Technical Report
South Spokane Street Viaduct Project

Air Quality

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The City of Seattle Department of Transportation

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Chapter 1 Abstract/Summary

This technical report analyzes existing air quality conditions and potential impacts associated with the South Spokane Street Viaduct Widening Project. This project meets all regional and local conformity requirements.

1.1 Studies, Coordination, and Methods

Localized carbon monoxide (CO) concentrations were modeled for existing conditions (2004), opening year (2009) and design year (2030), using standardized Puget Sound Regional Council (PSRC) and Environmental Protection Agency (EPA) modeling procedures.

1.2 Affected Environment

Intersection operations in the project area were evaluated for their potential to cause localized adverse air quality conditions. CO concentrations were modeled at two intersections in the project area: Eastbound South Spokane Street/1st Avenue South and westbound South Spokane Street/6th Avenue South.

The predicted worst-case CO concentrations for existing conditions (2004) do not exceed the one-hour or eight-hour average National Ambient Air Quality Standards (NAAQS) for CO at any location. Modeled maximum eight-hour CO concentrations from vehicle emissions under existing conditions ranged from 4.7 to 6.8 parts per million (ppm). This is below the eight-hour average NAAQS of 9 ppm for CO.

1.3 Impacts

Predicted worst-case one-hour and eight-hour average CO concentrations were evaluated for the South Spokane Street Viaduct Widening Project and found to be within air quality standards, so no impact would occur. Concentrations of other pollutants during project operation would be less than for CO. The project is included in regional conformity modeling completed by the Puget Sound Regional Council. Regional pollutant emissions, including the effects of this viaduct project, were demonstrated to be within regionally allowable amounts.

With the Build Scenario, the predicted worst-case CO concentrations for years 2009 and 2030 would not exceed the one-hour or eight-hour average NAAQS for CO at any location (**Table 1-1**). Predicted maximum eight-hour CO concentrations from vehicle emissions under the Build Scenario ranged from 4.0 to 4.8 ppm for the opening year (2009) and 3.3 to 3.9 ppm for the design year (2030). These values are all below the eight-hour average NAAQS of 9 ppm for CO.

With the No Build Scenario, predicted maximum eight-hour CO concentrations from vehicle emissions (**Table 1-1**) would range from 4.0 to 5.5 ppm for the opening year (2009) and 3.3 to 3.6 ppm for the design year (2030). These values are all below the eight-hour average NAAQS of 9 ppm for CO.

Because the project would not cause or contribute to any violation of the NAAQS for CO, it would not cause any adverse localized CO impacts.

Table 1-1:
Summary of Air Quality Impacts and Mitigation

Scenario	Construction Impacts	Operation Impacts	Mitigation Measures
No Build	None	Worst-case eight-hour CO concentrations were modeled to range from 4.0 to 5.5 ppm in 2009 and from 3.3 to 3.6 ppm in 2030.	None required
Build	Construction activities would result in temporary emissions of pollutants	Worst-case eight-hour CO concentrations were modeled to range from 4.0 to 4.8 ppm in 2009 and 3.3 to 3.9 ppm in 2030.	Use of Best Management Practices during construction would control particulate emissions. No mitigation would be required during operation.

1.4 Mitigation

Because the South Spokane Street Viaduct Widening Project is not predicted to result in any exceedances of NAAQS, no design or operational changes would be required.

Construction emissions could include particulate matter (PM), oxides of nitrogen (NO_x) and carbon monoxide (CO). Construction activities would result in temporary pollutant emissions, including dust and odors. To reduce dust emissions, Best Management Practices (BMP) would be required during construction to meet City of Seattle Standard Specification 1-07.5(3).

Chapter 2 Introduction

This report describes the potential air quality impacts associated with construction and operation of the South Spokane Street Viaduct Widening Project. It provides background project information, discusses transportation air quality in general, assesses the potential for air quality impacts, and discusses appropriate impact avoidance measures.

1.5 Background

The U.S. Environmental Protection Agency (EPA), the Washington State Department of Ecology (Department of Ecology), and the Puget Sound Clean Air Agency (PSCAA) regulate air quality in the project area. Under the Clean Air Act, EPA has established the National Ambient Air Quality Standards (NAAQS), which specify maximum concentrations for carbon monoxide (CO), particulate matter less than 10 micrometers in size (PM_{10}), particulate matter less than 2.5 micrometers in size ($PM_{2.5}$), ozone, sulfur dioxide, lead, and nitrogen dioxide. The standards applicable to transportation projects are summarized in **Table 2-1**. EPA is in the process of implementing eight-hour ozone and $PM_{2.5}$ standards. The eight-hour CO standard of 9 parts per million (ppm) is the standard most likely to be exceeded as a result of transportation projects. Nonconformance with NAAQS can threaten federal funding of transportation projects.

Nonattainment areas are geographical regions where air pollutant concentrations exceed the NAAQS for a pollutant. Air quality maintenance areas are regions that have recently attained compliance with the NAAQS. The South Spokane Street Viaduct Widening Project area lies within ozone, particulate matter and CO maintenance areas (**Figure 2-1**).

Air quality emissions in the Puget Sound Region are currently being managed under the provisions of Air Quality Maintenance Plans (AQMP) for ozone and CO. The current plans were developed by PSCAA and the Department of Ecology and approved by the EPA in 1996. Any regionally significant transportation project in the Puget Sound Air Quality Maintenance Area must conform to the AQMPs. Conformity is demonstrated by showing that the project would not cause or contribute to any new violation of any NAAQS, would not increase the frequency or severity of any existing violation of any NAAQS, or would not delay timely attainment of the NAAQS.

Table 2-1: Summary of Ambient Air Quality Standards

Pollutant	National Primary Standard	Washington State Standard	PSCAA Regional Standard
CARBON MONOXIDE (CO)			
One-Hour Average (not to be exceeded more than once per year)	35 ppm	35 ppm	35 ppm
Eight-Hour Average (not to be exceeded more than once per year)	9 ppm	9 ppm	9 ppm
PM_{10}			
Annual Arithmetic Mean	50 µg/m^3	50 µg/m^3	50 µg/m^3
24-Hour Average Concentration (not to be exceeded more than once per year)	150 µg/m^3	150 µg/m^3	150 µg/m^3
$PM_{2.5}$			
Annual Arithmetic Mean	15 µg/m^3	NS	NS
24-Hour Average Concentration (not to be exceeded more than once per year)	65 µg/m^3	NS	NS
TOTAL SUSPENDED PARTICULATES (TSP)			
Annual Arithmetic Mean	NS	60 µg/m^3	60 µg/m^3
24-Hour Average Concentration (not to be exceeded more than once per year)	NS	150 µg/m^3	150 µg/m^3
OZONE			
One-Hour Average (not to be exceeded more than once per year)	0.12 ppm	0.12 ppm	0.12 ppm
Eight-Hour Average (not to be exceeded more than once per year)	0.08 ppm	NS	NS

Notes: ppm = parts per million
µg/m^3 = micrograms per cubic meter
NS = No Standard
Sources: 40 CFR Part 50 (1997)
WAC chapters. 173-470, 173-474, 173-175 (1987)

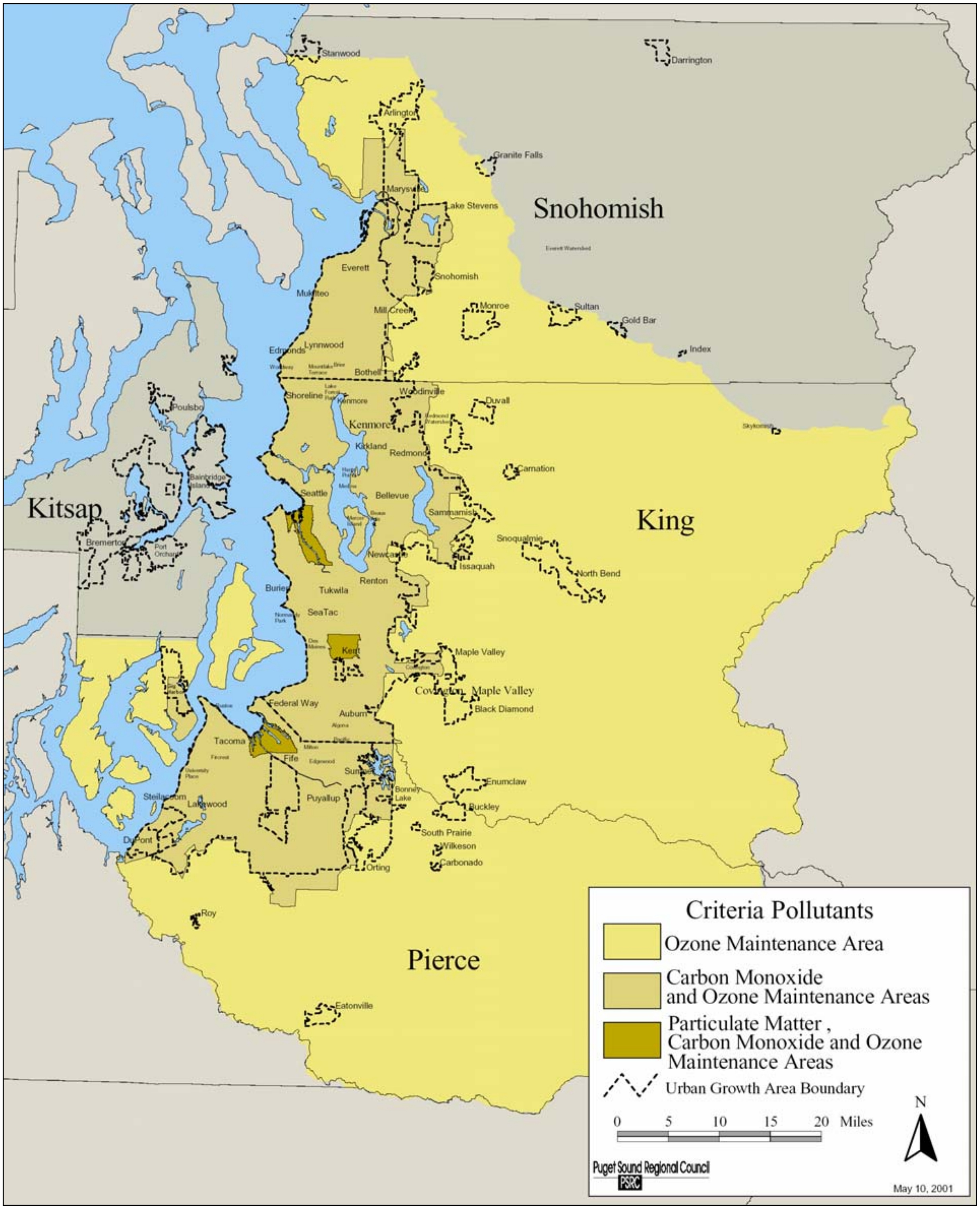


Figure 2-1:
Puget Sound Region Maintenance Areas

Climate

Weather directly influences air quality. Important meteorological factors include wind speed and direction, atmospheric stability, temperature, sunlight intensity, and mixing depth. Temperature inversions, which are associated with higher air pollution concentrations, occur when warmer air overlies cooler air. During temperature inversions in late fall and winter, particulates and CO from wood stoves and vehicle sources can be trapped close to the ground, which can lead to violations of the NAAQS. In the greater Puget Sound area, the highest ozone concentrations occur from mid-May until mid-September, when urban emissions are trapped by temperature inversions and followed by intense sunlight and high temperatures.

Carbon Monoxide

Carbon monoxide (CO) is a colorless, odorless, poisonous gas that reduces the blood's oxygen-carrying capability by bonding with hemoglobin and forming carboxyhemoglobin, which prevents oxygenation of the blood. Exposure to CO concentrations of 80 ppm over eight hours results in a carboxyhemoglobin level of approximately 15 percent (Erlich, 1977). Acute health effects such as headaches, slowed reflexes, weakened judgment, and impaired perception begins at about 3 percent carboxyhemoglobin (carbon monoxide bonding with 3 percent of the hemoglobin). Chronic effects include aggravation of pre-existing cardiovascular disease and increased heart disease risk in healthy individuals. At carboxyhemoglobin levels of approximately 30 percent, individuals become nauseous and collapse, and at very high levels (above 50 percent carboxyhemoglobin) they are in danger of losing their lives.

Vehicular traffic, industry, wood stoves, and slash burns are the major sources of CO. In urban areas, motor vehicles are often the source of over 90 percent of the CO emissions that may cause ambient levels to exceed the NAAQS (EPA, 1992).

Areas of high CO concentrations are usually localized. They occur near congested roadways and intersections in fall and winter and are associated with light winds, cool temperatures, and stable atmospheric conditions. These localized areas of elevated CO levels are referred to as *hot spots*. Decreased CO concentrations in most areas have resulted from stringent federal emission standards for new vehicles and the gradual replacement of older, more polluting vehicles. CO levels have declined in urban areas, but are leveling off in areas experiencing rapid growth in traffic volumes, including suburban parts of the greater Puget Sound region.

Particulate Matter

Particulate matter includes small particles of dust, soot, and organic matter suspended in the atmosphere. Particulates less than 100 micrometers in diameter are measured as Total Suspended Particulates (TSP). Particles less than 10 micrometers in size are measured as PM_{10}, a component of TSP. Particles less than 2.5 micrometers in size are measured as $PM_{2.5}$, a component of PM_{10} and TSP. The smaller $PM_{2.5}$ and PM_{10} particles can be inhaled deeply into the lungs. This can potentially lead to respiratory diseases and cancer, because particulate matter may carry absorbed toxic substances and the particles themselves may be inherently toxic.

Particulate matter can affect visibility, plant growth, and building materials. Sources of particulates include motor vehicles, industrial boilers, wood stoves, open burning, and dust from roads, quarries, and construction activities. Most vehicular emissions are in the $PM_{2.5}$ size range, and road and construction dust is often in the larger PM_{10} range. Most fine-particulate vehicle emissions result from diesel vehicles that release fine particulates both directly (mostly as carbon compounds) and indirectly in the form of sulfur dioxide (SO_2), a gas that reacts in the atmosphere to form sulfate particulates. High $PM_{2.5}$ and PM_{10} concentrations occur in fall and winter during periods of air stagnation and high use of wood for heat.

Particulates emitted from diesel vehicles pose specific health risks compared to other types of particulate matter. The EPA's Clean Air Scientific Advisory Committee is currently reviewing recent health assessment data on diesel emissions, but the data is not yet available for citation. Previous EPA research (EPA, 1993) found that components of diesel particulates (primarily high-molecular-weight organic compounds) have several negative health effects, including carcinogenesis, accumulation of particles in the lungs, tissue inflammation, respiratory irritation, and other related effects. Health effects associated with diesel particulates were one of the major contributing factors in establishing the new $PM_{2.5}$ standard.

Ozone

Ozone is a highly toxic form of oxygen and a major component of the complex chemical mixture that forms photochemical smog. Ozone is not produced directly, but is formed by a reaction between sunlight, nitrogen oxides (NO_x), and hydrocarbons (HC). Ozone is primarily a product of regional vehicular traffic, and point-source and fugitive emissions of the ozone precursors. Tropospheric (ground-level) ozone, which results from ground-level precursor emissions, is a health risk. Stratospheric (upper-atmosphere) ozone, which is produced through a different set of chemical reactions that only require oxygen and intense sunlight, protects people from harmful solar radiation. In the remainder of this report, the term *ozone* refers to *tropospheric ozone*.

Ozone irritates the eyes and respiratory tract and increases the risk of respiratory and heart diseases. It reduces the lung function of healthy people during exercise, can cause breathing difficulty in susceptible populations such as asthmatics and the elderly, and damages crops, trees, paint, fabric, and synthetic rubber products. The severity of health effects is both dose and exposure-duration related (National Research Council, 1992). As with $PM_{2.5}$, the EPA has adopted a new eight-hour ozone standard (**Table 2-1**), but the old one-hour standard is still applicable for current nonconformity and maintenance areas. Regional ozone planning efforts by PSCAA consider both standards.

In the Puget Sound area, the highest ozone concentrations occur from mid-May until mid-September, when urban emissions are trapped by temperature inversions followed by intense sunlight and high temperatures. Maximum ozone levels generally occur between noon and early evening at locations several miles downwind from sources, after NO_x and

HC have had time to mix and react under sunlight. Light, northeasterly winds arising during these conditions result in high ozone concentrations near the Cascade foothills, to the south and southeast of major cities.

Chapter 3 Project Description

3.1 Background

The South Spokane Street Viaduct is a City owned 0.75 mile (about 3,500 feet) transportation corridor that links I-5, SR 99, and the West Seattle Bridge. The viaduct also connects West Seattle and the area south of downtown (SODO) with other Seattle neighborhoods including downtown and the Port of Seattle. It is the major transportation corridor in a heavily industrialized area approximately two miles south of downtown Seattle (see **Figure 3-2**, Vicinity Map).

The viaduct has continued to undergo major changes and improvements since 1994 when SDOT began design of a safety project for the segment between I-5 and SR 99. The project included widening traffic lanes and shoulders, and replacing the 4th Avenue South on/off-ramp with a rebuilt on/off ramp at 1st Avenue South. These improvements were intended to reduce traffic accidents and make the viaduct more seismically and structurally sound. As funding has become available, the City has completed the following components of the project that began in 1994:

- Seismic Retrofit (1998-1999): Under Contract 1, the existing viaduct was seismically retrofitted to improve its ability to withstand an earthquake.
- Median Barrier Installation (1999): Under Contract 2, a median barrier was built along the center of the viaduct. The barrier increased safety and eliminated the potential for head-on collisions by dividing the two directions of traffic.
- Utilities Relocation (2001-2003): Under Contract 3, street level utilities were relocated to make room for the viaduct widening proposed under Contract 4. The viaduct improvements proposed under Contract 4 are described in Section 1.3 (Proposed Widening Project).

3.2 Existing Viaduct Configuration

Currently, the South Spokane Street Viaduct comprises four narrow lanes with limited shoulders, sub-standard on/off ramps. Prior to recent temporary safety improvements, this was one of the City's highest accident locations. When the viaduct structure was built in the early 1940s it met the design standards of that time. However, it does not meet current standards for today's traffic volumes.

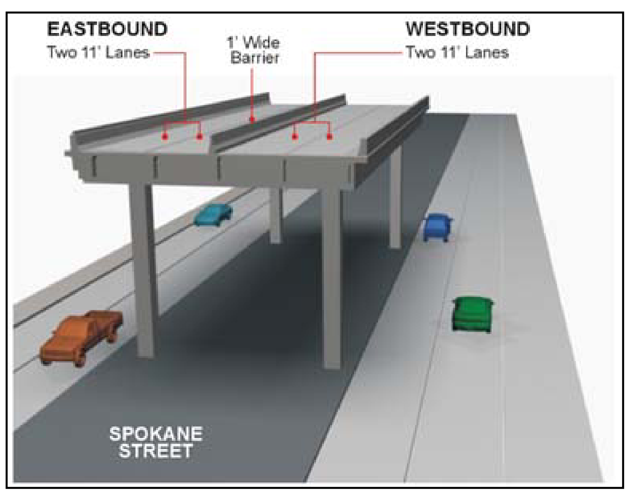


Figure 3-1: Existing Viaduct

Figure 3-2: Vicinity Map

3.3 Proposed Widening Project

The proposed project (Contract 4) would complete all unfinished components of the original project that began in 1994. In addition, a new eastbound 4th Avenue South off-ramp is proposed. All currently proposed project components are shown in **Figure 3-3** and described below. The completed project would reduce conflicts among freight movement, intercity rail passenger traffic, commuter traffic, and ferry access, while increasing the safety and mobility of people and goods. The project would also improve lane channelization and signage on the lower-level South Spokane Street roadway, which also has a high accident rate.

Project Components

Widen Roadway: The existing viaduct is 45 feet wide. The proposed project would widen the viaduct to the north by 41 feet, for a total width of about 86 feet. The widened viaduct would accommodate a new westbound "weave" lane between I-5 and the new 1st Avenue South on/off-ramp (described below) and replace two narrow existing lanes. Traffic lanes on the widened viaduct would be reconfigured to 12 feet wide, with 8-foot-wide shoulders and a wider relocated permanent median, or remain at 11 feet wide with reduced shoulders of 5 feet wide. The decision on final lane widths and configuration will be based on ongoing preliminary design work for the 4th Avenue South off-ramp. Under either option, the entire roadway surface of the elevated structure would be repaved in concrete.

Relocate the Westbound 4th Avenue South On/Off-Ramp: New westbound on- and off-ramps that meet today's design standards would be constructed at 1st Avenue South, replacing the existing ones at 4th Avenue South, which would be removed. The existing westbound 1st Avenue South on-ramp would also be removed.

Build a New Eastbound 4th Avenue South Off-Ramp: A new eastbound off-ramp to 4th Avenue South would be built. The new ramp would touch down on 4th Avenue South south of South Spokane Street, and potentially connect the South Spokane Street Viaduct to the E-3 Busway, creating a new a transit link between West Seattle and downtown Seattle during replacement of the Alaskan Way Viaduct.

Build Lower-Level Roadway Improvements: Full curbs and sidewalks would be constructed on the north side of South Spokane Street to serve as a multi-use pathway, improving pedestrian and bicycle safety and access. The new sidewalk would connect to a planned bicycle path along 5th Avenue South (also known as the E-3 Busway).

The roadway would be repaved with asphalt and a gravel-paved median would be added under the viaduct. These improvements would be built along the entire project length.

Figure 3-3: Location of Proposed Project Improvements

Other Improvements

0 The South Spokane Street stormwater system would be replaced, and runoff from the new impervious surface areas would be treated for water quality improvement.

1 A fire protection system would be provided for the viaduct roadway.

2 Viaduct and ground-level lighting would be built.

3 Final seismic improvements would be made, as identified in the original 1994 project plan.

4 Electrical service to properties along the north side of South Spokane Street would be relocated underground.

Construction Phases

Construction of the proposed project could occur in one, two or three phases, depending on the availability and timing of funding. Construction would begin in the second half of 2006 at the earliest and be completed in either 2009 or 2010, depending on how it is phased. It is likely that westbound lanes on South Spokane Street would be closed and parking under the viaduct would be eliminated during the entire construction period. Access to businesses would be from eastbound South Spokane Street via north-south connections that cross the lower South Spokane Street roadway. All three phases, if constructed together, could be completed in three years.

Phase 1 (18-24 months): This phase includes widening the viaduct from about 300 feet east of 1st Avenue South to the Harbor Island off-ramp, which is the western terminus of the project. The new westbound ramps would also be constructed at 1st Avenue South. The existing westbound 4th Avenue South off-ramp would remain open during Phase 1 construction. Phase 1 construction is planned for 2006 through 2007.

Phase 2 (15 months): This phase includes widening the viaduct from the eastern terminus of the Phase 1 improvement to the I-5 interchange (the project's eastern terminus) and removing the old westbound 4th Avenue South ramps. Phase 2 construction is planned for mid-2007 through 2009.

Phase 3 (12 months): This phase includes building the eastbound 4th Avenue South off-ramp. Phase 3 construction is planned for 2009 through 2010. Depending on the availability of funding, this component could also be built as part of Phase 2.

Chapter 4 Methodology

For the South Spokane Street Viaduct Widening Project and most other roadway air quality studies, predictions of existing and future localized air pollution concentrations in the project vicinity are made for CO only. Most other pollutants must be monitored and dealt with regionally. This is done for three reasons:

5 Total CO emissions are greater than the emissions of all other pollutants combined from automobiles (MOBILE 6.2 results). Section 4.1 describes the MOBILE 6.2 model.

6 Motor vehicles are the greatest source of CO emissions, accounting for over 90 percent of total CO emissions in urban areas. Therefore, it is generally not necessary to account for other (often unquantified) sources of CO near the project area (EPA, 1993).

7 CO emissions from motor vehicles may be high enough to affect individuals in the immediate area, while most other pollutant emissions are not (Erlich, 1977).

Figure 4-1 shows the intersections modeled for CO levels, which include only the two intersections affected by the project with a level of service (LOS) D or worse for the predicted 2030 AM and PM peak-hour conditions. Eastbound South Spokane Street and 1st Avenue South had an LOS E for the 2030 PM peak hour, and westbound South Spokane Street and 6th Avenue South had an LOS D for the 2030 AM peak hour. Average carbon monoxide (CO) peak-hour concentrations (in parts per million: ppm) were estimated for existing conditions (2002), year of opening (2007), and the project design year (2030).

CO concentrations for the Build and No Build scenarios were estimated using the traffic volumes presented in the *Draft Technical Report: South Spokane Street Viaduct Project – Transportation* (Parsons Brinckerhoff Quade & Douglas, Inc., 2005) using MOBILE 6.2 emission factors and CAL3QHC software.

1.6 MOBILE 6.2 Model

MOBILE 6.2 is an updated version of the Mobile Source Emission Factor Model computer program, which the EPA developed to calculate emission factors from highway motor vehicles in the units of grams of pollutant per mile traveled. Because MOBILE 6.2 accounts for gradual replacement of older vehicles with newer, less-polluting vehicles, the predicted emission rates for future years are lower than current emission rates.

The Puget Sound Regional Council (PSRC) provided air quality pollutant emission factors for analysis of existing conditions (2004), opening year (2009), and design year (2030) for the Build and No Build scenarios.

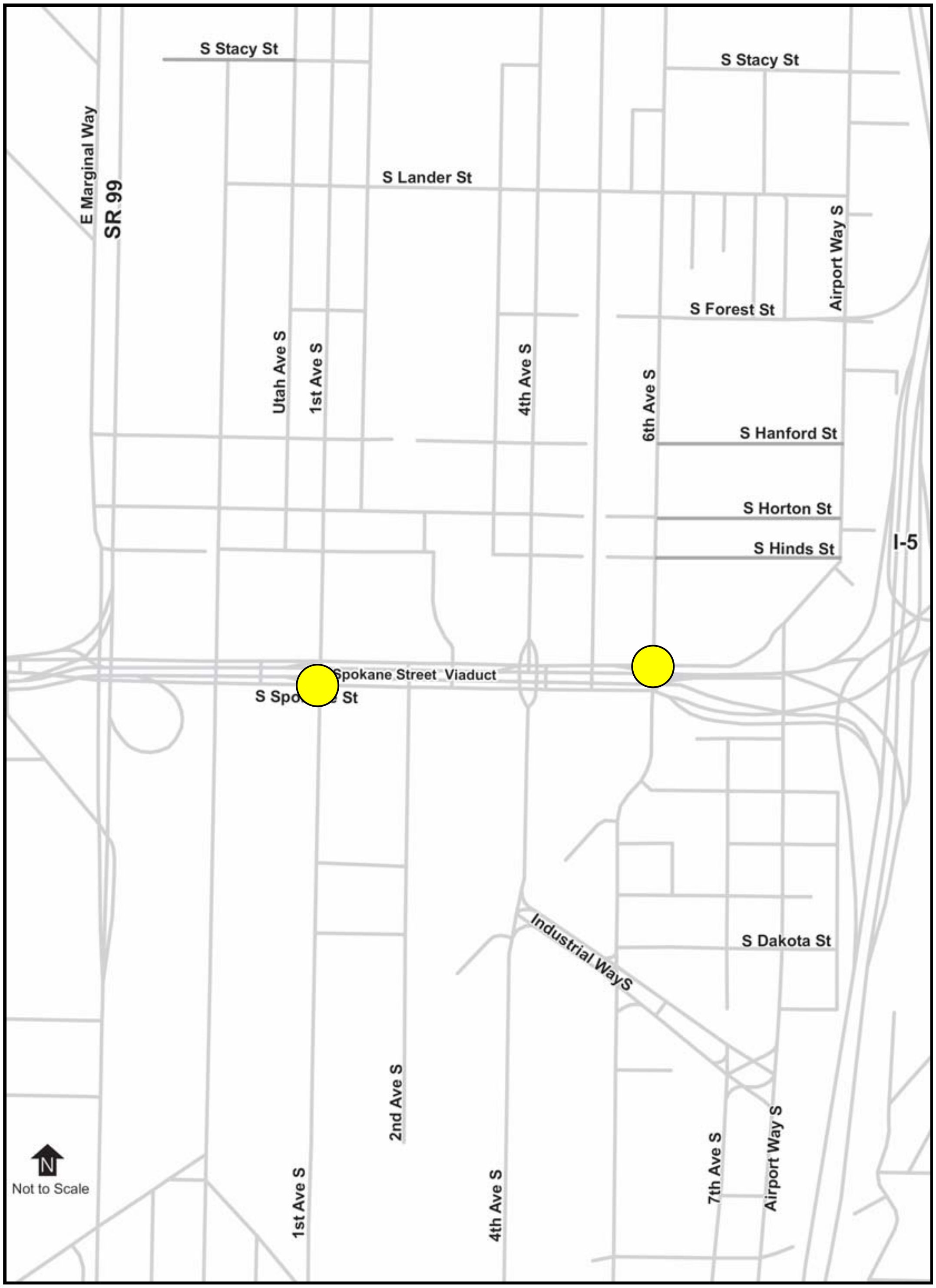


Figure 4-1:
Intersections Modeled for CO

1.7 CAL3QHC Model

CAL3QHC Version 2 is a line-source dispersion model that predicts pollutant concentrations near roadways. CAL3QHC input variables include MOBILE 6.2 free-flow and calculated idle emission factors, roadway geometries, traffic volumes, site characteristics, background pollutant concentrations, signal timing, and meteorological conditions. CAL3QHC predicts inert pollutant concentrations in parts per million (ppm) averaged over a one-hour period near roadways. CAL3QHC was used to predict CO concentrations at affected project area intersections (Appendix A).

CAL3QHC predicts peak one-hour pollutant concentrations based on stable meteorology and peak-hour traffic flow. This study assumed a wind speed of 3 feet per second and evaluated wind directions in 10-degree increments to select the worst-case wind angle. Background CO concentrations were assumed to be 3 ppm averaged over one hour, to represent Puget Sound conditions (WDOE, 1995). An atmospheric stability class of D (urban land use) was modeled according to EPA Guidance (EPA, 1992). These conditions do not usually persist for an eight-hour period, so the worst-case eight-hour CO concentrations are lower than the maximum one-hour concentrations. The eight-hour average CO concentration is calculated by multiplying the maximum one-hour concentration by a persistence factor, which accounts for the time variance in traffic and meteorological conditions. The EPA recommends a persistence factor of 0.7 for this area (EPA, 1992), and the background eight-hour CO concentrations were assumed to be 2.1 ppm.

Free-flow traffic was modeled at the posted speed limit. Traffic volumes were obtained from the *Draft Technical Report: South Spokane Street Viaduct Project – Transportation* (Parsons Brinckerhoff Quade & Douglas, Inc., 2005). Traffic operations data including turn movements channelization (Appendix B), signal times, and saturation flow rates were taken from the Synchro runs completed as part of the traffic study for this project.

Specific locations where CO concentrations are predicted are known as *receptors*. Receptors are modeled in locations where the highest concentrations would likely occur because of traffic congestion, and where the general public would have access (EPA, 1992). For this analysis, receptors were located in areas accessible to the general public at mid-distance from the edge of the travel lane and 6 feet off the ground. At each intersection, individual receptors were modeled from the corners and at 75-foot intervals, at a distance of 10 feet from each intersection. Only the highest concentration of CO at each intersection was reported for each modeled scenario.

Typical link and receptor geometry is illustrated in **Figure 4-1**.

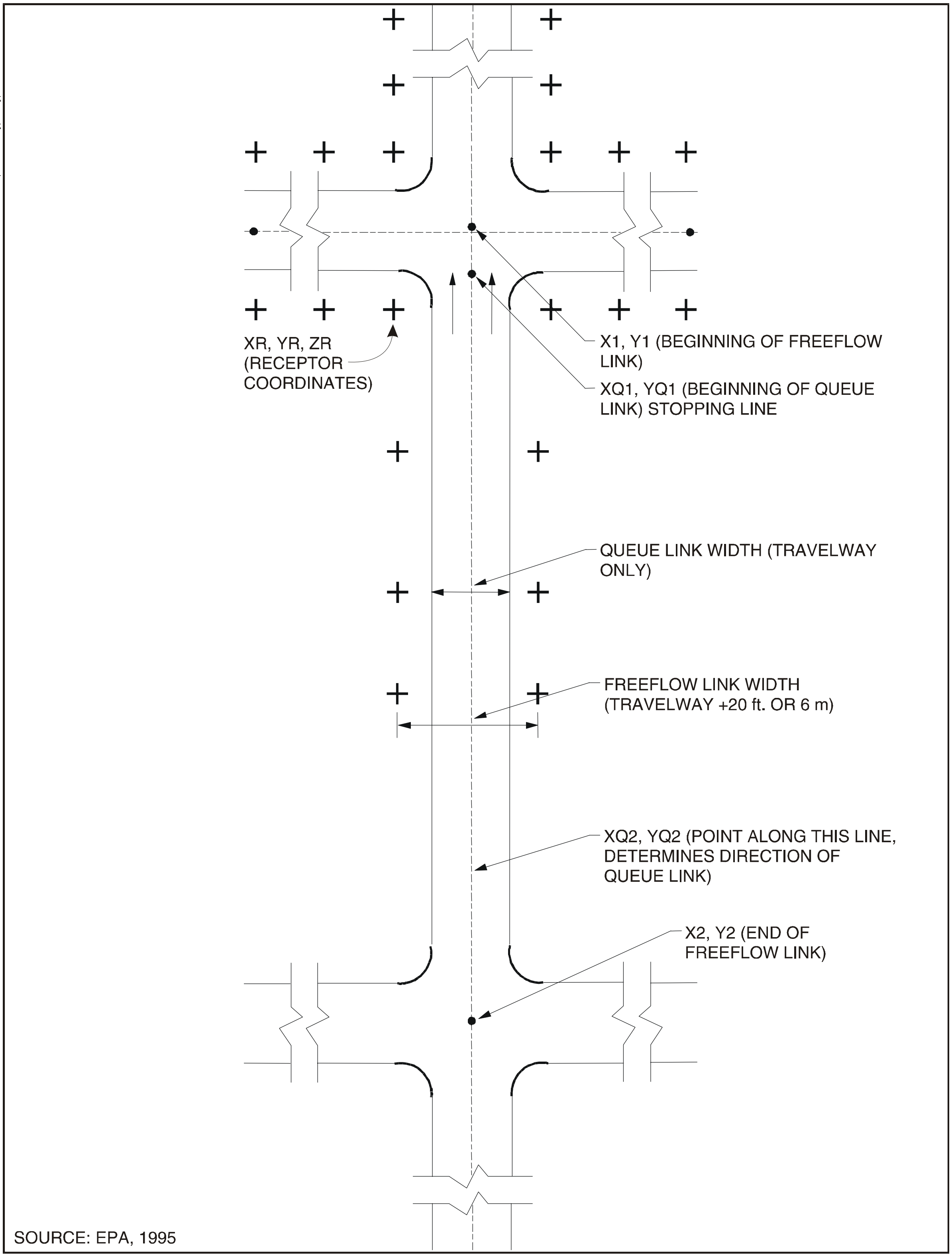


Figure 4-1:
Typical Link and Receptor Geometry

Chapter 5 Affected Environment

This chapter describes the project area, emission trends, localized carbon monoxide (CO) concentrations.

1.8 Description of Project Area

Land uses adjacent to the proposed project area are mostly industrial with some commercial. The terrain is relatively flat.

1.9 Emission Trends

Fuel combustion from motor vehicles and other sources releases carbon dioxide (CO_2), which is a "greenhouse gas" that traps heat within the earth's atmosphere. CO_2 is not directly harmful to human health and is not a criteria pollutant. Considerable progress has been made in the U.S. and the Puget Sound region to reduce criteria air pollutant emissions from motor vehicles and improve air quality since the 1970s, even as vehicle travel has increased rapidly.

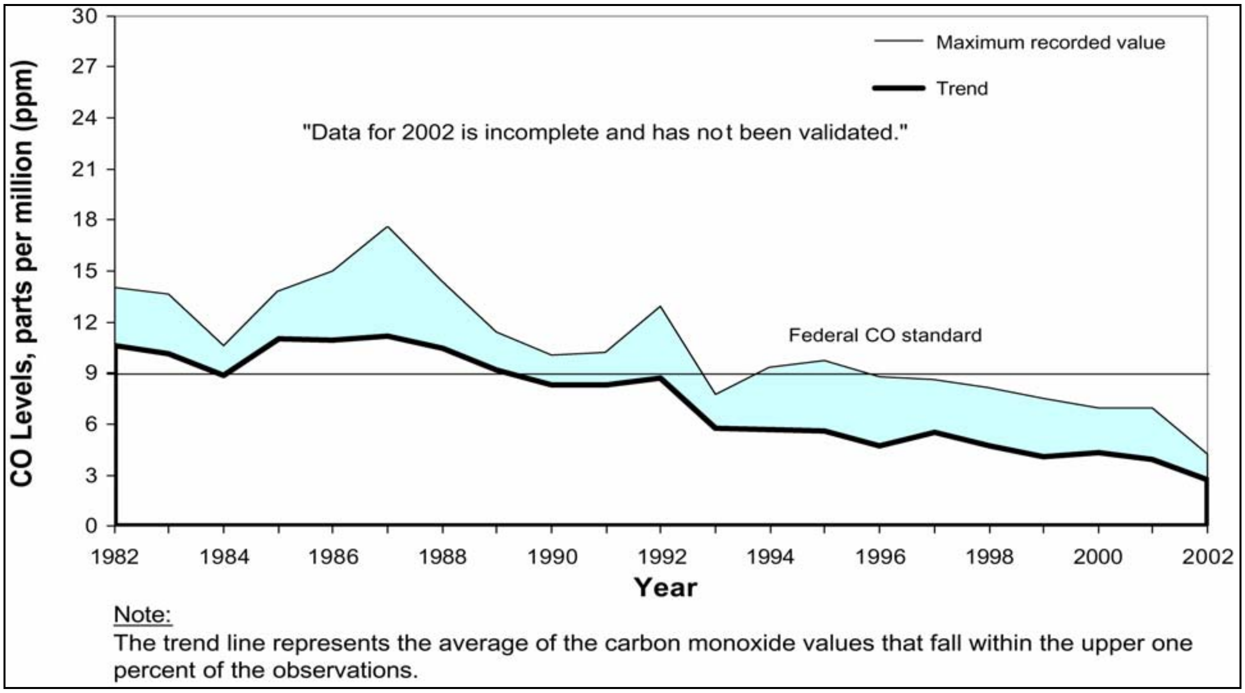
Nationally, criteria pollutant emissions decreased 25 percent between 1970 and 2001. In general, the air is noticeably cleaner than in 1970, and all criteria pollutant emissions from motor vehicles are less than they were in 1970 despite the fact that vehicle miles of travel have more than doubled. Still, challenges remain. Based on monitored data, approximately 46 million people in the U.S. reside in counties that did not meet the air quality standard for at least one National Ambient Air Quality Standards (NAAQS) pollutant in 1996 (EPA, 2002).

National Air Pollution Trends

Nationwide, air pollutant emissions from motor vehicles have dropped considerably since 1970. Volatile Organic Compound emissions (also referred to as hydrocarbon (HC) emissions) have decreased by 38 percent, oxides of nitrogen (NO_x) emissions have increased 15 percent, emissions from particulate matter less than 10 micrometers in size (PM_{10}) have decreased by 76 percent, and carbon monoxide (CO) emissions have decreased by 19 percent. These reductions have occurred despite increasing population, economic growth, and vehicle travel (EPA, 2002).

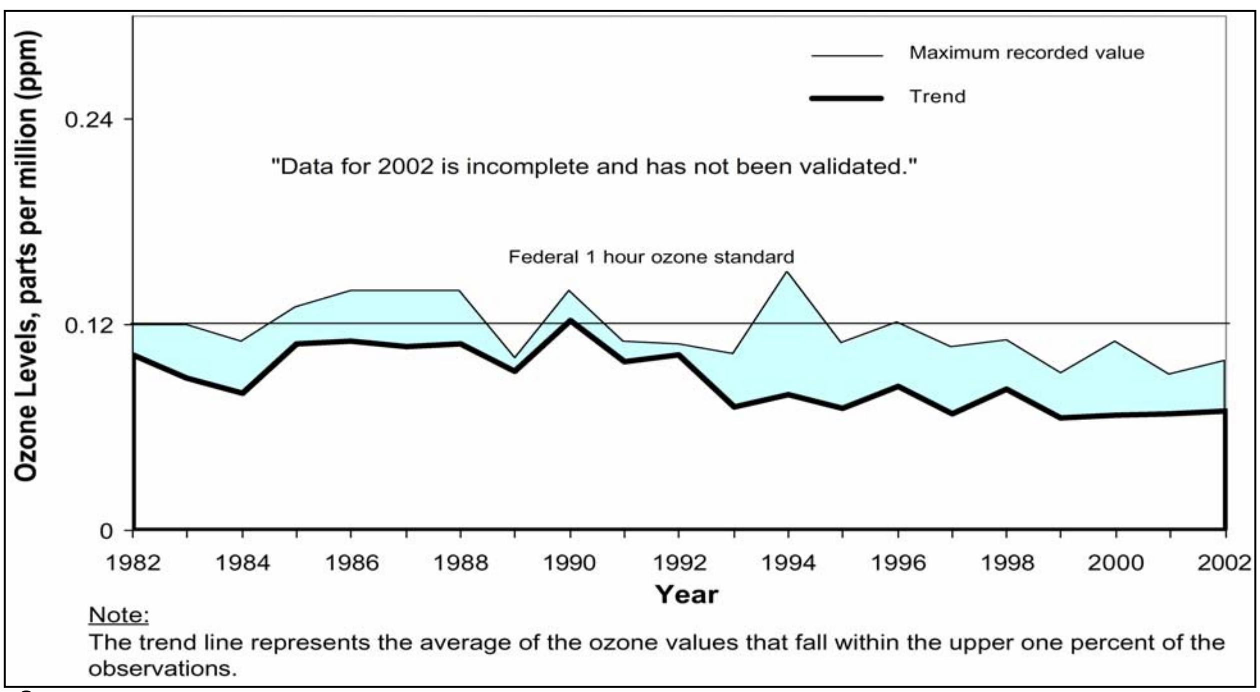
Regional Air Pollution Trends

Regional air pollutant trends have generally followed national patterns over the last 20 years. Carbon monoxide (CO) is the criteria pollutant most closely tied to transportation, and over 90 percent of the CO emissions in the Puget Sound region come from transportation sources. Regionally, the maximum measured CO concentrations have decreased over the past 20 years (**Figure 5-1**). Other transportation pollutants have followed similar but less pronounced trends (**Figure 5-2**).



Source:
2000-2003 Air Quality Trends Report (Washington Department of Ecology, 2003)

Figure 5-1: Puget Sound CO Trends



Source:
2000-2003 Air Quality Trends Report (Washington Department of Ecology, 2003)

Figure 5-2: Puget Sound Ozone Trends

1.10 Localized Carbon Monoxide Concentrations

CO concentrations were modeled at the following intersections:

- South Spokane Street and 1st Avenue South
- South Spokane Street and 6th Avenue South

The modeled worst-case CO concentrations for existing conditions (2002) did not exceed the one-hour average or the eight-hour average National Ambient Air Quality Standards (NAAQS) for CO at any location (**Table 6-1**). Modeled maximum one-hour CO concentrations from vehicle emissions ranged from 6.7 to 9.7 ppm. This is below the one-hour average NAAQS of 35 ppm for CO. Predicted maximum eight-hour CO concentrations from vehicle emissions ranged from 4.7 to 6.8 ppm. This is below the eight-hour average NAAQS of 9 ppm for CO.

5.4 Localized Particulate Mater Concentration

The project is located in the Duwamish PM_{10} maintenance area. As part of the qualitative analysis conducted in December 2003 for the SR 99 Alaskan Way Viaduct and Seawall Replacement Project the following intersection, located within the Duwamish PM_{10} maintenance area, was modeled: 1st Avenue South/S. Royal Brougham Way (approximately 1.5 miles north of Spokane Street). The highest average predicted 2030 PM_{10} concentration was modeled to be 48 $\mu g/m^3$ (the PM_{10} standard is 150 $\mu g/m^3$ – see **Table 2-1**). Because this intersection was not predicted to experience violations of the PM_{10} standard, it is unlikely that any intersection in the South Spokane Street Viaduct Project study area would experience violation of the PM_{10} standard.

Chapter 6 Environmental Consequences

6.1 Operation

For the Build Scenario, the maximum estimated one-hour CO concentrations from vehicle emissions would range from 5.7 to 6.8 ppm in 2009 and from 4.7 to 5.5 ppm in 2030 (**Table 6-1**). The maximum estimated eight-hour CO concentrations would range from 4.0 to 4.8 ppm in 2009 and 3.3 and 3.9 ppm in 2030 (**Table 6-2**). No exceedance of the NAAQS for CO is predicted with the South Spokane Street Viaduct Widening Project.

Table 6-1: Maximum One-Hour Average CO Concentrations

Intersection	2004 Existing Conditions	2009 No Build	2009 Build	2030 No Build	2030 Build
South Spokane Street and 1st Avenue South	9.7	7.8	6.8	5.2	5.5
South Spokane Street and 6th Avenue South	6.7	5.7	5.7	4.7	4.7
Concentration values are in parts per million (ppm). The one-hour NAAQS for CO is 35 ppm.					

Table 6-2: Maximum Eight-Hour Average CO Concentrations

Intersection	2004 Existing Conditions	2009 No Build	2009 Build	2030 No Build	2030 Build
South Spokane Street and 1st Avenue South	6.8	5.5	4.8	3.6	3.9
South Spokane Street and 6th Avenue South	4.7	4.0	4.0	3.3	3.3
Concentration values are in parts per million (ppm).- The eight-hour NAAQS for CO is 9 ppm.					

The modeled intersections include all areas affected by the project that are accessible to the general public and where elevated CO concentrations would likely occur. Because the project would not cause or contribute to any violation of the NAAQS for CO, it would not cause any adverse localized CO impacts.

6.2 Construction

During construction of the project, air pollutant emissions would occur. Fugitive emissions from particulate matter less than 10 micrometers in size (PM_{10}) would be associated with demolition, ground excavation, and grading operations.

PM_{10} emissions would vary from day to day, depending on the level of activity, specific operations, and weather conditions. PM_{10} emissions would depend on soil moisture, the soil's silt content, wind speed, and the amount and type of operating equipment. Larger dust particles would settle near the source, and fine particles would be dispersed over greater distances from the construction site.

The quantity of particulate emissions would be proportional to the area of construction operations and level of activity. Based on field measurements of suspended dust emissions from construction projects, an approximate emission factor for construction operations would be 1.2 tons per acre of construction per month of activity (EPA, 1999). Emissions would be reduced if less site area was disturbed or mitigation was performed.

Several industrial and commercial buildings are located within 200 feet of the construction area for the proposed viaduct project. At that distance, fugitive PM_{10} emissions from construction activities would be noticeable, if uncontrolled. Mud and particulates from trucks would also be noticeable near construction truck routes. Construction would require mitigation measures to comply with the Puget Sound Clean Air Agency (PSCAA) regulations that require dust control during construction and 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 identified in Chapter 7 (*Mitigation).*

In addition to particulate emissions, heavy trucks and construction equipment powered by gasoline and diesel engines would generate small particulates, 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 would result in short-term odors, particularly during paving operations using asphalt. These odors might be detectable to some people near the project site, and would be diluted as distance from the site increases. There would be no burning of slash.

6.3 Conformity Determination

The South Spokane Street Viaduct Widening Project area lies within PM_{10}, ozone and CO maintenance areas and must comply with the project-level conformity criteria of the EPA Conformity Rule and with WAC Chapter 173-420. Regionally significant projects in non-attainment and maintenance areas must be included in a conforming Metropolitan Transportation Plan (MTP) and Transportation Improvement Plan (TIP) by the regional Metropolitan Planning Organization (MPO). The project is included in the latest version of the Puget Sound Regional Council (PSRC) MTP and TIP as number SEA-91. As stated in 40 Code of Federal Regulation (CFR) Part 93, the following criteria must be met when determining project conformity. A brief summary of the project's conformity to the State Implementation Plan (SIP) is discussed with each criterion (criteria are indicated by italics and a reference to where they are required in the CFR).

- *The conformity determination must be based on the latest planning assumptions (40CFR Part 93.110).* The project is included in the latest version of the PSRC's MTP and TIP as Project SEA-91. The plans rely on the most current planning assumptions approved by the PSRC.
- *The conformity determination must be based on the latest emission estimation model available (40CFR Part 93.111).* Emissions to determine conformity to the MTP and TIP were calculated using MOBILE 6.2, the emission model used to model conformity of the current Puget Sound Air Quality Maintenance Plans.
- *The project must come from a conforming transportation plan and program (40CFR Part 93.114).* The project is included in the latest version of the PSRC's MTP and TIP as Project SEA-91. The MTP and TIP conform to the current Puget Sound Air Quality Maintenance Plans.
- *There must be a current conforming plan and a current conforming TIP at the time of project approval (40CFR Part 93.115).* There is a current conforming MTP and TIP.
- *The FHWA project must not cause or contribute to any new localized CO or violation in CO and PM_{10} nonattainment or maintenance areas (40CFR Part 93.116).* The project is located in a CO maintenance area. As shown in **Table 6-1** and **Table 6-2**, no CO violations would occur in the project area in 2009 or 2030. The project would likely not cause exceedence of the PM_{10} standard (Chapter 5.)
- *The FHWA project must comply with PM_{10} control measures in the applicable implementation plan (40CFR Part 93.117).* During construction contractors are required to meet City of Seattle Standard Specification 1-07.5(3), which requires contractors to meet PSCAA requirements to control PM_{10} emissions.

Conformity Finding: The project meets the criteria of 40 CFR Part 93 and WAC 173-420 for projects from a conforming plan and TIP. The project also meets all of the hot-spot criteria of 40 CFR Part 93 and WAC 173-420-065 and the conformity criteria of the EPA Conformity Rule, 40 CFR Part 93 and WAC 173-420. The project also conforms to the SIP.

Chapter 7 Mitigation

7.1 Operation

Because no exceedances of National Ambient Air Quality Standards (NAAQS) are predicted, no design or operational changes would be required.

7.2 Construction

The Puget Sound Clean Air Agency (PSCAA) regulates particulate emissions (in the form of fugitive dust during construction activities). The operator of a source of fugitive dust must take reasonable precautions to prevent fugitive dust from becoming airborne and must maintain and operate the source to minimize emissions. Construction impacts from the viaduct project would be reduced by requiring contractors to meet City of Seattle Standard Specification 1-07.5(3), which requires contractors to meet PSCAA requirements. Possible mitigation measures that would be used to control PM_{10}, deposition of particulate matter, and emissions of CO and NOx during construction include:

8 Evaluating all structures to be demolished for asbestos containing materials.

9 Covering stockpiles and spraying exposed soil with water or other dust palliatives to reduce PM_{10} emissions and deposition of particulate matter.

10 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 PM_{10} and deposition of particulates during transportation.

11 Sweeping to remove particulate matter deposited on paved, public roads to reduce mud on area roadways.

12 Routing and scheduling construction trucks to reduce traffic delays during peak travel times, to reduce secondary air quality impacts caused by reduced traffic speeds while waiting for construction trucks.

13 Placing quarry spall aprons where trucks enter public roads to reduce mud track-out.

14 Requiring appropriate emission-control devices on all construction equipment powered by gasoline or diesel fuel, to reduce CO and NOx emissions in vehicular exhaust.

Chapter 8 Secondary/Cumulative Impacts

Secondary and cumulative impacts and benefits may occur in the proposed South Spokane Street Viaduct Widening Project area. Generally, secondary impacts and benefits result from a proposed project action, but take place later in time than the initial action. Cumulative impacts and benefits result from the combined effects of several proposed or considered project actions that may take place in the project area before, during, or after the project timeframe.

1.11 Secondary Impacts and Benefits

The air quality analysis described in this report was performed using projected traffic volumes for future years, including the effects of other planned transportation improvements. Therefore, the air quality analysis includes the project's secondary effects and other traffic growth that would be associated with the project.

1.12 Cumulative Impacts and Benefits

The air quality analysis described in this report was performed using projected traffic volumes that incorporate anticipated traffic generation from planned development in the project vicinity. Therefore, the air quality analysis includes the cumulative affects of the project and other traffic growth that would be associated with other planned regional project.

Chapter 9 References

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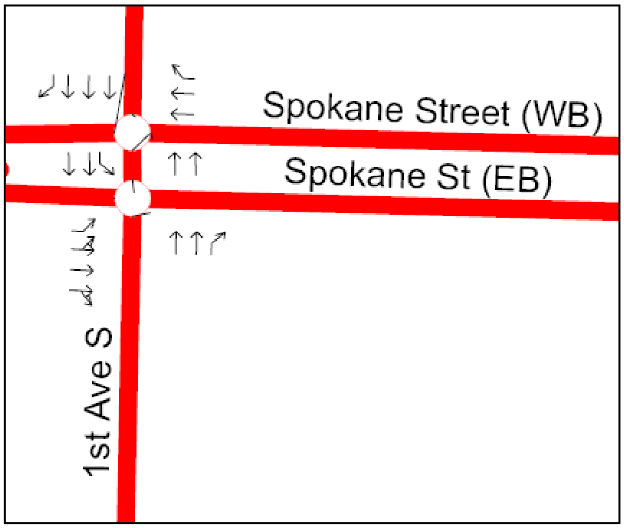
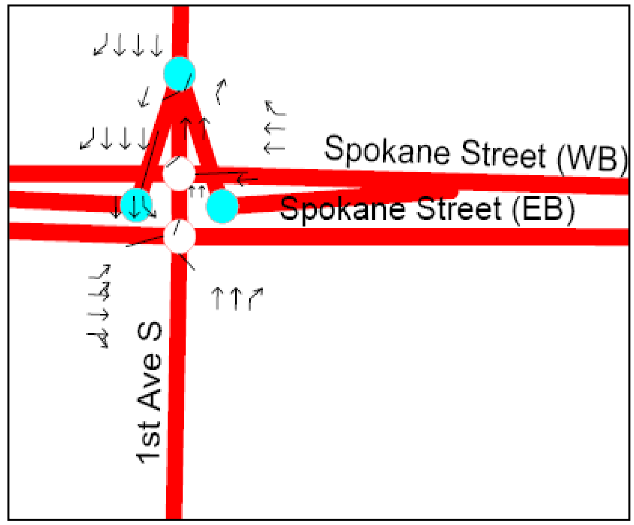
Appendix A Cal3QHC Model Outputs

See attached CD files

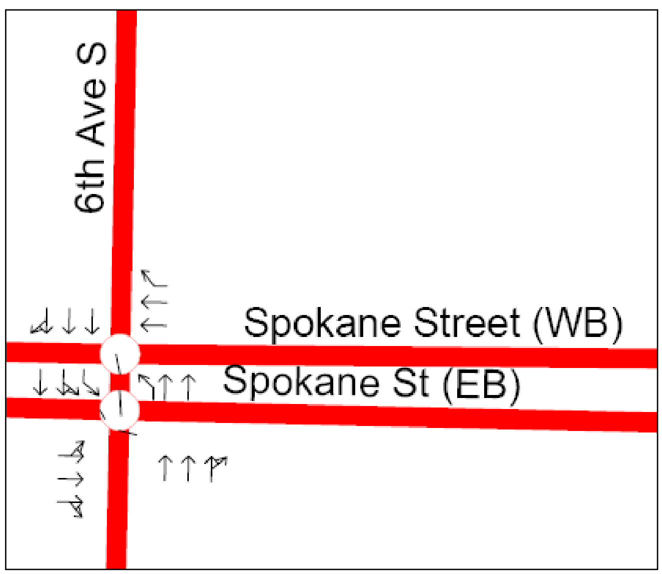
Appendix B Channelization Plans



1st Avenue and Spokane Street Baseline



1st Avenue and Spokane Street Build



6th Avenue and Spokane Street All Alternatives