WSDOT

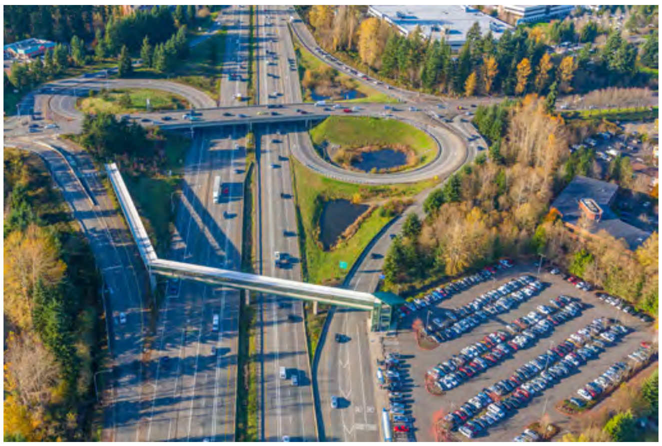
U. S. Department of Transportation
Federal Highway Administration

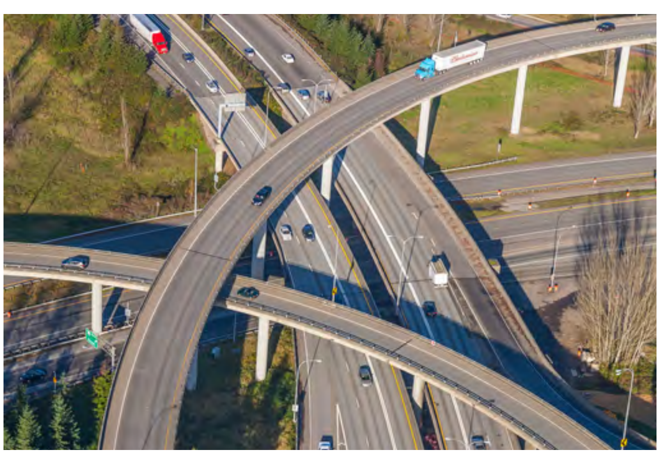
MAY 2020

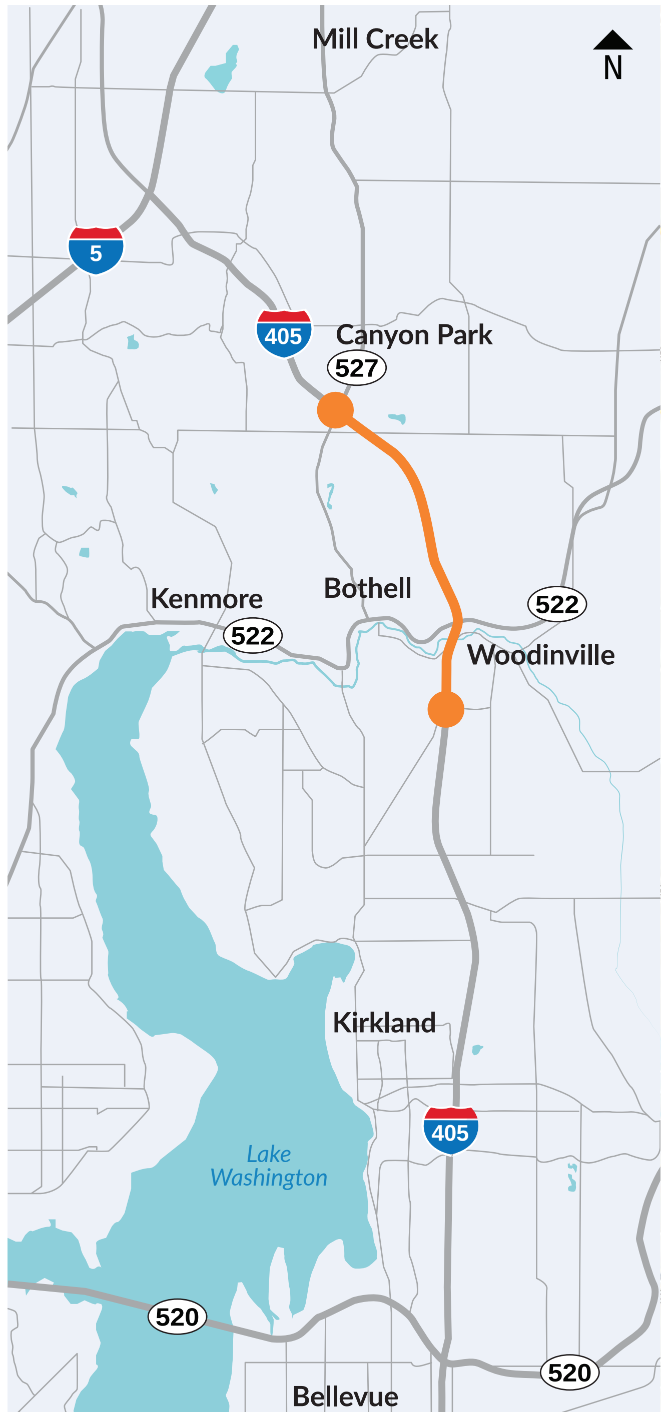
ENVIRONMENTAL ASSESSMENT

Appendix D: Air Quality Discipline Report

I-405, SR 522 Vicinity to SR 527 Express Toll Lanes Improvement Project (MP 21.79 to 27.06)







Title VI Notice to Public

It is the Washington State Department of Transportation's (WSDOT) policy to assure that no person shall, on the grounds of race, color, national origin or sex, as provided by Title VI of the Civil Rights Act of 1964, be excluded from participation in, be denied the benefits of, or be otherwise discriminated against under any of its federally funded programs and activities. Any person who believes his/her Title VI protection has been violated, may file a complaint with WSDOT's Office of Equal Opportunity (OEO). For additional information regarding Title VI complaint procedures and/or information regarding our non-discrimination obligations, please contact OEO's Title VI Coordinator at (360) 705-7090.

Americans with Disabilities Act (ADA) Information

This material can be made available in an alternate format by emailing the Office of Equal Opportunity at wsdotada@wsdot.wa.gov or by calling toll free, 855-362-4ADA (4232). Persons who are deaf or hard of hearing may make a request by calling the Washington State Relay at 711.

Notificación de Titulo VI al Público

Es la política del Departamento de Transporte del Estado de Washington el asegurarse que ninguna persona, por razones de raza, color, nación de origen o sexo, como es provisto en el Título VI del Acto de Derechos Civiles de 1964, ser excluido de la participación en, ser negado los beneficios de, o ser discriminado de otra manera bajo cualquiera de sus programas y actividades financiado con fondos federales. Cualquier persona quien crea que su protección bajo el Titulo VI ha sido violada, puede presentar una queja con la Comisión Estadounidense Igualdad de Oportunidades en el Empleo. Para obtener información adicional sobre los procedimientos de queja bajo el Titulo VI y/o información sobre nuestras obligaciones antidiscriminatorias, pueden contactar al coordinador del Título VI en la Comisión Estadounidense de Igualdad de Oportunidades en el Empleo 360-705-7090.

Información del Acta Americans with Disabilities Act (ADA)

Este material es disponible en un formato alternativo enviando un email/correo electrónico a la Comisión Estadounidense de Igualdad de Oportunidades en el Empleo wsdotada@wsdot.wa.gov o llamando gratis al 855-362-4ADA (4232). Personas sordas o con discapacidad auditiva pueden solicitar llamando Washington State Relay al 711.

TABLE OF CONTENTS

EXHIBITS

ATTACHMENTS

SECTION 1 SUMMARY

The *Air Quality Discipline Report* was prepared in support of the I-405, SR 522 Vicinity to SR 527 Express Toll Lanes Improvement Project (Project) Environmental Assessment (EA). This report evaluates the environmental effects of proposed improvements on Interstate 405 (I-405) from milepost (MP) 21.79 to MP 27.06 in support of the EA.

1.1 Purpose of the Report

The Washington State Department of Transportation (WSDOT) and Federal Highway Administration (FHWA) are proposing the Project to help address increasing traffic congestion and improve transit reliability in King and Snohomish counties. The Project is required to undergo environmental review. For projects requiring an EA, WSDOT must evaluate and compare air quality effects. Per National Environmental Policy Act (NEPA) requirements and based on WSDOT guidance, this report evaluates air emissions for criteria pollutants, mobile source air toxics (MSATs), and greenhouse gases (GHGs); and discloses the Project's emission levels.

1.2 Study Approach

To conduct this analysis, WSDOT followed current federal, state, and regional air quality requirements and gathered relevant data and information. WSDOT then evaluated the status of air quality in the study area by comparing recent air quality monitoring data available from the U.S. Environmental Protection Agency (EPA), Washington State Department of Ecology (Ecology), and the Puget Sound Clean Air Agency (PSCAA) to applicable air quality standards.

WSDOT evaluated Project effects by modeling estimated emissions from motor vehicles on the affected network using the latest EPA Motor Vehicle Emission Simulator model for the years 2015, 2025, and 2045. The emissions burden analysis compared operational (long-term) effects from the Project (Build Alternative) in 2025 and 2045 with 2015 existing data and with the No Build Alternative in 2025 and 2045 to demonstrate how air quality would be affected by the proposed Project's improvements.

1.3 Existing Conditions Overview

The I-405 corridor is in attainment for air pollutants regulated by the National Ambient Air Quality Standards. Air quality in the Puget Sound area, including the study area, has improved over the last several decades because of more stringent fuel standards and control technology used on vehicles to reduce emissions.

1.4 Operational Effects Overview

Overall, the Project would have minimal effects on air quality. The Project's criteria emissions under the 2025 and 2045 No Build and Build Alternatives are expected to decrease, compared to existing conditions, because of newer and cleaner automobiles in the future. With the exception of volatile organic compounds (VOCs), emissions would be lower under the Build Alternative than under the No Build Alternative in 2025 and 2045. VOC emissions would be only marginally higher (less than 0.5 percent) under the Build Alternative.

MSAT emissions under the 2025 and 2045 No Build and Build Alternatives are expected to decrease as compared to existing conditions despite increased vehicle miles traveled (VMTs) because of improved vehicle technology. Because the estimated VMT with the Project in each forecast year would vary by less than 2 percent compared to No Build Alternative, there would be no appreciable difference in overall MSAT emissions between the Build and No Build Alternatives.

GHG emissions would be lower than existing conditions under the No Build and Build Alternatives in both 2025 and 2045. In addition, both the 2025 and 2045 Build Alternative would have lower GHG emissions than the No Build Alternative.

1.5 Construction Effects Overview

Construction effects would be temporary, including fugitive dust from excavation and earth moving, and emissions from diesel-fueled construction equipment. WSDOT would implement best management practices to avoid or minimize potential effects on the environment.

SECTION 2 PROJECT DESCRIPTION

2.1 Proposed Project Elements

The Project begins on I-405 south of the I-405/SR 522 interchange at milepost (MP) 21.79 and continues to just north of the I-405/SR 527 interchange to MP 27.06. Exhibit 2-1 lists improvements proposed with the Project. Exhibit 2-2, Sheets 1 through 5, show the locations of the proposed improvements.

Exhibit 2-1. Improvements Proposed with the I-405, SR 522 Vicinity to SR 527 Express Toll Lanes Improvement Project

Project Element	Proposed Improvements
I-405 lanes and shoulders from SR 522 to SR 527	– Create a dual ETL system from MP 21.79 (south of the I-405/SR 522 interchange) to MP 27.06 (just north of the I-405/SR 527 interchange). • From MP 21.79 to MP 22.30: Restripe existing lanes to create a dual ETL system. • From MP 22.30 to MP 26.30: Resurface and widen I-405 to add one ETL in each direction. • From MP 26.30 to MP 27.06: Widen I-405 to construct direct access ramps and connect to the existing single ETL starting near MP 26.30.
I-405 tolling from SR 522 to SR 527	– Construct new tolling gantries to collect tolls for the ETLs and direct access ramps.
I-405/SR 522 interchange area	– Construct new direct access ramps and two inline transit stations (one in each direction) in the I-405 median. Transit stations would include station platforms, signage, artwork, lighting, fare machines, and site furnishing such as shelters, lean rails, benches, bollards, bicycle parking, and trash receptacles. – Construct a bus station and turnaround loop, pick-up and drop-off facilities, and new nonmotorized connection to the North Creek Trail near the SR 522 interchange. Funding and construction timeline to be coordinated with local transit agencies. – Construct new northbound bridge through the SR 522 interchange. • Reconfigure the northbound I-405 to eastbound SR 522 ramp from one lane to two lanes. – Reconfigure I-405 on- and off-ramps. • Realign the southbound I-405 to westbound SR 522 ramp. • Realign the eastbound and westbound SR 522 ramps to northbound I-405.
SR 522 roadway	– Add three signalized intersections, which would change where the freeway portion of SR 522 begins and ends. Signals would be added at the following locations: • The northbound I-405 to westbound SR 522 off-ramp and the eastbound SR 522 to northbound I-405 on-ramp. • The southbound I-405 to eastbound SR 522 ramp. • Between the above two locations where the new I-405 ETL direct access ramps connect with SR 522.
228th Street SE	– Widen the northbound I-405 bridge over 228th Street SE.

Exhibit 2-1. Improvements Proposed with the I-405, SR 522 Vicinity to SR 527 Express Toll Lanes Improvement Project

Project Element	Proposed Improvements
SR 527 interchange area	– Construct new direct access ramps to the north, south and east just south of SR 527 at 17th Avenue SE. – Construct two inline transit stations (one in each direction) in the I-405 median. Transit stations would include station platforms, signage, artwork, lighting, fare machines, and site furnishing such as shelters, lean rails, benches, bollards, bicycle parking, and trash receptacles. – Reconstruct the pedestrian bridge over I-405.
17th Avenue SE, 220th Street SE, SR 527	– Reconfigure 17th Avenue SE and portions of 220th Street SE and SR 527 to include a roundabout at the Canyon Park Park and Ride, bicycle and pedestrian improvements, and improvements at the SR 527 and 17th Avenue SE intersections with 220th Street SE.
Fish barrier corrections	– Replace five fish barriers with restored stream connections at the following streams: • Par Creek (WDFW ID 993083) • Stream 25.0L (WDFW ID 993104) • North Fork of Perry Creek (WDFW ID 08.0070 A0.25) • Two fish barriers at Queensborough Creek (WDFW ID 993084 and 993109)
Sammamish River bridges	– Remove the existing northbound I-405 to eastbound SR 522 bridge over the Sammamish River, including two bridge piers within the OHWM. – Remove the existing northbound I-405 to westbound SR 522 bridge over the Sammamish River, including two bridge piers within the OHWM. – Build a new bridge for northbound I-405 traffic over the Sammamish River. – Build a new bridge over the Sammamish River for the new direct access ramp at SR 522. – Build a new bridge over the Sammamish River for the northbound I-405 to SR 522 ramp.
Noise and retaining walls	– Construct 3 new noise walls near NE 160th Street and SR 527. See Exhibit 2-2, Sheets 1, 4 and 5. – Construct several new retaining walls. See Exhibit 2-2, Sheets 1 through 5.
Stormwater management	– Provide enhanced treatment for an area equivalent to 100 percent of new PGIS (approximately 24 acres). – Retrofit about 23 acres of existing untreated PGIS and continue to treat stormwater from the approximately 44 acres of PGIS that currently receives treatment. – Construct three new stormwater outfalls, one on the Sammamish River and two on the North Fork of Perry Creek.
Construction duration	– Construction is expected to last 3 to 4 years, beginning in 2021.

ETL = express toll lane; ID = identification number; MP = milepost; OHWM = ordinary high water mark; PGIS = pollution-generating impervious surfaces; WDFW = Washington Department of Fish and Wildlife

Exhibit 2-2. I-405, SR 522 Vicinity to SR 527 Express Toll Lanes Improvement Project, Sheet 1 of 5

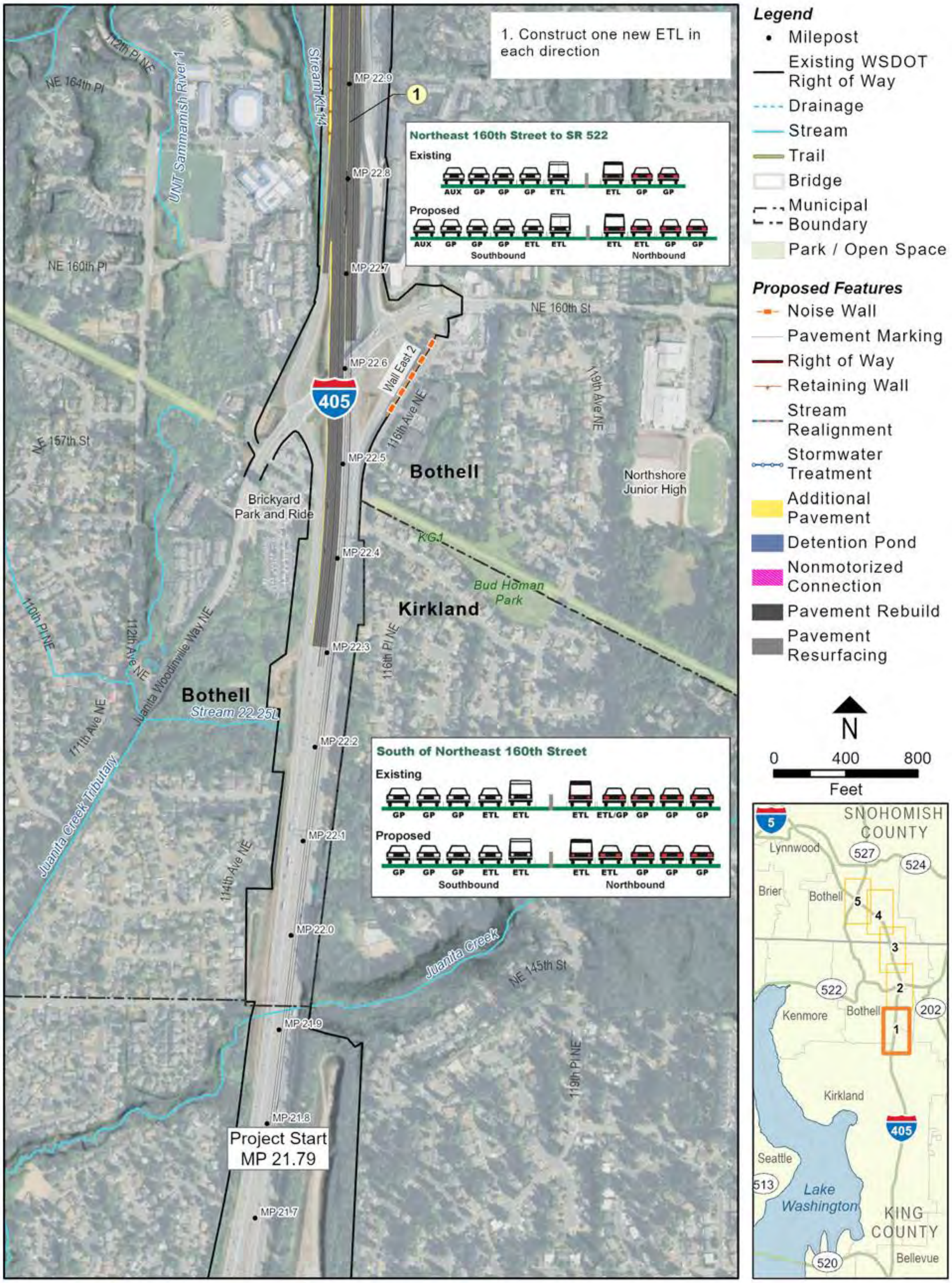


Exhibit 2-2. I-405, SR 522 Vicinity to SR 527 Express Toll Lanes Improvement Project, Sheet 2 of 5

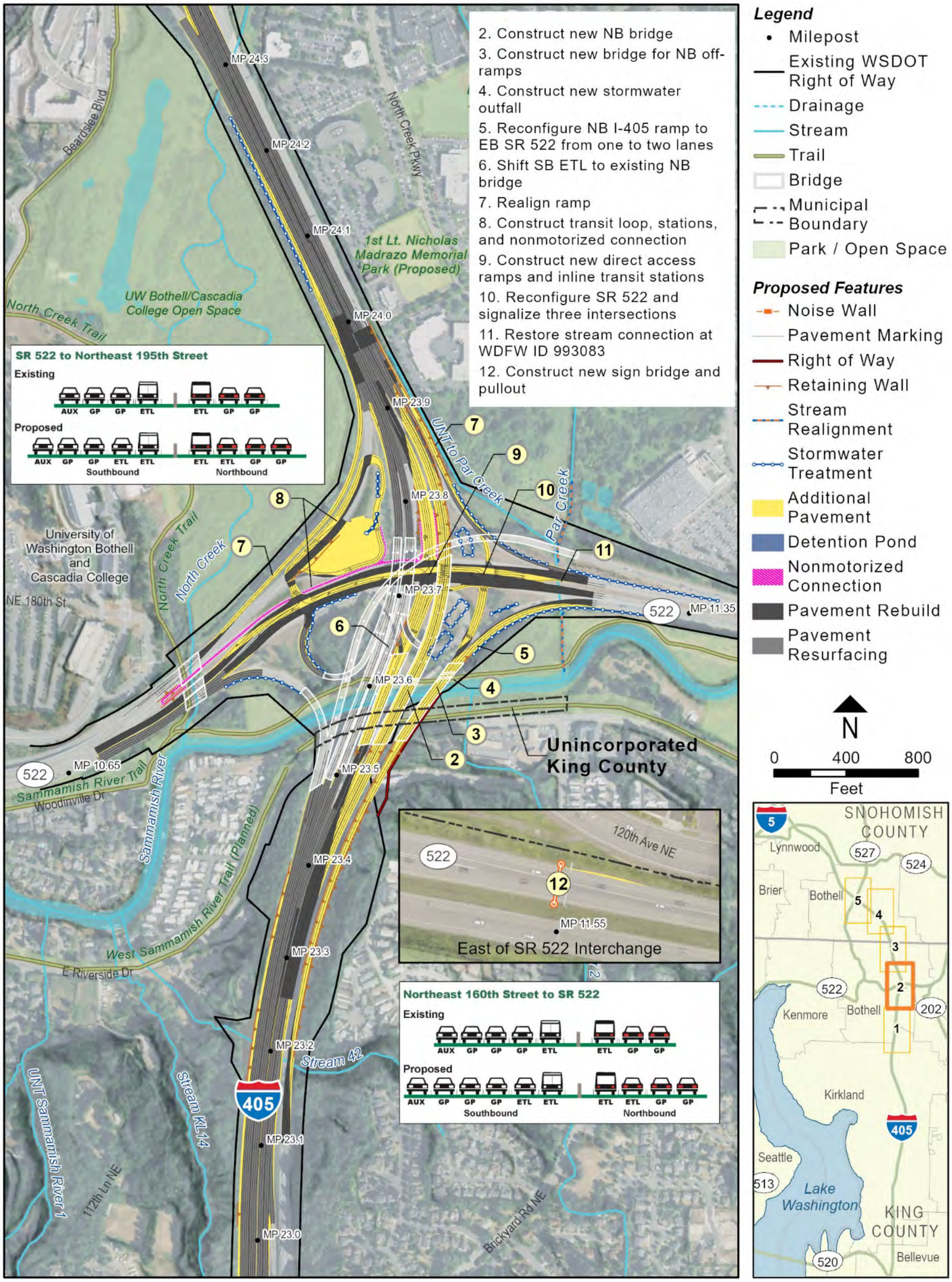


Exhibit 2-2. I-405, SR 522 Vicinity to SR 527 Express Toll Lanes Improvement Project, Sheet 3 of 5

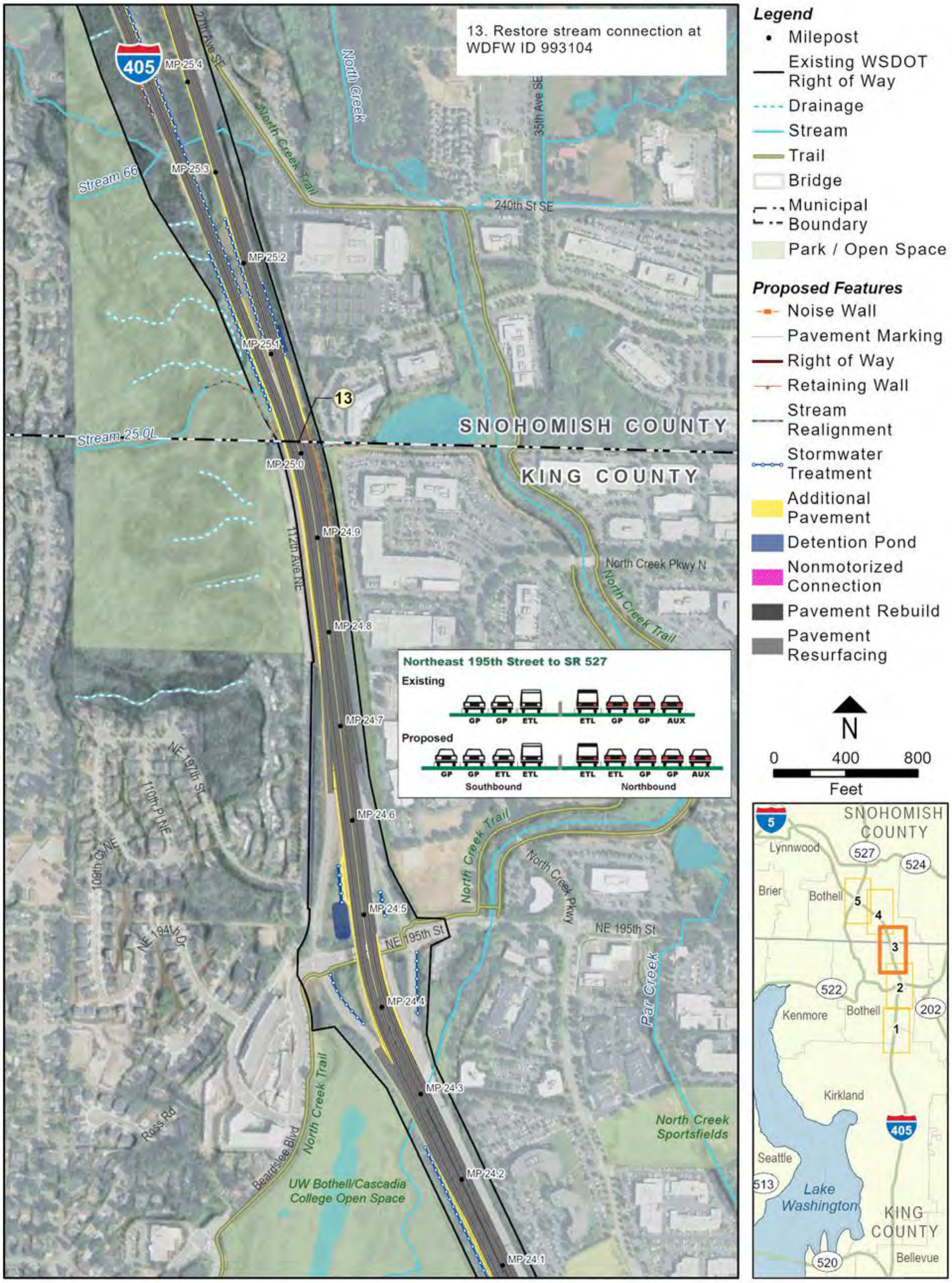
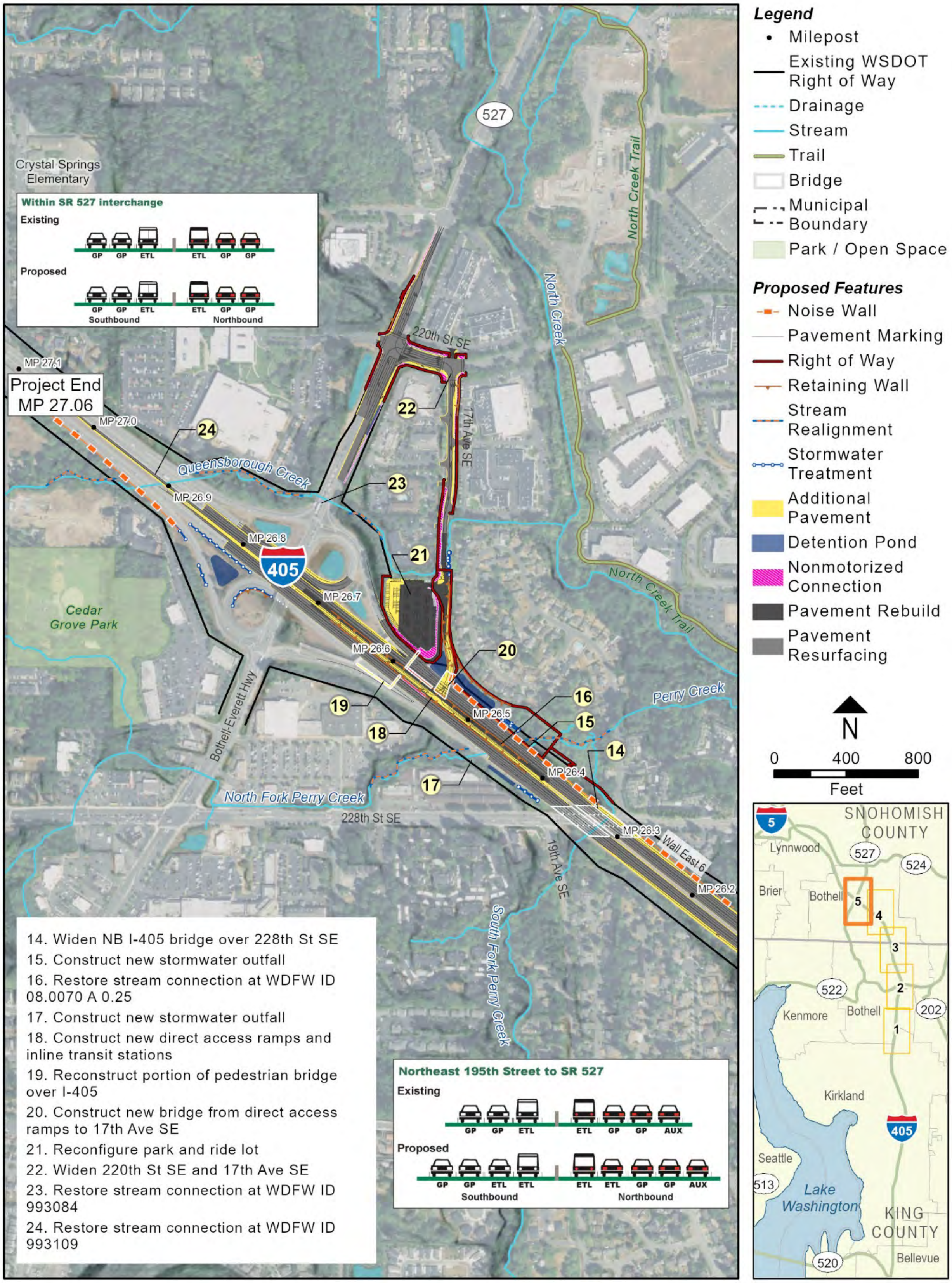


Exhibit 2-2. I-405, SR 522 Vicinity to SR 527 Express Toll Lanes Improvement Project, Sheet 4 of 5

Exhibit 2-2. I-405, SR 522 Vicinity to SR 527 Express Toll Lanes Improvement Project, Sheet 5 of 5



2.2 Express Toll Lanes Overview

How do I get more information about ETLs on I-405?

https://wsdot.wa.gov/Tolling/405/

Currently, there is one ETL in each direction of I 405 between SR 522 and SR 527. WSDOT expects that the new ETL in this section would operate in the same way as the existing ETL, from 5 a.m. to 7 p.m. on weekdays. At all other times and on major holidays, the ETLs would be free and open to all without a Good To Go! pass. During operating hours:

- **Single-occupancy vehicles** would pay a toll to use the ETLs with or without a *Good To Go!* pass.
- **Transit, High-Occupancy Vehicles (HOV) 3+, and motorcycles** would travel for free with a *Good To Go!* flex or motorcycle pass.
- **HOV 2+** would travel for free from 9 a.m. to 3 p.m. with a *Good To Go!* flex pass. From 5 a.m. to 9 a.m. and 3 p.m. to 7 p.m. HOV 2+ would pay a toll to use the ETLs with or without a *Good To Go!* flex pass.
- **Large vehicles** over 10,000 pounds gross vehicle weight would not be able to use the ETLs at any time.

2.3 Project Construction Overview

WSDOT expects to construct the Project using a design-build delivery method, in which WSDOT executes a single contract with one entity for design and construction services. With design-build projects, contractors have the flexibility to offer innovative and cost-effective alternatives to deliver the project, improve project performance, and reduce project effects. If the contractor proposes design modifications not covered by this Environmental Assessment, additional environmental review would be conducted as needed.

Construction would generally occur between 2021 and 2025, but construction activities in some areas would be complete prior to 2025. Once a contractor is selected for the Project, they could use multiple work crews in multiple locations to reduce the overall construction period. Work would include removing existing asphalt and concrete surfaces, clearing and grading adjacent areas, laying the aggregate roadway foundation, placing new asphalt and concrete surfaces, replacing culverts, and building and demolishing bridges. Removing bridge piers from the Sammamish River could require the construction of temporary work bridges and would require in-water work, which may include temporary use of cofferdams and a work barge, depending on the contractors' chosen means and methods. Realigning the I-405 mainline would require approximately 170,000 cubic yards of excavation and 166,000 cubic yards of fill.

Construction equipment would include backhoes, excavators, front-end loaders, pavement grinders, jack hammers, trucks, vactor trucks, cranes, drilling rigs and augers, concrete pumping equipment, and slurry processing equipment. Specific haul routes and the number of construction vehicles would not be known until a construction contract is signed. When possible, the work sites would be accessed from I-405 and SR 522. Construction staging areas for employee parking, large equipment storage, and material stockpiles would be located within WSDOT and Bothell right of way to the extent possible. The contractor may also find other locations for construction staging.

SECTION 3 STUDY APPROACH

This section presents the analysis approach for the analysis of air quality effects for the Project. Section 5, Project Effects, presents the results of the analysis.

3.1 Policies and Regulations

The National Environmental Policy Act (NEPA) and Washington State Environmental Policy Act (SEPA) regulations require that environmental reviews include an evaluation of the effects of a proposed Project on air quality.

The federal Clean Air Act (CAA) and its amendments, and the Washington State Clean Air Act currently regulate air quality in the state. The U.S. Environmental Protection Agency (EPA), Washington State Department of Ecology (Ecology), and Puget Sound Clean Air Agency (PSCAA) enforce regulations developed to protect air quality.

EPA delegates authority to manage air quality issues to the states but sets the criteria for National Ambient Air Quality Standards (NAAQS) and conformity requirements. In Washington, Ecology oversees the development of and conformity to the State Implementation Plan, which is the state's plan for meeting and maintaining NAAQS. PSCAA has local authority for setting regulations and permitting of stationary air pollutant sources and construction emissions.

For the analysis of both operational and construction Project effects, WSDOT followed the agency's *Environmental Manual* for air quality for projects undergoing NEPA review (WSDOT 2019). NEPA requires documenting and comparing air quality effects of project alternatives for criteria pollutants and mobile source air toxics (MSATs). WSDOT policy requires the evaluation of greenhouse gas emissions (GHG) and temporary construction emissions (fugitive dust), as described in the next sections.

3.1.1 Criteria Pollutants

EPA has identified several air pollutants of concern nationwide, 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 CAA, EPA has established NAAQS, which specify maximum allowable concentrations for six criteria pollutants: carbon monoxide (CO), lead, nitrogen dioxide (NO_2), particulate matter (PM_{10} and $PM_{2.5}$), ozone, and sulfur dioxide (SO_2) (EPA 2015a and 2015b).

The criteria pollutants of interest for transportation projects are CO, PM, ozone and the ozone precursors, volatile organic compounds (VOCs), and nitrogen oxides (NOx). Both federal and state standards regulate these pollutants. Lead and SO_2 are not considered in this report because they are not pollutants of concern for transportation projects.

The NAAQS for these criteria pollutants are separated into two standard categories: Primary and Secondary standards (40 Code of Federal Regulations [CFR] 50). The Primary standards were created to protect public health; the Secondary pollutant standards were established to protect public welfare and the environment.

Exhibit 3-1 shows the air quality standards for federal, state, and local jurisdictions. Ecology and PSCAA have authority to adopt more stringent standards, although many of the state and local standards are equivalent to the federal mandate.

Areas not in compliance with the NAAQS are deemed nonattainment areas. An area remains a nonattainment area for that pollutant until concentrations are in compliance with the NAAQS. When the NAAQS are attained, an area is redesignated as in attainment but must adhere to a maintenance plan for 20 years, which can require continued transportation conformity determinations.

Air quality in the Puget Sound area, including the study area, has improved over the last several decades because of more stringent fuel standards and control technology used on vehicles to reduce emissions. The study area is in attainment for all criteria pollutants. Transportation conformity is no longer required for CO because maintenance requirements for the area expired October 11, 2016 (EPA 2004). Likewise, transportation conformity is no longer required in the Puget Sound area for the revoked 1-hour ozone standard.

Exhibit 3-1. Ambient Air Quality Standards by Government Jurisdiction

Pollutant	National[a]		State of Washington[b]	Puget Sound Region[b]
	Primary	Secondary		
Nitrogen Dioxide (NO_2)				
1-Hour (ppm)	0.10	NS	0.10	0.10
Annual Average (ppm)	0.053	0.053	0.053	0.053
Carbon Monoxide (CO)				
1-Hour Average (ppm)	35.0	NS	35.0	35.0
8-Hour Average (ppm)	9.0	NS	9.0	9.0
Ozone (O_3)				
8-Hour Average (ppm)	0.070	0.070	0.070	0.075
1-Hour Average (ppm)	Revoked	Revoked	NS	NS
Lead				
Calendar Quarter (µg/m^3)	1.5	1.5	NS	NS
Rolling 3-Month Average (µg/m^3)	0.15	0.15	0.15	0.15
Sulfur Dioxide (SO_2)				
1-Hour Average (ppm)	0.075[c]	NS	0.075	0.075
3-Hour Average (ppm)	NS	0.5	0.5	0.5
24-Hour Average (ppm)	0.14 (certain areas)	NS	0.14	NS
Annual Arithmetic Average (ppm)	0.03 (certain areas)	NS	0.02	NS

Exhibit 3-1. Ambient Air Quality Standards by Government Jurisdiction

Pollutant	National[a]		State of Washington[b]	Puget Sound Region[b]
	Primary	Secondary		
Particulate Matter (PM_{10})				
24-Hour Average (µg/m^3)	150	150	150	150
Annual Arithmetic Average (µg/m^3)	Revoked	Revoked	NS	NS
Particulate Matter ($PM_{2.5}$)				
24-Hour Average (µg/m^3)	35	35	35	35
Annual Arithmetic Average (µg/m^3)	12	15	12	15

µg/m3 = micrograms per cubic meter; ppm = parts per million (by volume); NS = no standard established

[a] National standards other than O_3, PM, and those based on annual averages or annual arithmetic means are not to be exceeded more than once a year. The O_3 standard is attained when the fourth highest 8-hour concentration in a year, averaged over three years, is equal to or less than the standard. For PM_{10}, the 24-hour standard is attained when the expected number of days per calendar year with a 24-hour average concentration above 150 µg/m^3 is equal to or less than 1. For $PM_{2.5}$, the 24-hour standard is attained when 98 percent of the daily concentrations, averaged over 3 years, is equal to or less than the standard.

[b] State and Puget Sound regional standards criteria for violation are the same as the national standards unless otherwise noted.

[c] Final rule signed June 2, 2010. To attain 1-hour SO_2 standard, the 3-year average of the 99th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 75 parts per billion.

Source*:* EPA 2015a, WAC PSCAA 2018, State of Washington 2016.

3.2 Study Approach

For the air quality analysis of both operational and construction effects, WSDOT followed the agency's *Environmental Manual* (WSDOT 2019). The air quality analysis included emissions burden modeling of criteria pollutants, MSATs, and GHG emissions under existing conditions, the Build Alternative, and the No Build Alternative as described in the next sections. WSDOT also completed a quantitative analysis of construction GHG emissions.

3.2.1 Criteria Pollutants, Mobile Source Air Toxics, and Greenhouse Gas Emissions during Operations

As recommended by WSDOT's guidance for projects being evaluated under NEPA, WSDOT used the EPA Motor Vehicle Emissions Simulator (MOVES2014b) model, and the corresponding default MOVES database and relevant local inputs for this analysis to calculate daily emissions rates.

The MOVES2014b model generated Project-specific daily emissions rates for the analysis years 2015 (existing) and 2025 and 2045 (future Build Alternative and No Build Alternative) for criteria, MSATs, and GHG pollutants in the study area based on user-provided input files and run specifications. The process for developing the input files and setting up the MOVES2014b model for the run specification is discussed and fully documented in Attachment C, Motor Vehicles Emission Simulator Version 2014B.

WSDOT used an emissions burden analysis to demonstrate the changes in tailpipe emissions for the criteria, MSAT, and GHG pollutants between 2015 existing conditions and the analysis years 2025 and 2045 with and without the Project.

3.2.2 Criteria Pollutant Emissions during Construction

Section 5 of this report, Project Effects, presents a qualitative discussion of temporary emissions from construction, and Section 6, Measures to Avoid or Minimize Effects, lists associated best management practices to reduce emissions.

3.2.3 Greenhouse Gas Emissions during Construction

Following the *WSDOT Guidance for Project-Level Greenhouse Gas Evaluations under NEPA and SEPA*, WSDOT quantified GHG emissions during construction to assess the Project's effects on the climate (WSDOT 2018).

This guidance recommends the use of FHWA's Infrastructure Carbon Estimator (ICE) spreadsheet tool to calculate GHG emissions from fuel usage, traffic delays, and maintenance emissions resulting from construction of the Project (FHWA 2016b). FHWA's ICE tool incorporates project features and construction-related traffic delays to calculate emissions from construction equipment, materials, and routine maintenance. Maintenance emissions come from similar sources but occur over a project's lifespan. The results of this analysis are provided in Section 5, and a discussion of the inputs used in the ICE model is provided in Attachment E, Infrastructure Carbon Estimator Spreadsheet Tool.

3.3 Study Area

The study area evaluated for air quality effects includes areas likely to be affected by changes in pollutant levels because of Project-related changes in traffic conditions. The air quality analyses for the Project followed current guidelines developed by EPA, FHWA, WSDOT, Ecology, and the Puget Sound Regional Council (PSRC). The general study area encompasses the construction limits of the Project, as shown in Exhibit 2-2 in Section 2.

Using the PSRC regional transportation demand model, WSDOT identified the study area limits by considering how the Project would affect congested roadways, traffic volume increases, and traffic circulation patterns on major arterials and higher classification roadways. This effort provided a distinct roadway network that encompasses the limits of construction for the Project, as well as a broader roadway network that defines the study area for this analysis. Exhibit 3-2 indicates the identified air quality study area that would potentially be affected by the Project.

Exhibit 3-2. Project Air Quality Study Area

For this Project, WSDOT incorporated additional roadway segments where substantial changes in peak period speeds were observed. These segments include I-405 between NE 85th Street and NE 124th Street (south of the Project's southern construction limit) and SR 527 and I-5 (just north of the Project's northern construction limit).

3.4 Data Sources and Information Collected

WSDOT identified current air quality standards and EPA, Ecology, and PSCAA regulations that apply to the study area. They identified the required analyses to be performed for the Project and gathered local air quality monitoring data, regulatory models and approaches, regional air quality modeling input files from Ecology, and Project-specific traffic information for the study area. WSDOT evaluated the status of air quality in the study area by comparing recent air quality monitoring data available from EPA, Ecology, and PSCAA to applicable air quality standards.

WSDOT developed Project-specific traffic input files for the MOVES model by using traffic data supplied by the Project's traffic engineer. After reviewing the Project traffic data, WSDOT identified the following parameters for study area traffic: road types affected, vehicle classifications (the type of vehicle traveled on the roadway), the speeds for each vehicle classification based on the time of day, and the daily vehicle miles traveled (VMT).

WSDOT further defined the parameters for the MOVES traffic input files. The road types affected were classified as freeways (urban restricted) and affected arterial local roadways (urban unrestricted). The numbers of cars and trucks were provided for the time period of analysis by road type for existing conditions (2015) and the future Build and No Build Alternative (2025 and 2045). WSDOT then used this information to develop a speed distribution for each alternative and year by vehicle classification and road type.

Five MOVES input files are related to project-specific traffic data: roadway type, average speed distribution, source type population, ramp fraction and VMT by vehicle type. These input files influence the effects of Project traffic on air quality. For the roadway type input file, the percentage of each vehicle classification's VMT was distributed on each roadway type—urban restricted (freeway) or urban unrestricted (arterials). For the average speed distribution input file, information is required on the time of day a particular vehicle class is traveling at a particular speed on a certain roadway type. This information was calculated for each vehicle classification operating at a different speed for each hour and distributed by roadway type. The source type population was obtained from the highest daily volume in the project area and distributed to source types. Ramp fraction was obtained from the fraction of ramp VHT (vehicle hours traveled, or time spent on the ramps) of the total freeway VHT. Lastly, the annual VMT (derived from traffic data) was distributed for each vehicle type.

WSDOT obtained additional input files from Ecology to account for fuel supply, meteorological data, inspection and maintenance data, and the ages of vehicles registered in King and Snohomish counties. For the construction analysis, WSDOT obtained information from the design engineers on project construction features for the ICE spreadsheet tool (as shown in Attachment E).

SECTION 4 EXISTING CONDITIONS

4.1 Criteria Pollutants

Air quality is monitored and areas are designated according to whether a pollutant meets the National Ambient Air Quality Standards (NAAQS). The study area is in attainment with the NAAQS. The Puget Sound Clean Air Agency (PSCAA) and Washington State Department of Ecology (Ecology) monitor criteria air pollutant concentrations in King County. Two monitoring stations located near the project vicinity (Beacon Hill and Lynnwood stations) measure concentrations of carbon monoxide (CO), particulate matter $(PM)_{10}$, $PM_{2.5}$, and ozone.

Exhibit 4-1 displays the last three years of monitoring data, which show that the air pollutant concentration trends for these pollutants remain below the NAAQS.

Exhibit 4-1. Ambient Air Quality Monitoring Data at Beacon Hill and Lynnwood Stations

Pollutant	NAAQS	2016 Maximum Concentration	2017 Maximum Concentration	2018 Maximum Concentration
Carbon Monoxide (CO)[a]				
1-hour average (ppm)	35	1.1	1.3	1
8-hour average (ppm)	9	0.9	1.1	0.9
Ozone (O_3)[a]				
1-hour average (ppm)	0.070	0.050	0.064	0.068
8-hour average (ppm)	0.070	0.058	0.052	0.062
Particulate Matter (PM_{10})[a]				
24-hour average (µg/m³)	150	No data available	No data available	104
Particulate Matter ($PM_{2.5}$)[b]				
24-hour average (98th Percentile) (µg/m³)	35.0	17.6	NA	17.0

NAAQS = National Ambient Air Quality Standards, ppm = parts per million; PM_{10} = PM of 10 microns or less in diameter; $PM_{2.5}$ = PM of 2.5 microns or less in diameter; µg/m³ = micrograms per cubic meter

[a] Concentrations of CO, O_3, and PM_{10} are from the Beacon Hill station located at 4103 Beacon Avenue S in Seattle.
[b] Concentrations of $PM_{2.5}$ are from the Lynnwood station located at 6120 212th Street SW in Lynnwood, 2017 data is not included here since that was incomplete.

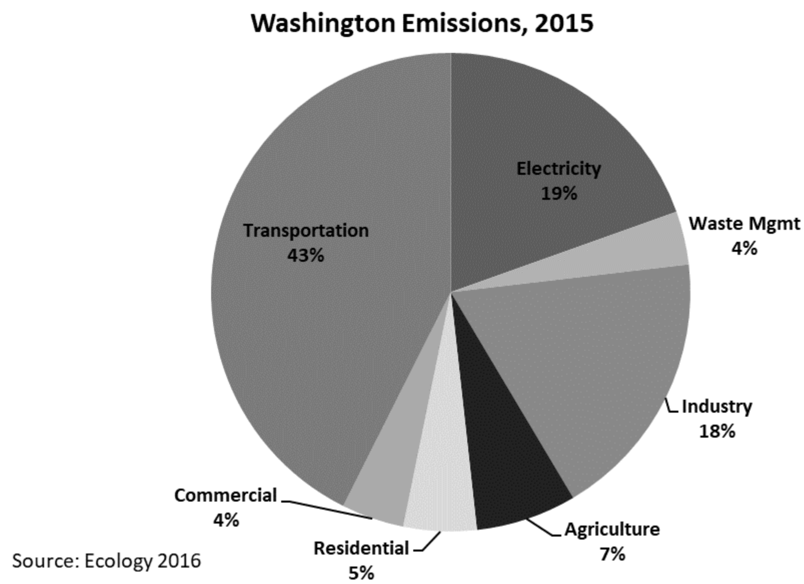
Source: EPA 2018

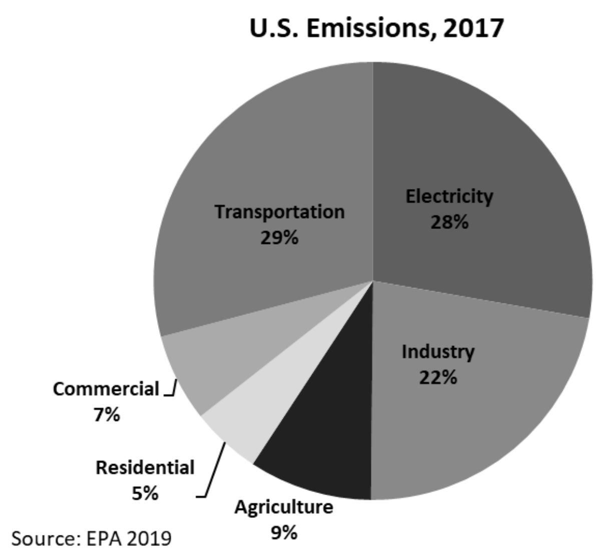
4.2 Greenhouse Gases and Climate Change

Vehicles emit a variety of gases during their operation; some of these are greenhouse gases (GHGs). The GHGs associated with transportation are carbon dioxide (CO_2), methane, and nitrogen oxide. Any process that burns fossil fuel releases CO_2 into the air; CO_2 makes up the bulk of the emissions from transportation. Vehicles are a significant source of GHG emissions and contribute to global warming primarily through the burning of gasoline and diesel fuels.

Exhibit 4-2 shows gross GHG emissions by sector for Washington State and nationally (Ecology 2016; EPA 2019). National estimates show that the transportation sector (including on-road vehicles, construction activities, airplanes, and boats) accounts for about 29 percent of total domestic CO_2 emissions. However, in Washington State, transportation accounts for nearly half of GHG 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. The next-largest contributors to total GHG emissions in Washington State are electricity consumption at 19 percent and industry at 18 percent.

Exhibit 4-2. Greenhouse Gas Emissions by Sector, Washington State (2015) and National (2017)





SECTION 5 PROJECT EFFECTS

This section compares the Project effects with existing year 2015 using the approach described in Section 3, Study Approach, for the 2025 and 2045 No Build Alternative and Build Alternative (with the Project).

5.1 Operational Effects

This section summarizes the Project's effects on regional air quality related to criteria pollutants, mobile source air toxics (MSATs), and greenhouse gas (GHG) emissions.

5.1.1 Criteria Pollutants

The criteria pollutants of concern from motor vehicles are CO, particulate matter (PM), and ozone. Ozone is not emitted at ground level; nitrogen oxides (NOx) and volatile organic compounds (VOCs) react under the presence of sunlight and heat to form ozone. For this reason, these emissions are considered as part of evaluating criteria pollutants.

Exhibit 5-1 summarizes total emissions for criteria pollutants for the existing and future forecast years. Compared to existing conditions, all criteria pollutants under the 2025 and 2045 No Build and Build Alternatives would have lower emissions except PM_{10} because of improved vehicle technology. There would be a marginal increase (1 percent) in PM_{10} in future years because of increased emissions from brake wear and tire wear, offset by decreases in exhaust emissions. With the exception of volatile organic compounds (VOCs), emissions under the Build Alternative are expected to be lower than those under the No Build Alternative in both 2025 and 2045. In both future years, VOC emissions under the Build Alternative would be only marginally higher (less than 0.5 percent) than the No Build Alternative and substantially lower than existing conditions.

Exhibit 5-1. Criteria Pollutants Daily Regional Emissions Burden Assessment for Forecast Years 2025 and 2045

Daily VMT/ Criteria Pollutant (lbs/day)	Existing 2015	2025 No Build Alternative	2025 Build Alternative	2045 No Build Alternative	2045 Build Alternative	% Change from 2015 to 2025 No Build	% Change from 2025 No Build to 2025 Build	% Change from 2015 to 2045 No Build	% Change from 2045 No Build to 2045 Build
Daily VMT	2,885,471	3,219,611	3,260,405	3,623,795	3,681,594	12%	1%	26%	2%
CO	63,221.80	32,474.82	30,845.80	18,521.85	18,146.57	-49%	-5%	-71%	-2%
$PM_{2.5}$	212.37	114.80	108.48	98.95	95.86	-46%	-6%	-53%	-3%
PM_{10}	417.46	355.52	346.33	421.24	409.53	-15%	-3%	1%	-3%
VOCs	5,860.58	2,600.69	2,607.76	1,552.51	1,557.25	-56%	0%	-74%	0%
NO_x	7,584.30	2,329.36	2,300.18	1,103.23	1,102.32	-69%	-1%	-85%	0%

CO = carbon monoxide; lbs/day = pounds per day; NOx = nitrogen oxides; PM_{10} = particulate matter of 10 microns or less in diameter; $PM_{2.5}$ = particulate matter of 2.5 microns or less in diameter; VMT = vehicle miles traveled; VOCs = volatile organic compounds

5.1.2 Mobile Source Air Toxics

Exhibit 5-2 summarizes the tailpipe emissions for MSATs in the study area. Although the estimated vehicle miles traveled (VMT) under the Build Alternative for both 2025 and 2045 would increase over existing conditions, MSATs are estimated to be lower than existing conditions as a result of improved vehicle technology. In addition, because the estimated VMT with the Project in each forecast year would vary by less than 2 percent compared to No Build Alternative, it is expected that there would be no appreciable difference in overall MSAT emissions. Attachment D, Effects on Mobile Source Air Toxics Results Using MOVES Version 2014A, provides additional details regarding the limitations of incomplete or unavailable for the MSAT analysis.

Exhibit 5-2. Toxic Air Pollutants Daily Regional Emissions Burden Assessment for Forecast Years 2025 and 2045

Daily VMT/ MSAT (lbs/day)	Existing 2015	2025 No Build Alternative	2025 Build Alternative	2045 No Build Alternative	2045 Build Alternative	% Change from 2015 to 2025 No Build	% Change from 2025 No Build to 2025 Build	% Change from 2015 to 2045 No Build	% Change from 2045 No Build to 2045 Build
Daily VMT	2,885,471	3,219,611	3,260,405	3,623,795	3,681,594	12%	1%	26%	2%
1-3-Butadiene	23.29	9.29	9.37	4.29	4.35	-60%	1%	-82%	1%
Acrolein	4.29	2.08	2.09	1.23	1.24	-51%	0%	-71%	1%
Acetaldehyde	64.74	31.88	32.03	18.52	18.70	-51%	0%	-71%	1%
Benzene	172.81	73.55	73.65	38.61	38.84	-57%	0%	-78%	1%
Ethyl Benzene	100.87	42.57	42.69	25.07	25.13	-58%	0%	-75%	0%
Formaldehyde	64.58	27.34	27.33	16.62	16.69	-58%	0%	-74%	0%
Naphthalene	10.28	4.18	4.19	2.24	2.25	-59%	0%	-78%	1%
Diesel PM	54.21	13.61	13.30	5.34	5.25	-75%	-2%	-90%	-2%
PAHs	4.01	1.54	1.52	0.76	0.76	-62%	-1%	-81%	0%

lbs/day = pounds per day; MSAT = mobile source air toxic; PM = particulate matter; PAH = polycyclic aromatic hydrocarbons; VMT = vehicle miles traveled

5.1.3 Greenhouse Gases

Exhibit 5-3 shows the estimated carbon dioxide equivalent (CO_2e) emissions with the Build Alternative as compared to existing and future conditions for the No Build Alternative. Based on the modeling results, CO_2e emissions for 2025 and 2045 under both the No Build and Build Alternatives are estimated to be lower than existing conditions. GHG emissions from the Build Alternative would be slightly lower than the No Build Alternative in both 2025 and 2045.

The Project's widening, lane additions, and intersection improvements would decrease the number of stop-and-go conditions, thereby conserving fuel. The Project would also promote more efficient energy use by moderating speeds. The Project would enable better movement of vehicles in 2025 and 2045 for study area intersections and interchanges and on the I-405 mainline, thereby reducing traffic congestion and collisions. Decreased vehicle delay at on- and off-ramps would further reduce collisions and promote more efficient driving.

Exhibit 5-3. Greenhouse Gas Emissions in Terms of CO_2e for Forecast Years 2025 and 2045

	Existing 2015	2025 No Build Alternative	2025 Build Alternative	2045 No Build Alternative	2045 Build Alternative	% Change from 2015 to 2025 No Build	% Change from 2025 No Build to 2025 Build	% Change from 2015 to 2045 No Build	% Change from 2045 No Build to 2045 Build
Daily VMT	2,885,471	3,219,611	3,260,405	3,623,795	3,681,594	12%	1%	26%	2%
Daily CO_2e (MT)	1,363.61	1,180.22	1,167.84	1,104.63	1,094.36	-13%	-1%	-19%	-1%
Annual Total CO_2e (MT)	497,718.80	430,779.87	426,262.31	403,190.94	399,440.32	-13%	-1%	-19%	-1%

CO_2e = carbon dioxide equivalent; MT = metric tons; VMT = vehicle miles traveled

Annual total CO_2e is calculated by multiplying the daily CO_2e by 365.

5.2 Construction Effects

Construction activities generate fugitive dust and exhaust from construction equipment engines. The regulated pollutants of concern for fugitive dust are $PM_{2.5}$ and PM_{10}. Engine and motor vehicle exhaust would result in emissions of CO, VOCs, NO_X, PM_{10}, $PM_{2.5}$, MSATs, and GHGs.

Construction of the Project would occur over a period of three to four years. PM_{10} and $PM_{2.5}$ emissions would vary from day to day, depending on level of activity, specific operations, and weather conditions. Particulate emissions would depend on soil moisture, silt content of soil, wind speed, and the amount and type of equipment in operation. Larger dust particles would settle near their source, while fine particles would disperse over greater distances from the construction site.

The quantity of fugitive dust or particulate emissions would be related to the area of the construction operations and the level of activity. Uncontrolled fugitive dust from construction activities could be noticeable near construction sites. PSCAA regulations require mitigation measures to control dust during construction and avoid depositing mud on paved streets (PSCAA 2018). Measures to control and minimize dust during construction are summarized in Section 6, Measures to Avoid or Minimize Effects.

In addition to particulate emissions, heavy trucks and construction equipment powered by gasoline and diesel engines would emit CO, NO_X, and MSATs. If construction traffic reduces the speed of other vehicles in the area, emissions from traffic would increase slightly while those vehicles are delayed. These emissions would be temporary and limited to the immediate area around the construction site. Their contribution to total emissions in the study area would be small compared with automobile traffic because construction traffic would be a very small fraction of the total traffic in the area.

Some phases of construction would result in short-term odors, particularly when asphalt is used for paving operations. People near the construction site might notice such odors, but the atmosphere would dilute their effect as distance from the site increases.

GHGs from construction would come from the fuel used on site to power construction equipment, as well as the emissions released in the production of materials. Traffic delays resulting from construction activities would be another source of construction emissions. Maintenance emissions would come from similar sources but would occur over the Project's lifespans. The WSDOT *Environmental Manual* requires the use of FHWA's Infrastructure Carbon Estimator (ICE) spreadsheet tool to calculate GHG emissions from fuel usage, traffic delays, and maintenance emissions resulting from project construction (WSDOT 2019). The FHWA ICE spreadsheet tool incorporates project features and construction traffic delays to calculate emissions from construction equipment, materials, and routine maintenance. Attachment E, Infrastructure Carbon Estimator Spreadsheet Tool, provides a discussion of the inputs used in the ICE model.

Exhibit 5-4 presents the total annual GHG emissions in metric tons (MT) of CO_2e per year over three years for new construction and roadway rehabilitation for the Project. WSDOT predicts that construction of the Project would emit a total of 7,592 MT of CO_2e per year over a three-year construction period.

Exhibit 5-4. Annual Greenhouse Gas Emissions Per Year Over 3 Years

	Roadway – New Construction	Roadway – Rehabilitation	Roadway – Total	Bridges	Rail, bus, bicycle, pedestrian	Total
Upstream Emissions Materials	929	327	1,256	529	5,084	6,869
Direct Emissions						
Construction Equipment						673
Routine Maintenance	426	57	483	167	23	50
Total	1,355	384	1,739	696	5,107	7,592

5.3 Indirect Effects

No indirect effects have been identified for the Project.

SECTION 6 MEASURES TO AVOID OR MINIMIZE EFFECTS

The Project will mitigate for impacts during and after construction using the strategies described in this section.

6.1 Operational Mitigation

No negative effects that would require mitigation are expected from operation of the Project.

6.2 Construction Mitigation

The construction contractor will be contractually obligated to control fugitive dust in accordance with the *Memorandum of Agreement between WSDOT and Puget Sound Clean Air Agency Regarding Control of Fugitive Dust from Construction Projects* (WSDOT 1999).

The following measures will be used, where applicable, to control and minimize dispersion of dust (PM_{10} and $PM_{2.5}$); transmission of particulate matter (PM); and emissions of carbon monoxide (CO), nitrogen oxide (NO_x) and volatile organic compounds (VOCs) during construction:

- Encourage contractors to use newer construction equipment and maintain all equipment in good mechanical condition to minimize exhaust emissions.
- Encourage contractors to carpool, and use commute trip reduction and other transportation demand management programs for construction workers.
- Stage construction between other I-405 transportation projects to minimize congestion that contributes to regional emissions of pollutants during construction.
- Encourage contractors to reduce construction truck idling.
- Locate construction equipment and staging areas away from sensitive receptors such as fresh-air intakes to buildings, air conditioners, and sensitive populations, such as the elderly and the young.
- Spray exposed soil with water or other suppressant as needed to minimize emissions of PM_{10} and reduce deposition of PM.
- Cover all loads in trucks transporting materials and wet materials in trucks, or will provide adequate freeboard (space from the top of the material to the top of the truck bed) to minimize PM_{10} and deposition of particulates during transportation.
- Provide wheel washers to remove PM that would otherwise be carried off site by vehicles to decrease deposition of PM on area roadways.
- Remove PM deposited on paved roads, public roads, sidewalks, and bicycle and pedestrian paths to reduce mud and dust.
- Cover and stabilize project-site dirt, gravel, and debris piles, as needed, to minimize dust and wind-blown debris. This may include using wind fencing to reduce soil disturbance.

- Restrict the speed of construction vehicles when operating in areas of exposed earth.
- WSDOT will route and schedule construction trucks to reduce delays to traffic during peak travel times to minimize air quality impacts caused by a reduction in traffic speeds.

SECTION 7 REFERENCES

Ecology (Washington State Department of Ecology). 2016. *Report to the Legislature on Washington Greenhouse Gas Emissions Inventory: 2010-2013*. Publication No. 16-02-025. October.

EPA (U.S. Environmental Protection Agency). 2004. *Puget Sound Area CO 2nd 10-Year Maintenance Plan Summary*.

EPA. 2015a. National Ambient Air Quality Standards (NAAQS) Table. Retrieved on June 25, 2019, from https://www.epa.gov/criteria-air-pollutants/naaqs-table.

EPA. 2015b. 2015 National Ambient Air Quality Standards for Ozone. Retrieved on June 25, 2019, from https://www.epa.gov/ozone-pollution/2015-national-ambient-air-quality-standards-naaqs-ozone.

EPA. 2018. Washington State Air Quality Monitoring Station Reporting-Outdoor Air Quality Data. Retrieved on June 25, 2019, from https://www.epa.gov/outdoor-air-quality-data/monitor-values-report.

EPA. 2019. *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2017. Report Number EPA-430-R-19-001*. Retrieved on August 29, 2019 from https://www.epa.gov/sites/production/files/2019-04/documents/us-ghg-inventory-2019-main-text.pdf.

FHWA (Federal Highway Administration). 2016a. *Updated Interim Guidance on Mobile Source Air Toxic Analysis in NEPA Documents*. Retrieved on June 25, 2019, from https://www.fhwa.dot.gov/environment/air_quality/air_toxics/policy_and_guidance/msat/.

FHWA. 2016b. Infrastructure Carbon Estimator Tool. Retrieved on April 18, 2019, from https://www.fhwa.dot.gov/environment/sustainability/energy/tools/carbon_estimator/index.cfm.

PSCAA (Puget Sound Clean Air Agency). 2018. Regulation 1. Retrieved on July 30, 2019, from https://www.pscleanair.org/DocumentCenter/View/354/Regulation-I?bidId=.

State of Washington. 2016. Washington State Ambient Air Quality Standards. Washington Administrative Code (WAC) 173-476. Retrieved on July 30, 2019 from https://apps.leg.wa.gov/wac/default.aspx?cite=173-476-900.

WSDOT (Washington State Department of Transportation). 1999. *Memorandum of Agreement between WSDOT and Puget Sound Clean Air Agency Regarding Control of Fugitive Dust from Construction Projects*. December.

WSDOT. 2018. *WSDOT Guidance-Project-Level Greenhouse Gas Evaluations under NEPA and SEPA*. Retrieved on June 25, 2019, from https://www.wsdot.wa.gov/sites/default/files/2019/02/08/ENV-ANE-GHGGuidance.pdf.

WSDOT. 2019. *Environmental Manual*. M 31-11.21. Engineering and Regional Operations, Development Division, Environmental Services Office. June.

ATTACHMENT A ACRONYMS AND ABBREVIATIONS

Acronym	Meaning
ADA	Americans with Disabilities Act
BMP	best management practice
BTU	British Thermal Unit
CAA	Clean Air Act
CFR	Code of Federal Regulations
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
EA	Environmental Assessment
Ecology	Washington State Department of Ecology
EIS	Environmental Impact Statement
EPA	U.S Environmental Protection Agency
ETL	express toll lane
FHWA	Federal Highway Administration
FR	Federal Register
GHG	greenhouse gases
GP	general purpose
HOV	high-occupancy vehicle
I-405	Interstate 405
I-5	Interstate 5
ICE	Infrastructure Carbon Estimator
$\mu g/m^3$	micrograms per cubic meter
MOVES	motor vehicle emissions simulator
MP	milepost
MSAT	mobile source air toxics
MT	metric tons
NAAQS	National Ambient Air Quality Standards

Acronym	Meaning
NEPA	National Environmental Policy Act
NO_2	nitrogen dioxides
NO_x	nitrogen oxides
O_3	ozone
OEO	Office of Equal Opportunity
OHWM	ordinary high water mark
PAH	polycyclic aromatic hydrocarbons
PGIS	pollution-generating impervious surfaces
PM	particulate matter
$PM_{2.5}$	particulate matter 2.5 microns or less in diameter
PM_{10}	particulate matter 10 microns or less in diameter
PSCAA	Puget Sound Clean Air Agency
ppm	parts per million
PSRC	Puget Sound Regional Council
SEPA	State Environmental Policy Act
SO_2	sulfur dioxide
SOV	single-occupant vehicle
SR	State Route
VHT	vehicle hours traveled
VMT	vehicle miles traveled
VOC	volatile organic compound
WAC	Washington AdministrativeCode
WSDOT	Washington State Department of Transportation WSTC
WSTC	Washington State Transportation Commission

ATTACHMENT B GLOSSARY

Term	Meaning
Air emissions	Pollutants emitted into the air, such as ozone, carbon monoxide, nitrogen oxide, nitrogen dioxide, sulfur dioxide and others.
Air pollutant	Any substance in air that could, in high enough concentration, harm people, animals, vegetation, or material. Pollutants include any natural or artificial matter capable of being airborne. They may be in the form of solid particles, liquid droplets, gases, or a combination thereof. Generally, they fall into two main groups: (1) those emitted directly from identifiable sources and (2) those produced in the air by interaction between two or more primary pollutants, or by reaction with normal atmospheric constituents.
Air quality standards	The level of pollutants prescribed by regulations that may not be exceeded during a given time in a defined area.
Attainment area	An area considered to have air quality as good as or better than the national ambient air quality standards as defined in the federal Clean Air Act. An area may be an attainment area for one pollutant and a non-attainment area for others
Best management practice (BMP)	BMPs are generally accepted techniques that, when used alone or in combination, prevent or reduce adverse effects of a project. Examples include erosion control measures and construction management to minimize traffic disruption. Please see Section 6 for a complete list of BMPs.
Criteria pollutants	The 1970 amendments to the Clean Air Act required the EPA to set National Ambient Air Quality Standards for certain pollutants known to be hazardous to human health. EPA has identified and set standards to protect human health and welfare for six pollutants: ozone, carbon monoxide, particulate matter, sulfur dioxide, lead, and nitrogen oxide. The term, "criteria pollutants" derives from the requirement that EPA must describe the characteristics and potential health and welfare effects of these pollutants. Standards are set or revised on the basis of these criteria.
Emissions standard	The maximum amount of air-polluting discharge legally allowed from a single source, mobile or stationary.
Express toll lane	A limited-access freeway lane that is actively managed through a variable toll system to regulate its use and thereby maintain express travel speeds and reliability. Toll prices rise as the lane approaches

Term	Meaning
	capacity. This ensures that traffic in the express toll lane remains flowing at express travel speeds of 45 to 60 miles per hour.
Fugitive emissions	Dust released to the air.
Hazardous air pollutants	Air pollutants that are not covered by ambient air quality standards but which, as defined in the Clean Air Act, may reasonably be expected to cause or contribute to irreversible illness or death. Such pollutants include asbestos, beryllium, mercury, benzene, coke oven emissions, radionuclides, and vinyl chloride.
Maintenance area	Area that has recently met the National Ambient Air Quality Standards for the criteria pollutants designated in the Clean Air Act and for which air quality is being managed to continue to meet the standards.
Mobile source	Any non-stationary source of air pollution such as cars, trucks, motorcycles, buses, airplanes, and locomotives.
Nonattainment area	Area that does not meet one or more of the National Ambient Air Quality Standards for the criteria pollutants designated in the Clean Air Act.

ATTACHMENT C MOTOR VEHICLES EMISSION SIMULATOR VERSION 2014B

The Motor Vehicle Emissions Simulator (MOVES2014b) is the latest EPA tool for estimating emissions of VOCs, nitrogen oxide, CO, PM10, PM2.5, ozone, mobile source air toxic pollutants, and greenhouse gas emissions from motor vehicles. The MOVES model was used to calculate daily emissions for the existing conditions, 2015, and No Build Alternative and Build Alternative (with the Project) for the 2025 and 2045 analysis years.

During the modeling process, the MOVES model has a series of input screens that provide an opportunity to customize modeling parameters or select default values to have an influence on emission rates. For the Project, the following modeling input parameters were used to reflect the affected network. Specific input files were provided by Washington State Department of Ecology to reflect current modeling inputs for King and Snohomish counties. These input files reflect inspection and maintenance information, meteorology, fuel supply data, age distribution, and VMT distribution between months of the year and weekday/weekend ratio of vehicles within the study area. The hourly distribution factor for the project area were obtained from the average hourly volume counts for September to October in 2015.

Project-specific traffic input files were derived for the MOVES model by utilizing traffic data supplied by the traffic engineer for the Project. For the study area, two roadway types were classified for the I-405 freeway and the associated affected local roadways as urban restricted (freeway) and urban unrestricted (arterials). Traffic speeds were provided in two categories: light-duty (cars and light trucks) and medium and heavy duty trucks. This information was used to develop speeds for each alternative by vehicle classification by road type.

Five MOVES input files related to project-specific traffic data are: roadway type, average speed distribution, source type population, ramp fraction and VMT by vehicle type. These input files influence the effects of project-related traffic on air quality. For the Roadway Type input file, the percentage of each vehicle classification’s VMT was distributed on each roadway type, urban restricted (freeway) or urban unrestricted (arterials). For the Average Speed Distribution input file, information is required on the time of day a particular vehicle classification is traveling at a particular speed on a certain roadway type. This information was calculated for each vehicle classification operating at different speed for each hour and distributed by roadway type. The source type population was obtained from the highest daily volume in the project area and distributed to source types. Ramp fraction was obtained from the fraction of ramp VHT of the total freeway VHT. Lastly, the annual VMT was distributed for each vehicle type.

Exhibit C-1 presents a summary of all MOVES input files and the respective data source.

Exhibit C-1: MOVES Input Data Sources

MOVES INPUT	Source
Age Distribution	Projected from EPA MOVES tool with provided 2014 data by Washington State Department of Ecology
Average Speed Distribution	Provided modeled traffic data
Fuel Usage Fraction	MOVES default
AVFT	MOVES default
Fuel Formulation	MOVES default
Fuel Supply	Existing -Washington State Department of Ecology, Future - MOVES default
I/M Programs	Existing-Washington State Department of Ecology, Future- discontinued after 2019
Meteorology Data	MOVES default
Source Type Population	Provided modeled traffic data
Vehicle Type VMT	Provided modeled traffic data
Month VMT Fraction	Washington State Department of Ecology
Day VMT Fraction	Washington State Department of Ecology
Hour VMT Fraction	Provided traffic counts
Road Type Distribution	Provided modeled traffic data
Ramp Fraction	Provided modeled traffic data

I/M = inspection/maintenance; VMT = vehicle miles traveled

The modeling was performed on the affected network for the study area. The emissions were estimated using MOVES temperature default values.

Utilizing the input files discussed above, run specifications were developed to obtain PM10, PM2.5, NOx, VOC, CO, and nine MSAT emissions in grams per day and converted to pounds per day for each analysis year.

Whereas some emissions are obtained directly from MOVES output files, some pollutants are obtained from further calculation.

Total emission for PM10 and PM2.5 was calculated from the summation of exhaust emission, brake wear particulate, and tire wear particulate.

Diesel PM was calculated by selecting the PM10 emission for diesel fuel vehicles and running exhaust and crankcase running exhaust processes. Naphthalene emission was obtained from the total of Naphthalene gases and Naphthalene particles.

Polycyclic Aromatic Hydrocarbons (PAH) also is not a direct MOVES output. It is calculated from the following pollutants:

- Dibenzo(a,h)anthracene particle
- Fluoranthene particle
- Acenaphthene particle
- Acenaphthylene particle
- Anthracene particle
- Benz(a)anthracene particle
- Benzo(a)pyrene particle
- Benzo(b)fluoranthene particle
- Benzo(g,h,i)perylene particle
- Benzo(k)fluoranthene particle
- Chrysene particle
- Fluorene particle
- Indeno(1,2,3,c,d)pyrene particle
- Phenanthrene particle
- Pyrene particle
- Dibenzo(a,h)anthracene gas
- Fluoranthene gas
- Acenaphthene gas
- Acenaphthylene gas
- Anthracene gas
- Benz(a)anthracene gas
- Benzo(a)pyrene gas
- Benzo(b)fluoranthene gas
- Benzo(g,h,i)perylene gas
- Benzo(k)fluoranthene gas
- Chrysene gas
- Fluorene gas
- Indeno(1,2,3,c,d)pyrene gas
- Phenanthrene gas
- Pyrene gas

In addition, operational GHG emissions were also provided in pounds per day and converted to an annual value in metric tons of estimated carbon dioxide (CO2e) per year. Specific details of the Run Specs that were developed are provided electronically.

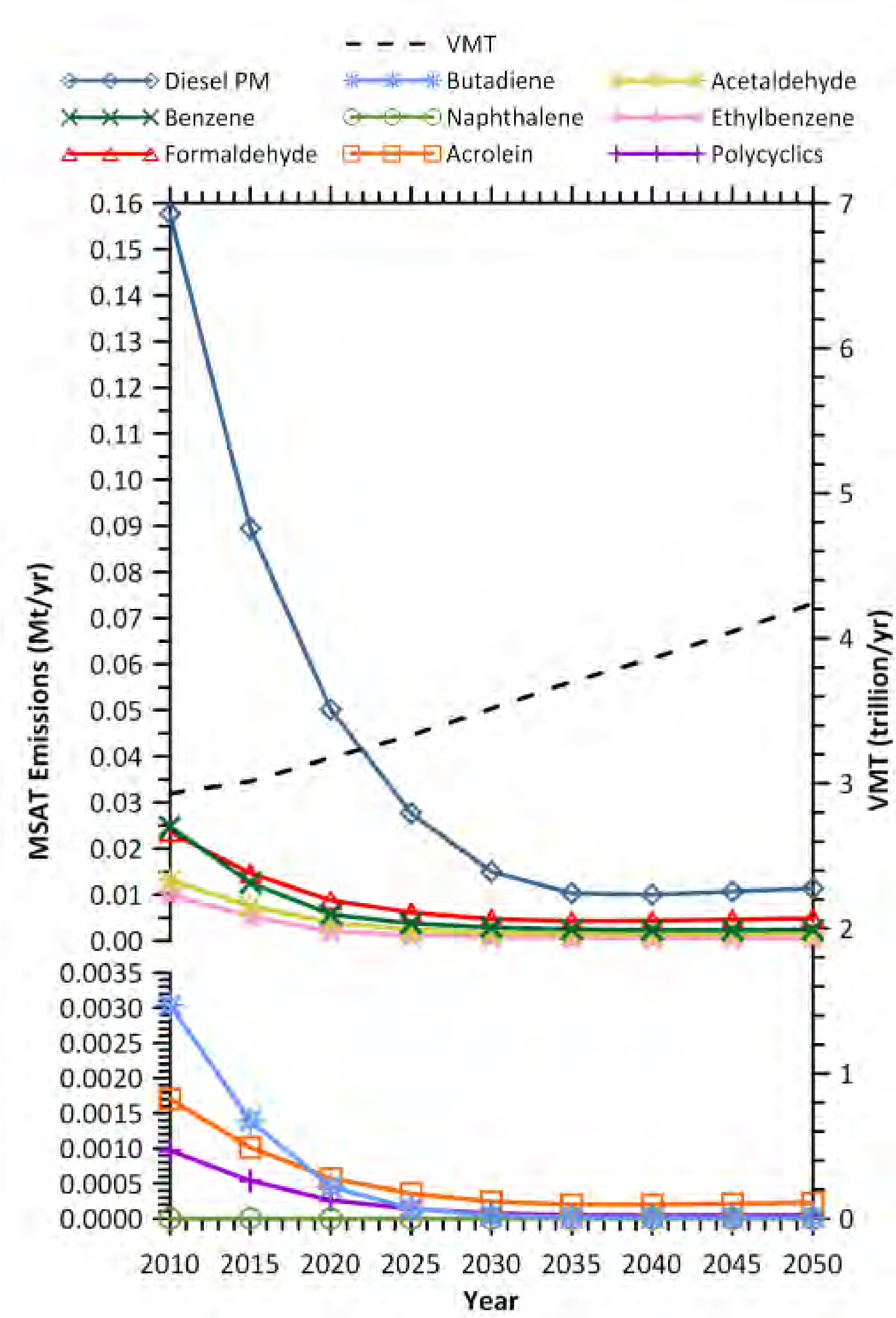
ATTACHMENT D EFFECTS ON MOBILE SOURCE AIR TOXICS RESULTS USING MOVES VERSION 2014A

According to the U.S. Environmental Protection Agency (EPA), MOVES2014 is a major revision to MOVES2010 and improves upon it in many respects. MOVES2014 includes new data, new emissions standards, and new functional improvements and features. It incorporates substantial new data for emissions, fleet, and activity developed since the release of MOVES2010. These new emissions data are for light- and heavy-duty vehicles, exhaust and evaporative emissions, and fuel effects. MOVES2014 also adds updated vehicle sales, population, age distribution, and VMT data. MOVES2014 incorporates the effects of three new federal emissions standard rules not included in MOVES2010. These new standards are all expected to affect mobile source air toxic (MSAT) emissions and include Tier 3 emissions and fuel standards starting in 2017 (79 Federal Register [FR] 60344), heavy-duty greenhouse gas regulations that phase in during model years 2014– 2018 (79 FR 60344), and the second phase of light-duty greenhouse gas regulations that phase in during model years 2017 to 2025 (79 FR 60344).

Since the release of MOVES2014, EPA has released MOVES2014a. In the November 2015 *MOVES2014a Questions and Answers Guide*, EPA states that for on-road emissions, MOVES2014a adds new options requested by users for the input of local VMT, includes minor updates to the default fuel tables, and corrects an error in MOVES2014 brake wear emissions. The change in brake wear emissions results in small decreases in PM emissions, while emissions for other criteria pollutants remain essentially the same as MOVES2014.

Using EPA's MOVES2014a model, as shown in Exhibit D-1, FHWA estimates that even if VMT increases by 45 percent from 2010 to 2050 as forecasted, a combined reduction of 91 percent in the total annual emissions for the priority MSAT is projected for the same time-period (2016a).

Exhibit D-1. MSAT Emissions Trends for Increasing VMT 2010 to 2050



Incomplete or Unavailable Information for Project-Specific MSAT Health Impacts Analysis

In FHWA's view, information is incomplete or unavailable to credibly predict the project-specific health impacts due to changes in MSAT emissions associated with a proposed set of highway alternatives. The outcome of such an assessment, adverse or not, would be influenced more by the uncertainty introduced into the process through assumption and speculation rather than any genuine insight into the actual health impacts directly attributable to MSAT exposure associated with a proposed action.

The EPA is responsible for protecting the public health and welfare from any known or anticipated effect of an air pollutant. They are the lead authority for administering the Clean Air Act and its amendments and have specific statutory obligations with respect to hazardous air pollutants and MSAT. The EPA is in the continual process of assessing human health effects, exposures, and risks posed by air pollutants. They maintain the Integrated Risk Information System (IRIS), which is "a compilation of electronic reports on specific substances found in the environment and their potential to cause human health effects" (EPA https://www.epa.gov/iris). Each report contains assessments of non-cancerous and cancerous effects for individual compounds and quantitative estimates of risk levels from lifetime oral and inhalation exposures, with uncertainty spanning perhaps an order of magnitude.

Other organizations are also active in the research and analyses of the human health effects of MSAT, including the Health Effects Institute (HEI). A number of HEI studies are summarized in Appendix D of FHWA's *Updated Interim Guidance on Mobile Source Air Toxic Analysis in NEPA Documents* (FHWA 2016a). Among the adverse health effects linked to MSAT compounds at high exposures are cancer in humans in occupational settings; cancer in animals; and irritation to the respiratory tract, including the exacerbation of asthma. Less obvious is the adverse human health effects of MSAT compounds at current environmental concentrations (HEI Special Report 16, https://www.healtheffects.org/publication/mobile-source-air-toxics-critical-review-literature- exposure-and-health-effects) or in the future as vehicle emissions substantially decrease.

The methodologies for forecasting health impacts include emissions modeling; dispersion modeling; exposure modeling; and then final determination of health impacts – each step in the process building on the model predictions obtained in the previous step. All are encumbered by technical shortcomings or uncertain science that prevents a more complete differentiation of the MSAT health impacts among a set of project alternatives. These difficulties are magnified for lifetime (i.e., 70 year) assessments, particularly because unsupportable assumptions would have to be made regarding changes in travel patterns and vehicle technology (which affects emissions rates) over that time frame, since such information is unavailable.

It is particularly difficult to reliably forecast 70-year lifetime MSAT concentrations and exposure near roadways, to determine the portion of time that people are actually exposed at a specific location, and to establish the extent attributable to a proposed action, especially given that some of the information needed is unavailable.

There are considerable uncertainties associated with the existing estimates of toxicity of the various MSAT because of factors such as low-dose extrapolation and translation of occupational exposure data to the general population, a concern expressed by HEI (Special Report 16, https://www.healtheffects.org/publication/mobile-source-air-toxics-critical-review-literature-exposure-and-health-effects). As a result, there is no national consensus on air dose-response values assumed to protect the public health and welfare for MSAT compounds, and in particular for diesel PM. The EPA states that with respect to diesel engine exhaust, "[t]he absence of adequate data to develop a sufficiently confident dose-response relationship from the epidemiologic studies has prevented the estimation of inhalation carcinogenic risk[1]."

There is also the lack of a national consensus on an acceptable level of risk. The current context is the process used by the EPA as provided by the Clean Air Act to determine whether more stringent controls are required to provide an ample margin of safety to protect public health or to prevent an adverse environmental effect for industrial sources subject to the maximum achievable control technology standards, such as benzene emissions from refineries. The decision framework is a two-step process. The first step requires EPA to determine an "acceptable" level of risk due to emissions from a source, which is generally no greater than approximately 100 in a million. Additional factors are considered in the second step, the goal of which is to maximize the number of people with risks less than 1 in a million due to emissions from a source. The results of this statutory two-step process do not guarantee that cancer risks from exposure to air toxics are less than 1 in a million; in some cases, the residual risk determination could result in maximum individual cancer risks that are as high as approximately 100 in a million.

Because of the limitations in the methodologies for forecasting health impacts described, any predicted difference in health impacts between alternatives is likely to be much smaller than the uncertainties associated with predicting the impacts. Consequently, the results of such assessments would not be useful to decision-makers, who would need to weigh this information against project benefits, such as reducing traffic congestion, accident rates, and fatalities plus improved access for emergency response, that are better suited for quantitative analysis.

[1] *U.S. Environmental Protection Agency. 2003. IRIS database, Diesel Engine Exhaust, Section II.C. Retrieved July 2019 at https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=642.*

ATTACHMENT E INFRASTRUCTURE CARBON ESTIMATOR SPREADSHEET TOOL

The Washington State Department of Transportation *Environmental Manual* requires the use of FHWA's Infrastructure Carbon Estimator (ICE) spreadsheet tool to calculate GHG emissions from fuel usage, traffic delays, and maintenance emissions resulting from the construction of the Projects. FHWA's ICE spreadsheet tool incorporates project features and construction traffic delays to calculate emissions from construction equipment, materials, and routine maintenance. The following project-specific inputs were obtained as inputs for the ICE model.

Project Features

- The Projects would be constructed within a 3-year period.
- The average daily traffic per lane mile is assumed 5,000.
- Total existing lane miles is 25 miles.
- Total existing center line miles is 4.1 miles.
- The newly constructed lane miles that would occur on I-405 is 8.2 miles.
- There would be 0.6 mile of realignment lane miles for the northbound I-405 realignment.
- Lane-widening lane miles, is 0 miles. Lane widening is reconstruction of lanes wider than the replaced section of roadway.
- Shoulder improvement (centerline miles) is 3.5 miles.
- Reconstruction pavement (lane miles) is 0.5 miles.
- Resurfacing pavement (lane miles) is 8 miles.
- Rail bus, bicycle and pedestrian facilities: construction of 6 new Bus Rapid Transit (BRT) stations: two at I-405/SR 522 interchange direct access ramp, two at SR 522 transit loop and two at I-405/SR 527 interchange direct access ramp.
- Bike and pedestrian facilities
  - New off-street bike/ped path – 1.25 miles
  - New on-street bike lanes – 0.5 miles, depending on city acceptance, either on-street or off-street bike lanes will be provided. The off-street 1.25-mile bike lane is included in the ICE tool as that yields higher emissions than 0.5 mile of on-street bike lanes.
  - New sidewalk – 0.5 miles
  - Resurfacing off-street bike/ped path – 0 miles
  - Resurfacing on-street bike lanes – 0.5 miles

- Reconstruct Canyon Park Park and Ride to maintain 300 parking spaces
- Construct three new bridges over Sammamish River

Construction Delays

There are 30 project-days of lane closures expected during construction at this time. All the lanes in one direction (50% of lanes) would be closed during construction.

Mitigation Inputs

Currently no mitigation inputs have been provided. As the Projects near construction, the contractor may incorporate recycled asphalt material to reduce GHG emissions. The inputs provided above were used to generate annualized energy consumption in million British thermal units per year and GHG emissions in metric tons of CO_2e per year. Two main construction activities would be occurring for the Projects: new construction of roadway and roadway rehabilitation. For each of the two construction activities, GHG emissions were calculated for upstream and direct emissions. Upstream GHG emissions are associated with the lifecycle emissions embodied in the materials used in construction, including raw materials, extraction ram materials transportation, materials production (such as crushing of aggregate and asphalt batch plants), and chemical reactions in materials (calcination of limestone). Direct GHG construction emissions are related to fuel usage in construction equipment and routine maintenance.