19	21

PM Peak Hour
in Minutes

	2015 Existing Viaduct	2015 Bored Tunnel	2030 Bored Tunnel
Ballard to S. Spokane Street – via Alaskan Way, Alaskan Way Viaduct			
SOUTHBOUND	17	17	18
NORTHBOUND	21	22	27
Ballard to S. Spokane Street – via Mercer Street, Bored Tunnel			
SOUTHBOUND	NA	16	21
NORTHBOUND	NA	21	23



AM Peak Hour
in Minutes

	2015 Existing Viaduct	2015 Bored Tunnel	2030 Bored Tunnel
Mercer Street – I-5 to Elliott Avenue			
WESTBOUND	9	10	11
EASTBOUND	7	8	8

PM Peak Hour
in Minutes

	2015 Existing Viaduct	2015 Bored Tunnel	2030 Bored Tunnel
Mercer Street – I-5 to Elliott Avenue			
WESTBOUND	11	11	14
EASTBOUND	12	10	14

Exhibit 5-15

Appendix C, Transportation Discipline Report

Travel times are discussed in *Appendix C*, Section 5.4.

morning commute and trips leaving downtown during the afternoon commute are expected to be comparable between the 2015 Bored Tunnel and 2015 Existing Viaduct, as shown in Exhibit 5-15.

Through Trips on SR 99 – Travel times for trips traveling on SR 99 through downtown from S. Spokane Street to Woodland Park are expected to decrease by 2 to 4 minutes with the 2015 Bored Tunnel as compared to the 2015 Existing Viaduct. Travel times for through trips on SR 99 are expected to improve because ramps would be consolidated and relocated, which would reduce weaving and merging conflicts. In addition, SR 99 roadway conditions for drivers would improve due to increased lane and shoulder widths.

Trips to and from Northwest Seattle – Travel times for trips heading to or from northwest Seattle are expected to be about the same with the 2015 Bored Tunnel as compared to the 2015 Existing Viaduct in both the AM and PM peak hours, despite proposed access changes that remove the Elliott and Western ramps. As shown in Exhibit 5-15, travel times for people traveling to and from northwest Seattle with either of the Bored Tunnel Alternative routes (the Alaskan Way route or the bored tunnel/Mercer route) would be similar during both the AM and PM peak hours.

I-5 Travel Times – As shown in Exhibit 5-15, I-5 travel times during the AM and PM peak hours are expected to be the same for the 2015 Bored Tunnel and the 2015 Existing Viaduct. For a discussion on how vehicle volumes are expected to increase on I-5, see Question 7.

Traffic Volumes on SR 99

Exhibits 5-16 and 5-17 show estimated daily traffic volumes on the SR 99 mainline and ramps for the 2015 Existing Viaduct, 2015 Bored Tunnel, and 2030 Bored Tunnel. Daily traffic volumes on SR 99 in the south and north sections are expected to be comparable in most areas between the 2015 Existing Viaduct and 2015 Bored Tunnel. The exceptions are discussed below:

SR 99 Daily Vehicle Volumes

2015 Existing Viaduct

2015 Bored Tunnel

2030 Bored Tunnel

Exhibit 5-16

- Daily traffic volumes on SR 99 near the Battery Street Tunnel are expected to increase by about 17,000 vehicles per day with the Bored Tunnel, as compared to the Existing Viaduct in 2015. Vehicle volumes are expected to increase in this area because the new bored tunnel would provide wider lanes and shoulders than the existing Battery Street Tunnel, which would improve traffic flow.

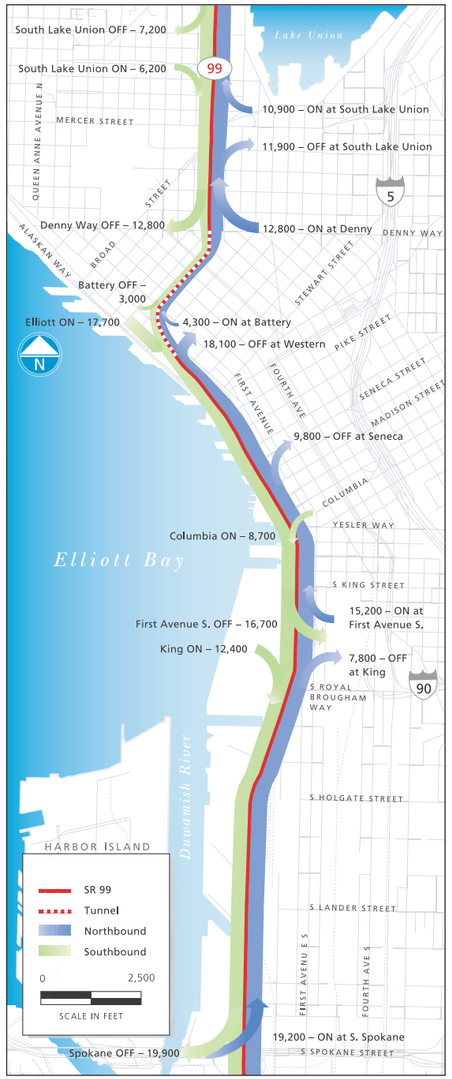
- From S. King Street to just north of Seneca Street, vehicle volumes on SR 99 are projected to decrease by about 30,000 vehicles per day for the 2015 Bored Tunnel as compared to the 2015 Existing Viaduct.

Despite these differences in estimated vehicle volumes on SR 99 in 2015, screenline analysis of the transportation network in the downtown Seattle area shows that most of the 30,000 daily trips on SR 99 from S. King Street to just north of Seneca Street would be accommodated elsewhere in the transportation system. Most of these trips (about 28,000 vehicles per day) would shift to downtown city streets, and a small volume (about 1,000 vehicles per day) would shift to I-5 through downtown. Potential effects of these traffic shifts are discussed in greater detail in Questions 6, 7, and 8 of this chapter.

SR 99 volumes between S. King Street and just north of Seneca Street are expected to be lower with the Bored Tunnel Alternative because Elliott and Western Avenue ramps and Columbia and Seneca Street ramps would be removed. Removing the Elliott and Western ramps would change traffic patterns and volumes on SR 99, such that this traffic volume (representing about one-third of SR 99 traffic) would likely travel one of two ways—either these drivers would use the bored tunnel and ramps at Republican Street to access Mercer Street or they would travel on Alaskan Way. In addition, access to downtown currently provided by the Columbia and Seneca ramps would be provided via ramps near S. King Street, which would eliminate these trips through the midtown section of SR 99.

SR 99 Daily Ramp Volumes

2015 Existing Viaduct



2015 Bored Tunnel

2030 Bored Tunnel

Exhibit 5-17

The 2030 volume estimates for the Bored Tunnel Alternative are generally similar to the 2015 Bored Tunnel results, with modest volume increases expected due to expected population and employment growth.

6 Where would SR 99 traffic go?

If traffic volumes on SR 99 between S. King Street and just north of Seneca Street are expected to decrease by about 30,000 vehicles per day in 2015, but the overall traffic accommodated in the transportation system remains similar to the existing facility, it raises the question, "where would traffic go?"

Questions 7 and 8 explain where SR 99 traffic between S. King Street and just north of Seneca Street is expected to shift to with the Bored Tunnel Alternative in 2015. About 1,000 trips are expected to shift to I-5 near Seneca Street and about 28,000 trips are expected to shift to city streets. Questions 7 and 8 describe how these roadways would be affected by increased vehicle volumes.

7 Would traffic conditions on I-5 change?

As shown in Exhibit 5-18, a small number of vehicles are expected to shift to I-5 with the Bored Tunnel Alternative in 2015. Exhibit 5-19, below indicates the number of vehicles that are expected to shift to I-5 in the project area in 2015.

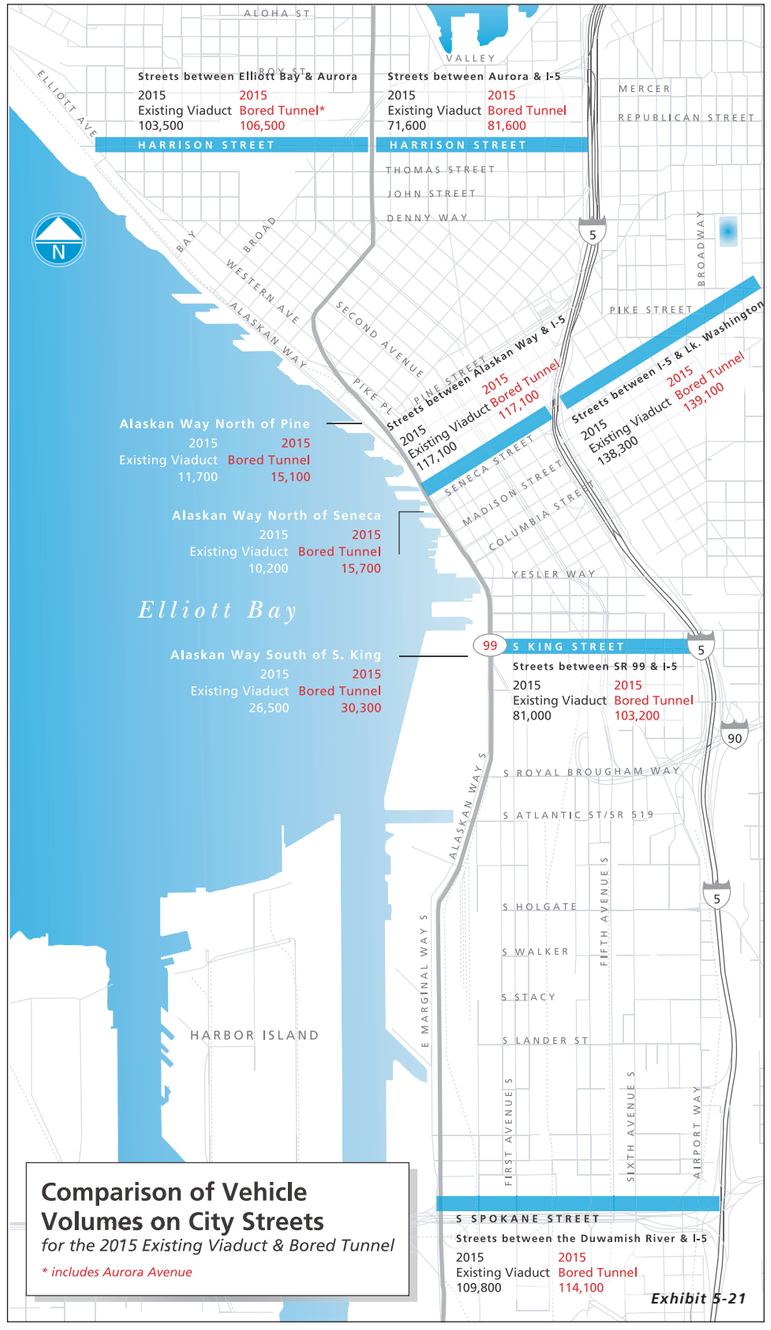
Exhibit 5-19
Increase in Daily Vehicle Volumes on I-5 in 2015

Location	Increase in Vehicles	Percent Change
I-5 South of I-90	+2,400	> 1% increase
I-5 North of Seneca	+1,000	> 1% increase
I-5 South of SR 520	+300	> 1% increase

As indicated in Exhibits 5-18 and 5-19, the number of vehicles using I-5 each day is expected to increase by a range of 300 vehicles per day in the north to 2,400 vehicles per day in the south for the 2015 Bored Tunnel as compared to the 2015 Existing Viaduct. These increases are negligible and are not expected to negatively affect traffic flow or operations on I-5 for two reasons:

Comparison of I-5 Vehicle Volumes
for the 2015 Existing Viaduct & Bored Tunnel

Exhibit 5-18



Comparison of Vehicle Volumes on City Streets
for the 2015 Existing Viaduct & Bored Tunnel

** includes Aurora Avenue*

Exhibit 5-21

1 In 2015, this stretch of I-5 is expected to carry between 262,000 and 318,000 vehicles per day. An increase of 300 to 2,400 vehicles per day along this stretch represents a negligible or less than 1 percent change in daily vehicle volume on I-5.

2 Vehicle volumes on I-5 are not expected to change much during the AM and PM peak hour when I-5 is most congested. Vehicle volumes on I-5 during the AM and PM peak hours are expected to increase by less than 1 percent with the 2015 Bored Tunnel Alternative as compared to the 2015 Existing Viaduct. As a result, during the AM and PM peak hours, travel times on I-5 are expected to be the same for the 2015 Existing Facility and 2015 Bored Tunnel Alternative as shown in Exhibit 5-15 and discussed in Question 5 of this chapter. Similarly, the expected changes in vehicle volumes on I-5 during off-peak hours are expected to less than 0.5 percent. This expected increase in vehicle volumes during off-peak hours is not expected to have a measurable effect on I-5 operations because I-5 is less congested during these times and has more capacity to accommodate these trips.

Exhibit 5-20 below compares vehicle volumes on I-5 for the Viaduct Closed, Existing Viaduct, and the Bored Tunnel.

Exhibit 5-20
Comparison of Vehicle Volumes on I-5

	2015 Viaduct Closed	2015 Existing Viaduct	2015 Bored Tunnel	2030 Viaduct Closed	2030 Bored Tunnel
I-5 South of I-90	279,900	270,400	272,800	286,600	274,300
I-5 North of Seneca	274,000	262,600	263,600	283,200	269,900
I-5 South of SR 520	318,000	317,800	318,100	324,900	324,500

8 How would traffic volumes on area streets change?

Exhibit 5-21 (on previous page) compares daily vehicle volumes on Alaskan Way and other city streets for the 2015 Existing Viaduct and the 2015 Bored Tunnel. Exhibit 5-21 shows that some trips are expected to shift from SR 99 to city streets (particularly Alaskan Way) as a result of access changes proposed with the Bored Tunnel Alternative. Exhibit 5-22 compares vehicle volumes on Alaskan Way for 2015 and 2030. Exhibit 5-23 compares vehicle volumes on city streets at specific screenline locations for 2015 and 2030.

Congested Intersections AM Peak

2015 Existing Viaduct | *2015 Bored Tunnel* | *2030 Bored Tunnel*

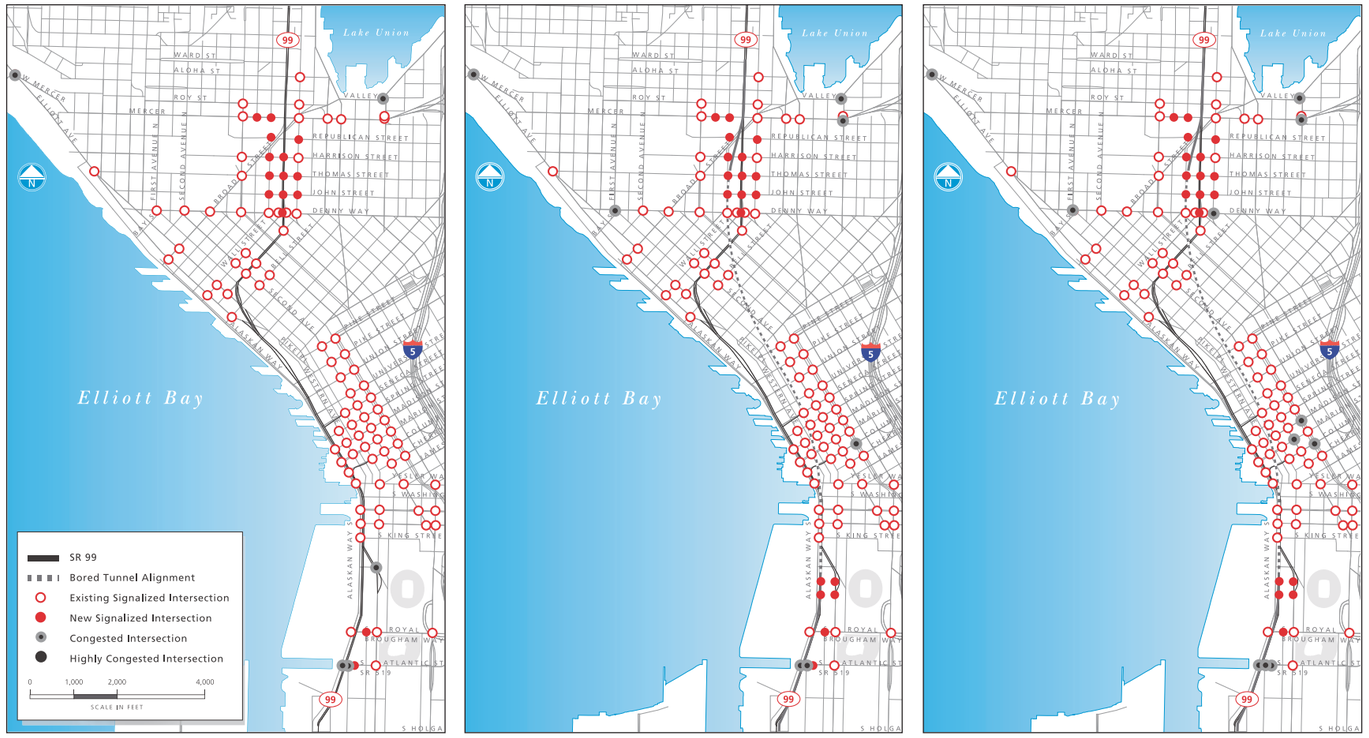


Exhibit 5-24

Exhibit 5-22
Comparison of Vehicle Volumes on Alaskan Way

	2015 Viaduct Closed	2015 Existing Viaduct	2015 Bored Tunnel	2030 Viaduct Closed	2030 Bored Tunnel
South of S. King Street	44,100	26,500	30,300	47,300	32,600
North of Seneca Street	21,300	10,200	15,700	23,300	18,600
North of Pine Street	22,800	11,700	15,100	23,000	17,800

Exhibit 5-23
Comparison of Vehicle Volumes at Screenlines

	2015 Viaduct Closed	2015 Existing Viaduct	2015 Bored Tunnel	2030 Viaduct Closed	2030 Bored Tunnel
S. Spokane Street *Streets between the Duwamish River & I-5*	139,400	109,800	114,100	162,600	136,400
S. King Street *Streets between SR 99 & I-5*	111,900	81,000	103,200	124,100	110,700
Seneca Street West *Streets between Alaskan Way & I-5*	134,700	117,100	117,100	143,000	120,400
Seneca Street East *Streets between I-5 & Lake Washington*	151,700	138,300	139,100	167,400	152,800
Harrison Street West *Streets between Elliott Bay & Aurora Avenue*	104,600	103,500	106,500*	113,700	117,800*
Harrison Street East *Streets between Aurora Avenue & I-5*	69,400	71,600	81,600	79,500	92,000

* *Includes vehicle volumes on Aurora Avenue*

Exhibits 5-24 and 5-25 show congested intersections for the 2015 Existing Viaduct, 2015 Bored Tunnel, and 2030 Bored Tunnel to provide information to understand how these shifts might affect delay at key intersections. As shown in Exhibits 5-24 and 5-25, the specific locations of congested intersections vary between the 2015 Existing Viaduct and the 2015 Bored Tunnel, but the total number of congested intersections is expected to be similar.

The text below discusses other expected changes in vehicle volumes on city streets located in the south, central, and north sections of the project area.

South of S. King Street

The 2015 Bored Tunnel is expected to shift about 7,400 trips daily from SR 99 as shown previously in Exhibit 5-16 to other routes such as I-5 and city streets. Exhibit 5-18 shows that about 2,400 trips are expected to shift to I-5, which represents an increase of less than 1 percent. Between S. Spokane Street and just south of S. Atlantic Street, north-south arterials such as First and Fourth Avenues are expected to accommodate about 4,300 more trips with the 2015 Bored Tunnel than the 2015 Existing Viaduct. The remaining difference between the 2015 Existing Facility and the 2015 Bored Tunnel represents expected changes in travel patterns due to access changes proposed with the Bored Tunnel Alternative as reflected in results of the screenline analysis as presented previously in Exhibit 5-7. Despite this additional traffic on city streets, Exhibits 5-24 and 5-25 show a similar number of intersections are expected to be congested for the 2015 Bored Tunnel and the 2015 Existing Viaduct.

Central – S. King Street to Denny Way

As previously discussed, at about S. King Street the 2015 Bored Tunnel is expected to shift about 30,000 trips daily from SR 99 to other routes such as I-5 and city streets. This shift is mostly related to removing SR 99 ramps at Columbia and Seneca Streets and Elliott and Western Avenues. As a result, traffic coming from the south, destined for downtown would exit SR 99 via the ramps near Alaskan Way at about S. King Street and traffic heading to and from northwest Seattle would either travel along Alaskan Way or would use the bored tunnel/Mercer Street route.

As shown previously in Exhibit 5-18, about 1,000 trips are expected to shift to I-5, which represents a negligible change in I-5 vehicle volumes. An additional 22,200 trips are expected to shift to city streets located just south of S. King Street between SR 99 and I-5, and about 5,500 trips are expected to shift to Alaskan Way along the central waterfront, as shown in Exhibit 5-21. The remaining difference between the 2015 Existing Facility and the 2015 Bored Tunnel represents expected changes in travel patterns due to access changes proposed with the Bored Tunnel Alternative, as reflected in results of the screenline analysis, as presented previously in Exhibit 5-7.

It is worth noting that just north of Seneca Street, vehicle volumes on city streets located between Alaskan Way and I-5 are expected to be the same for the 2015 Bored Tunnel and the 2015 Existing Viaduct. This means that forecasted vehicle volume increases would peak near S. King Street where drivers would enter and exit downtown with the new ramps, but that these increases are highly localized to city streets located in the southern portion of downtown between S. King and Seneca Streets and Alaskan Way and I-5.

Congested Intersections PM Peak

2015 Existing Viaduct | *2015 Bored Tunnel* | *2030 Bored Tunnel*

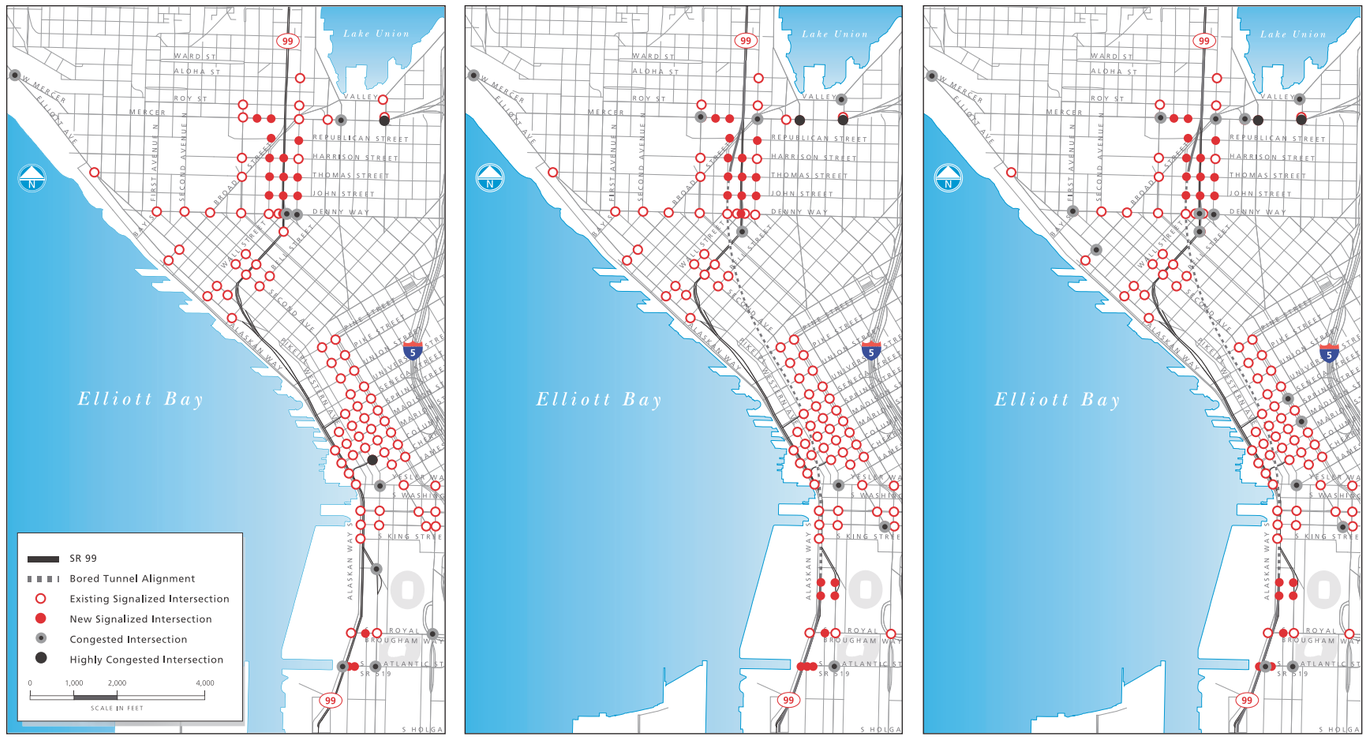


Exhibit 5-25

What are congested and highly congested intersections?

For the traffic analysis conducted for this project, congested intersections are intersections that may cause drivers considerable delay. A driver might wait about 1 or 2 minutes to travel through a traffic signal at a congested intersection. At a highly congested intersection a driver might wait 2 minutes or more to get through the traffic signal.

Appendix C, Transportation Discipline Report

Traffic operations at key intersections are discussed in ***Appendix C***, Section 5.3.

Despite expected increases in vehicle volumes on Alaskan Way and city streets between Alaskan Way and I-5, intersection operations on city streets are not expected to change substantially. Exhibits 5-24 and 5-25 compare congested intersections on specific streets for the 2015 Existing Viaduct, 2015 Bored Tunnel, and 2030 Bored Tunnel, during the AM and PM peak hour. The number of congested intersections is expected to be similar in both the AM and PM peak hours for the 2015 Existing Viaduct and 2015 Bored Tunnel. As shown in Exhibit 5-24, in the AM peak hour the intersection of Fourth Avenue and Columbia Street is expected to have increased vehicle delay for the 2015 Bored Tunnel Alternative, as compared to the 2015 Existing Viaduct. Exhibit 5-25 shows that in the PM peak hour, the number of congested intersections through downtown is expected to be comparable for the 2015 Existing Viaduct and 2015 Bored Tunnel Alternative. With the 2015 Bored Tunnel, vehicle delay is expected to improve at the intersection of First Avenue and Columbia Street as compared to the 2015 Existing Viaduct. This improvement can be attributed to removing the Columbia on-ramp in downtown. The tradeoff is that vehicles passing through the intersection of Second Avenue and Jackson Street are expected to experience an increase in delay compared to the 2015 Existing Viaduct.

Travel times were assessed on Second and Fourth Avenues to determine possible effects of increased vehicle volumes on city streets. In particular, this travel time analysis shows the cumulative delay that a driver traveling on Second or Fourth Avenues through downtown might experience while traveling through several intersections. As shown in Exhibit 5-26, in the AM peak hour travel times are expected to increase by about 1 minute on Second and Fourth Avenues with the 2015 Bored Tunnel. In the PM peak hour, Exhibit 5-27 shows that travel times on Fourth Avenue are expected to be the same for the 2015 Existing Viaduct and 2015 Bored Tunnel. On Second Avenue, travel times are expected to increase by about 2 minutes with the 2015 Bored Tunnel as compared to the 2015 Existing Viaduct. Increases in travel times on city streets for the 2015 Bored Tunnel can be attributed to increased traffic volumes due to changes in access locations.

Exhibit 5-26
Travel Time Comparison on Second & Fourth Avenues
in the AM Peak Hour

Route	2015 Existing Viaduct	2015 Bored Tunnel
Second Avenue – S. Jackson Street to Wall Street	8	9
Fourth Avenue – S. Jackson to Battery Street	8	9

Exhibit 5-27
Travel Time Comparison on Second & Fourth Avenues
in the PM Peak Hour

Route	2015 Existing Viaduct	2015 Bored Tunnel
Second Avenue – S. Jackson Street to Wall Street	9	11
Fourth Avenue – S. Jackson to Battery Street	9	9

North of Denny Way

North of Denny Way, expected SR 99 traffic volumes are nearly identical, despite proposed access changes. However, there are notable changes to traffic volumes on north-south arterials located west and east of SR 99. As shown in Exhibit 5-21, for the 2015 Bored Tunnel, vehicle volumes on north-south arterials located west of SR 99 are expected to increase by about 3,000 vehicles per day compared with the 2015 Existing Viaduct. Vehicle volumes on arterials located east of SR 99 are expected to increase by about 10,000 vehicles per day with the 2015 Bored Tunnel. These changes suggest that the new east-west connections provided across Aurora Avenue at John, Thomas, and Harrison Streets with the Bored Tunnel Alternative improve mobility in the South Lake Union area by providing drivers with an improved street grid. The improved street grid benefits drivers by providing them with more options to make east-west trips across Aurora Avenue. These new street connections also better utilize available capacity on existing streets like Dexter Avenue N. and Westlake Avenue N.

As shown in Exhibits 5-24 and 5-25, intersection operations vary slightly between the 2015 Bored Tunnel and 2015 Existing Viaduct, but intersection performance is expected to be comparable despite proposed changes to the roadway network. With the 2015 Bored Tunnel, intersection congestion during the PM peak hour is expected to shift away from Denny Way and Aurora Avenue to intersections located along Mercer Street. This shift is likely due to proposed changes to ramp access, which would be provided near Harrison and Republican Streets, as well as the conversion of Mercer Street to a two-way street.

9 How would conditions change for drivers, bicyclists, and pedestrians?

This section focuses on how specific users would be affected by proposed changes to SR 99 with the Bored Tunnel Alternative.

How would conditions change for drivers headed into and out of downtown from the south?

As previously discussed, the Bored Tunnel Alternative would change access points on SR 99 for drivers heading to and from downtown. Downtown access to and from the south would be provided via the Alaskan Way S. ramps, just south of S. King Street. An advantage of this configuration is that the access location is better able to accommodate traffic flows than the current Columbia and Seneca Street ramps. In addition, drivers would be able to distribute from Alaskan Way to the downtown street grid using any of several cross streets, including S. Jackson Street, S. Main Street, Yesler Way, and Columbia, Marion, Madison, and Spring Streets, rather than being concentrated to single locations at Columbia and Seneca Streets.

Because access would be less centrally located to downtown than it is today, trips destined to the central and northern portions of downtown would have to travel a few additional blocks on arterial streets rather than on SR 99. Conversely, drivers heading to and from the southern areas of downtown would find that the new ramps provide more direct access. In addition, access to SR 99 for trips to and from ferry service at Colman Dock would be more direct with the new ramps proposed with the Bored Tunnel Alternative than it is today with the Seneca and Columbia Street ramps.

How would conditions change for drivers heading to and from northwest Seattle (Ballard, Interbay, and Magnolia)?
The Bored Tunnel Alternative would remove the northbound off-ramp to Western Avenue and southbound on-ramp from Elliott Avenue. The lightly used ramps at Battery Street would also be removed. Drivers that currently use these ramps could either use Alaskan Way or the bored tunnel. As previously discussed, 2015 Bored Tunnel travel times for these routes are comparable to the 2015 Existing Viaduct.

How would conditions change for drivers north of Denny Way?
The Bored Tunnel Alternative would maintain access north of Denny Way and enhance roadway safety compared to the 2015 Existing Viaduct. Between John and Mercer Streets, arterial connections to SR 99 would be replaced with consolidated access at Harrison and Republican Streets. Aurora Avenue would be built to grade level between Denny Way and John Street, and John, Thomas, and Harrison Streets would be connected as cross streets. Broad Street would be closed between Taylor Avenue N. and Ninth Avenue N. Mercer Street would continue to cross under Aurora Avenue as it does today, but it would be widened and converted to a two-way street with three lanes in each direction. North of Mercer Street, arterial connections to SR 99 would not change from the existing facility.

How would conditions change for freight?
Freight connections to the Ballard/Interbay area would change with the Bored Tunnel Alternative, since the Elliott and Western ramps would be removed. Freight traffic heading to or from the Ballard/Interbay area could either travel through the bored tunnel to Mercer Street or use Alaskan Way. As discussed previously, 2015 travel times would be comparable to the 2015 Existing Viaduct with either the Alaskan Way or bored tunnel route.

Arterial connections to SR 99 north of Denny Way would be consolidated to ramps at Republican and Harrison Streets. Direct connections to Mercer Street (northbound) and Broad Street (southbound) would be eliminated but would be replaced by new connections to Republican Street and Harrison Street. These new ramps would involve turns onto the cross streets and would be designed to accommodate truck movements.

In addition, hazardous and flammable cargo would be prohibited in the bored tunnel. This type of cargo is prohibited in the Battery Street Tunnel today and is restricted from using the viaduct during peak travel times from 7:00 a.m. to 9:00 a.m. and 4:00 p.m. to 6:00 p.m. Instead of traveling on SR 99 through downtown, freight carrying hazardous or flammable cargo would be required to use another route, such as Alaskan Way or I-5. This change is estimated to affect 55 to 70 tanker trucks per day that currently may be legally carrying flammable or hazardous loads on the viaduct.

How would conditions change for transit?
For the Bored Tunnel Alternative, transit access would change for buses entering downtown from the south. Buses traveling from the south on SR 99 currently enter and exit downtown using the ramps at Seneca and Columbia Streets. With the Bored Tunnel Alternative, downtown ramps would be provided to Alaskan Way farther south near S. King Street. Buses that currently use the Columbia and Seneca ramps would likely travel to and from downtown using these new ramps. The northbound off-ramp to downtown would have a transit-only lane to accommodate buses coming from West Seattle and south King County. From the off-ramp, buses would likely travel north on Alaskan Way to S. Main Street or other east/west streets to connect to Third or Fourth Avenues.

The new ramps would extend transit service coverage to a larger portion of the downtown area—particularly the Pioneer Square area. Bus travel times to most downtown destinations would remain similar to the 2015 Existing Viaduct, depending on the rider's final destination. Bus travel times to areas near the Pioneer Square area could decrease, although travel times to areas toward the north end of downtown might increase since the buses would enter the street grid farther south.

For transit vehicles serving downtown Seattle from the north, the Denny Way ramps would be replaced with ramps to Harrison Street and surface Aurora Avenue, providing a similar connection to what exists today at Denny Way. Buses operating along Aurora Avenue would likely use this left-side exit to access downtown Seattle and then transition to the new right-side transit lanes on Aurora Avenue. In the southbound direction, a transit-only lane would be provided between Harrison Street and Denny Way that would continue on Wall Street to Third Avenue. In the northbound direction, a transit-only lane would be provided on Battery Street between Third Avenue and Denny Way. The northbound transit-only lane would continue north of Denny Way to John Street. In addition, proposed street improvements at John, Thomas, and Harrison Streets and Sixth Avenue N. would provide opportunities for potential new transit connections in South Lake Union and improved pedestrian access to transit.

Changes in Transit Ridership
Exhibit 5-28 compares estimated daily transit ridership at three screenline locations.

Exhibit 5-28
Estimated Daily Transit Riders

	2015 Viaduct Closed	2015 Existing Viaduct	2015 Bored Tunnel	2030 Viaduct Closed	2030 Bored Tunnel
SOUTH – South of S. King Street	99,200	95,600	97,000	160,800	163,700
CENTRAL – North of Seneca Street	126,900	120,500	124,800	162,400	179,200
NORTH – North of Thomas Street	118,700	119,100	118,800	165,300	169,900

Exhibit 5-28 indicates that the number of transit riders in the study area is expected to increase substantially between 2015 and 2030. These increases reflect a variety of transit improvements, including Link light rail to the south to Federal Way, east to Overlake, and north to Lynnwood, and King County Metro's RapidRide service from West Seattle, Ballard, and North Seattle.

For the central and south screenlines, daily transit ridership for the 2015 Bored Tunnel would be about 2 percent less than the 2015 Existing Viaduct. The slight decrease in transit demand between the 2015 Existing Viaduct and 2015 Bored Tunnel would likely be due to

Appendix C, Transportation Discipline Report

Truck traffic and freight are discussed in *Appendix C*, Section 5.7.

Transit information is discussed in *Appendix C*, Section 5.6.

anticipated changes in transit access in south downtown. With the Bored Tunnel Alternative, bus routes from West Seattle and south King County would exit to downtown farther south than the current access locations at Columbia and Seneca Streets. While this routing change would expand the bus service coverage, it would also increase travel times for some riders.

Transit Mode Share Changes

Existing (2005) daily transit mode share is about 31 percent for commute trips and 8.1 percent for non-work related trips, which is similar to forecasted mode share in 2015, as shown in Exhibit 5-29. Between 2015 and 2030, the percentage of transit ridership compared with automobile traffic is expected to increase substantially, as shown in Exhibit 5-29. During this time, expanded bus and rail service, particularly Link light rail service, would contribute to this growth in transit mode share. Exhibit 5-29 also shows that transit mode share is nearly equal among the 2015 Existing Viaduct, 2015 Viaduct Closed, and 2015 Bored Tunnel.

Exhibit 5-29
Daily Transit Mode Share To and From Seattle's City Center

	2015 Viaduct Closed	2015 Existing Viaduct	2015 Bored Tunnel	2030 Viaduct Closed	2030 Bored Tunnel
Commute Trips – Work Trips	34.0%	34.2%	34.2%	39.6%	40.5%
Non-Work-Related Trips	8.7%	8.9%	8.8%	9.8%	10.1%

Transit Travel Times

Exhibit 5-30 compares expected peak hour travel times between the 2015 Existing Viaduct and 2015 Bored Tunnel. With the 2015 Bored Tunnel, peak hour travel times for most trips along selected transit corridors would be comparable to 2015 Existing Viaduct conditions. The greatest travel time variations between the 2015 Existing Viaduct and the 2015 Bored Tunnel are estimated for AM peak hour trips heading to and from West Seattle. For these trips, projected travel time increases of 3 or 4 minutes are expected. This travel time increase is likely because vehicles would need to pass through more signalized intersections. The extent of added travel time would not likely require added resources in terms of more buses on the affected bus routes.

How would conditions change at the Seattle Ferry Terminal?

Very few changes are expected to occur at the Seattle Ferry Terminal in terms of traffic operations and congestion levels. During peak periods for the 2015 and 2030 Bored Tunnel, overall operations at the intersections of Alaskan Way and Marion Street or Yesler Way would be comparable to the 2015 Existing Viaduct.

As with existing ferry operations, service disruptions such as issues with vessels or terminals or demand spikes associated with peak summer holiday traffic would likely continue to cause disruptions to traffic flow and circulation along Alaskan Way near Marion Street and Yesler Way. Traffic analysis findings indicate that peak hour queues for vehicles entering Colman Dock may exceed the storage capacity of the left-turn pocket and therefore affect northbound through traffic on Alaskan Way.

How would conditions change for event traffic?

During special events at the stadiums or Seattle Center, overall congestion levels would be similar for the 2015 Existing Viaduct and 2015 Bored Tunnel.

In the south portal area, improvements proposed with the Bored Tunnel Alternative are expected to improve circulation and reduce congestion levels at key intersections near the stadiums during large events by providing more direct access to regional facilities such as SR 99 and I-5.

In the north portal area, improvements proposed for the Bored Tunnel Alternative would provide an improved street grid (particularly for east-west traffic), which improves traffic flow by providing more options for vehicles to distribute across multiple streets. The improved street grid could reduce congestion on major arterials such as Mercer Street. The capacity of Mercer Street to handle event traffic leaving the Seattle Center area may be reduced to some degree with its conversion to a two-way street with three eastbound lanes instead of the four that are provided today east of Fifth Avenue N. However, the

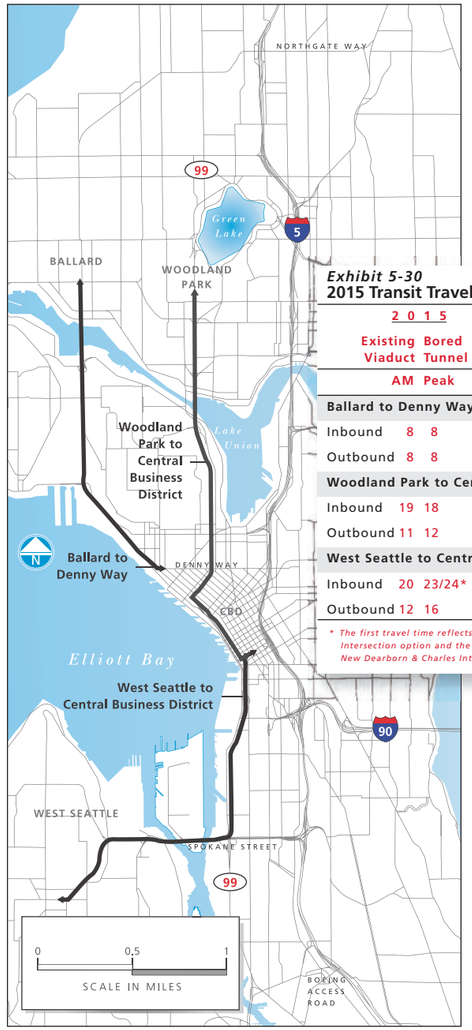


Exhibit 5-30
2015 Transit Travel Time Comparison

	2015 Existing Viaduct AM Peak	2015 Bored Tunnel AM Peak	2015 Existing Viaduct PM Peak	2015 Bored Tunnel PM Peak
Ballard to Denny Way				
Inbound	8	8	8	8
Outbound	8	8	7	8
Woodland Park to Central Business District				
Inbound	19	18	18	16
Outbound	11	12	14	15
West Seattle to Central Business District				
Inbound	20	23/24*	15	17
Outbound	12	16	25	22

* *The first travel time reflects the New Dearborn Intersection option and the second reflects the New Dearborn & Charles Intersections options.*

added east-west connections across Aurora Avenue at John, Thomas, and Harrison north of Denny Way would provide alternate routes for this traffic that are expected to serve event traffic more efficiently overall.

How would conditions change for pedestrians?
Proposed roadway improvements in the south portal area would improve pedestrian access and mobility. Specific improvements that would benefit pedestrians include removing the Railroad Way ramps from First Avenue S., constructing new cross streets and associated sidewalks between S. Royal Brougham Way and S. King Street, and reconfiguring and widening the multi-use path located on the east side of Alaskan Way S.

Removing the Railroad Way ramps would reduce potential pedestrian and vehicle conflicts at First Avenue S. The new cross-street connections would provide sidewalks, which would enhance pedestrian mobility. Finally, the reconfigured Alaskan Way would have a sidewalk on the west side and a minimum 25-foot-wide multi-use path, called the City Side Trail, on the east side. The City Side Trail would travel from S. Atlantic Street up to S. King Street and would improve conditions for pedestrians compared to the existing Waterfront Bicycle/Pedestrian Facility located on the east side of Alaskan Way S.

In the north portal area, Aurora Avenue would be built to grade level between Denny Way and John Street. John, Thomas, and Harrison Streets would be connected across Aurora Avenue with signalized intersections at Denny Way and John, Thomas, and Harrison Streets. The new cross-streets would be signalized and would have sidewalks on both sides, which would improve east-west pedestrian connections in this area. In addition, Mercer Street would be converted to a two-way street between Dexter and Fifth Avenues N., and sidewalks would be constructed on both sides of Mercer Street, which would be an improvement for pedestrians. Finally, Broad Street would be filled between Ninth Avenue N. and Taylor Avenue N., which would eliminate this pedestrian connection, but the combination of pedestrian improvements proposed north of Denny Way would provide improved safety and mobility for pedestrians as compared to existing conditions.

As described above, there are several planned enhancements associated with the Bored Tunnel Alternative that would improve pedestrian connections. However, in some locations, as discussed in Question 8, traffic volumes on surface streets are expected to increase, which may increase traffic noise and have a long-term negative effect on the pedestrian environment.

How would conditions for bicyclists change?
In the south portal area, bicycle conditions would be improved by replacing the existing 15-foot-wide Waterfront Bicycle/Pedestrian Facility currently located on the east side of Alaskan Way S. with the new 25-foot-wide City Side Trail that would be constructed east of Alaskan Way S. between S. Atlantic Street and S. King Street.

In the north portal area, bicycle connections would be improved by connecting the street grid at John, Thomas, and Harrison Streets. A dedicated bike lane would be provided on John Street. These improvements to the street grid would benefit bicyclists. In addition, a bicycle path would be constructed on the north side of Mercer Street.

As described above, there are several planned enhancements associated with the Bored Tunnel Alternative that would improve connections for bicyclists. However, in some locations, as discussed in Question 8, traffic volumes on surface streets are expected to increase and require bicyclists to share the roadway with more vehicles, which may have a negative effect on the environment for bicyclists.

10 What are the tradeoffs between the south portal options?

Two options are proposed at the south portal: the New Dearborn Intersection option and the New Dearborn and Charles Intersections option. The primary differences between the two options are discussed in the following section.

Traffic and Intersection Performance
In most cases, traffic operations would be similar between these two options; however, there are a couple of minor differences. The additional intersection at S. Charles Street would slightly increase delay encountered by vehicles using Alaskan Way S. to access the new SR 99 ramps near S. King Street because drivers would need to pass through two intersections instead of one. The New Dearborn Intersection option offers a minor safety and operational improvement compared to the New Dearborn and Charles Intersections option because with one intersection, SR 99 traffic exiting to Alaskan Way would have more "green time" at the traffic signal, which would prevent the off-ramp queue from spilling back onto the SR 99 mainline. In addition, by having one intersection instead of two, traffic control and signal timing is simpler and easier to manage on S. Royal Brougham Way. During large events at the stadiums, the New Dearborn Intersection option offers fewer options for vehicles and pedestrians to route through the area, but it is expected to clear traffic from the area somewhat more efficiently due to simpler traffic control.

Future Land Use and Urban Design Considerations
The New Dearborn and Charles Intersection option requires slightly more tunnel construction to extend to S. Charles Street. Because of this small increase in tunnel area, the additional area provides slightly more developable land than the New Dearborn Intersection option. In addition, there is an opportunity to reduce noise slightly in the area between S. Dearborn and S. Charles Streets with this option, since the tunnel would extend slightly south of S. Charles Street.

Cost
The New Dearborn and Charles Intersections option would cost slightly more (up to an additional $23 million) than the New Dearborn Intersection option because it would require building more roadway improvements, including a small extension of the cut-and-cover tunnel required in this area.

Appendix C, Transportation Discipline Report

Effects to bicyclists are discussed in *Appendix C*, Section 5.10.

Ferry conditions are discussed in *Appendix C*, Section 5.11.

Event traffic discussed in *Appendix C*, Section 5.1.3.

Effects to pedestrians are discussed in *Appendix C*, Section 5.9.

Which option is preferred in each portal area?

The New Dearborn Intersection is the preferred option in the south portal area.

Curved Sixth Avenue is the preferred option in the north portal area.

11 What are the tradeoffs between the north portal options?

Two options are proposed at the north portal: the Straight Sixth Avenue option and the Curved Sixth Avenue option. The primary differences between the two options are discussed below.

Turning Movements

The Straight Sixth Avenue option would provide a traffic signal at the intersection of Sixth Avenue and Mercer Street, which would allow for all turning movements at this intersection. The traffic signal would accommodate all turning movements, including a left turn so that traffic heading westbound on Mercer Street could easily access SR 99 via the Republican Street on-ramp. A signal is not proposed with the Curved Sixth Avenue option due to limited sight distance for drivers and because the spacing between intersections on Mercer Street may not be sufficient to allow left turns. As a consequence, traffic heading westbound on Mercer Street would be able to access SR 99 via the Republican Street on-ramp, but the route drivers would take would be more circuitous, which may add travel time and be difficult for truck traffic.

Traffic and Intersection Performance

The intersections of Mercer Street with Dexter Avenue N. and Fifth Avenue N. are expected to operate with less delay during the AM and PM peak hours for the Straight Sixth Avenue option, because this option provides an additional intersection to accommodate turning movements at Sixth Avenue N. and Mercer Street. However, the additional traffic signal on Mercer Street could increase travel times on Mercer Street, since drivers would need to travel through an additional traffic signal.

Bicycle and Pedestrian Mobility

Of the two north portal options evaluated, the Straight Sixth Avenue option would provide better mobility and access for pedestrians and bicyclists because it provides an additional signalized pedestrian crossing of Mercer Street.

Land Use

The Straight Sixth Avenue option would acquire about 0.9 acre of the Bill and Melinda Gates Foundation (Gates Foundation) property, which could adversely affect current planned development at the site by dividing the parcel. The Curved Sixth Avenue option would acquire about 15,507 square feet (about 0.4 acre) of the Gates Foundation property and would not divide the parcel.

12 How would noise levels change?

Noise from traffic and the diverse activities of city dwellers is a normal part of life in the project area. Existing outdoor noise levels in the project area range from 61 to 80 A-weighted decibels (dBA) (both for short durations and over a 24-hour period), which is typical for major downtown metropolitan areas. Noise levels tend to be about 10 dBA quieter during the nighttime and early morning hours (midnight to 6:00 a.m.).

To compare how noise levels would change, traffic noise levels were modeled at 68 sites for both existing conditions and the year 2030 with the Bored Tunnel Alternative. The noise levels modeled for the Bored Tunnel Alternative and the change compared to existing conditions are shown in Exhibit 5-31.

Traffic noise levels currently approach or exceed FHWA noise abatement criteria at 48 of the 68 sites, which represent approximately 3,746 residential units, 1,612 hotel rooms, 120 shelter beds, 1 church, 12 parks or public spaces, and 7 commercial use areas. One site, an apartment building adjacent to the Elliott Avenue on-ramp, currently exceeds the severe noise impact criterion of 80 dBA at sensitive land uses. With the 2030 Bored Tunnel Alternative, traffic noise levels would approach or exceed FHWA noise abatement criteria at 40 of the 68 sites, which represent approximately 3,449 residential units, 1,444 hotel rooms, 120 shelter beds, 2 schools, 1 church, 10 parks or public spaces, and 3 commercial use areas. None of these sites would exceed the severe noise impact criterion of 80 dBA at sensitive land uses. The number of modeled sites that exceed the noise abatement criteria would be reduced by 8 sites with the Bored Tunnel Alternative compared to existing conditions. The loudest hour traffic noise levels with the Bored Tunnel Alternative would range between 59 and 74 dBA at the modeled locations.

Noise levels were studied at 9 locations near the south portal of the Bored Tunnel Alternative. The noise levels would decrease by 1 to 4 dBA in 2030 at 8 locations and would increase by 1 dBA at one location. Noise levels for both of the south portal options would exceed FHWA noise abatement criteria at 6 of the 9 modeled sites, as they do today. The 6 sites represent approximately 135 residential units, 220 hotel rooms, and 2 parks or public spaces. Noise levels with the Bored Tunnel Alternative would range from 66 to 71 dBA at modeled locations in the south portal area.

Along Seattle's central waterfront, noise levels would decrease in most locations studied. However, at five sites noise levels are expected to increase by 1 or 3 dBA. Two sites are located just south of the intersection of Alaskan Way S. and Broad Street, and two additional sites are located just east of this intersection. Noise is expected to increase at these four locations because of changes in traffic patterns due to removing the Elliott and Western Avenue ramps. At the fifth site near First Avenue S. and Yesler Way, noise is expected to increase by 1 dBA. The noise level is expected to increase slightly because the volume of traffic at this intersection is expected to increase slightly. Traffic noise levels near the central portion of the project area would continue to be typical of an urban city. Noise levels were modeled to approach or exceed the FHWA noise abatement criteria at 18 of the 37 modeled sites for the Bored Tunnel Alternative, as compared to 29 of 37 sites that approach of exceed FHWA criteria today. The 18 sites represent approximately 2,977 residential units, 353 hotel rooms, 120 shelter beds, 4 parks or public open space uses, and 2 commercial or other less noise-sensitive uses. Noise levels with the Bored Tunnel Alternative would range from 61 to 74 dBA at modeled locations in the central waterfront area.

What is a dBA?

Sound levels are expressed on a logarithmic scale in units called decibels (dB). A-weighted decibels (dBA) are a commonly used frequency that measures sound at levels that people can hear.

A 2-dBA change in noise levels is the smallest change that can be heard by sensitive listeners.

Appendix F, Noise Discipline Report

Methods used for assessing existing conditions, environmental effects, and mitigation are described in *Appendix F*, **Chapter 3**. In **Chapter 4**, **Exhibit 4-1** shows the noise measurement locations. **Chapter 5** provides additional information on noise and vibration effects and operational mitigation. The feasibility and reasonableness of noise abatement measures is discussed in *Appendix F*, **Section 5.4**.

At the north tunnel portal, changes in future noise levels vary depending on location. At some sites, noise levels decrease by up to 5 dBA and at other sites noise levels are predicted to stay the same or increase by 1 to 4 dBA. With the Bored Tunnel Alternative, traffic noise levels modeled for both of the north portal options approach or exceed the FHWA noise abatement criteria at 16 of the 22 modeled sites, which is an increase of four sites compared to existing conditions. The 16 sites represent approximately 337 residential units, 871 hotel rooms, 2 schools, 1 church, 4 parks or public open space uses, and 1 commercial or other less noise-sensitive use. These sites would have noise levels that increase by 1 to 4 dBA. Noise levels with the Bored Tunnel Alternative would range from 61 to 75 dBA at modeled locations in the north portal area.

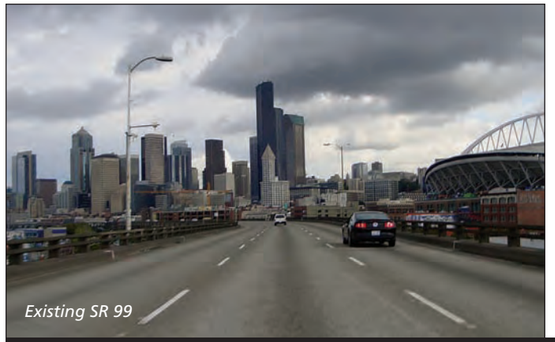
The Bored Tunnel Alternative would require a ventilation system with several ventilation stacks, which would be included as part of the tunnel operations buildings proposed at the tunnel portals. At the south portal, the tunnel operations building would be located on the block bounded by S. Dearborn Street, Alaskan Way S., and the new Railroad Way S. access road. At the north portal, the tunnel operations building would be located between Thomas and Harrison Streets on the eastside on Sixth Avenue N. The ventilation fans would be designed not to exceed either 60 dBA at the nearest commercial uses or 57 dBA at the property line of the nearest residential use during normal operations. Ventilation fans must be routinely tested in emergency mode operation, which is subject to the property line noise limits. Testing of ventilation fans would likely occur during normal daytime hours, and these periodic tests are not expected to have a noticeable effect to ambient noise levels in the area. Between the portals, the tunnel would not affect noise levels in nearby areas, since it would be located deep beneath the ground.

Measures for noise abatement as required by federal regulations (23 CFR 772) were evaluated to determine what measures are feasible and reasonable. These measures include the following:

Exhibit 5-31

- Traffic management
- Land acquisition for noise buffers or barriers
- Realigning the roadway
- Noise insulation of buildings
- Noise barriers

None of these measures were identified to be feasible and reasonable.



Existing SR 99

13 How would views be affected?

The Bored Tunnel Alternative would change views in the existing SR 99 corridor, particularly along the central waterfront where the project would remove the existing viaduct. Once the viaduct is removed, views to and from the waterfront that are currently obstructed by the structure would be substantially improved. The changes to views at the south and north ends of the project area would not be as dramatic.

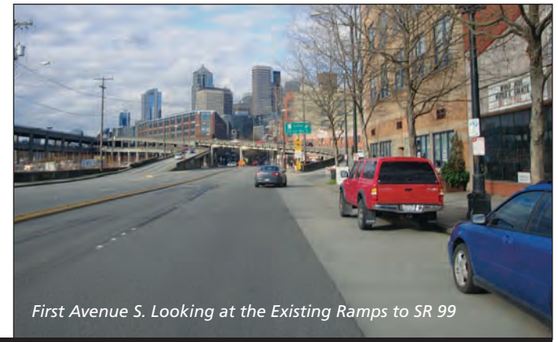
South Portal Area

The Bored Tunnel Alternative would connect to the newly replaced SR 99 structure at S. Royal Brougham Way. At this point, occupants of northbound vehicles would have similar views of the downtown skyline as they do today, as shown in Exhibit 5-32. As northbound vehicles begin descending into the tunnel, views of downtown and Elliott Bay would become blocked. Occupants of southbound vehicles exiting at the south portal would see the Port of Seattle (Terminal 46) and industrial facilities as they emerge from the tunnel.

Views for people on the surface streets in the south portion of the project area would generally be similar to existing conditions or they would improve by removing the existing viaduct. Above the portal, one or two new surface streets would be created. Views to the west would include Terminal 46 and surface streets more prominently. Near the south portal, the existing elevated ramps along Railroad Way S. at First Avenue S. would be removed as shown in Exhibit 5-33. This change would likely cause people to feel that the Pioneer Square and stadium areas were more connected visually. The proposed tunnel operations building may be constructed in a portion of the Railroad Way S. right-of-way underneath the existing ramps, which may obscure some views. The building would be designed to fit into the surrounding neighborhood. The tunnel operations building is expected to be

Appendix D and Appendix E, Visual Quality

The methodology used for visual assessment is described in **Chapter 2** of *Appendix D, Visual Quality Discipline Report*. **Chapter 5** provides additional information on visual effects. *Appendix E* contains the visual simulations.



First Avenue S. Looking at the Existing Ramps to SR 99

Visual Simulation Looking North Towards the South Portal

Exhibit 5-32

Visual Simulation Looking North Towards the South Portal near S. Atlantic Street

Visual Simulation Looking North at the First Avenue S. Ramps

Exhibit 5-33

First Avenue S. Without the Viaduct

approximately 65 feet tall with vent stacks extending up to 30 feet above the roof. Zoning in this area now allows building heights of up to 65 feet, and the height of stacks is exempt from zoning restrictions.

Many of the people traveling to the south portal area are attending events at Qwest or Safeco Fields. For fans congregating around Safeco Field, views would not change much. Inside the stadium, the 300 level would continue to have unobstructed views to the west. Viewers looking northwest and north would see the transition of SR 99 to the tunnel portal, although this view could be obstructed in the future by private development. The downtown skyline would continue to be the main feature for views to the north. For attendees at Qwest Field events, views toward Elliott Bay from the upper level of the west side of the stadium would be altered by removing the existing viaduct and the ramps to First Avenue S. Removing these structures would open up views across Terminal 46 to Elliott Bay and down the Railroad Way S. corridor.

Existing View of the Alaskan Way Viaduct along Alaskan Way

Visual Simulation Looking South on Alaskan Way S. at Union Street *Exhibit 5-35*

This simulation is conceptual. The design for Alaskan Way S. is under development.

Bored Tunnel and the Central Waterfront

Once inside the tunnel, both northbound and southbound vehicle occupants would no longer have the scenic views of the central waterfront and downtown as they do today. Exhibit 5-34 shows what the interior of the bored tunnel could look like.

Removing the existing viaduct would transform the relationship the neighborhoods east of the viaduct have to the central waterfront, as shown in Exhibit 5-35. Views of the Pioneer Square Historic District from the waterfront would be unobstructed for the first time since the early 1950s. Historic brick buildings, high-rise buildings, and other features (such as parking lots) would face viewers along the waterfront. Views down streets that are perpendicular to the existing viaduct would no longer be obstructed by the viaduct. These views would be framed by buildings primarily of the same period with similar materials and architectural style, together with complementary elements of the streetscape, including sidewalks, street trees, and the roadway itself. The Pioneer Square Historic District has a large number of visitors, and people would likely find the area more appealing after the existing viaduct is removed. Viaduct removal supports policies in the Pioneer Square Neighborhood Plan to improve the connection of east-west streets to the waterfront, by improving views and pedestrian connections.

Views from private property, including those available to employees and residents in buildings that face the existing viaduct and from buildings along perpendicular street corridors, would also no longer be obstructed by the existing viaduct. Views from buildings at the east side of the viaduct's right-of-way would have unobstructed foreground views of the waterfront; middle ground views of Elliott Bay, Puget Sound, West Seattle, Alki Point, and Magnolia; and distant views of the Kitsap Peninsula Hills and the Olympic Mountains. Buildings on perpendicular streets to the east would enjoy views down the streets. The changes to the visual environment along the waterfront would support the Downtown Urban Center Neighborhood Plan policies.

At the north end of the central waterfront is the Pike Place Market Historic District. Views from the market and Victor Steinbrueck Park toward the waterfront would no longer be obstructed by the viaduct.

Views for pedestrians on the waterfront and piers along Alaskan Way towards downtown Seattle would no longer

Visual Simulation Inside the Bored Tunnel – Northbound

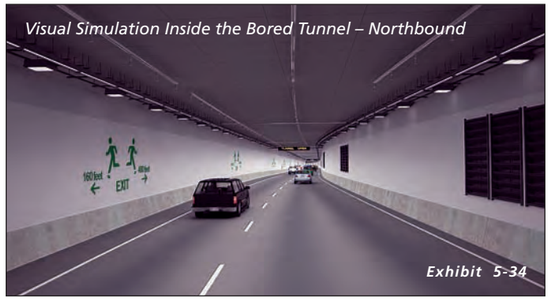


Exhibit 5-34

have the visual barrier of the viaduct between the waterfront and downtown. From a distance near the ends of the piers and from ferries and other vessels in Elliott Bay, downtown towers loom above the existing viaduct and the views would not change dramatically.

Lighting associated with the existing viaduct would be replaced by lighting typical of an urban arterial. The removal of above-grade lighting for the viaduct would be more in keeping with the character of the area and would be beneficial in reducing glare effects to upper levels of buildings adjacent to the viaduct.

North Portal Area

Views exiting the bored tunnel for vehicle occupants traveling northbound on SR 99 would be nearly identical to what people experience today when exiting the Battery Street Tunnel. Views from southbound SR 99 would also be similar to existing conditions. Vehicle occupants traveling southbound would see the downtown access off-ramp in the center lane connecting at Harrison Street. SR 99 would continue to have semi-restricted-access north of the portals with a barrier in the center. Exhibit 5-36 shows what the north portal area would look like with each of the Sixth Avenue N. options. Views from perpendicular streets would continue to be of a standard urban roadway with large volumes of fast-moving traffic, much like today.

Between Harrison Street and Denny Way, the rebuilt Aurora Avenue surface street would be integrated with the surrounding neighborhood as shown in Exhibit 5-37. John, Thomas, and Harrison Streets would connect across Aurora Avenue. The neighborhood would no longer be divided by SR 99, and vehicle, bicycle, and pedestrian circulation would be enhanced. This would not change the visual quality of the street, which would continue to be a six-lane urban arterial. The major difference would be the slower speed of traffic and the periodic queuing of

Visual Simulation Looking at Aurora Avenue from Denny Way *Exhibit 5-37*

Visual Simulation Looking at the North Portal *Exhibit 5-36*

Exhibit 5-39

Exhibit 5-38
Parcels Needed for the Bored Tunnel Alternative

				APPROXIMATE PROPERTY ACQUISITION	
Existing Ownership	**Existing Land Use***	**Existing Zoning***	**Partial**	**Full**
SOUTH PORTAL AREA				
1 Pyramid Alehouse	Terminal/Warehouse – parking lot	Industrial Commercial	11,400 square feet – approximately 50 parking spaces	
2 Seattle Hometown Fans, LLC Warehouse and	Terminal/Warehouse	Industrial Commercial	6,500 square feet – 2 parcels	
3 Vacant Lot				
4 MSI Triangle, LLC	Terminal/Warehouse	Industrial Commercial		37,000 square feet
5 Washington-Oregon Shippers Cooperative Association (WOSCA)	Terminal/Warehouse – vacant, currently leased by WSDOT	Industrial Commercial		136,000 square feet
South Portal Subtotal			***17,900 square feet (approximately 0.4 acre)***	***173,900 square feet (approximately 4.0 acres)***
NORTH PORTAL AREA				
6 Clise Properties, Inc.	Parking Lot	Seattle Mixed	393 square feet	
7 Carl Fennema	Office	Seattle Mixed	714 square feet	
8 Cedarstrand Properties, LLC	Office	Seattle Mixed		38,880 square feet
9 City of Seattle Maintenance Yard	Vacant – although currently in use as a temporary City of Seattle maintenance yard	Seattle Mixed		73,400 square feet
10 Vacant parcel with billboard	Vacant	Seattle Mixed		1,000 square feet
11 Gates Foundation Campus	Office – under construction	Seattle Mixed	*Straight Sixth Avenue* – Partial Acquisition, 37,100 square feet *Curved Sixth Avenue* – Partial Acquisition, 14,400 square feet	
North Portal Subtotal			***15,507 - 56,107 square feet (approximately 0.4 - 0.9 acre)***	***113,280 square feet (approximately 2.6 acres)***
Total			***33,407 - 56,107 square feet (approximately 0.8 - 1.9 acres)***	***286,280 square feet (approximately 6.6 acres)***

**Existing Land Use Types and Zoning Designations, City of Seattle 2009a*

cars at intersections. The area would be much more conducive to pedestrian activity and could unify the neighborhood.

The tunnel operations building located on Sixth Avenue N. between Thomas and Harrison Streets would be similar in size to existing buildings in the vicinity. The tunnel operations building is expected to be approximately 65 feet tall with vent stacks extending up to 30 feet above the roof. This could be somewhat shorter than other buildings that may be developed in the future, since zoning in this area now allows building heights of up to 85 feet.

There would be few indirect effects to views with the Bored Tunnel Alternatives because it is already a densely developed urban environment, and any land use and development changes are expected to be very small.

However, modest expansion of properties along the east side of Alaskan Way could change views toward Seattle slightly. To the extent that the existing viaduct has been perceived as a barrier to waterfront uses, new development on vacant or under-used property or redevelopment may take place around the new Alaskan Way surface street.

14 How would properties be affected?

Eleven properties would be partially or fully acquired for the Bored Tunnel Alternative, as listed in Exhibit 5-38 and shown in Exhibit 5-39. No residential displacements have been identified.

South Portal Area

In the south portal area, three properties would be partially acquired and two properties would be fully acquired. Fully acquired properties would total about 173,000 square feet (about 4.0 acres). All of the acquired

and partially acquired properties are zoned for Industrial Commercial use. The Industrial Commercial zone is intended to promote development of businesses that incorporate a mix of industrial and commercial activities, such as light manufacturing and research and development facilities, while also allowing for a wide range of other employment activities. Transportation facilities are an allowable use in this zone.

North Portal Area
In the north portal area, three properties would be partially acquired and three would be fully acquired. Fully acquired properties would total about 113,280 square feet (about 2.6 acres) of land zoned as Seattle Mixed, a zone where mixed-use neighborhood development is encouraged. Transportation facilities are an allowable use in this zone.

The Straight Sixth Avenue option would acquire about 38,207 square feet (about 0.9 acre) of the Gates Foundation property, which could adversely affect current planned development at the site by dividing the parcel. The Curved Sixth Avenue option would acquire about 15,507 square feet (about 0.4 acre) of the Gates Foundation property. When Broad Street is closed and filled, the right-of-way would go through the City of Seattle's street vacation process.

When acquiring properties, WSDOT would follow the amended provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970. This act implements federal and state constitutional guarantees that private property will not be taken or damaged for public use without just compensation.

A variety of properties are available for sale or lease in the south Seattle and Greater Duwamish areas that could provide similar space for businesses located on properties acquired in the south. Similarly, several properties in the South Lake Union area are also available. The sizes of available properties vary greatly, as do prices and lease rates. The current market has slowed due to difficult economic conditions. This has resulted in higher vacancy rates than were experienced at the end of the 1990s and early 2000s when the economy was stronger. It is difficult to predict how long the current economic environment will last; however, as the economy improves, the demand for all property types downtown is expected to be relatively high, based on activity during the recent past.

In addition to property acquisitions listed in Exhibit 5-38, permanent tieback easements for subsurface wall shoring systems would be needed on three properties in the north portal area:

- Hostess Cake Continental Baking Company at the northwest corner of Aurora Avenue and Republican Street (225 square feet)
- School of Visual Arts between Republican and Mercer Streets on the east side of SR 99 (1,588 square feet)
- Gates Foundation Campus between Broad and Mercer Streets on the west side of SR 99: Curved Sixth Avenue option (19,780 square feet), or Straight Sixth Avenue option (23,905 square feet)

Bored Tunnel
The Bored Tunnel Alternative would also require subsurface property acquisitions for between 52 to 59 parcels located above the tunnel alignment. These subsurface acquisitions may constrain future improvements to land uses above the tunnel if excavations for grouting, pilings, installing heat pumps, or other ground stabilization improvements are needed. The subsurface acquisitions are not anticipated to change the development potential of the affected properties under current zoning.

Areas Used for Construction
Except for property owned by the Port of Seattle, all of the potential staging areas for the Bored Tunnel Alternative are already owned by WSDOT or are other public rights-of-way. WSDOT and the Port of Seattle are developing agreements for the potential use the Port of Seattle properties. No permanent changes in land use would occur as a result of a property being used as a staging area.

15 How would land use be affected?
The Bored Tunnel Alternative would be consistent and compatible with existing land use plans. Several properties in the south and north portal areas would be permanently converted from office, retail, and commercial land uses to transportation uses due to right-of-way acquisitions discussed in Question 14. Conversion of land to transportation use would result in a slight reduction in the overall density of potential development in the project area. However, it is not expected to influence development activity or trends in affected areas. Several private developments are planned or already under construction near the project area. Planned development near the south portal includes an office and residential mixed-use project on Qwest Field's north parking lot as well as other mixed-use residential and office developments. In the north, much of the development continues to be focused on residential and office uses, and includes the Gates Foundation Campus.

A tunnel operations building would be built at each of the portals to house ventilation equipment and maintenance and control facilities. Each building would likely be about 65 feet tall, with ventilation stacks extending up to 30 feet beyond the roof, which meets existing zoning and land use code requirements. The tunnel operations buildings would be designed to fit into their surrounding neighborhoods.

The new east-west surface street at S. Dearborn or S. Dearborn and S. Charles Streets in the south portal area would improve east-west connections between existing land uses such as the sports stadiums, Seattle Ferry Terminal, and waterfront businesses.

In the north portal area, new connections across Aurora Avenue at John, Thomas, and Harrison Streets and the extension of Sixth Avenue N. to Mercer Street would improve vehicle, bicycle, and pedestrian mobility between the Uptown, Belltown, and South Lake Union

Appendix G, Land Use Discipline Report

Methods used for assessing existing conditions, environmental effects, and mitigation are described in **Chapter 2** of *Appendix G*. **Chapter 5** provides additional information on effects to land use.

Attachment A of the report includes the list of the subsurface property acquisitions for the Bored Tunnel Alternative.

What is a tieback easement?

A tieback easement allows for use of a property below the surface for a wall shoring system that would be used to build a permanent wall and may be abandoned after the permanent wall is constructed.

neighborhoods. Broad Street would be closed between Ninth Avenue N. and Taylor Avenue N. Although the removal of Broad Street would change pedestrian, bicycle, and vehicle circulation patterns, it would not decrease accessibility to adjacent land uses, and overall mobility in the area would be improved compared to existing conditions.

The Bored Tunnel Alternative represents only one of numerous ongoing improvements occurring in the city. Because the Bored Tunnel Alternative would replace an existing facility to meet safety and mobility needs, it is consistent with land use plans and generally maintains and supports conditions. Therefore, the potential to induce growth in Seattle would be minor.

It is expected that future development along a new Alaskan Way would be an indirect effect of removing the existing viaduct. Development would likely occur in the form of modest expansions of existing buildings on the east side of the roadway. In addition, changes would occur in the relationship between the waterfront and upland properties leading to the downtown core. To the extent that the existing viaduct has been perceived as a barrier to waterfront uses, new development on vacant or underused property or redevelopment may take place around the new Alaskan Way surface street.

16 How would the local and regional economy be affected?

Effects to Businesses and Employees

As shown previously in Exhibits 5-38 and 5-39, 11 properties would be acquired. Of the 11 properties acquired, 5 would be fully acquired and 6 would be partially acquired. The economic effects of acquiring these properties are summarized in Exhibit 5-40.

Exhibit 5-40
Acquired Property Effects

	South Portal	North Portal	Total
Number of parcels subject to acquisition	5	6	11
Number of parcels subject to full acquisition	2	3	5
Number of buildings acquired	2	1	3
Approximate area of work space relocated or displaced *in square feet*	70,400	51,500	121,900
Estimated number of permanent jobs relocated or displaced[1]	25	119	144
Approximate property tax paid by fully acquired parcels[2]	$189,300	$74,800	$264,100
Area of fully acquired tax-paying parcels *in square feet*[3]	173,730	39,900	213,630

1 This estimate was based on the total square footage of each individual building, the use of the building (car wash, educational, and office), and the average square feet required per worker based on the use of the building (U.S. Department of Energy 2006).

2 This estimate was based on actual amounts collected in 2009 by the King County Finance and Business Operations for all of the parcels to be acquired. This estimate is for 1 year and represents less than 0.01 percent of all property tax revenue collected by King County in 2009 (King County GIS Center 2010).

3 The area of tax-paying parcels is less than the total area of property acquired because the City-owned maintenance yard is not a tax-paying property.

Partially acquired properties would retain their existing buildings, maintain their current function, and continue to pay property taxes at a reassessed value. Three buildings on fully acquired parcels would be removed. The loss of parcels with buildings would relocate or displace an estimated 144 workers, which represents about 0.07 percent of the total 2010 forecasted workforce in the Seattle Central Business District.

The temporary loss of on-street and off-street parking would result in less convenient access to some businesses by patrons and would, therefore, create an adverse effect.

Effects to Freight

Freight connections to the downtown core and Ballard/Interbay area would change with the Bored Tunnel Alternative since the existing ramps to Columbia and Seneca Streets and Elliott and Western Avenues would be removed. Routes for these trips would change, and travel times could increase depending on the route taken and the time of day. Travel times are discussed earlier in Question 5 of this chapter.

Surface street connections to SR 99 between Denny Way and Mercer Street would be consolidated to ramps at Republican and Harrison Streets. Direct connections to Mercer Street (northbound) and Broad Street (southbound) would be replaced by new connections to Republican Street and Harrison Street. These new ramps would be designed to accommodate truck movements.

Vehicles carrying hazardous and flammable cargo would be prohibited in the bored tunnel (this type of cargo is not permitted in the Battery Street Tunnel today). Instead of traveling on SR 99 through downtown, freight carrying hazardous or flammable cargo would be required to use another route, such as Alaskan Way or I-5. This change is estimated to affect 55 to 70 tanker trucks per day that currently may be legally carrying flammable or hazardous loads on the viaduct.

Improved east-west connections with the new surface streets and sidewalk improvements in both the south and north portal areas would benefit adjacent businesses and residences by improving accessibility for employees, customers, and residents.

Effects to Parking

The Bored Tunnel Alternative would remove approximately 570 parking spaces, as shown in Exhibit 5-41.

Exhibit 5-41
Parking Spaces Removed by the Bored Tunnel Alternative

	On-Street	Off-Street	Total
South Portal	110	250	**360**
North Portal	210	0	**210**
Total	**320**	**250**	**570**

Exhibit 5-42 shows the location of the parking spaces affected in the south portal area. In the south portal area, approximately 80 of the existing 190 on-street spaces would be replaced and 110 on-street spaces would be removed. The Seattle Department of Transportation will manage the on-street parking spaces and would likely encourage short-term parking. It is likely that replaced parking spaces would be designated as paid short-term parking. Currently, each paid parking space located along the waterfront generates approximately $6,600 per year in

Appendix C, Transportation Discipline Report

Additional information on parking is provided in *Appendix C*, Section 5.8.

revenue. If this estimate holds true for the south portal area and 110 paid on-street parking spaces were removed, approximately $726,000 would be lost from the City of Seattle's General Fund.

All of the approximately 250 off-street parking spaces near the south portal would be permanently removed by the project. Of these spaces, about 200 are on the Washington–Oregon Shippers Cooperative Association (WOSCA) property and are currently unavailable due to construction of the S. Holgate Street to S. King Street Viaduct Replacement Project. However, the S. Holgate Street to S. King Street Viaduct Replacement Project assumed that these 200 spaces would be replaced. With the Bored Tunnel Alternative, there may be space on the WOSCA site to replace some of the off-street parking; however, the conservative assumption is that these spaces would not be replaced. As a result, the Bored Tunnel Alternative assumes that the 200 spaces on the WOSCA site would be permanently removed. Future use of the WOSCA property will be determined by WSDOT or potential future property owners.

In the stadium area, there is abundant and underutilized off-street parking (public pay lots) when events are not taking place. The off-street parking utilization rate for the stadium area is about 31.1 percent on an average non-event weekday.[1] Because of this, off-street parking spaces are not anticipated to be difficult to find on typical days.

During events at the stadiums, finding available parking may be more challenging or may cost more than it does today. However, a number of major parking facilities are located near the stadiums, including the Safeco Field Garage, Stadium Exhibition Center Garage, Union Station Garage, North Lot (Qwest Field), Impark Parking, and Home Plate Parking. These six parking facilities provide about 6,900 parking spaces. Many smaller parking lots and garages are also within walking distance of the stadiums. Event-goers would continue to be encouraged to use bus and rail service and to carpool to the stadiums. The Safeco Field Transportation Management Plan and the Qwest Field Transportation Management Program both include parking reduction and transit-related goals and mitigation measures that aim to reduce the number of event attendees who require parking near the stadiums.

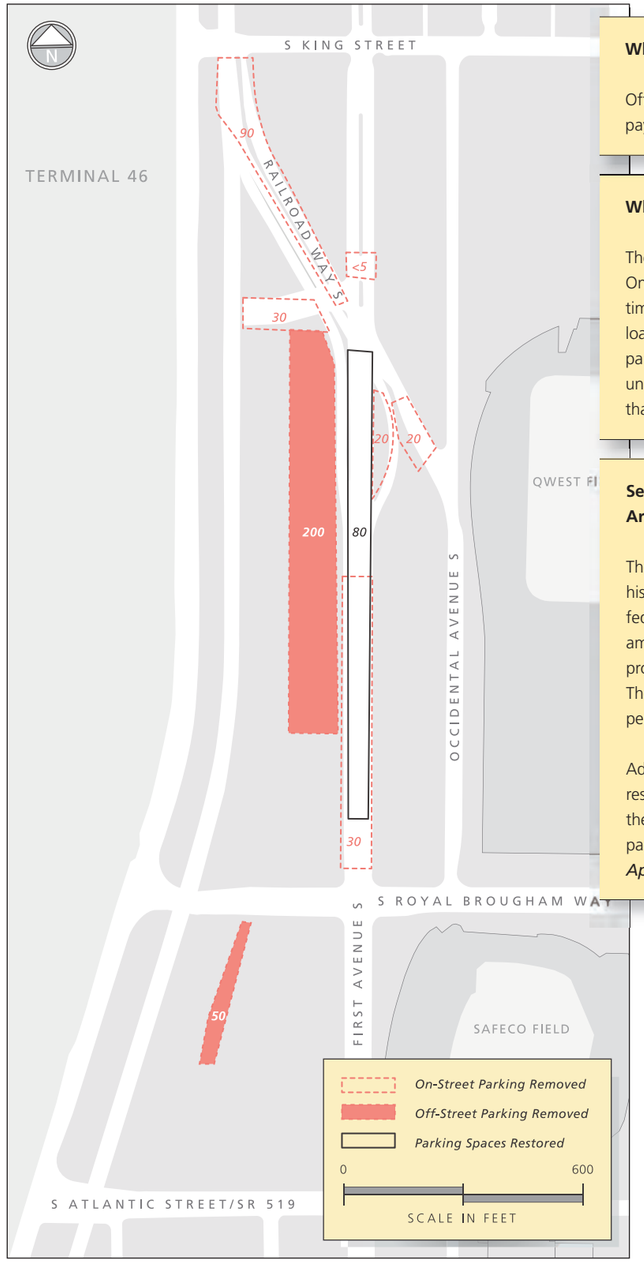
Along the central waterfront, the City of Seattle expects to begin work on the Alaskan Way Promenade/Public Space and the new Alaskan Way surface street after the viaduct is removed (see Chapter 8). It has not been determined how the space under the viaduct will be configured, but it is likely that the City's project will reduce the number of parking spaces compared to what exists under the viaduct today.

Exhibit 5-43 shows the location of the affected parking spaces in the north portal area. In the north portal area, there are approximately 140 on-street short-term parking spaces and approximately 230 on-street long-term spaces, for a total of 370 on-street spaces. The on-street, long-term spaces mainly consist of metered spaces with a 10-hour limit. For the Bored Tunnel Alternative, approximately 160 spaces would be replaced, resulting in a loss of 210 on-street spaces. The Seattle Department of Transportation will manage the on-street parking spaces, so no assumptions are made about whether the new and replaced on-street spaces would be long- or short-term spaces. However, if 210 paid on-street parking spaces were removed in the north portal area, approximately $1.4 million would be lost annually from the City of Seattle's General Fund.

17 How would historic and archaeological resources be affected?

The Bored Tunnel Alternative would demolish the Alaskan Way Viaduct and decommission the Battery Street Tunnel, which are eligible for the National Register of Historic Places. These structures have been documented with photos and a narrative history in accordance with Historic Engineering Record (HAER) standards. FHWA has consulted with the Washington Department of Archaeological and Historic Preservation, who concurred on July 8, 2010 that the project will have an adverse effect on one or more structures that are on or eligible for the

South Portal Affected Parking Spaces



What is off-street parking?

Off-street parking includes parking garages and lots where people pay to park. Most off-street parking is privately owned or operated.

What is on-street parking?

There are two types of on-street parking, short-term and long-term. On-street short-term parking includes metered spaces, time-restricted public parking spaces (such as 1-hour parking and loading zones), bus/taxi zones, and spaces reserved for police parking. On-street long-term parking includes unmetered, unrestricted on-street public parking spaces and metered spaces that allow all day parking.

Section 4(f) and Protection of Historic and Archaeological Resources

The project is adjacent to some of Seattle's most well-known historic buildings and neighborhoods. Section 4(f) is a provision of federal law pertaining to transportation projects that requires, among other things, that project proponents carefully consider protection of these resources in order to receive federal funding. The Alaskan Way Viaduct/Battery Street Tunnel would be permanently affected by the project.

Additional construction-related effects to historic and cultural resources are discussed in **Chapter 6**, **Questions 24** and **25** and in the Section 4(f) Evaluation found at the end of this document on page 225. The Section 4(f) Supplemental Materials are provided in ***Appendix J*** of this ***2010 Supplemental Draft EIS***.

Appendix I, Section 106: Historic, Cultural, and Archaeological Resources Discipline Report

Methods used to assess existing conditions, environmental effects, and mitigation are described in ***Appendix I***, **Chapter 2**. **Chapter 5** of ***Appendix I*** provides additional information on effects to historic, cultural, and archaeological resources.

Exhibit 5-42

1 PSRC. 2007.

National Register of Historic Places. These properties are the Alaskan Way Viaduct and Battery Street Tunnel, Western Building, Polson Building, and the Dearborn South Tideland site. WSDOT and FHWA have also determined that there is a potential adverse effect to an archaeological site that is currently a Seattle maintenance yard adjacent to the north portal. This site has not yet been determined eligible for the NRHP, but is assumed to be eligible. Potential effects to the Western Building, Polson Building, the Dearborn Tideland site, and the site on the Seattle maintenance yard would occur during construction and are discussed in Chapter 6, Questions 24 and 25. Adverse affects to these resources would be addressed by a Memorandum of Agreement developed in consultation with the State Historic Preservation Office, tribes, and the consulting parties and would meet the requirements of Section 106 of the National Historic Preservation Act and other applicable laws, regulations, and policies.

At the south portal, the presence of an approximately 65-foot-high tunnel operations building that would contain ventilation fans, exhaust stacks, emergency generators, and electrical and fire support utilities would be constructed on the block bordered by Alaskan Way S., Railroad Way S., and S. Dearborn Street. This site is across the street from the Pioneer Square Historic District and the Triangle Building, which is listed on the National Register of Historic Places. It would be a noticeable new feature, but less obtrusive than the adjacent ramp to First Avenue S. along Railroad Way S. that would be demolished as part of the Bored Tunnel Alternative. The tunnel operations building would be constructed at this location because the building must be adjacent to the portal to accommodate the ventilation needs of the tunnel. Because it is outside of the historic district and will be of compatible design and materials, the introduction of this building is not considered an adverse effect.

The Pioneer Square Historic District and Piers 54 through 62/63 on the central waterfront would benefit from removing the existing viaduct structure. This change would reduce noise, vibration, and air pollution and would improve views of and from the historic buildings. Removing the adjacent Columbia and Seneca Street ramps would provide similar benefits for the Polson and Journal buildings (both in the Pioneer Square Historic District) and the Colman, Grand Pacific, and Olympic Warehouse buildings (listed in the National Register of Historic Places).

18 How would neighborhoods be affected?

The Bored Tunnel Alternative would generally benefit neighborhoods in the project area. The new ramps near the stadiums would provide more direct access for people accessing the south downtown and Pioneer Square areas. On the other hand, removing the SR 99 ramps at Columbia and Seneca Streets and Elliott and Western Avenues would change how some drivers access downtown. Potential adverse effects would primarily be related to access changes in the Commercial Core and Belltown neighborhoods. Some travel routes to businesses and residences in the Central Business District and Belltown may take more time, since drivers would need to exit SR 99 at either the north or south portal and then travel via local streets.

Access to businesses and residences in the Uptown and South Lake Union neighborhoods would be maintained or improved with the Bored Tunnel Alternative. The Bored Tunnel Alternative would maintain SR 99 access north of Denny Way and enhance roadway safety, since arterial connections to and from SR 99 between John and Roy Streets would be replaced with consolidated access at Harrison and Republican Streets. Circulation for all modes of travel to, from, and within neighborhoods and community resources would improve north of Denny Way since the John, Thomas, and Harrison streets would be built to cross Aurora Avenue. As a result, some areas within these neighborhoods may become more desirable, which would be an indirect effect of the project. The north portal improvements would help the Belltown, Uptown, and South Lake Union neighborhoods to be more cohesive and connected. The elimination of the Western Avenue and Battery Street SR 99 ramps and the decommissioning of the Battery Street Tunnel would likely

North Portal Affected Parking Spaces

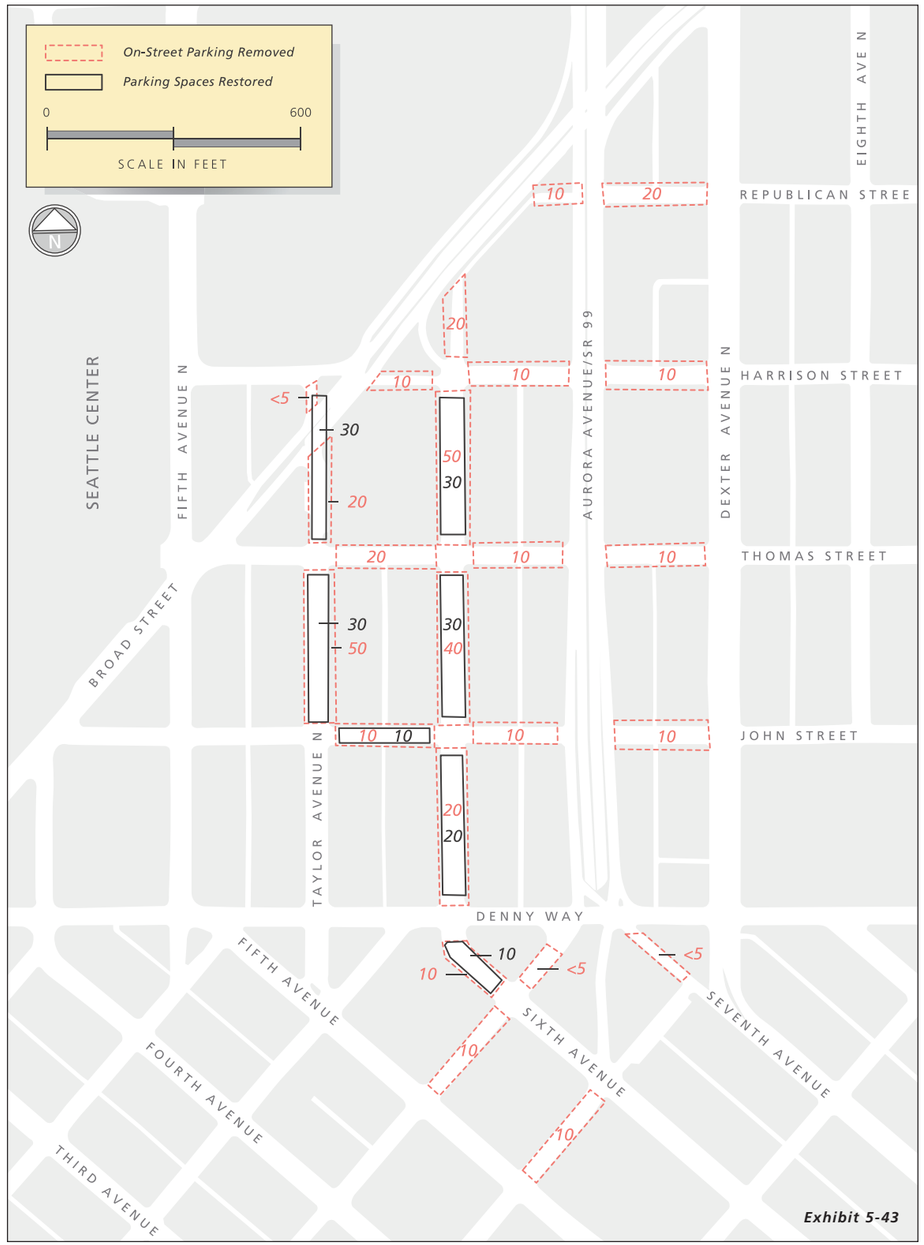


Exhibit 5-43

increase the perceived quality of life and desirability of surrounding Belltown properties.

Removing the viaduct along the central waterfront would also likely have an indirect effect on the adjacent neighborhoods, increasing the desirability of existing properties immediately adjacent to the existing elevated structure.

19 How would community and social services be affected?
For people who work or seek services at downtown area community and social service facilities, access would change only slightly. Access would not change for residents in the project area neighborhoods who seek services. However, for residents traveling on SR 99 to access services from outside of the downtown area, there would be no midtown on- or off-ramps for vehicles or transit. Vehicles and transit would exit SR 99 farther south on Alaskan Way S. near S. King Street. Some routes might be slightly more circuitous, and travel times may be somewhat longer, while other routes (such as those to the Pioneer Square area) may become more direct and travel times may decrease. short term as people and service providers adjust to changes. Some minority and low-income populations, including those with physical and mental disabilities, economic disadvantages, and language and cultural barriers, may have more difficulty adapting to such transitions. Continued community outreach and communication will be a crucial part of minimizing any potential effects.

The changes would not result in a disproportionately high and adverse impact because the city's downtown low-income and homeless residents would continue to have good transit and pedestrian access to key service providers in the area. For social service organization workers and patrons living outside of downtown Seattle, travel routes may be altered because of the changes in SR 99 access. Travel times could increase or decrease slightly depending on their end location, but this would not substantially affect the organizations continued operations.

Homeless people who currently seek shelter under the viaduct may be affected by its removal. However, seeking shelter underneath the viaduct is illegal. Regardless, the lead agencies have considered ways to coordinate with social service providers to notify homeless individuals who may be using areas under the viaduct for shelter.

20 How would low-income or minority populations be affected?
The Bored Tunnel Alternative would not displace any residences. The Bored Tunnel Alternative would acquire and remove a building where a non-profit organization, the Seattle Jobs Initiative, has office space. This office space is located north of Denny Way and is used primarily for administration purposes. Seattle Jobs Initiative works directly with low-income individuals out of other locations, so this office space could be relocated in the area without a substantial disruption to low-income individuals served. Relocation assistance would be provided in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended, and the Washington Relocation Assistance – Real Property Acquisition Policy Act of 1970, as amended.

One concern for minority and low-income populations with this project is changes in SR 99 access, pedestrian routes, and transit services. These effects are likely to be

The Bored Tunnel Alternative would displace on- and off-street parking near the south and north portals. This reduction would not have a disproportionately high and adverse effect on low-income and minority populations, since there would continue to be parking available in the project area.

Overall, the Bored Tunnel Alternative would not have a disproportionately high and adverse effect on low-income or minority populations.

21 How would parks, recreation, and open space be affected?
The Bored Tunnel Alternative would benefit parks and recreational resources by removing the existing viaduct, which would improve connections between elements of Seattle's park and recreation system into Seattle's downtown neighborhoods.

Near the south portal, the Bored Tunnel Alternative would change the configuration of SR 99 and nearby streets. The on- and off-ramps near the stadiums would provide more direct connections to recreational facilities such as Qwest and Safeco Fields. One or two new east-west cross-streets would be built west of Qwest Field (at S. Dearborn Street, or S. Dearborn and S. Charles Streets) and would have sidewalks on both sides.

The existing 15-foot-wide Waterfront Bicycle/Pedestrian Facility located east of Alaskan Way S. would be replaced with a 25-foot-wide multi-use path called the City Side Trail. The City Side Trail would connect to the Mountains to Sound Greenway Trail at S. Royal Brougham Way.

In the Pioneer Square area, conditions for people visiting the Washington Street Boat Landing would be improved due to viaduct removal. Viaduct removal may encourage more pedestrian movement between the waterfront and Pioneer Square. The additional open space provided by removing the viaduct would be consistent with the Pioneer Square and Downtown Urban Center Neighborhood Plans.[2,3]

In the central waterfront, viaduct removal would improve the integration of existing park and recreation uses between the waterfront piers and downtown Seattle and reduce noise levels. The Seattle Aquarium is likely to benefit from more pedestrian-friendly connections between the aquarium and downtown along east-west streets such as University Street and the Pike Street Hillclimb. The relationship between the waterfront and the Pike Place Market, which is a major tourist destination, would be strengthened. Piers 55 to 62/63 also attract many tourists and would be enhanced by reduced noise levels, improved views, and a more pedestrian-friendly environment. Access to the boat service to Blake Island State Park in Puget Sound from Pier 55 to Tillicum Village would also potentially benefit from these changes.

Appendix H, Social Discipline Report

Methods used for assessing social resources are described in *Appendix H*, **Chapter 2**. **Chapter 5** provides additional information on effects to neighborhoods, community, social services, and park and recreational resources.

Environmental Justice is also discussed in *Appendix H*.

Chapter 9 Tolling

The Bored Tunnel Alternative evaluated in this chapter is an un-tolled facility. However, the state legislature has directed WSDOT to analyze the performance of a tolled facility and how it might affect traffic and effects to other resources. Tolls have the potential to be a burden on low-income individuals. Tolling is discussed in **Chapter 9** of this Supplemental Draft EIS.

Section 4(f) and Protection of Public Park and Recreation Resources

The project is adjacent to some of Seattle's well-known public parks and open spaces. Section 4(f) is a provision of federal law pertaining to transportation projects that requires, among other things, that project proponents carefully consider protection of these resources in order to receive federal funding.

Additional construction-related effects to park and recreational resources are discussed in **Chapter 6, Questions 29** and in the **Section 4(f) Evaluation** found at the end of this document on page 225. The Section 4(f) Supplemental Materials are provided in **Appendix J** of this *2010 Supplemental Draft EIS*.

2 City of Seattle. 1998.

3 City of Seattle. 1999.

The Wave Rave Cave was designed as long-term temporary public art installation that recognized future construction to replace the viaduct would eliminate its current site beneath the existing viaduct at Western Avenue. Prior to construction, a decision will be made to remove or relocate the installation. A relocation site has not been identified at this time.

Near the north portal, the Bored Tunnel Alternative would change the configuration of SR 99 and connect three surface streets across Aurora Avenue. Providing new connections at John, Thomas, and Harrison Streets would improve circulation near Denny Park and provide increased opportunities for park access. Along with new street connections, closing the Broad Street underpass and widening Mercer Street to accommodate two-way traffic would change the circulation of local traffic accessing Seattle Center. This may change travel routes for people destined for area park and recreational facilities, but would not affect the physical configuration of these facilities.

22 How would public services (such as police and fire) and utilities be affected?

Public Services

Response and travel times for public services could change slightly with the Bored Tunnel Alternative due to changes in access, intersection operations, and travel times. Effects to public services (including fire, police, emergency service vehicles, solid waste/recycling services, postal carriers, and school buses) would depend on the time of day and route taken.

SR 99 through traffic is expected to operate better for the 2015 Bored Tunnel Alternative than the 2015 Existing Viaduct due to the removal of the merging and weaving conflicts associated with the Elliott and Western ramps and the Columbia and Seneca ramps. Peak hour travel speeds are expected to be faster for the 2015 Bored Tunnel Alternative compared to the 2015 Existing Viaduct.

Other benefits for public services with the Bored Tunnel Alternative include the following:

- Improved mobility in the South Lake Union area due to the connection of three east/west streets across SR 99
- Improved access from Mercer Street to southbound SR 99 as a result of the extension of Sixth Avenue N. to Mercer Street
- Improved connection between downtown and the Seattle Center area with the extension of Sixth Avenue N. between Harrison and Mercer Streets

Travel times for most of the routes are not expected to vary noticeably between the 2015 Existing Viaduct and the 2015 Bored Tunnel Alternative, with the majority of travel times generally within 1 or 2 minutes of each other. During the PM peak hour, the 2015 Bored Tunnel is expected to have more congested intersections located along Mercer Street than the 2015 Existing Viaduct; however, as shown previously in Exhibit 5-15, travel times along Mercer Street are expected to vary by 1 or 2 minutes.

The Bored Tunnel Alternative is not expected to adversely affect emergency service response times and operations, because emergency responders would have comparable access to SR 99 in the case of an emergency, and traffic operations on downtown streets are expected to be comparable to the 2015 Existing Viaduct. For some non-emergency public service providers (such as postal carriers or waste disposal), trip times may vary depending on the route taken and the time of the trip.

Tunnel Safety and Security

A variety of measures would be employed to minimize potential risks associated with emergencies such as a tunnel fire or an accident where hazardous materials, such as oil or gasoline, are spilled. One of the measures includes prohibiting trucks that carry flammable and hazardous materials from using the tunnel in accordance with City regulations. Other measures include designing the bored tunnel to provide emergency access, evacuation routes, ventilation, and fire suppression systems in accordance with National Fire Protection Association standards and other codes and regulations. Access to the tunnel would be maintained at all times to ensure prompt emergency response times and the safety of people traveling in the tunnel. Depending on the location and extent of an emergency, a spill incident could require response from a number of emergency management agencies could be required, including the Seattle Office of Emergency Management, Port of Seattle, Washington State Ferries, and the City of Seattle.

For law enforcement services, the Bored Tunnel Alternative could require additional police staff or additional patrol cars to monitor the system, including the bored tunnel and other areas. However, careful planning and design of the system and its related facilities, in association with local law enforcement services, could help deter criminal activity.

Utilities

Long-term operations are not expected to restrict utility capacity, disrupt utility service, or impair access and maintenance functions. The Bored Tunnel Alternative is being designed to address access and maintenance concerns of various utility providers, and efforts are being made to reduce conflicts wherever possible. Additional electric power would be needed for life safety requirements in the tunnel for lighting, ventilation, pump operation, and impressed current for corrosion control. Ventilation and electrical lighting in the tunnel would use an estimated 239 million British thermal units (BTUs) daily, which is a small portion of the total daily operational energy consumption of 748,944 million BTUs.

Appendix K, Public Services and Utilities Discipline Report

Methods used for assessing existing conditions, environmental effects, and mitigation are described in *Appendix K*, Chapter 2. Chapter 5 provides additional information on effects to public services and utilities.

23 How would air quality be affected?

Air quality is not expected to be affected by the Bored Tunnel Alternative. The estimated carbon monoxide (CO) concentrations at intersections for the Bored Tunnel Alternative are all projected to be below the 1-hour and 8-hour National Ambient Air Quality Standards (NAAQS) of 35 and 9 parts per million (ppm), respectively. Analysis of the tunnel portals and tunnel operations buildings also showed that all estimated concentrations of CO and particulate matter with a diameter of 2.5 micrometers or less ($PM_{2.5}$) would be below the NAAQS, as shown in Exhibit 5-44.

Exhibit 5-44
Maximum Predicted CO and $PM_{2.5}$ Concentrations
Near the Tunnel Portals

	CO Concentrations – ppm				$PM_{2.5}$ Concentrations – µg/m³			
	2015		2030		2015		2030	
	1 hr	8 hr	1 hr	8 hr	24 hr	Annual	24 hr	Annual
South Protal – *New Dearborn Intersection*	12.1	4.1	9.9	3.5	22.6	8.1	22.5	8.1
South Protal – *New Dearborn & Charles Intersections*	12.3	4.3	10.0	3.7	22.6	8.1	22.6	8.1
North Portal – *both options*	12.0	4.7	10.0	4.1	24.2	8.4	23.9	8.2

Notes: *ppm = parts per million*
µg/m³ = micrograms per cubic meter
hr = hour
For CO, 1-hour levels include a background concentration of 2.3 ppm; 8-hour levels include a background concentration of 1.5 ppm. The 1-hour NAAQS is 35 ppm; the 8-hour NAAQS is 9 ppm.
For $PM_{2.5}$ annual levels include a background concentration of 7.5 micrograms per cubic meter (µg/m³); 24-hour levels include a background concentration of 20.2 µg/m³. The annual NAAQS is 15 µg/m³; the 24-hour NAAQS is 35 µg/m³.

Even though the VMT in the Seattle Center City area is predicted to increase by about 17 percent with the 2030 Bored Tunnel Alternative as compared to the 2005 existing conditions, mobile source air toxic emissions are predicted to decrease dramatically compared to existing levels. Emissions are expected be lower than present levels in 2030 (the design year for the roadway) as a result of the U.S. Environmental Protection Agency's (EPA's) national control programs, which are projected to reduce diesel particulate matter by approximately 94 percent and reduce other mobile source air toxic emissions by 54 to 63 percent.

24 How would greenhouse gas emissions be affected?

Projected increases in greenhouse gases would be due primarily to the increases in future vehicle traffic and fuel use in the region. The greenhouse gas emissions with the Bored Tunnel Alternative in 2030 are predicted to be higher than existing conditions and the 2015 Existing Viaduct because of the increases in future vehicular volumes and the power needed to operate tunnel operations and lighting systems. Most greenhouse gas emissions with the Bored Tunnel Alternative would come from vehicle exhaust. Emissions from energy sources that will power tunnel systems would produce a much smaller portion of greenhouse gas emissions.

Typical greenhouse gases that are in the atmosphere include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated gases. For this project, the greenhouse gas analysis used CO_2 as the standard and emissions are expressed in terms of CO_2 equivalents to compare different greenhouse gases. Exhibit 5-45 shows that greenhouse gas emissions from vehicles in Seattle's City Center area and in the region would be slightly lower with the Bored Tunnel Alternative in 2015 than with the 2015 Existing Viaduct. When the emissions from vehicles are combined with the ventilation, lighting, and maintenance emissions, the resulting greenhouse gas emissions would be higher for the Bored Tunnel Alternative than the 2015 Existing Viaduct. The greenhouse gas emissions in 2030 are predicted to be higher than conditions in 2015 because of the increases in vehicle volumes. The potential direct emissions of greenhouse gases under the Bored Tunnel Alternative were estimated using the MOVES2009 model and the results of the energy analyses.

The estimates are conservative because they do not take into account the expected future shift in vehicle mix (i.e., fewer light-duty trucks and more fuel-efficient vehicles, including hybrids) or the new Corporate Average Fuel Economy (CAFE) standards, which would lead to better fleet-wide fuel efficiency and result in lower CO_2 equivalent emissions generated. CAFE regulations are expected to improve vehicle emissions by approximately 21 percent by 2030, as compared to the level that would occur without the regulations.[4]

Exhibit 5-45
Daily Greenhouse Gas (CO_2 equivalent) Roadway Emissions Estimates
Metric Tons per Day

	2005 Existing Conditions	2015 Existing Viaduct	2015 Bored Tunnel	2030 Bored Tunnel
City Center[1]	988	1,137	1,133	1,236
City Center[1] – *with ventilation, lighting, and maintenance*	989	1,138	1,163	1,266
Regional[2]	39,189	46,557	46,554	55,806
Regional[2] – *with ventilation, lighting, and maintenance*	39,190	46,558	46,584	55,836

1 *The City Center study area is bordered by Prospect Street on the north, 15th Avenue on the east, S. Holgate Street on the south, and Elliott Bay on the west.*
2 *The regional study area includes King, Pierce, Snohomish, and Kitsap Counties.*

25 Would energy consumption be affected?

As shown in Exhibit 5-46, the energy consumed within the broader Center City transportation network would be very similar with the 2015 Bored Tunnel than the 2015 Existing Viaduct. This slight decrease in energy consumption is because the Bored Tunnel Alternative is expected to have slightly fewer vehicle miles traveled than the 2015 Existing Viaduct. The total energy use in 2030 is expected to increase compared to 2015 due to increased vehicle volumes. In addition, about 9 million BTUs of energy would be consumed by maintenance of the roadway. Ventilation and electrical lighting in the tunnel would use an additional 239 million BTUs.

Exhibit 5-46
Daily Roadway Vehicular Energy Consumption
in million BTUs

	2005 Existing Conditions	2015 Existing Viaduct	2015 Bored Tunnel	2030 Bored Tunnel
City Center[1]	13,221	15,252	15,186	16,583
Regional[2]	524,473	624,145	624,098	748,696

1 *The City Center study area is bordered by Prospect Street on the north, 15th Avenue on the east, S. Holgate Street on the south, and Elliott Bay on the west.*
2 *The regional study area includes King, Pierce, Snohomish, and Kitsap Counties.*

The EPA MOVES2009 model was used to calculate the amount of energy consumed by vehicles. The future energy consumption estimate is conservative because it does not take into account the expected future shift in vehicle mix (fewer light-duty trucks and more fuel-

Appendix M, Air Discipline Report

Modeling for the screening level mobile source analysis was conducted using the Washington State Intersection Screening Tool (WASIST). The tunnel portal and ventilation building analysis was conducted using the AERMOD model. Methods used for the air quality analysis are described in detail in ***Appendix M***, **Chapter 3**, and results are described in **Chapter 5**.

What are Mobile Source Air Toxics?

To help protect air quality, EPA identified a group of 21 pollutants as mobile source air toxics in a 2001 final rule, Control of Emissions of Hazardous Air Pollutants from Mobile Sources (66 FR 17235). From the list of 21, EPA identified six priority mobile source air toxics. These are benzene, formaldehyde, acetaldehyde, diesel particulate matter/diesel exhaust organic gases, acrolein, and 1,3-butadiene.

In 2007, EPA finalized a rule to reduce hazardous air pollutants from mobile sources. In September 2009, FHWA released guidance on when and how to analyze mobile source air toxics in the National Environmental Policy Act (NEPA) process for highways. According to FHWA's tiered approach, this project is a Tier 3 and requires quantitative analysis for Mobile Source Air Toxics (MSATs). More information on mobile source air toxics is available in ***Appendix M***, ***Air Discipline Report***.

Appendix R, Energy Discipline Report

Methods used for assessing existing conditions, environmental effects, and mitigation are described in ***Appendix R***, **Chapter 2**. This appendix also provides additional information on CO_2 equivalents, greenhouse gases, and energy consumption.

What are CO_2 equivalents?

Greenhouse gases have different abilities to trap heat. To compare different greenhouse gases, scientists use a weighting factor. CO_2 is used as the standard. Other gases are converted into CO_2 equivalents using the weighting factor.

4 NHTSA. 2010.

efficient vehicles) or the new CAFE standards, which would lead to better fleet-wide fuel efficiency and result in lower energy consumption. CAFE regulations are expected to improve vehicle emissions by approximately 21 percent by 2030, as compared to the level that would occur without the regulations.[4]

26 How would water resources be affected?

Runoff from impervious surfaces such as streets and highways, particularly in urban environments, contains pollutants that affect the water quality of receiving waters like Lake Union, Elliott Bay, and Puget Sound. Compared to existing conditions, the Bored Tunnel Alternative would reduce the overall amount of pollutant-generating impervious surface within the area that drains to these receiving waters. This is expected to improve water quality. Also, some portions of the project area currently discharge to Elliott Bay and Lake Union without treatment. The Bored Tunnel Alternative would provide water quality treatment for pollutant-generating impervious surfaces in these areas.

The project area studied for water resources included approximately 55 acres of pervious and impervious surface area. The Bored Tunnel Alternative would reduce the total pollutant-generating impervious surfaces. However, the overall impervious surface area would actually increase compared to existing conditions. This additional surface area would be non-pollutant-generating impervious surfaces and would increase the total impervious area by less than 1.5 acres. Most of the increase would occur because of the wider pedestrian and bicycle facility in the south portal area, new sidewalks, and the tunnel operations building at each portal. Stormwater detention would be provided in certain areas to mitigate the potential for increases in overflows from the combined sewer system that might occur because of these increases in impervious surfaces.

In the south portal area, most of the stormwater runoff is currently collected by the combined sewer system and would continue to be in the future. Under typical conditions, water in the combined sewer system gets treated at the West Point Sewage Treatment Plan prior to being discharged. There is one small area located between S. Atlantic Street and S. Royal Brougham Way that, during very heavy rains, currently drains to Elliott Bay without treatment. Under the Bored Tunnel Alternative, basic water quality treatment would be provided in this area using best management practices (BMPs) selected from the *Seattle Stormwater Manual*[5] and/or the WSDOT *Highway Runoff Manual*.[6] Treating stormwater prior to discharge would reduce the volume of pollutants entering receiving water bodies. In the south portal area, modeling has shown that detention would not reduce the potential frequency or volume of overflows from the combined sewer system. As a result, the City has granted an exception from detention requirements for the stormwater draining to the combined sewer system in the south portal area.[7]

In the central portion of the project area, some of the stormwater runoff from the viaduct is directed to the combined sewer system for treatment at West Point Sewage Treatment Plant. However, some of the stormwater runoff from the viaduct discharges directly to Elliott Bay and Lake Union without being treated. The new roadway would be placed in an underground tunnel, which would reduce the surface area that can catch rainfall and produce runoff containing roadway pollutants. Some stormwater is expected to enter the tunnel at each portal area. This water would be pumped to each respective portal and discharged to the combined sewer system. Other drainage associated with the bored tunnel, such as testing and operation of the emergency fire suppression system, tunnel washing, and groundwater seepage, would be collected and pumped to the south portal for discharge and treatment through the combined sewer system.

In the north portal area, the Bored Tunnel Alternative would change the existing drainage basin boundaries somewhat. Peak stormwater flow control would be provided by installing one or more detention facilities as required by the Seattle Stormwater Code. Using detention in the north portal area would mitigate the potential for increases in overflows from the combined sewer system that might occur because of the increase in impervious surfaces. Water quality treatment in the north portal area would be provided in one of two ways:

1 Stormwater would be collected entirely by the combined sewer and treated at West Point Treatment Plant.

2 A portion of the stormwater would be collected by the combined sewer for treatment at West Point Treatment Plant, and the remaining pollutant-generating impervious surfaces would be treated with BMPs and discharged to Lake Union through an existing outfall.

An area that currently discharges to Lake Union without treatment would be treated using one of these methods. Water quality treatment BMPs would be selected from the *Seattle Stormwater Manual*[5] and/or the WSDOT *Highway Runoff Manual*.[6] The amount of water that discharges to Lake Union through the existing outfall would increase slightly.

27 How would fish, aquatic, and wildlife habitat be affected?

The Bored Tunnel Alternative would improve water quality compared to existing conditions because stormwater runoff would be treated prior to being discharged. Treating stormwater runoff prior to discharge would reduce potential effects to fish, wildlife, and vegetation resources compared to existing conditions.

Removing the viaduct would substantially reduce the existing traffic noise occurring along Seattle's central waterfront. While most species occupying the study area are expected to be accustomed to the existing noise, reducing these noise levels could potentially reduce the stress levels and improve the overall environmental conditions for wildlife species occurring in the area.

What is a British thermal unit (BTU)?

A BTU is the approximate amount of energy needed to heat 1 pound of water 1 degree Fahrenheit.

What is the EPA MOVES2009 model?

The EPA Motor Vehicle Emission Simulator (MOVES) 2009 model estimates overall fuel usage based on characteristics such as vehicle mix, vehicle age, speed, and area-specific meteorological data.

What is an impervious surface?

A surface is considered impervious if water cannot easily pass through it. Common impervious surfaces in the project area are pavement and concrete.

What is a pollutant-generating impervious surface?

A pollutant-generating impervious surface is an area such as a street where pollution from vehicles can build up and when it rains may runoff in the stormwater.

What is a BMP?

A best management practice (BMP) is an action or structure that reduces or prevents pollutants from entering stormwater or treats stormwater to reduce possible degradation of water quality.

Appendix O, Surface Water Discipline Report

Methods used for assessing existing conditions, environmental effects, and mitigation are described in *Appendix O*, Chapter 2. Chapter 5 provides additional information on effects to water resources. Attachment A of *Appendix O* provides the detailed pollutant-loading analysis.

5 City of Seattle. 2009b.

6 WSDOT. 2008.

7 City of Seattle. 2009c.

Generalized Subsurface Profile

Along Bored Tunnel Alternative

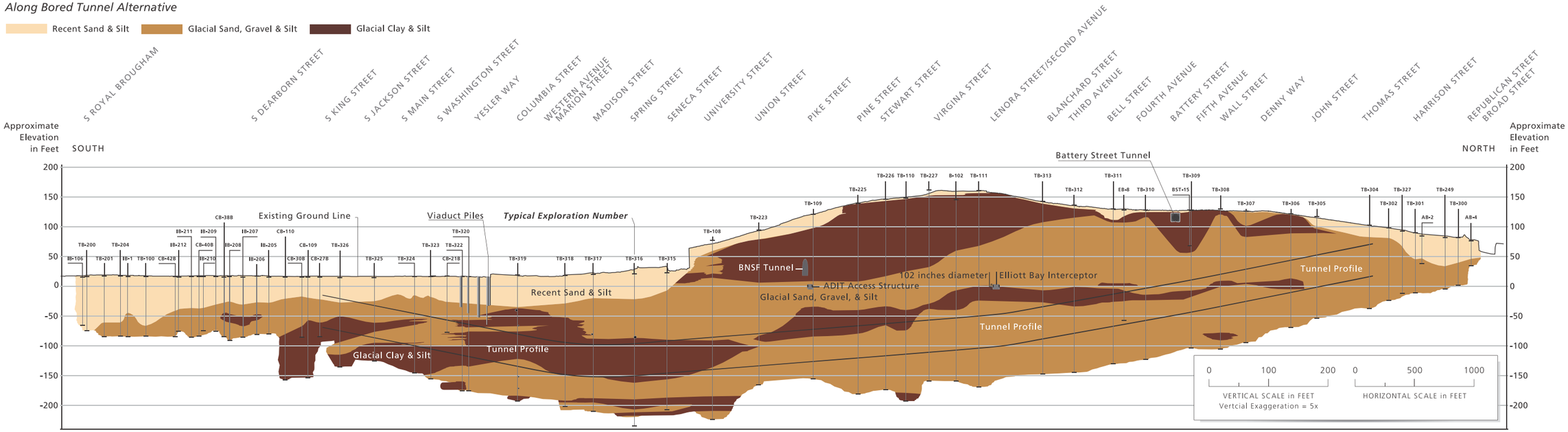


Exhibit 5-47

28 How would soil conditions and groundwater be affected?

South Portal Area

Fill and soil improvements would modify existing soil conditions in portions of the south portal area. A small fill embankment (generally less than 6 feet high) would be required to connect SR 99 to the new bored tunnel near S. Royal Brougham Way. Some fill may also be needed to align roadways and restore the surface grade level for new surface streets near the south portal. Soil conditions beneath these fill areas consist of loose and soft silt that are susceptible to settlement. The proposed tunnel operations building would likely be supported on deep foundations consisting of drilled shafts or a mat foundation.

When the Bored Tunnel Alternative goes below the ground level at the south portal, retained cuts and cut-and-cover sections of the roadway and ramps would likely be supported by retaining walls, such as secant pile walls or slurry walls. The water table in the south portal area is about 2 to 12 feet below the ground surface. Groundwater flow may be altered by the presence of the walls supporting the retained cuts and cut-and-cover tunnel and soil improvement areas. Areaways and basements adjacent to the alignment could also experience leakage or partial flooding if groundwater mounding occurs. To prevent potential impacts, groundwater monitoring devices have been installed in the study area to evaluate groundwater levels over time. If the groundwater mounding is higher than anticipated, then mitigation measures could include constructing pipes or drainage trenches that connect the groundwater flow between the west and east sides of wall or soil improvement zones. If feasible for design, gaps could be left in the ground improvement zones to allow groundwater to flow through the unimproved areas.

Locally contaminated groundwater may be encountered in the project area. The flow of contaminated groundwater could be altered by the presence of the walls supporting the retained cuts, cut-and-cover portions of the tunnel, and soil improvement areas, particularly in the south project area.

Specific areas of soil improvement have not yet been planned for the area between the south portal and where the tunnel boring machine would be launched. During final design, soil improvement may be required around or beneath retained cuts, cut-and-cover tunnel sections, or foundations to mitigate liquefaction, reduce groundwater flow, and provide additional soil strength.

Settlements in some types of soil could occur more slowly, over a period of several months to more than a year, and could require soil improvements. Settlement during construction is discussed in Chapter 6, Question 18.

Appendix N, Wildlife, Fish, and Vegetation Discipline Report

Methods used for assessing existing conditions, environmental effects, and mitigation are described in *Appendix N*, Chapter 2. Chapter 5 provides additional information on potential effects from the Bored Tunnel Alternative.

Appendix P, Earth Discipline Report

Methods used for assessing existing conditions, environmental effects, and mitigation are described in *Appendix P*, Chapter 2. This appendix also includes information on the geologic setting and hazards in the project corridor.

What is groundwater mounding?

Groundwater mounding occurs when water is blocked and builds up behind a barrier. A barrier could be something natural such as a dense soil layer, or something man-made such as a building foundation or subsurface retaining wall.

Bored Tunnel
The general subsurface geology along the bored tunnel alignment is shown in Exhibit 5-47. Soil improvements may be installed beneath some of the buildings along the alignment to mitigate potential settlement caused by tunneling. In addition, soil improvement may be performed in several locations along the tunnel alignment between S. King Street and Seneca Street to strengthen recent soil deposits along the crown of the tunnel. No soil improvements would occur between S. Main and S. Washington Streets to avoid potential archaeological deposits. Near the north portal, soil improvement may be performed near John and Thomas Streets to stabilize areas of soft and loose soils, reduce perched groundwater flow, and mitigate potential future liquefaction.

Once construction is completed, no effects to soils are expected. Soil conditions along the bored tunnel alignment generally consist of very dense and hard soils that have been compacted by the weight of glaciers. Since the net weight of the tunnel would likely be less than the soil that is removed, additional loads would not be placed on the soil by the tunnel structure.

To provide uplift resistance from the water table, ground anchors may be considered for the tunnel. The water table between S. King Street and Yesler Way is within 10 feet of the ground surface. Groundwater flow may be altered by the presence of the bored tunnel and potential soil improvements. The combination of these improvements could obstruct groundwater flow and cause it to mound up against the east side of the tunnel alignment, raising the groundwater table in this area. A higher water table would not cause soil settlement; however, utilities and other subsurface structures that were previously above the water table could become partially submerged if groundwater mounding occurs. Areaways and basements adjacent to the south end of the alignment could also experience leakage or partial flooding if groundwater mounding occurs but mitigation measures would be put in place to prevent potential impacts. If groundwater mounding occurs, it is not expected to affect contaminant concentrations or the amount of contaminants that ultimately reach Elliott Bay.

North of Yesler Way, groundwater mounding along the bored tunnel is not anticipated. The lower aquifers that the 54-foot-high tunnel would intersect are widespread, interconnected, and highly pervious, allowing water to flow around the tunnel.

North Portal Area
In the north portal area, SR 99 would include a cut-and-cover and retained cut structure connecting to the existing at-grade SR 99 roadway at Roy Street. These sections of the roadway and ramps would likely be supported by retaining walls. No soil improvements are anticipated because the soils are hard or dense in this area.

Both options for the Sixth Avenue connection would require a retained cut, about 20 feet deep at Mercer Street, extending south until it reaches existing grade near Broad Street. The Bored Tunnel Alternative includes filling in Broad Street between Ninth Avenue N. and Taylor Avenue N. Fill would also be placed over the cut-and-cover transition section to restore the surface grade and construct the surrounding street grid. Since soil conditions near the north portal are hard or dense; effects related to settlement beneath the fills are not anticipated. The north portal area would also include a tunnel operations building.

During the design process, site-specific mitigation measures would be identified to address potential operational effects on adjacent facilities. With mitigation, no indirect effects to soils or groundwater are anticipated.

29 What are indirect effects and would the Bored Tunnel Alternative have any?

An indirect effect is a reasonably foreseeable effect that may be caused by a project but would occur in the future or outside of the project area. Once the project is built, it would result in very few indirect effects, and these possible effects would be positive rather than negative. For example, once the existing viaduct is removed, buildings directly adjacent to SR 99 may eventually be renovated due to improved views and reduced noise. In addition, changes would occur in the relationship between the waterfront and upland properties leading to the downtown core. To the extent that the existing viaduct has been perceived as a barrier to waterfront uses, new development on vacant or under-used property or redevelopment may take place around the new Alaskan Way surface street.

Part of the reason why this project's indirect effects are limited is because this project is a replacement project, not a new roadway or highway expansion project. The surrounding area and region have been developed and planned assuming this type of transportation facility. The project would replace failing infrastructure critical to the city, region, and state. Once built, the project would remove a significant risk to the stability of Seattle's waterfront and the state's highway system. The replacement would not increase existing roadway capacity. As such, the replacement would continue to provide the infrastructure required to connect and support many well-established, densely developed urban areas. In some areas, the built project may support renovation and revitalization of existing urban land uses.

The project would change routes and travel times for some of those who use the existing viaduct. These types of changes can affect businesses and residents, and hence potentially have an indirect effect on future land use and development patterns. However, these patterns are largely determined by land use regulations and economic conditions. The land use changes due to the Bored Tunnel Alternative are so small they would be insignificant.

30 What irreversible decisions or irretrievable resources would be committed to building the Bored Tunnel Alternative?

The only anticipated irreversible commitment of resources for this project would be converting existing commercial, industrial, or retail properties into transportation land uses. The Bored Tunnel Alternative would require purchasing property, and some of the needed properties have buildings on them that may be demolished.

A few resources would be irretrievable once the project was completed. If archaeological resources are located in

What is liquefaction?

Liquefaction is what can happen to loose soils when shaking motions from an earthquake causes the soil to turn into a quicksand-like condition. This can cause foundations to fail.

areas where soil improvements are made, they would no longer be retrievable. In these areas, the cement grout or material used for soil improvements would encapsulate any archaeological resources not able to be recovered during construction.

Other resources that would not be retrievable would be the physical materials used to build the project. These include resources such as aggregate used to make concrete and asphalt, steel needed to make rebar and steel structures, oil to make asphalt, and fill material. These are finite resources; however, they are not currently in short supply. Contaminated soil, spoil material, and excavated soil would be transported to landfills; thus, the space used for this project would not be available for other disposal uses. However, there is adequate space available for this type of disposal at landfills.

Finally, the energy used to keep SR 99 operating would not be retrievable. Once the project is built, the tunnel's lighting and ventilation systems would require energy to keep the roadway operational.

31 What are the tradeoffs between short-term uses of environmental resources and long-term gains (or productivity)?

This question is really asking if the long-term benefits from the Bored Tunnel Alternative make it worth the short-term effects. Because the project involves replacing failing infrastructure that people depend on, this question has a fairly simple answer. The Bored Tunnel Alternative would require approximately 5.5 years of construction. Even with the best planning, construction would be disruptive for the many people who travel, work, and live along the project area. That's the short-term effect. When the project is complete, people in Seattle and the region would benefit from having a solid, safe, and less intrusive transportation facility for many generations. That's the long-term benefit.

The viaduct is an important asset to the region's infrastructure that we have relied on for several generations. The project area contains critical utilities such as power, water, sewer, natural gas, and communications systems that serve a substantial portion of downtown Seattle and surrounding neighborhoods. The viaduct carries more than 110,000 vehicles each day. Failure of the viaduct in an earthquake such as the 2001 Nisqually earthquake could cause tremendous damage, injury, and even loss of life. Even a relatively small earthquake could cause damage that could disrupt traffic in the region for many months. Unlike with most projects, the Viaduct Closed (No Build Alternative) is simply not a feasible option.

The Bored Tunnel Alternative provides a long-term solution that would serve the region for many generations. It provides long-term benefits that offer a significant improvement over existing conditions. Specifically, it would fulfill the following needs:

- Reduce the risk of catastrophic failure in an earthquake by providing a facility that meets current seismic safety standards
- Improve traffic safety
- Provide capacity for automobiles, freight, and transit to efficiently move people and goods to and through downtown Seattle
- Provide linkages to the regional transportation system and to and from downtown Seattle and the local street system
- Avoid major disruption of traffic patterns due to loss of capacity on SR 99
- Protect the integrity and viability of adjacent activities on the central waterfront and in downtown Seattle
- Improve the overall environment along the waterfront area

32 How would we develop mitigation plans, and what types of mitigation measures could be utilized?

The Bored Tunnel Alternative is expected to have few long-term adverse effects on the surrounding area. Most of the effects of the Bored Tunnel Alternative that would require mitigation are related to short-term construction effects. Many of the potential long-term, adverse effects from the project will be addressed through design. After consideration of public input provided through community briefings, open houses, and comments on the previous environmental documentation and this Supplemental Draft EIS, the lead agencies will finalize mitigation measures and commit to implementation in the Final EIS and the Record of Decision. The following paragraphs discuss in more detail how some of the long-term project effects might be avoided through design or mitigated by other actions.

The best way to mitigate long-term effects of a project is by avoiding and minimizing them where feasible through design. For example, the fans for the tunnel operations buildings proposed at the south and north portals can be designed not to exceed certain decibel levels, as stipulated in local and federal regulations. The feasibility and reasonableness of mitigation measures such as noise barriers and the implementation of other noise mitigation methods would be considered in the Final EIS.

Near the south portal, the visual effect of the tunnel operations building on the adjacent Pioneer Square historic district would be mitigated by careful design to ensure that it would be compatible with the surrounding buildings and historic context of the area. The tunnel operations building would be reviewed by the Seattle Design Commission and by the City Historic Preservation Officer under the City's State Environmental Policy Act (SEPA) policies (Seattle Municipal Code 25.05.675).

The effect of changed traffic patterns would be mitigated through publicity and signage directing drivers to the best routes for reaching the retail and commercial areas and access to appropriate parking locations.

Section 106: Historic, Cultural, and Archaeological Resources

An archaeological site would be permanently affected during construction activities. The effect and mitigation is discussed in **Chapter 6** of this ***Supplemental Draft EIS***.

Some properties would be acquired to build the new ramps, portals, and other improvements included in the project. The lead agencies will provide relocation assistance to the affected property owners and tenants. Relocation assistance will comply with the Federal Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended.

33 What effects would not be mitigated?

The Bored Tunnel Alternative would permanently change travel patterns compared to the existing viaduct. For example, the Columbia and Seneca ramps would be removed, which would require drivers that currently use these ramps to change their travel patterns to use ramps provided near Alaskan Way S. Similarly, the Elliott and Western ramps would be removed, which would require drivers to change travel patterns to use either Alaskan Way or Mercer Street and the bored tunnel. Changes to travel patterns may permanently increase travel times for some routes as shown previously in Exhibit 5-15. There are some specific trips that may be 1 to 3 minutes slower as compared to the 2015 Existing Viaduct, and there are other trips where travel times may be 1 to 4 minutes faster.

The Bored Tunnel Alternative would not mitigate for the loss of 320 on-street parking spaces. The City manages on-street parking according to the goals and policies listed in Seattle's Comprehensive Plan section C-3, specifically goal TG18 and policy T42 are applicable to this project. These policies state the primary purpose of arterials is to move people and goods, and to replace short-term parking only when there is a concentrated substantial loss.