

Appendix E
Air Quality Discipline Report

S. Holgate Street to S. King Street
Viaduct Replacement Project
Environmental Assessment

SR 99: ALASKAN WAY VIADUCT & SEAWALL REPLACEMENT PROGRAM

Air Quality Discipline Report S. Holgate Street to S. King Street Viaduct Replacement Project ENVIRONMENTAL ASSESSMENT AGREEMENT NO. Y-7888

Submitted to:

Washington State Department of Transportation

Alaskan Way Viaduct and Seawall Replacement Project Office
999 Third Avenue, Suite 2424
Seattle, WA 98104

The SR 99: Alaskan Way Viaduct & Seawall Replacement Program is a joint effort between the Washington State Department of Transportation (WSDOT), the City of Seattle, and the Federal Highway Administration (FHWA). To conduct this project, WSDOT contracted with:

Parsons Brinckerhoff

999 Third Avenue, Suite 2200
Seattle, WA 98104

In association with:

Arthur G. Bendelius
BERGER/ABAM Engineers Inc.
Black & Veatch Corporation
Bolima Drafting & Design
Cosmopolitan Engineering Group, Inc.
David Evans and Associates, Inc.
EarthTech, Inc.
Entech Northwest, Inc.
EnviroIssues, Inc.
HDR Engineering, Inc.
Hirschmugl, Heine & Associates, Inc.
Hough, Beck and Baird, Inc.
ICX Transportation Group, Inc.
Jacobs Engineering Group, Inc.
John F. McDonald, Inc.

KBA, Inc.
Mimi Sheridan, AICP
Nelson Nygaard Consulting Associates, Inc.
Parametrix, Inc.
PB Consult Inc.
POWER Engineers, Inc.
ROMA Design Group
RoseWater Engineering, Inc.
Sequana Environmental
Shannon & Wilson, Inc.
So-Deep, Inc.
Taylor Associates, Inc.
Telvent Farradyne, Inc.
Tetra Tech, Inc.
William P. Ott

This Page Intentionally Left Blank

TABLE OF CONTENTS

Chapter 1 Summary.....	1
1.1 Introduction.....	1
1.2 Study Area.....	1
1.3 Alternatives Studied.....	1
1.3.1 No Build Alternative.....	3
1.3.2 Build Alternative.....	3
1.4 Affected Environment.....	4
1.5 Operational Effects and Mitigation.....	5
1.6 Construction Effects and Mitigation.....	5
Chapter 2 Background, Studies, and Coordination.....	7
2.1 Air Quality Standards.....	7
2.2 Pollutants of Concern.....	9
2.2.1 Carbon Monoxide.....	9
2.2.2 Particulate Matter.....	9
2.2.3 Ozone.....	10
2.2.4 Nitrogen Dioxide.....	10
2.2.5 Lead.....	10
2.2.6 Greenhouse Gases.....	10
2.3 Mobile Source Air Toxics.....	11
Chapter 3 Methodology.....	15
3.1 Traffic Data.....	15
3.2 Analysis Years.....	15
3.3 Analysis Periods.....	15
3.3.1 Microscale Analysis.....	15
3.3.2 Mesoscale Analysis.....	15
3.4 Air Quality Analysis Locations.....	16
3.4.1 Mobile Source Analysis Sites and Receptor Locations.....	16
3.4.2 Background CO Concentrations.....	18
3.5 Vehicular Emissions.....	18
3.5.1 CO Emissions.....	18
3.5.2 Emissions of Greenhouse Gases.....	19
3.6 CO Modeling Methodology.....	20
3.7 Mobile Source Air Toxic Emissions Modeling Methodology.....	21
3.8 Analysis of Construction Effects.....	22
Chapter 4 Affected Environment.....	23
4.1 Study Area Characteristics.....	23
4.2 Regulatory Status of the Study Area.....	23
4.3 Air Pollution Trends.....	25
4.4 Monitored Air Quality Concentrations.....	25
4.5 Estimated Existing Air Pollutant Conditions.....	26
4.5.1 Mobile Source Analysis.....	26

Chapter 5 Operational Effects, Mitigation, and Benefits.....	27
5.1 Operational Effects	27
5.1.1 Mobile Source Analysis	27
5.1.2 PM ₁₀ Analysis	28
5.1.3 Mobile Source Air Toxic Emissions Analysis	29
5.1.4 Greenhouse Gas Analysis	32
5.2 Operational Mitigation and Benefits	32
Chapter 6 Construction Effects and Mitigation	33
6.1 Construction Effects	33
6.1.1 Stationary Source Effects	33
6.2 Construction Mitigation	34
Chapter 7 Indirect and Cumulative Effects.....	37
7.1 Indirect Effects	37
7.2 Cumulative Effects	37
Chapter 8 Regulatory Compliance	39
8.1 Compliance With NAAQS	39
8.2 Conformity.....	39
Chapter 9 References	41

LIST OF EXHIBITS

Exhibit 1-1. Study Area.....	2
Exhibit 2-1. Summary of Ambient Air Quality Standards	8
Exhibit 2-2. 2005 Greenhouse Gas Emissions by Sector, US and Washington State.....	11
Exhibit 3-1. Mobile Source Analysis Sites.....	16
Exhibit 3-2. CO Analysis Locations.....	17
Exhibit 4-1. CO and PM ₁₀ Maintenance Areas	24
Exhibit 4-2. Highest Recorded Monitored Ambient Air Quality Levels (2006).....	25
Exhibit 4-3. 2005 Maximum Predicted CO Concentrations (ppm).....	26
Exhibit 5-1. Opening and Design Year Maximum Predicted CO Concentrations (ppm)	27
Exhibit 5-2. Vehicle Miles Traveled vs. Mobile Source Air Toxics.....	30
Exhibit 5-3. Predicted MSAT Levels (Tons/Year) – Existing vs. Future No Build.....	31
Exhibit 5-4. Predicted MSAT Levels (Tons/Year) – Future No Build vs. Future Build	31

ATTACHMENTS

- A EMIT Input Parameters and Output Tables
- B WASIST Output Tables

ACRONYMS

µg/m ³	micrograms per cubic meter
AADT	average annual daily traffic
CO	carbon monoxide
CO ₂	carbon dioxide
EA	Environmental Assessment
Ecology	Washington State Department of Ecology
EMIT	Easy Mobile Inventory Tool
EPA	U.S. Environmental Protection Agency
FHWA	Federal Highway Administration
HOV	high-occupancy vehicle
IRIS	Integrated Risk Information System
LOS	level of service
MSAT	Mobile Source Air Toxics
MTP	Metropolitan Transportation Plan
NAAQS	National Ambient Air Quality Standards
NO	nitric oxide
NO ₂	nitrogen dioxide
NO _x	nitrogen oxides
PM _{2.5}	particulate matter less than 2.5 micrometers in size
PM ₁₀	particulate matter less than 10 micrometers in size
ppm	parts per million
Project	SR 99: S. Holgate Street to S. King Street Viaduct Replacement Project
PSCAA	Puget Sound Clean Air Agency
PSRC	Puget Sound Regional Council
SIG	Seattle International Gateway
SIP	State Implementation Plan
SO ₂	sulfur dioxide
SR	State Route
TIP	Transportation Improvement Program
VMT	vehicle miles traveled
VOC	volatile organic compound
WASIST	Washington State Intersection Screening Tool
WSDOT	Washington State Department of Transportation

Chapter 1 SUMMARY

1.1 Introduction

The purpose of this Air Quality Discipline Report is to identify potential air quality effects associated with the SR 99: S. Holgate Street to S. King Street Viaduct Replacement Project (the Project). The Alaskan Way Viaduct is part of State Route (SR) 99, a regionally important north-south highway on the western edge of downtown Seattle.

Traffic in the project area would be affected by changes in the number of vehicles, travel speed, and the levels of congestion experienced on local roadways. Air quality, which is a general term used to describe pollutant levels in the atmosphere, can be affected by these changes.

1.2 Study Area

The study area evaluated for air quality effects includes areas likely to be affected by changes in pollutant levels as a result of Project-related changes in traffic conditions. The study area is roughly bordered by Fourth Avenue S. to the east, the Duwamish River and Elliott Bay to the west, S. King Street to the north, and S. Spokane Street to the south (Exhibit 1-1).

The air quality analyses for this Project followed current guidelines developed by the United States Environmental Protection Agency (EPA), Federal Highway Administration (FHWA), Washington State Department of Transportation (WSDOT), Washington State Department of Ecology (Ecology), and Puget Sound Regional Council (PSRC).

1.3 Alternatives Studied

The Project involves demolishing and replacing the SR 99 mainline from S. Holgate Street to the vicinity of S. King Street, with additional improvements from S. Walker to S. Holgate Streets. The Project would also provide grade-separated access for freight and general purpose traffic traveling between SR 519 (S. Royal Brougham Way and S. Atlantic Street), First Avenue S. and E. Marginal Way S., the BNSF railyard, and the Port of Seattle. These east-west movements would be provided via a U-shaped, lowered roadway (undercrossing) that extends from the intersection of S. Atlantic Street and Colorado Avenue S. to the intersection of S. Atlantic Street and E. Marginal Way S. The undercrossing would improve vehicle access by providing a travel route for east-west traffic when railroad cars on the tail track block the at-grade roadway. At-grade crossing of the tail track

would continue to be provided via S. Atlantic Street and used when railroad cars are not occupying the tail track.

The Project's Environmental Assessment (EA) describes the configuration of the Build Alternative in detail and provides illustrative figures.

1.3.1 No Build Alternative

The No Build Alternative assumes continued operation and maintenance of the existing viaduct structure. Although this scenario is useful for assessing the Build Alternative's performance and effects relative to the facility in place today, it should be recognized that the current facility is reaching the end of its service life. The current facility is unlikely to remain in satisfactory condition for long-term use and is at risk of catastrophic failure in an earthquake.

1.3.2 Build Alternative

The Build Alternative would replace the viaduct from S. Holgate Street to S. King Street. The SR 99 improvements would begin at S. Walker Street as an at-grade side-by-side roadway with three lanes traveling in each direction. SR 99 would transition to an aerial side-by-side roadway crossing over S. Atlantic Street and the tail track, and would continue to S. Royal Brougham Way, then transition to an at-grade roadway. North of S. Royal Brougham Way, SR 99 would be a side-by-side at-grade roadway for approximately 1,800 feet, and would then transition to a stacked aerial structure connecting with the existing stacked viaduct at about S. King Street.

A new northbound off-ramp and southbound on-ramp would be provided south of S. King Street. The existing northbound on-ramp and southbound off-ramp at Railroad Way S. would be maintained.

New roadways and connections would be provided near S. Atlantic Street. These connections include:

- Grade-separated access for freight and general purpose traffic traveling between the BNSF railyard, SR 519, and the Port of Seattle. This new access would be provided via a U-shaped undercrossing, a lowered roadway extending from the intersection of S. Atlantic Street and Colorado Avenue S. to the intersection of S. Atlantic Street and E. Marginal Way S. This facility would improve vehicle access by providing a route for east-west traffic when railroad cars on the tail track block the at-grade roadway.
- Northbound and southbound frontage roads to connect S. Atlantic Street and S. Royal Brougham Way to Alaskan Way S. The

northbound frontage road would also provide access to the new remote holding area for the Seattle Ferry Terminal. S. Royal Brougham Way would no longer provide the direct, at-grade east-west connection between First Avenue S. and Alaskan Way S. that it does today.

- Improvements to Colorado Avenue S. to enhance access to the new North Seattle International Gateway (SIG) Railyard.

Pedestrian and bicycle access would be maintained and improved where feasible. From S. Holgate Street to S. Atlantic Street, a bike lane would be added in the southbound direction, resulting in bike lanes in both the southbound and northbound directions of E. Marginal Way S./Alaskan Way S. There would be sidewalk improvements west of the E. Marginal Way S. roadway, starting at S. Holgate Street. Between S. Atlantic Street and S. King Street, bicycle and pedestrian facilities would be provided to the west and east of SR 99. At about S. King Street, the sidewalks and bike lanes would connect with the existing sidewalk on the west side of Alaskan Way S. and the existing bike/pedestrian path on the east side of Alaskan Way S.

The tail track would be relocated west of the new SR 99 roadway and would extend north from the railyard to the vicinity of S. King Street.

A remote holding area for the Seattle Ferry Terminal would be added between S. Royal Brougham Way and S. King Street along the east side of the corridor.

1.4 Affected Environment

EPA identified several air pollutants as being of concern nationwide. These pollutants are known as “criteria pollutants.” The sources of these pollutants, their effects on human health and the nation’s welfare, and their concentration in the atmosphere vary considerably. Under the Clean Air Act, EPA has established National Ambient Air Quality Standards (NAAQS), which specify maximum allowable concentrations for these criteria pollutants. Areas not in compliance with NAAQS are deemed nonattainment areas. Areas that were once classified as nonattainment but have since demonstrated attainment are classified as maintenance areas. The study area includes maintenance areas for carbon monoxide (CO) and particulate matter (PM₁₀).

In addition to the criteria pollutants for which there are NAAQS, EPA also regulates air toxics. Toxic air pollutants are those pollutants known or suspected to cause cancer or other serious health effects. The Clean Air Act identified 188 air toxics. In 2001 EPA provided a list of 21 Mobile Source Air Toxics (MSAT) and highlighted six of these MSAT as priority MSAT (benzene, acrolein, formaldehyde, 1,3-butadiene, acetaldehyde, and diesel particulate

matter/diesel exhaust). However, conformity requirements for MSAT emissions do not yet exist because EPA has not established ambient standards for MSAT levels.

1.5 Operational Effects and Mitigation

The Washington State Intersection Screening Tool (WASIST) was used to estimate CO levels at sensitive receptor sites near heavily congested intersections expected to be affected by the Project under existing and future conditions. A qualitative assessment was conducted to determine whether the Project could significantly affect localized PM₁₀ levels. The analysis showed that the Project would not cause or contribute to any new localized CO or PM₁₀ violations, increase the frequency or severity of any existing violations, or delay timely attainment of the NAAQS.

In accordance with FHWA guidelines, the Easy Mobile Inventory Tool (EMIT) was used to calculate annual MSAT pollutant burdens (in tons per year) for the six priority MSAT pollutants (see Section 2.3 for discussion). To assess potential Project effects, MSAT existing pollutant levels were compared to future conditions for the Build and No Build Alternatives. Future MSAT levels are predicted to be lower than existing levels, even with increased vehicle miles traveled (VMT).

Because the regional MSAT emissions are not expected to increase and no exceedances of the NAAQS are anticipated, no significant adverse air quality effects are expected to result from the Project. Therefore, no operational mitigation measures would be required.

1.6 Construction Effects and Mitigation

Air pollutant emissions that result from construction activities were qualitatively assessed for the Project. The Project will create a construction fugitive dust control plan to control dust during construction. The control plan could include measures such as spraying exposed soil with water, covering truck loads and materials as needed, washing truck wheels before leaving the site, removing particulate matter from roads, routing and scheduling construction trucks to reduce delays, ensuring well-maintained equipment, and implementing other temporary mitigation measures as needed and considered appropriate.

This Page Intentionally Left Blank

Chapter 2 BACKGROUND, STUDIES, AND COORDINATION

2.1 Air Quality Standards

EPA identified several air pollutants as being of concern nationwide. These pollutants, known as “criteria pollutants,” are CO, particulate matter less than 10 micrometers in size (PM₁₀), particulate matter less than 2.5 micrometers in size (PM_{2.5}), ozone, sulfur dioxide (SO₂), lead, and nitrogen dioxide (NO₂). The sources of these pollutants, their effects on human health and the nation’s welfare, and their concentration in the atmosphere vary considerably. Under the Clean Air Act, EPA has established NAAQS, which specify maximum allowable concentrations for these criteria pollutants. The standards applicable to transportation projects are summarized in Exhibit 2-1.

The current PM_{2.5} standards were published in the *Federal Register* on July 30, 2004, and became effective on that date. EPA adopted new PM_{2.5} standards on October 17, 2006, and they went into effect on December 17, 2006. These standards consist of a stricter 24-hour standard for PM_{2.5} (35 micrograms per cubic meter [$\mu\text{g}/\text{m}^3$] versus the previous standard of 65 $\mu\text{g}/\text{m}^3$), but no change was made to the annual PM_{2.5} standard. In addition, EPA has not yet developed a method for estimating annual PM_{2.5} effects, which should be evaluated on a neighborhood, and not on a discrete receptor, basis. For PM₁₀, the 24-hour standard remained the same and the annual standard was dropped. EPA will redesignate nonattainment areas for PM_{2.5} based on the new 24-hour PM_{2.5} standard. Compliance with the recently adopted 24-hour PM_{2.5} standard is not yet required.

A violation of the NAAQS may threaten federal funding of transportation projects, and proposed roadway projects requiring federal funding or approval must demonstrate compliance with EPA’s Transportation Conformity Rule. Conformity is demonstrated by showing that a project would not cause or contribute to any new violation of any NAAQS, increase the frequency or severity of any existing NAAQS violations, or delay timely attainment of the NAAQS.

2.2 Pollutants of Concern

2.2.1 Carbon Monoxide

CO is a colorless gas that interferes with the transfer of oxygen to the brain. CO is emitted almost exclusively from the incomplete combustion of fossil fuels. Prolonged exposure to high levels of CO can cause headaches, drowsiness, loss of equilibrium, or heart disease. CO concentrations can vary greatly over relatively short distances. Relatively high concentrations of CO are typically found near congested intersections, along heavily used roadways carrying slow-moving traffic, and in areas where atmospheric dispersion is inhibited by urban “street canyon” conditions. Consequently, CO concentrations are predicted on a localized, or microscale, basis.

2.2.2 Particulate Matter

Particulate pollution is composed of solid particles or liquid droplets that are small enough to remain suspended in the air. Of particular concern are those particles that are smaller than, or equal to, 10 microns (PM₁₀) or 2.5 microns (PM_{2.5}).

PM₁₀ consists of very small liquid and solid particles floating in the air, which can include smoke, soot, dust, salts, acids, and metals. It also forms when gases emitted from motor vehicles or industrial sources undergo chemical reactions in the atmosphere. Major sources of PM₁₀ include motor vehicles; wood-burning stoves and fireplaces; dust from construction, landfills, and agriculture; wildfires and brush/waste burning; industrial sources; windblown dust from open lands; and atmospheric chemical and photochemical reactions. Suspended particulates produce haze and reduce visibility.

PM₁₀ poses a greater health risk than larger-sized particles. When inhaled, these tiny particles can penetrate the human respiratory system’s natural defenses and damage the respiratory tract. PM₁₀ can increase the number and severity of asthma attacks, cause or aggravate bronchitis and other lung diseases, and reduce the body’s ability to fight infections.

PM_{2.5} results from fuel combustion (from motor vehicles, power generation, and industrial facilities), residential fireplaces, and wood stoves. In addition, PM_{2.5} can be formed in the atmosphere from gases such as sulfur dioxide, nitrogen oxides, and volatile organic compounds (VOCs). The main health effects of airborne PM_{2.5} are on the respiratory system. Like PM₁₀, PM_{2.5} can penetrate the human respiratory system’s natural defenses and damage the respiratory tract when inhaled. Whereas particles 2.5 to 10 microns in diameter tend to collect in the upper portion of the respiratory system,

particles 2.5 microns or less in diameter are so tiny that they can penetrate deeper into the lungs and damage lung tissues.

2.2.3 Ozone

Ozone (O₃) is a colorless toxic gas that enters the blood stream and interferes with the transfer of oxygen, depriving sensitive tissues in the heart and brain of oxygen. Ozone also damages plants by inhibiting their growth. Although ozone is not directly emitted, it forms in the atmosphere through a chemical reaction between reactive organic gases and nitrogen oxides, which are emitted from industrial sources and automobiles. Substantial ozone formations generally require a stable atmosphere with strong sunlight.

2.2.4 Nitrogen Dioxide

NO₂ is a brownish gas that irritates the lungs. It can cause breathing difficulties at high concentrations. Like ozone, NO₂ is not directly emitted but is formed through a reaction between nitric oxide (NO) and atmospheric oxygen. NO and NO₂ are collectively referred to as nitrogen oxides (NO_x) and are major contributors to ozone formation. NO₂ also contributes to the formation of PM₁₀. At atmospheric concentrations, NO₂ is only potentially irritating. In high concentrations, the result is a brownish-red cast to the atmosphere and reduced visibility. There is some indication of a relationship between NO₂ and chronic pulmonary fibrosis. Some increase in bronchitis in children (2 and 3 years old) has also been observed at concentrations below 0.3 parts per million (ppm).

2.2.5 Lead

Lead (Pb) is a stable element that persists and accumulates in the environment and in animals. Its principal effects in humans are on the blood-forming, nervous, and renal systems. Lead levels in the urban environment from mobile sources, such as automobiles, have significantly decreased since the federally mandated switch to unleaded gasoline.

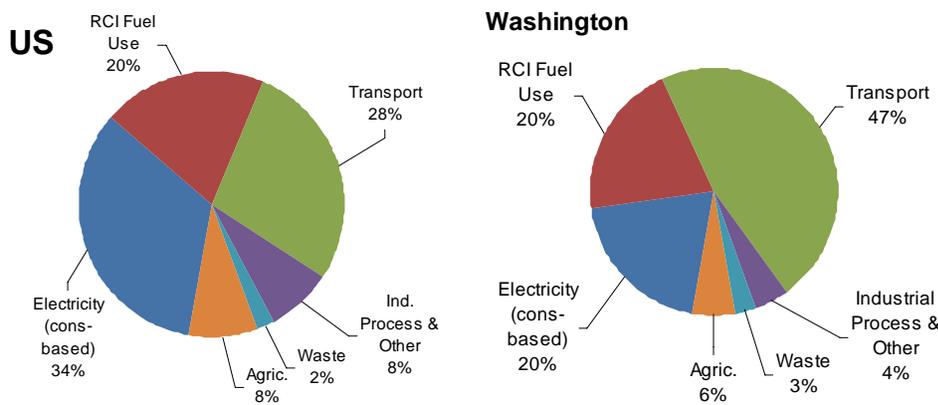
2.2.6 Greenhouse Gases

Climate-changing greenhouse gases come in several forms. The gases associated with transportation are water vapor, carbon dioxide (CO₂), methane (also known as marsh gas), and nitric oxide (found in dentists' offices as laughing gas). CO₂ makes up the bulk of the emissions from transportation and is the focus of this evaluation. Any process that burns fossil fuel releases CO₂ into the air. Vehicles are a significant source of greenhouse gas emissions and contribute to global warming, primarily through the burning of gasoline and diesel fuels.

As shown in Exhibit 2-2, according to national estimates, the transportation sector (including on-road, construction, airplanes, and boats) accounts for

almost 30 percent of total domestic CO₂ emissions.¹ However, in Washington State, transportation accounts for nearly half of greenhouse gas emissions because the state relies heavily on hydropower for electricity generation, unlike other states that rely on fossil fuels such as coal, petroleum, and natural gas to generate electricity. The next largest contributors to total gross greenhouse gas emissions in Washington are fossil fuel combustion in the residential, commercial, and industrial (RCI) sectors at 20 percent and in electricity generation facilities, also 20 percent.

Exhibit 2-2. 2005 Greenhouse Gas Emissions by Sector, US and Washington State



Source: Washington Climate Advisory Team, 2008

2.3 Mobile Source Air Toxics

In addition to the criteria pollutants for which there are NAAQS, EPA also regulates air toxics. Toxic air pollutants are those pollutants known or suspected to cause cancer or other serious health effects. Most air toxics originate from human-made sources, including vehicles, nonroad mobile sources (e.g., airplanes), area sources (e.g., dry cleaners), and stationary sources (e.g., factories or refineries). The Clean Air Act identified 188 air toxics. In 2001 EPA provided a list of 21 MSAT and highlighted six of these MSAT as priority MSAT. Since 2001, EPA has conducted an extensive review of the literature to produce a list of the compounds identified in the exhaust or evaporative emissions from on-road and nonroad equipment as well as

¹ This percentage is based on 2004 data from the International Energy Administration and is consistent with 1996 guidelines on greenhouse gas emissions calculations issued by the Intergovernmental Panel on Climate Change (IPCC).

alternative fuels. This list currently includes approximately 1,000 compounds, many emitted in trace amounts.

In February 2007, EPA finalized a rule to reduce hazardous air pollutants from mobile sources (Control of Hazardous Air Pollutants from Mobile Sources, February 9, 2007). The rule limits the benzene content of gasoline and reduces toxic emissions from passenger vehicles and gas cans. EPA estimates that in 2030 this rule will reduce total MSAT emissions by 330,000 tons and VOC emissions (precursors to ozone and PM_{2.5}) by over 1 million tons.

By 2010, EPA's existing programs will reduce MSAT by over 1 million tons from 1999 levels. In addition to controlling pollutants such as hydrocarbons, particulate matter, and nitrogen oxides, EPA's recent regulations controlling emissions from highway vehicles and nonroad equipment will result in large air toxic reductions. Furthermore, EPA has programs under development that would provide additional benefits from further controls for small nonroad gasoline engines and diesel locomotive and marine engines. Finally, EPA has developed a variety of programs to reduce risk in communities, such as Clean School Bus USA, Voluntary Diesel Retrofit Program, Best Workplaces for Commuters, and National Clean Diesel Campaign.

EPA is in the process of assessing the risks of various kinds of exposures to these pollutants. The EPA Integrated Risk Information System (IRIS) is a database of human health effects that may result from exposure to various substances in the environment. The IRIS database is located at <http://www.epa.gov/iris>. The following toxicity information for the six prioritized MSAT was taken verbatim from the IRIS database's Weight of Evidence Characterization summaries. This information represents the agency's most current evaluations of potential hazards and toxicology of these chemicals or mixtures.

- **Benzene** is characterized as a known human carcinogen.
- The potential carcinogenicity of **acrolein** cannot be determined because the existing data are inadequate for an assessment of human carcinogenic potential for either the oral or inhalation route of exposure.
- **Formaldehyde** is a probable human carcinogen based on limited evidence in humans and sufficient evidence in animals.
- **1,3-Butadiene** is characterized as carcinogenic to humans by inhalation.
- **Acetaldehyde** is a probable human carcinogen based on increased incidence of nasal tumors in male and female rats and laryngeal tumors in male and female hamsters after inhalation exposure.

- **Diesel exhaust** is likely to be carcinogenic to humans by inhalation from environmental exposures. Diesel exhaust, which is the combination of diesel particulate matter and diesel exhaust organic gases, also causes chronic respiratory effects, possibly the primary noncancer hazard from MSAT. Prolonged exposures may impair pulmonary function and could produce symptoms such as cough, phlegm, and chronic bronchitis. Exposure relationships have not been developed from these studies.

This Page Intentionally Left Blank

Chapter 3 METHODOLOGY

3.1 Traffic Data

Detailed traffic analyses were completed for existing (2005) conditions and for the Build and No Build alternatives for the opening year (2013) and the Project's design year (2030) to evaluate how the transportation system would function under each of these conditions. The transportation study area includes the portion of the city of Seattle where traffic patterns would most likely be affected by the Project. The results of the analysis are documented in Appendix F, Transportation Discipline Report. The evaluation of transportation air quality effects was based on the data and findings of the transportation analysis.

3.2 Analysis Years

Local (microscale) air quality was analyzed for existing conditions (2005), the Project's opening year (2013), and the Project's design year (2030). Regional (mesoscale) air quality analysis was conducted for the Project's design year (2030).

3.3 Analysis Periods

3.3.1 Microscale Analysis

Afternoon and morning peak-period traffic data were used to estimate maximum 1-hour and 8-hour CO concentrations. The afternoon peak is the highest traffic-volume period of the day in downtown Seattle. Average daily traffic volumes were used to estimate 24-hour average PM₁₀ concentrations.

3.3.2 Mesoscale Analysis

Emission estimates were forecasted for VMT and travel speed in the study area for the Project's design year (2030). The volume and speed forecasts developed for Appendix F, Transportation Discipline Report were used.

These estimates were developed with a traffic assignment model based on current and future population, employment, and travel and congestion information. The forecasting model was developed using the latest planning assumptions consistent with the current conforming Transportation Plan and Transportation Improvement Program (TIP) for the study area.

3.4 Air Quality Analysis Locations

3.4.1 Mobile Source Analysis Sites and Receptor Locations

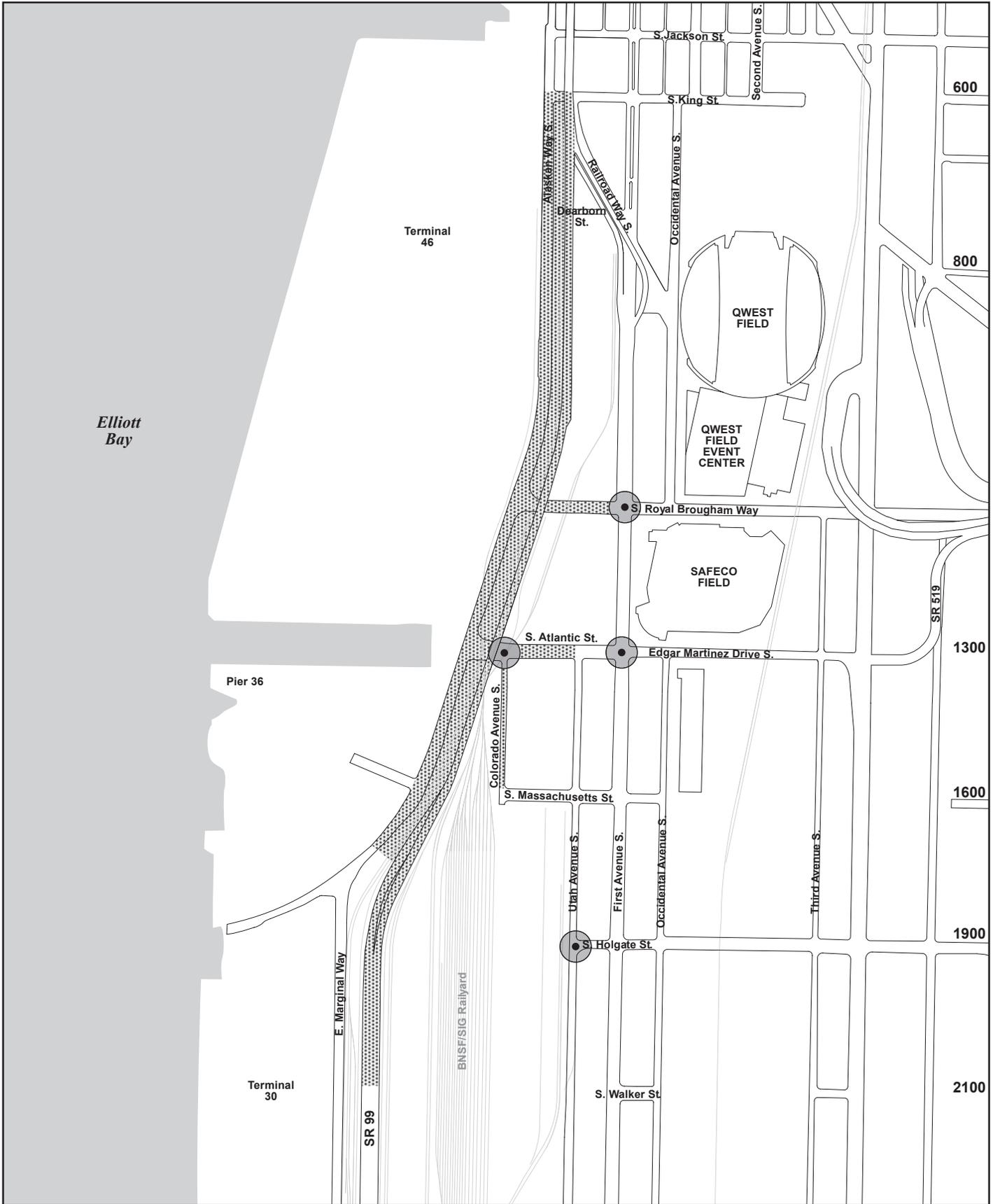
Analysis sites include critical roadway links and heavily congested intersections, connecting bus routes, locations adjacent to sensitive land uses, and representative locations throughout the study area that may be affected by the Project. All major signalized intersections experiencing high delays (level of service [LOS] D or worse) with the Project for the year 2030 were selected for analysis (Exhibit 3-1). The potential of the Project to create localized CO concentrations that would exceed the NAAQS at these locations were estimated.

Exhibit 3-1. Mobile Source Analysis Sites

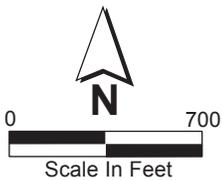
Intersection	LOS	Peak Period (AM or PM)
Alaskan Way S./S. King Street	D	PM
Colorado Avenue S./Alaskan Way S. (Southbound) & S. Atlantic Street	F	AM
Colorado Avenue S./Alaskan Way S. (Southbound) & S. Atlantic Street	E	PM
E. Marginal Way S./T-46 Driveway & S. Atlantic Street	D	AM
E. Marginal Way S./T-46 Driveway & S. Atlantic Street	D	PM
First Avenue S. & S. Royal Brougham Way	D	PM
First Avenue S. & S. Atlantic Street	E	PM
First Avenue S./S. Lander Street	D	PM

Note: T-46 = Terminal 46

Specific locations near analysis sites where pollutant concentrations are predicted are called receptors. Mobile source modeling receptors are located where maximum concentrations would likely occur because of traffic congestion and where the general public would have access (EPA 1992). For this analysis, mobile source receptors were located in areas accessible to the public at mid-sidewalk distance from the edge of the travel lane and 6 feet (1.8 meters) off the ground. At each roadway intersection, individual receptors were located at the corners and along roadways that allow pedestrian access. The intersections that were screened for CO for this study are shown in Exhibit 3-2.



AWV/554-1585-030/BW(01) 5/15/08



-  Intersection screened for CO concentrations
-  Project Limits

Exhibit 3-2
CO Analysis Locations

3.4.2 Background CO Concentrations

Microscale modeling analyses are used to estimate concentrations resulting from motor vehicle emissions on roadways adjacent to receptor locations. To estimate total pollutant concentrations at a prediction site, background concentrations are added to these values to account for pollution entering the area from other sources upwind.

The CO background concentrations used in this analysis were estimated using the monitoring data for the latest 3 years available (2004–2006) at the Beacon Hill Reservoir station. Of the second highest levels recorded for each year, the highest of those levels were selected. The calculated 1-hour CO background concentration is 2.7 ppm, and the 8-hour CO background concentration is 1.9 ppm. A conservative value of 3.0 ppm for both the 1-hour and 8-hour background concentrations was added to the results of the modeling analyses to estimate total pollutant concentrations, which were then compared to the NAAQS.

3.5 Vehicular Emissions

3.5.1 CO Emissions

Pollutant emissions from motor vehicles are affected by many factors, including travel speed; temperature; operating mode; and the age, type, and condition of the vehicle. Emission models calculate emission factors for average vehicles operating under specific parameters, such as speed, vehicle (which is a composite of automobiles, light trucks, heavy trucks, sport utility vehicles, etc.), age, and local emission control requirements.

Emission factors for CO from vehicles traveling on Seattle's arterials and highways were estimated using the latest version of EPA's emission factor algorithm (MOBILE6.2.03). The data inputs provided by PSRC are based on implementation of Washington State's enhanced inspection and maintenance and anti-tampering programs, which require biannual inspections of automobiles and light trucks to determine if emissions from the vehicles' exhaust systems are below the emission standards. Vehicles that fail the emissions test must undergo maintenance and pass a retest, or receive a waiver, to be registered in Washington State.

MOBILE6.2.03 emission factors were developed for existing (2005) conditions, the Project's opening year (2013), and the design year (2030). Emission factors were developed for winter conditions, which provide worst-case CO estimates. Emission factors generally decrease over time as a result of the gradual replacement of older vehicles with newer, less-polluting vehicles.

3.5.2 Emissions of Greenhouse Gases

In February 2007, the Governor issued Executive Order 07-02 requiring state agencies to find ways to reduce greenhouse gas emissions and adapt to the future that climate change may create.

On May 3, 2007, the Washington State Legislature passed Senate Bill 6001, which among other things, adopted Governor Gregoire's climate change goals into state law. The law aims to achieve 1990 greenhouse gas levels by 2020, a 25 percent reduction below 1990 levels by 2035, and a 50 percent reduction by 2050.

WSDOT is part of the solution. We are aggressively pursuing strategies to address climate change and we recognize our responsibility to support the Governor's initiative. While the goals are clear, we also recognize that technical guidance and regulations to implement these goals are currently in development and will not be sufficiently determined before environmental documentation is completed for this Project.

At this time, the main way to reduce greenhouse gas emissions from transportation is to reduce the amount of fuel consumed by drivers. This can be achieved by three means:

- Create more efficient driving conditions (for example, reduced traffic congestion).
- Introduce more fuel-efficient vehicles.
- Reduce the amount of driving (for example, telecommuting, transit, carpooling, more efficient movement of goods and services).

As a state, we have made some progress towards each of the three efforts. The Governor and Legislature passed a new transportation revenue package to fund a 16-year plan to meet Washington State's most critical transportation needs. WSDOT and our transportation partners, including city, county, and transit agencies, are in various stages of development on a specific list of projects selected by the Legislature to help with better movement of people and goods. The revenue is invested in a three-tiered strategy designed to maximize the efficiency of the transportation system:

- **Tier 1** – Low-cost/high-return investments in active traffic management, ramp metering, and incident response combined with transportation demand management (including commute trip reduction, park-and-ride, and local land use planning).
- **Tier 2** – Moderate- to higher-cost road network improvements, such as adding short lanes to connect interchanges, direct access ramps for

transit and high-occupancy vehicles (HOVs), and center turn lanes to allow better traffic flow.

- **Tier 3** – Higher cost/corridorwide benefit from major investments in HOV lanes, high-occupancy tolled (HOT) lanes, transit, commuter rail, general purpose roadway lanes, interchange modifications, and bus access.

Many of our local, regional, and statewide transportation system improvements and ongoing programs will help to reduce the number of miles that vehicles need to travel each year (typically referred to as VMT).² In addition, the Governor and Legislature are actively working toward related improvements in land use decision making and more efficient transportation technology. In 2005 and 2007 the State Legislature mandated that vehicles sold in Washington starting with 2009 model years meet updated California emission standards. The new vehicle standards will reduce greenhouse gas emissions and help reduce CO and ozone pollutants. Researchers are also working to reduce the carbon content of motor fuel for the future.

A qualitative analysis was conducted to evaluate the Project's effect on greenhouse gases.

3.6 CO Modeling Methodology

A microscale modeling analysis was conducted that estimated CO levels at sensitive receptor sites near heavily congested intersections expected to be affected by the Project under existing and future conditions.

The WASIST, which was used in all mobile source analyses, is a Microsoft Windows-based screening model used for determining worst-case 1-hour and 8-hour CO concentrations at signalized intersections throughout the state. Results were based on the latest version of EPA's emission factor algorithm (MOBILE6.2.03) and EPA's CAL3QHC mobile source dispersion model. The CAL3QHC algorithm was used to calculate the CO concentrations in WASIST based on intersection geometry, user inputs, and worst-case assumptions. CO

² Some projects have applied EPA's equation: fuel consumed (FC) is the amount of fuel that would be used to operate a vehicle or bus. The emission factor (EF) is the amount of CO₂ that would be emitted during combustion of a gallon of fuel. This equation does not take into account the speed of vehicles on the roadway and is not a recommended analysis method for transportation projects. Light duty vehicles are most efficient at moderate speeds in the range of 40 to 55 miles per hour. Current modeling systems available in Washington State are not able to account for speed. The result is that we are unable to show the effect of this improvement in traffic flow on emissions until future EPA tailpipe emission models are issued.

emission factors were determined for each approaching leg of traffic and for idling vehicles.

WASIST uses readily available data in a user-friendly application to make a conservative estimate of CO levels near congested intersections. This is done by using a combination of worst-case conditions that, when occurring simultaneously, produce the highest levels of CO. The purpose of the model is to allow the user to conservatively estimate the highest CO concentrations that would occur at an intersection without having to perform a more time-consuming detailed analysis. If the results from WASIST do not violate the NAAQS for CO, the effect from any other combination of conditions would also be below the standards, and no further modeling is required.

Afternoon and morning peak-period traffic data were used to estimate maximum 1-hour and 8-hour CO concentrations. These peak periods are the highest traffic-volume period in downtown Seattle.

3.7 Mobile Source Air Toxic Emissions Modeling Methodology

On February 3, 2006, FHWA issued interim guidance regarding MSAT analysis in National Environmental Policy Act (NEPA) documentation. Given the emerging state of the science and of project-level analysis techniques regarding MSAT, there are no established criteria for determining when MSAT emissions should be considered a significant issue. FHWA has suggested a tiered approach in determining potential project-induced MSAT effects. The three tiers are:

- Tier 1 – No analysis for projects with no potential for meaningful MSAT effects.
- Tier 2 – Qualitative analysis for projects with low potential MSAT effects.
- Tier 3 – Quantitative analysis to differentiate alternatives for projects with higher potential MSAT effects.

FHWA has developed this approach because currently available technical tools do not enable us to predict project-specific health effects of the potential emission changes associated with the Project. These limitations include:

- Emissions – The EPA tools to estimate MSAT emissions from motor vehicles are not sensitive to key variables that determine emissions of MSAT in the context of a highway project.
- Dispersion – The tools to predict MSAT dispersion into the environment are limited. The current dispersion models were developed for the purpose of predicting episodic concentrations of CO

to determine compliance with the NAAQS. The performance of dispersion models is more accurate for predicting maximum concentrations rather than exposure patterns.

- Exposure Levels and Health Effects – Even if emission levels and concentrations of MSAT could be accurately predicted, shortcomings in current techniques for exposure assessment and risk analysis preclude reaching any meaningful conclusion about project-specific health effects. Exposure assessments are difficult because it is difficult to accurately calculate annual concentrations of MSAT near roadways, and to determine the portion of a year that people are actually exposed to those concentrations at a specific location.

Based on FHWA's recommended tiering approach, the Project falls within the Tier 3 approach (i.e., for projects with a high potential for MSAT effects). Following FHWA's recommendation, the EMIT was used to calculate annual MSAT pollutant burdens in tons per year for the Project. EMIT incorporates EPA's MOBILE6.2.03 emission factor model along with components for forecasting congested vehicle speeds and VMT as a function of area type and roadway functional class. EMIT focuses on six MSAT:

- Benzene
- Formaldehyde
- Diesel particulate matter/diesel exhaust organic gases
- Acetaldehyde
- Acrolein
- 1,3-Butadiene

The program focuses on these pollutants because they were previously (prior to the February 2007 EPA Final Rule) classified as priority MSAT. Summer and winter parameters were input into the MOBILE6.2.03 portion of EMIT to obtain an accurate annual pollutant burden estimate. MOBILE6.2.03 input parameters recommended by PSRC, Ecology, and FHWA were used in the EMIT model, along with traffic volumes, speeds, and travel characteristics forecasted for the Project. All parameters used in EMIT and the model's output are provided in Attachment A.

3.8 Analysis of Construction Effects

An analysis was conducted to evaluate potential effects during construction. The qualitative stationary source analysis includes potential effects associated with emissions from dust-generating activities, operation of heavy-duty diesel equipment, and trucking activities within major construction areas.

Chapter 4 AFFECTED ENVIRONMENT

4.1 Study Area Characteristics

The study area evaluated for air quality effects includes areas likely to be affected by changes in pollutant levels resulting from Project-related traffic conditions. The study area is roughly bordered by Fourth Avenue S. to the east, the Duwamish River and Elliott Bay to the west, S. King Street to the north, and S. Spokane Street to the south (see Exhibit 1-1).

Land uses in the area are mostly industrial but include interspersed commercial, retail, and residential uses. Safeco and Qwest Fields, major league baseball and football stadiums, compose the northeastern portion of the study area. A detailed description of the land use within the study area is provided in the EA.

4.2 Regulatory Status of the Study Area

Air quality in the study area is regulated by EPA, Ecology, and Puget Sound Clean Air Agency (PSCAA). Section 107 of the 1977 Clean Air Act Amendment requires EPA to publish a list of all geographic areas in compliance with the NAAQS, as well as those not attaining the NAAQS. Areas not in compliance with NAAQS are deemed nonattainment areas. Areas that were once classified as nonattainment but have since demonstrated attainment are classified as maintenance areas. The designation of an area is based on the data collected by the state monitoring network on a pollutant-by-pollutant basis.

With two exceptions, the study area is designated as being in attainment for all EPA-regulated pollutants. The Project is entirely located in a CO maintenance area, and the area just south of the existing viaduct is a PM₁₀ maintenance area, as illustrated in Exhibit 4-1. This area was designated as nonattainment for CO and PM₁₀ and classified as moderate upon enactment of the Clean Air Act Amendments of 1990. The state submitted a CO and PM₁₀ maintenance plan on August 23, 1999, which was approved by EPA on March 13, 2001. The plan relies on control of residential wood smoke, fugitive dust, industrial emissions, open burning, and diesel exhaust. Because these maintenance areas would be affected by the Project, the Project must demonstrate compliance with the Transportation Conformity Rule found in 40 CFR Part 93.

Exhibit 4-1. CO and PM₁₀ Maintenance Areas



4.3 Air Pollution Trends

Regional air pollutant trends have generally followed national patterns over the last 20 years. While the average weekday VMT in the central Puget Sound region has increased from 30 million miles in 1981 to 65 million in 1999 (PSRC 2000), pollutant emissions associated with transportation sources have decreased. CO is the criteria pollutant most closely tied to transportation, with over 90 percent of the CO emissions in the Puget Sound urban areas coming from transportation sources. Regionally, the maximum measured CO concentrations have decreased considerably over the past 20 years. Other transportation-related pollutants have followed similar but less pronounced trends.

4.4 Monitored Air Quality Concentrations

Air quality data were compiled using Ecology and EPA AirData databases for 2006, the latest calendar year for which these data are available.

Representative sites within or near the project area at which these data were monitored are shown in Exhibit 4-2. Monitored levels for the criteria pollutants do not exceed national and state ambient air quality standards in the project area.

Exhibit 4-2. Highest Recorded Monitored Ambient Air Quality Levels (2006)

Pollutant	Location (County)*	Averaging Time	Value	NAAQS
Carbon Monoxide	Fourth Avenue & Pike Street (King)	8 hour	2.0 ppm	9 ppm
		1 hour	2.8 ppm	35 ppm
Nitrogen Dioxide	Beacon Hill Reservoir (King)	Annual	0.018 ppm	0.053 ppm
Ozone	Lake Sammamish (King)	8 hour	0.070 ppm	0.08 ppm
Sulfur Dioxide	Casino Drive (Skagit)	Annual	0.001 ppm	0.03 ppm
		24 hour	0.003 ppm	0.14 ppm
		3 hour	0.011 ppm	0.5 ppm
PM _{2.5}	E. Marginal Way S. (King)	Annual	12.1 µg/m ³	15 µg/m ³
		24 hour	33 µg/m ³	35 µg/m ³
PM ₁₀	E. Marginal Way S. (King)	24 hour	51 µg/m ³	150 µg/m ³

Source: EPA AirData (<http://www.epa.gov/air/data/geosel.html>) and Ecology

Notes: Values shown correspond to NAAQS time periods.

If data are available from more than one monitoring station in a county, the highest values are provided.

4.5 Estimated Existing Air Pollutant Conditions

4.5.1 Mobile Source Analysis

The results of the screening-level mobile source analysis that was conducted using the WASIST model are shown in Exhibit 4-3. The values provided are the highest 1-hour and 8-hour CO concentrations predicted at any of the receptor sites near the selected intersections for 2005 conditions. The estimated CO concentrations are all below the 1-hour and 8-hour NAAQS of 35 and 9 ppm, respectively.

Exhibit 4-3. 2005 Maximum Predicted CO Concentrations (ppm)

Intersection	Peak Period (AM or PM)	2005 (Existing)	
		1 hr	8 hr
Alaskan Way S./S. King Street	PM	NS	NS
Colorado Avenue S./Alaskan Way S. (SB) & S. Atlantic Street	AM	NS	NS
Colorado Avenue S./Alaskan Way S. (SB) & S. Atlantic Street	PM	NS	NS
E. Marginal Way S./T-46 Driveway & S. Atlantic Street	AM	NS	NS
E. Marginal Way S./T-46 Driveway & S. Atlantic Street	PM	NS	NS
First Avenue S. & S. Royal Brougham Way	PM	10.4	8.2
First Avenue S. & S. Atlantic Street	PM	9.9	7.8
First Avenue S./S. Lander Street	PM	8.3	6.7

Notes: All values include a conservative background concentration of 3 ppm.
 The 1-hour NAAQS is 35 ppm; the 8-hour NAAQS is 9 ppm.
 SB = Southbound
 NS – The intersection at Colorado Avenue S. is currently not signalized.
 T-46 = Terminal 46

Chapter 5 OPERATIONAL EFFECTS, MITIGATION, AND BENEFITS

5.1 Operational Effects

5.1.1 Mobile Source Analysis

The results of the screening-level mobile source analysis that was conducted using the WASIST model are shown in Exhibit 5-1. The values provided are the highest 1-hour and 8-hour CO concentrations predicted at any of the receptor sites near the selected intersections for 2013 and 2030 conditions. The estimated CO concentrations for both the No Build and Build Alternatives are all below the 1-hour and 8-hour NAAQS of 35 and 9 ppm, respectively. Because the predicted results were all below the NAAQS, the results of this analysis indicate that a more in-depth mobile source air quality analysis is not required. See Attachment B for the WASIST output data tables.

Exhibit 5-1. Opening and Design Year Maximum Predicted CO Concentrations (ppm)

Intersection	Peak Period (AM or PM)	2013	2030	2013	2030
		No Build 1 hr/8 hr	No Build 1 hr/8 hr	Build 1 hr/8 hr	Build 1 hr/8 hr
Alaskan Way S./S. King Street	PM	NS	NS	6.1/5.2	5.3/4.6
Colorado Avenue S./Alaskan Way S. (SB) & S. Atlantic Street	AM	NS	NS	4.6/4.1	4.2/3.8
Colorado Avenue S./Alaskan Way S. (SB) & S. Atlantic Street	PM	NS	NS	5.0/4.4	4.3/3.9
E. Marginal Way S./T-46 Driveway & S. Atlantic Street	AM	NS	NS	4.3/3.9	3.9/3.6
E. Marginal Way S./T-46 Driveway & S. Atlantic Street	PM	NS	NS	4.5/4.0	4.1/3.8
First Avenue S. & S. Royal Brougham Way	PM	7.4/6.1	6.3/5.3	7.0/5.8	5.9/5.0
First Avenue S. & S. Atlantic Street	PM	7.6/6.2	6.3/5.3	7.6/6.2	6.3/5.3
First Avenue S./S. Lander Street	PM	6.2/5.2	5.6/4.8	6.2/5.2	5.6/4.8

Notes: 2013 is the opening year and 2030 is the design year.
 All values include a conservative background concentration of 3 ppm.
 The 1-hour NAAQS is 35 ppm; the 8-hour NAAQS is 9 ppm.
 SB = Southbound T-46 = Terminal 46
 NS – For the No Build Alternative, the intersection at Colorado Avenue S. is not signalized.

5.1.2 PM₁₀ Analysis

Section 176(c) of the Clean Air Act requires that federally supported highway and transit project activities be consistent with state air quality goals found in the State Implementation Plan (SIP). The process to ensure this consistency is called Transportation Conformity. Conformity to the SIP means that transportation activities will not cause new violations of the NAAQS, worsen existing violations of the standard, or delay timely attainment of the relevant standard.

Transportation Conformity is required for federally supported transportation projects in areas that have been designated by EPA as not meeting a NAAQS. These areas are called nonattainment areas if they currently do not meet air quality standards or maintenance areas if they have previously violated air quality standards but currently meet them and have an approved Clean Air Act Section 175A maintenance plan. Project-level conformity may require an assessment of localized emission effects, known as a hot-spot analysis, for certain projects.

Because a portion of the southern end of the study area is designated as a maintenance area for PM₁₀, the Project is required to demonstrate compliance with the Transportation Conformity requirements in 40 CFR Part 93. This analysis must determine whether the Project could significantly affect localized PM₁₀ levels in the maintenance area. On March 10, 2006, EPA issued amendments to the Transportation Conformity Rule to address localized effects of particulate matter, entitled "PM_{2.5} and PM₁₀ Hot-Spot Analyses in Project-level Transportation Conformity Determinations for the New PM_{2.5} and Existing PM₁₀ National Ambient Air Quality Standards" (71 FR 12468).

A qualitative project-level hot-spot assessment was conducted following the joint EPA and FHWA Transportation Conformity Guidance to assess whether the Project would cause or contribute to any new localized PM₁₀ violations, increase the frequency or severity of any existing violations, or delay timely attainment of the PM₁₀ NAAQS.

Following the methodologies provided in the March 2006 guidance, future average annual daily traffic (AADT) volumes on SR 99 were compared to existing AADT volumes on roadways near the Project and the concentrations measured at the ambient PM₁₀ monitors to determine whether the Project could cause or exacerbate a violation of the PM₁₀ NAAQS. The monitor selected for this analysis is located along the SR 99 corridor south of the study area at 4401 E. Marginal Way S. (see Exhibit 3-2).

The Project would not cause or contribute to any new localized PM₁₀ violations, increase the frequency or severity of any existing violations, or delay timely attainment of the PM₁₀ NAAQS because:

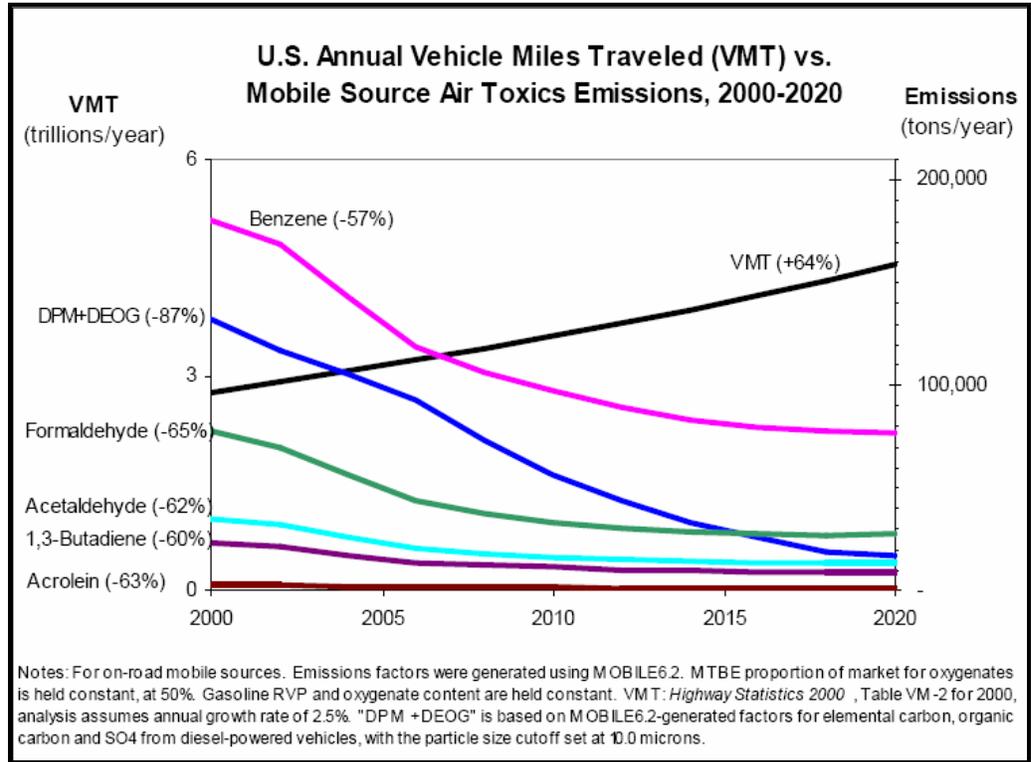
- No exceedances of the 24-hour PM₁₀ NAAQS have been recorded at the representative (E. Marginal Way S.) monitor in approximately 20 years.
- The highest 24-hour PM₁₀ value recorded at the monitor is well below the NAAQS, and the projected increase in AADT is not expected to cause an exceedance, even without the mandated vehicular emission reduction requirements.
- PM₁₀ effects from diesel truck emissions on a per vehicle basis should significantly decrease between 2005 and 2030 because national diesel engine and diesel sulfur fuel regulations would be implemented that are expected to cut heavy-duty diesel emissions. This reduction should offset the emission increases resulting from the 10 percent increase in traffic volumes.

5.1.3 Mobile Source Air Toxic Emissions Analysis

As shown in Exhibit 5-2, emissions will likely be lower than present levels in the design year as a result of EPA's national control programs that are projected to reduce MSAT emissions by 57 to 87 percent between 2000 and 2020. As shown in Exhibit 5-3, MSAT in the study area are predicted to dramatically decrease in the future as compared to existing conditions, even though the VMT of SR 99 is predicted to increase by 25 percent. This trend echoes the national trend illustrated in Exhibit 5-2. Local trends differ slightly from national trends due to fleet mix and turnover, VMT growth rates, and local control measures.

As shown in Exhibit 5-4, VMT is expected to increase approximately 8 percent within the study area for the Build Alternative as compared to the No Build Alternative. MSAT levels are predicted to increase approximately 8 percent for the Build Alternative as compared to the No Build Alternative. Though there are increases with the Project, future MSAT levels are predicted to be lower than existing levels even with increased VMT.

Exhibit 5-2. Vehicle Miles Traveled vs. Mobile Source Air Toxics



Source: FHWA 2006

Exhibit 5-3. Predicted MSAT Levels (Tons/Year) – Existing vs. Future No Build

Condition	Year	Vehicle Miles Traveled (VMT)	% VMT Change from Existing	Pollutant (tons/year)						% Change from Existing					
				Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	DPM	Formaldehyde	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	DPM	Formaldehyde
Existing	2005	93,585	NA	0.180	0.026	2.23	0.196	1.25	0.478						
No Build	2030	118,284	26%	0.084	0.011	1.034	0.075	0.077	0.214	-53%	-57%	-54%	-62%	-94%	-55%

Note: DPM = diesel particulate matter
 NA = not applicable

Exhibit 5-4. Predicted MSAT Levels (Tons/Year) – Future No Build vs. Future Build

Condition	Year	Vehicle Miles Traveled (VMT)	% VMT Change from No Build	Pollutant (tons/year)						% Change from No Build					
				Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	DPM	Formaldehyde	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	DPM	Formaldehyde
No Build	2030	118,284	NA	0.084	0.011	1.034	0.075	0.077	0.214						
Build	2030	127,670	8%	0.091	0.012	1.11	0.081	0.083	0.230	8%	8%	8%	8%	8%	8%

Note: DPM = diesel particulate matter
 NA = not applicable

5.1.4 Greenhouse Gas Analysis

Quantitative modeling tools to evaluate greenhouse gas emissions at the project level are limited at this time, but better tools are under development and will be available from the EPA within the next several years.³

This Project would replace a section of the Alaskan Way Viaduct with a new, seismically sound structure, but through capacity on SR 99 would not change. The Project would also provide new southbound on- and northbound off-ramps to SR 99. These new ramps would allow drivers to move into and out of the Seattle street system more directly, reducing stop and go travel and thereby reducing fuel consumption. In addition to improvements to SR 99, the Project would improve important freight connections at S. Atlantic Street. This would reduce congestion and idling time for many trucks moving between the BNSF SIG Railyard and the Port of Seattle's Terminal 46. Together, these changes would create more efficient driving conditions and reduce the amount of fuel consumed by drivers; therefore, the Project would not increase and could slightly reduce greenhouse gas emissions from transportation in the area.

5.2 Operational Mitigation and Benefits

Because the mesoscale MSAT emissions are not expected to increase and no exceedances of the NAAQS are anticipated, no significant adverse air quality effects are expected from the Project. Therefore, no mitigation measures would be required. Any transportation demand control measures that reduce traffic volumes and levels of congestion within the study area, such as improving transit connections into downtown, would reduce traffic-related air pollutant emissions.

³ Some projects have applied EPA's equation: fuel consumed (FC) is the amount of fuel that would be used to operate a vehicle or bus. The emission factor (EF) is the amount of CO₂ that would be emitted during combustion of a gallon of fuel. This equation does not take into account the speed of vehicles on the roadway and is not a recommended analysis method for transportation projects. Light duty vehicles are most efficient at moderate speeds in the range of 40 to 55 miles per hour. Current modeling systems available in Washington State are not able to account for speed. The result is that we are unable to show the effect of this improvement in traffic flow on emissions until future EPA tailpipe emission models are issued.

Chapter 6 CONSTRUCTION EFFECTS AND MITIGATION

Air quality effects related to construction of the Project would occur primarily as a result of emissions from heavy-duty construction equipment (such as bulldozers, backhoes, and cranes), diesel-fueled mobile sources (such as trucks, brooms, and sweepers), diesel- and gas-fueled generators, and on- and off-site Project-generated vehicles (such as service trucks and pickups).

6.1 Construction Effects

Fugitive PM₁₀ emissions are associated with demolition, land clearing, ground excavation, grading, cut-and-fill operations, and structure erection. PM₁₀ emissions would vary from day to day, depending on the level of activity, specific operations, and weather conditions. Emission rates would depend on soil moisture, silt content of soil, wind speed, and the amount and type of operating equipment associated with project construction. Larger dust particles would settle near the source, and fine particles would be dispersed over greater distances from the construction site.

Fugitive PM₁₀ emissions from construction activities could be noticeable, if uncontrolled. Mud and particulates from trucks would also be noticeable if construction trucks would be routed through residential neighborhoods.

In addition to PM₁₀ emissions, heavy trucks and construction equipment powered by gasoline and diesel engines would generate PM_{2.5}, CO, and NO_x in exhaust emissions. If construction traffic and lane closures were to increase congestion and reduce the speed of other vehicles in the area, emissions from traffic would increase temporarily while those vehicles are delayed. These emissions would be temporary and limited to the immediate area surrounding the construction site.

Some construction phases (particularly during paving operations using asphalt) would result in short-term odors. These odors might be detectable to some people near the site, and would be diluted as distance from the site increases.

6.1.1 Stationary Source Effects

PSCAA would regulate particulate emissions (in the form of fugitive dust) during construction activities. Operators of fugitive dust sources would be required to take reasonable precautions to prevent these emissions from becoming airborne and would have to maintain and operate the source to minimize emissions.

A Memorandum of Understanding is in place between WSDOT and PSCAA to help eliminate, confine, or reduce construction-related emissions for WSDOT projects in Washington State. In coordination with PSCAA, the air quality environmental documentation may also consider additional provisions or best practices approaches that may or may not be applied to this Project. More consultation with PSCAA will be conducted to refine the appropriate measures, and the Project will create a fugitive dust control plan to control dust during construction.

6.2 Construction Mitigation

Construction of the Project is currently planned to last 4 years 4 months, from 2009 to 2013. The construction traffic management plan being developed for the Project includes detours and strategic construction timing (like night work) to continue moving traffic through the area and reduce backups to the traveling public to the extent possible. Construction areas, staging areas, and material transfer sites would be set up in a way that reduces standing wait times for equipment, engine idling, or blocking the movement of other activities on the site. These strategies would reduce fuel consumption by reducing wait times and ensuring that construction equipment operates efficiently. Due to space constraints at the work site and the benefit of additional emissions reductions, we recommend that ridesharing and other commute trip reduction efforts be promoted for employees working on the Project.

WSDOT's Memorandum of Agreement with PSCAA requiring fugitive dust control planning on its projects will be implemented to comply with the PSCAA regulations that require dust control during construction and to prevent the deposition of mud on paved streets (PSCAA Regulation 1, Article 9). Measures to reduce the deposition of mud and emissions of particulates are listed below.

Other possible air pollutant emission control measures include (Associated General Contractors of Washington 1997):

- Spraying exposed soil with water or other dust palliatives to reduce emissions of PM₁₀ and deposition of particulate matter.
- Covering all trucks transporting materials, wetting materials in trucks, or providing adequate freeboard (space from the top of the material to the top of the truck) to reduce particulate emissions during transportation.

- Providing wheel washers to remove particulate matter that vehicles would otherwise carry offsite to decrease deposition of particulate matter on area roadways.
- Removing particulate matter deposited on paved public roads to reduce mud and resultant windblown dust on area roadways.
- Maintaining as many traffic lanes as possible during peak travel times to reduce air quality effects caused by increased congestion.
- Placing quarry spall aprons where trucks enter public roads to reduce the amount of mud tracked out.
- Requiring appropriate emission-control devices (e.g., diesel oxygen catalyst, diesel particulate filters, and particulate traps) on large pieces of diesel-fueled equipment to reduce CO, NO_x, and particulate emissions in vehicular exhaust.
- Using relatively new, well-maintained equipment to reduce CO and NO_x emissions.
- Planting vegetative cover on graded areas that would be left vacant for more than one season to reduce windblown particulates in the area.
- Routing construction trucks away from residential and business areas to minimize annoyance from dust.
- Requiring the use of low or ultra-low sulfur fuels in construction equipment to allow for the use of effective particulate-emission control devices on diesel vehicles.
- Coordinating construction activities with other projects in the area to reduce the cumulative effects of concurrent construction projects.

This Page Intentionally Left Blank

Chapter 7 INDIRECT AND CUMULATIVE EFFECTS

7.1 Indirect Effects

Indirect effects are reasonably foreseeable effects of an action that occur later in time or are farther removed in distance from the direct effects of a project. Generally, these effects are induced by the initial action. Indirect effects for the Project are considered to be unlikely, and any effects would be limited because the Project would not increase capacity compared to the existing configuration. Any transportation measures that reduce traffic volumes and levels of congestion within the study area, such as improving transit connections into downtown, would reduce traffic-related air pollutant emissions.

7.2 Cumulative Effects

Cumulative effects are additive effects of a project with other developments or actions in the past, present, or reasonably foreseeable future. The air quality analysis for the Project considers the long-term cumulative effects of air pollutant emissions from all traffic forecasted to operate within the downtown Seattle core. The addition of background concentrations in the analysis accounts for the cumulative effect of pollutant sources not specifically included in this air quality evaluation.

During construction of this Project, several other projects are expected to be under construction in the downtown Seattle area, including SR 519 Intermodal Access Project Phase 2, the City of Seattle's Bridging the Gap projects, and several other smaller or less well-defined projects. If construction detours and material haul routes are not well coordinated, the projects could have an adverse cumulative effect on traffic congestion and associated air pollutant emissions. If other construction projects are within the immediate vicinity (less than approximately 1,000 feet) of this Project's construction areas, the cumulative concentration of dust and other construction emissions could increase in the vicinity of those activities.

The detailed construction fugitive dust control plan developed for the Project will include mitigation measures that would reduce the cumulative effects the Project would generate. The Project's construction traffic management plan, which includes detours and strategic construction timing, will consider the effects of other projects in the downtown Seattle area.

This Page Intentionally Left Blank

Chapter 8 REGULATORY COMPLIANCE

8.1 Compliance With NAAQS

Maximum predicted 1-hour and 8-hour CO concentrations for 2013 and 2030 are shown in Exhibit 5-1. The values presented are the highest values obtained at each of the analysis sites using methods presented in this report. Estimated pollutant concentrations at all analysis sites are below the NAAQS. No significant adverse air quality effects are anticipated for the Project.

8.2 Conformity

The study area for the Project includes CO and PM₁₀ maintenance areas. Projects located in maintenance areas must comply with the project-level and regional conformity criteria described in the EPA Conformity Rule (40 CFR 93) and with WAC Chapter 173-420. Because this Project would not cause or increase any exceedance of the NAAQS, it meets project-level conformity requirements per 40 CFR 93.123.

The Project is not yet included in the Metropolitan Transportation Plan (MTP) or the TIP. The Project must be included in the MTP and TIP to show that it conforms to the Puget Sound region's Air Quality Maintenance Plans and would not cause or contribute to exceedances of the NAAQS at the regional level. Once it is included in the MTP and TIP, the Project will meet all requirements of 40 CFR Part 93 and WAC 173-420 and will demonstrate regional conformity.

This Page Intentionally Left Blank

Chapter 9 REFERENCES

- Associated General Contractors of Washington. 1997. Guide to handling fugitive dust from construction projects. Seattle, Washington.
- Ecology (Washington State Department of Ecology). 2000. 1999 Air quality trends in Washington. Olympia, Washington.
- Ecology (Washington State Department of Ecology). 2003a. Draft MOBILE 6/6.1/6.2 input parameters and processing. Olympia, Washington.
- Ecology (Washington State Department of Ecology). 2003b. MOBILE 6 input files for the Puget Sound region. Olympia, Washington.
- Ecology (Washington State Department of Ecology). 2003c. 2000-2002 Air quality trends. Olympia, Washington.
- Ehrlich, P.R., A.H. Ehrlich, and J.P. Holdren. 1977. *Ecoscience: Population, resources, environment*. W.H. Freeman and Company. San Francisco, California.
- EPA (U.S. Environmental Protection Agency). Ambient monitored data. AirData (<http://www.epa.gov/air/data/geosel.html>).
- EPA (U.S. Environmental Protection Agency). 1992. Automobiles and carbon monoxide. Fact sheet number EPA-400-F-92-005. Ann Arbor, Michigan.
- EPA (U.S. Environmental Protection Agency). 1993. Motor vehicle-related air toxics study. Report number EPA-420-R-93-005. Ann Arbor, Michigan.
- EPA (U.S. Environmental Protection Agency). 1994. Users guide to MOBILE6. Report number EPA-AA-AQAB-94-01. Ann Arbor, Michigan.
- EPA (U.S. Environmental Protection Agency). 1995. Compilation of air pollutant emission factors, Fifth Edition (AP-42).
- EPA (U.S. Environmental Protection Agency). 1997. Annual emissions and fuel consumption. Report number EPA420-F-97-037.
- EPA (U.S. Environmental Protection Agency). 1999. Transportation air quality.
- EPA (U.S. Environmental Protection Agency). 2000a. Air quality index: A guide to air quality and your health. Report number EPA-454/R00-R005.
- EPA (U.S. Environmental Protection Agency). 2000b. Global warming and our changing climate. Report number EPA 430-F-00-011.

EPA (U.S. Environmental Protection Agency). 2001. The projection of mobile source air toxics from 1996 to 2007: Emissions and concentrations (Draft). Report number EPA-420-R-01-038.

EPA (U.S. Environmental Protection Agency). 2002a. Latest findings on national air quality 2001 status and trends. Report number EPA-454/K-02-001.

EPA (U.S. Environmental Protection Agency). 2002b. National air toxics assessment.

EPA (U.S. Environmental Protection Agency). 2003. User's Guide to MOBILE6.1 and MOBILE6.2. Report number EPA-420-R-03-010. Ann Arbor, Michigan.

EPA (U.S. Environmental Protection Agency). 2004. User's Guide for the AMS/EPA Regulatory Model – AERMOD. Report number EPA-454/B-03-001.

FHWA (Federal Highway Administration). 2006. Interim guidance on air toxic analysis in NEPA documents. February 3, 2006.

National Research Council. 1992. Rethinking the ozone problem in urban and regional air pollution. Washington, D.C.

National Research Council. 2001. Climate change science: An analysis of some key questions (Draft). Washington, D.C.

PSCAA (Puget Sound Clean Air Agency, formerly Puget Sound Air Pollution Control Agency). 1994. Regulation 1 of the Puget Sound Air Pollution Control Agency. Seattle, Washington.

PSCAA (Puget Sound Clean Air Agency). 1997a. Puget Sound PM₁₀ emissions inventory. Seattle, Washington.

PSCAA (Puget Sound Clean Air Agency). 1997b. Techniques for improving project level conformity analyses in the Puget Sound metropolitan area. Seattle, Washington.

PSCAA (Puget Sound Clean Air Agency). 1999. Final report of the Puget Sound Clean Air Agency PM_{2.5} Stakeholder Group. Seattle, Washington.

PSCAA (Puget Sound Clean Air Agency). 2002. Draft Puget Sound air toxics evaluation. Seattle, Washington.

PSRC (Puget Sound Regional Council). 1995. Guidebook for conformity and air quality analysis assistance for nonattainment areas, Seattle, Washington.

PSRC (Puget Sound Regional Council). 1998. Metropolitan transportation plan. 1998 progress report.

PSRC (Puget Sound Regional Council). 2000. Puget Sound trends: Growth in traffic and vehicle miles traveled.

PSRC (Puget Sound Regional Council). 2001a. Destination 2030 metropolitan transportation plan for the central Puget Sound region.

PSRC (Puget Sound Regional Council). 2001b. Guidelines for the interim use of adjusted CO Mobile output files for project level conformity. Seattle, Washington.

TRB (Transportation Research Board). 2000. Highway capacity manual.

USDOE (U.S. Department of Energy). 2002. Transportation energy data book: Edition 22. Oak Ridge National Laboratory.

USDOT (U.S. Department of Transportation). 1998. Transportation and global climate change: A review and analysis of the literature. Federal Highway Administration.

USDOT (U.S. Department of Transportation). 2001. Transportation conformity reference guide. Federal Highway Administration.

Wayne, R. 1991. Chemistry of atmospheres. Oxford University Press, Oxford, England.

Washington Climate Advisory Team. 2008. Leading the way: A comprehensive approach to reducing greenhouse gases in Washington State.

WSDOT (Washington State Department of Transportation). 2005. Washington State Intersection Screening Tool (WASIST). Seattle, Washington.

This Page Intentionally Left Blank

ATTACHMENT A

EMIT Input Parameters and Output Tables

This Page Intentionally Left Blank

Attachment A is available electronically upon request.

This Page Intentionally Left Blank

ATTACHMENT B

WASIST Output Tables

This Page Intentionally Left Blank

Attachment B is available electronically upon request.

This Page Intentionally Left Blank