CHAPTER 9: AIR QUALITY AND GREENHOUSE GAS EMISSIONS

9.1 Introduction

This chapter first describes the existing air quality and greenhouse gas (GHG) baseline conditions in the study area, summarizes the regulatory context, and identifies air pollutants of concern. The chapter then compares each alternative's effect on air quality and GHGs in relation to existing regulations, plans, and policies, including the City of Seattle GHG guidelines for SEPA evaluations.

The chapter distinguishes between air pollutants and GHGs. Both are generated locally, but GHG emissions contribute to cumulative carbon dioxide levels on a global scale. Additionally, air pollutants and GHGs are regulated separately.

The study area selected for the analysis of air quality and GHG emissions is the same study area applied to the transportation analysis (see Chapter 7, Figure 7-1).

Changes from the DEIS

Chapter 9 includes an analysis of the newly developed Preferred Alternative, which was not included in the DEIS. The air quality and GHG analysis has also been updated to reflect new transportation data collected for all alternatives, including the No Build and Preferred Alternatives.

9.2 Affected Environment

9.2.1 Regulatory Agencies, Policies, and Requirements

Air quality in the Puget Sound region is regulated and enforced by federal, state, and regional agencies including the EPA, Ecology, and the Puget Sound Clean Air Agency (PSCAA). In addition, the City of Seattle has a plan to address climate change. These agencies' distinct roles are described below.

U.S. Environmental Protection Agency

The 1970 Clean Air Act (last amended in 1990) requires the EPA to set National Ambient Air Quality Standards (NAAQS) for six common air pollutants to protect the public from the negative health effects of air pollution (EPA, 2015c). The six principal pollutants, called "criteria" pollutants, include the following:

- ozone,
- carbon monoxide (CO),
- particle pollution or "particulate matter" (PM),
- nitrogen dioxide (NO2),
- sulfur dioxide (SO2), and
- lead.

The NAAQS specify the concentration of these pollutants to which the public can be exposed without adverse health effects and with an adequate margin of safety.

NAAQS are divided into two categories: primary standards and secondary standards. Primary standards protect the general public health, including sensitive populations such as asthmatics, children, and the elderly. Secondary standards protect the public welfare against hazards such as decreased visibility and damage to animals, crops, vegetation, and buildings (EPA, 2015a).

Two size categories of PM are regulated: "inhalable coarse particles" with diameters between 2.5 and 10 micrometers, and "fine particles" with diameters 2.5 micrometers and smaller (EPA, 2015a). A micrometer is one millionth of a meter. Particles less than 10 micrometers can pass through the nose and throat and enter the lungs.

The units of measure for the specified standards are parts per million (ppm) by volume, parts per billion (ppb) by volume, and micrograms per cubic meter of air (μg/m^3). Table 9-1 lists the primary and secondary standards set by the EPA for the six criteria pollutants (EPA, 2015a). The standards are periodically reviewed and may be revised by the EPA.

Table 9-1. National Ambient Air Quality Standards (NAAQS)

Pollutant		*Primary/ Secondary*	*Averaging Time*	*Level*	*Form*
Carbon Monoxide		Primary	8-hour	9 ppm	Not to be exceeded more than once per year.
			1-hour	35 ppm	
Lead		Primary and secondary	Rolling 3-month average	0.15 μg/m^3	Not to be exceeded.
Nitrogen Dioxide		Primary	1-hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years.
		Primary and secondary	Annual	53 ppb	
Ozone		Primary and secondary	8-hour	0.070 ppb	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years.
Particle Pollution	PM2.5	Primary	Annual	12.0 μg/m^3	Annual mean, averaged over 3 years.
		Secondary	Annual	15.0 μg/m^3	Annual mean, averaged over 3 years.
		Primary and secondary	24-hour	35 μg/m^3	98th percentile, averaged over 3 years.
	PM10	Primary and secondary	24-hour	150 μg/m^3	Not to be exceeded more than once per year on average over 3 years.
Sulfur Dioxide		Primary	1-hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years.
		Secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year.

Source: EPA, 2015a.

The agencies have designated areas of the United States according to whether they are meeting the NAAQS, as follows (Ecology, 2015a, 2015b, 2015c):

- **Nonattainment areas**: Areas that exceed the NAAQS for a pollutant by the number of times predesignated by the EPA;
- **Maintenance areas**: Areas that were once designated as nonattainment but are now achieving the NAAQS; and
- **Attainment areas:** Areas that have air pollution levels below the NAAQS.

In nonattainment areas, states must develop plans to reduce emissions and bring the area back into attainment of the NAAQS. The General Conformity Rule, established by the Clean Air Act Amendments of 1990, ensures that the actions taken by federal agencies in nonattainment and maintenance areas do not interfere with a state's plans to meet national standards for air quality (Ecology, 2015a).

In addition, EPA's Mandatory Reporting of Greenhouse Gases Rule requires large sources of GHGs to report their GHG emissions data. Several types of industries are subject to this rule, including suppliers of certain products that would result in GHG emissions if released, combusted, or oxidized; direct emitting source categories; and facilities that inject carbon dioxide underground for sequestration purposes. Facilities that emit 25,000 metric tons or more per year of GHGs are required to submit annual reports to EPA (EPA, 2015b).

> The principal source of Washington's GHG emissions is transportation (approximately 47% of total state gross GHG), followed by fossil fuel combustion in the residential, commercial, and industrial sectors (approximately 20%) and electricity consumption from these sectors (approximately 20%) (Ecology, 2007).

Washington State Department of Ecology

Ecology maintains an air quality program with a goal of safeguarding public health and the environment by preventing and reducing air pollution. Through the air quality program, Ecology collects and shares information regarding air quality conditions, effects, and mitigation on a statewide level. Ecology also oversees the development and conformity of the State Implementation Plan (SIP), a complex collection of documents that describes how the state implements, maintains, and enforces NAAQS. While states have the authority to adopt more stringent thresholds than the federal government, Ecology's ambient air quality standards parallel those of the EPA presented in Table 9-1 (Ecology, 2016).

In December 2010, Ecology adopted Chapter 173-441 WAC – Reporting of Emissions of Greenhouse Gases. This rule institutes mandatory GHG reporting for the following:

- Facilities that emit at least 10,000 metric tons of GHGs per year in Washington; or
- Suppliers of liquid motor vehicle fuel, special fuel, or aircraft fuel that supply products equivalent to at least 10,000 metric tons of carbon dioxide per year in Washington.

Puget Sound Clean Air Agency

The PSCAA is responsible for air quality in King County and has local authority for setting regulations and permitting of stationary air pollutant sources and construction emissions. PSCAA also maintains and operates a network of ambient air quality monitoring stations throughout its jurisdiction.

City of Seattle Climate Action Plan 2013

The City's Climate Action Plan (CAP) acknowledges that cities play a powerful role in addressing climate change. Since adoption of the original CAP in 2006, Seattle has taken action on 15 of the 18 strategies established to meet the Kyoto Protocol target for reducing GHG emissions (City of Seattle, 2013). The most recent version of the CAP was adopted in 2013, expanding the CAP vision to include zero net GHG emissions by 2050 and preparing for the likely impacts of climate change. The 2013 CAP provides an action strategy that focuses on reducing GHG emissions while supporting other community goals, including building vibrant neighborhoods, fostering economic prosperity, and enhancing social equity. The plan includes goals of tripling the amount of bicycling from 2007 levels by 2017; reducing passenger vehicle emissions by 82%; reducing passenger vehicle miles traveled by 20% by 2030; trending away from single occupant vehicles; and reducing GHG emissions per mile of Seattle vehicles by 2030 (City of Seattle, 2013).

9.2.2 Air Quality and Pollutants of Concern

Scientific evidence shows that long- and short-term exposure to air pollutants can cause a variety of adverse health effects, including respiratory conditions, cardiovascular conditions, cancer, and premature death (EPA, 2015d).

The Missing Link study area is in the Puget Sound lowland, which generally has sufficient wind most of the year to disperse air pollutants released into the atmosphere. However, CO and PM in the Puget Sound region have exceeded current federal standards in the past. A 1-hour ozone standard was also previously exceeded; however, EPA revoked its 1-hour ozone standard in 2005, and the 8-hour standard is currently being met. Therefore, CO and PM are the main criteria pollutants of concern for the project (see Table 9-2).

Table 9-2. NAAQS Maintenance Areas

NAAQS Criteria Pollutant	*Date of Nonattainment Designation*	*Date of Redesignation to Attainment*	*Affected Area*
CO 8-hour 9 ppm	11/15/1990	10/11/1996	King County
PM10 24-hour 150 $\mu g/m^3$	11/15/1990	5/14/2001	King County

Source: Ecology, 2015c.

Carbon Monoxide

CO is an odorless, tasteless, colorless gas emitted from mobile sources (e.g., autos, trucks, and buses); wood-burning stoves; open burning; and industrial combustion sources. CO reduces the blood's capacity to carry oxygen and can cause headaches, dizziness, nausea, listlessness, and, in high doses, may cause death. The federal CO standards have not been exceeded in the Puget Sound area for over 20 years and the area was redesignated to attainment in 1996 (Ecology, 2015c).

Particulate Matter

PM consists of fine particles such as soot, dust, and unburned fuel suspended in the air. It is emitted from a variety of sources, including vehicles, industry, and construction. This pollutant aggravates ailments such as bronchitis and emphysema and is especially harmful for those with chronic heart and lung diseases, as well as the very young, elderly, and pregnant women. The federal annual PM2.5 standard has not been exceeded in the Puget Sound area since monitoring began in 1990. All four counties in the PSCAA monitoring area (Kitsap, Pierce, King, and Snohomish) were below the daily and annual PM10 federal standards since the early 1990s until monitoring stopped in 2006 (PSCAA, 2016). While other areas of Puget Sound are designated maintenance areas, King County is not designated as such (Ecology, 2015c).

9.2.3 **Greenhouse Gases**

Greenhouse gases warm the earth by absorbing solar energy and slowing the rate at which the energy escapes to space. They act like a blanket and trap heat in the earth’s atmosphere, causing climate change. The principal GHGs are carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O).

Road transportation is Seattle’s largest source of GHG emissions, comprising approximately 40% of community emissions (City of Seattle, 2013). Fossil fuels burned by cars, trucks, transit, and freight vehicles as they travel throughout Seattle are responsible for the emissions. Because CH4 and N2O emissions constitute less than 0.1% of the total GHGs from these sources, CO2 is the principal GHG of concern for project construction (off-road equipment emissions) and operation (vehicle emissions) (City of Seattle, 2014).

CO2 is naturally present in the atmosphere as part of the Earth’s carbon cycle (the natural circulation of carbon among the atmosphere, oceans, soil, plants, and animals). The combustion of fossil fuels such as gasoline and diesel to transport people and goods accounted for about 31% of total CO2 emissions and 26% of total GHG emissions in the United States in 2013 (EPA, 2015d).

9.2.4 **Existing Emissions from Idling Vehicles**

The focus of this GHG analysis is on air pollutants emitted by idling vehicles. This method is appropriate because none of the alternatives are predicted to change future traffic volumes, but only to change idling times at intersections and as drivers wait for trail users to clear before turning onto or off of roadways. Existing emissions were calculated based on existing vehicle traffic volumes on roadway segments along the alternative routes (Parametrix, 2017). Traffic volumes are described in Chapter 7, Transportation and in the Transportation Discipline Report (Parametrix, 2017).

To establish a baseline of existing conditions, the amounts of pollutant and GHG (CO2) emissions were estimated using existing traffic volumes (Parametrix, 2017) and vehicle delay data at 19 locations, as presented in the Transportation Discipline Report (Parametrix, 2017). The existing daily vehicle volumes and associated delay times were obtained during peak hours to account for worst-case circumstances. Emissions estimates tabulated in Appendix C and presented in Table 9-3 were derived by converting idling times into CO, PM10, and CO2 emission volumes using idle emission factors published by the EPA (2008). The emission estimates used separate calculations for light-duty gasoline-fueled vehicles and heavy-duty diesel trucks. Table 9-3 contains the combined total emission estimates.

Table 9-3. Existing Annual Vehicle Idling Emissions Based on Vehicle Delay and Traffic Volumes

Main Pollutant of Concern	*Total Idling Emissions*
CO (tons/year)	24.35
PM10 (tons/year)	0.02
CO2 (metric tons/year)	1,503

9.3 Potential Impacts

The organization of this impact analysis is different than in other chapters of this FEIS. This section first describes the methods and criteria used to assess air quality impacts, then presents combined results (construction and operation) for GHGs and main criteria pollutants of concern (CO and PM10). This was done in order to compare the total potential pollutant emissions of each alternative including those from construction activities, lifecycle emissions of construction materials, long-term operational maintenance of the trail, and changes in vehicle traffic and idling emissions.

9.3.1 Analysis Methods

This analysis considers the following types of potential project impacts:

- Short-term CO and PM10 emissions generated by construction equipment, vendor truck trips, and construction worker trips;
- "Lifecycle" emissions of GHG (CO2) generated during manufacturing of the concrete used to pave the new trail; paving of the trail; and maintenance of the trail throughout its expected lifespan of 30 years; and
- Potential for the trail connection to negatively impact air quality and GHG emissions by causing delays for vehicles accessing driveways at trail crossings and at intersections.

The City of Seattle SEPA GHG Emissions Worksheet (2016) was used to calculate metric tons of CO2 equivalents created during the manufacture of paving materials, construction of the trail, and maintenance of the trail pavement over its expected lifespan. Air pollutant emissions were calculated using the Road Construction Emissions Model (South Coast Air Quality Management District, 2008).

The volume of nonmotorized trail users who may use the Missing Link once it is completed was estimated using nonmotorized user counts taken near the west and east trail ends. It is assumed that the number of users would be the same across alternatives, and that user volumes would continue to grow, which could result in more delays at driveways and intersections in the study area. See Chapter 7, Transportation, and the Transportation Discipline Report for details (Parametrix, 2017).

The number of pedestrians and bicyclists in the study area may increase with the completion of the Missing Link. However, the air quality analysis was based on the full predicted growth of motorized vehicle use, which represents a more conservative estimate of emissions. This analysis does not assume motorized trip reduction associated with conversion to trail use.

The presence of trail crossings at driveways could result in delays for vehicles using the driveways, thus increasing the amount of vehicle emissions due to increased idling times (Parametrix, 2017). Different types of motorized vehicles emit air pollutants and GHGs in varying volumes, so the types of vehicles that could be delayed are also evaluated. Some of the Build Alternatives would result in signalization of intersections, which would substantially reduce existing and projected vehicle delays during the 2040 horizon year and thus reduce pollutant and GHG emissions.

The significance of potential impacts was assessed using the following criteria:

- Significant adverse impacts would occur if:
    - The project would result in construction-related GHG emissions at or above the State of Washington reporting threshold of 10,000 metric tons in a given year, and the project would not implement BMPs to reduce GHG emissions. Construction-related impacts include the generation of GHG emissions by construction equipment hauling construction materials to the site, removing spoils and debris from the site, and resurfacing, as well as other activities. Lifetime construction-related GHG emissions for each alternative were quantified using the City of Seattle GHG guidelines for SEPA evaluations (City of Seattle, 2016).
    - The project construction plus operation would exceed state GHG reporting requirements or federal de minimis thresholds of 100 tons per year applicable within King County pursuant to the 1990 amendments to the federal Clean Air Act for CO and PM10.
- Minor impacts would occur if:
    - Project construction and operation would result in an increase in GHG emissions that falls below state reporting requirements; or
    - Project construction and operation would result in an increase in CO or PM10 that falls below federal NAAQS standards.

9.3.2 No Build Alternative

No construction would occur under the No Build Alternative, and therefore no construction-related air pollution or GHG emissions would occur.

Under the No Build Alternative, traffic congestion and delays would continue on their current trajectory as traffic volumes increase through 2040. Table 9-4 presents the estimated increase in vehicle idling emissions in 2040 under the No Build Alternative compared to existing conditions. (See Appendix C, Table B-1 and B-2 for a tabulation of daily emissions at studied roadway segments under existing and No Build conditions.)

Table 9-4. Vehicle Idling Emissions for the No Build Alternative (Existing Conditions and 2040) Based on Vehicle Delay and Traffic Volumes

	Carbon Dioxide (CO2) Metric Tons per Year			*Carbon Monoxide (CO) Tons per Year*			*Particulate Matter (PM10) Tons per Year*		
	Existing	*2040 No Build Total*	*2040 Increase over Existing*	*Existing*	*2040 No Build Total*	*2040 Increase over Existing*	*Existing*	*2040 No Build Total*	*2040 Increase over Existing*
Total Idling Emissions along Analyzed Roadways	1,503	4,044	2,541	24.35	49.57	25.22	0.02	0.09	0.07

9.3.3 Impacts Common to All Build Alternatives

Greenhouse Gases (CO2)

CO2 emissions come from multiple sources, including the extraction, processing, transportation, construction, and disposal of materials and landscape disturbance, and transportation demands created by the development after it is completed (City of Seattle, 2016). Table 9-5 presents the estimated construction, operation, and total CO2 emissions for each Build Alternative in 2040. Quantities shown are approximate.

Table 9-6 presents the estimated change in construction, operation, and total CO2 emissions for each Build Alternative, including the Preferred Alternative, in 2040 compared to the No Build Alternative. All Build Alternatives would result in a net decrease in GHG emissions compared to the No Build Alternative, largely as a result of intersection timing upgrades proposed in conjunction with the project that would substantially lower vehicle delays at high-volume intersections. The improvements to traffic flow from these upgrades would more than offset the increased vehicle delays at driveways, as well as construction-related GHG emissions.

Criteria Air Pollutants (CO and PM10)

All of the Build Alternatives would have no adverse impacts with respect to criteria air pollutant emissions of CO and PM10, with the exception of CO levels for the Leary Alternative, as shown in Table 9-6. The Leary Alternative would result in a minor increase in total emissions of CO relative to the No Build Alternative; however, total CO emissions would be well below the 100 ton per year de minimis thresholds applicable within King County pursuant to the 1990 amendments to the federal Clean Air Act (Table 9-6).

Similar to the reasons for the CO2 reductions seen for the Build Alternatives, the reduction in the criteria air pollutants for most of the Build Alternatives compared to the No Build Alternative is due to the intersection timing upgrades proposed as part of the project, which would substantially lower vehicle delays at high-volume intersections. Specifically, the intersection at Shilshole Ave NW and 17th Ave NW would see a marked decrease in projected delay time under all of the Build Alternatives.

Table 9-5. Annual 2040 GHG and Air Quality Emissions for Each Build Alternative

Preferred Alternative	CO_2 (metric tons)	CO (tons)	PM_{10} (tons)
Construction	353	5.1	1.6
Operation	3,303	43.41	0.07
Total	3,656	48.51	1.67
Shilshole South Alternative	CO_2 (metric tons)	CO (tons)	PM_{10} (tons)
Construction	325	5.1	1.6
Operation	3,222	42.44	0.06
Total	3,547	47.54	1.66
Shilshole North Alternative	CO_2 (metric tons)	CO (tons)	PM_{10} (tons)
Construction	333	5.1	1.6
Operation	3,211	42.08	0.06
Total	3,544	47.18	1.66
Ballard Avenue Alternative	CO_2 (metric tons)	CO (tons)	PM_{10} (tons)
Construction	378	5.1	1.6
Operation	3,225	40.52	0.07
Total	3,603	45.62	1.67
Leary Alternative	CO_2 (metric tons)	CO (tons)	PM_{10} (tons)
Construction	340	5.1	1.6
Operation	3,973	51.88	0.08
Total	4,313	56.98	1.68

Table 9-6. Change in Annual 2040 GHG and Air Quality Emissions for Each Build Alternative Compared to No Build Alternative

Preferred Alternative	CO_2 (metric tons)	CO (tons)	PM_{10} (tons)
Change from No Build	-741	-6.16	-.02
Threshold	10,000	100	100
+/- Threshold Standard	Net Benefit	Net Benefit	Net Benefit
Shilshole South Alternative	CO_2 (metric tons)	CO (tons)	PM_{10} (tons)
Change from No Build	-822	-7.14	-.02
Threshold	10,000	100	100
+/- Threshold Standard	Net Benefit	Net Benefit	Net Benefit
Shilshole North Alternative	CO_2 (metric tons)	CO (tons)	PM_{10} (tons)
Change from No Build	-833	-7.49	-.02
Threshold	10,000	100	100
+/- Threshold Standard	Net Benefit	Net Benefit	Net Benefit

Ballard Avenue Alternative	CO2 (metric tons)	CO (tons)	PM10 (tons)
Change from No Build	-819	-9.05	-.02
Threshold	10,000	100	100
+/- Threshold Standard	Net Benefit	Net Benefit	Net Benefit
Leary Alternative	CO2 (metric tons)	CO (tons)	PM10 (tons)
Change from No Build	-71	+2.31	-.006
Threshold	10,000	100	100
+/- Threshold Standard	Net Benefit	-97.69	Net Benefit

All Build Alternatives would require the manufacture and installation of new pavement, the transportation of construction materials, and other construction-related activities. These activities cause GHG and criteria air pollutant emissions that would be absent under the No Build Alternative.

Traffic in the study area is expected to grow under all Build Alternatives (Parametrix, 2017), which would generally add to GHG and criteria air pollutant emissions. Alternatives that include transportation system upgrades that could improve traffic flow and decrease idling times could reduce operational emissions compared to the No Build Alternative, since the same improvements are not associated with the No Build Alternative. Where improvements that facilitate traffic flow and reduce delay times offset construction-related emissions, net benefits to air quality could result.

All Build Alternatives would result in a net reduction in CO, CO2, and PM10 emissions over the No Build Alternative, with one exception. The Leary Alternative would result in slightly higher CO emissions compared to the No Build Alternative due to the smaller decreases in idling emissions, which then allow for the increases in construction emissions to predominate, but would be well below the significant adverse impact threshold. The remaining Build Alternatives would result in a decrease in GHG emissions and criteria air pollutants because nonmotorized uses of the transportation corridors would generally be shifted to the trail, which would decrease the delays caused by the conflicting uses at several key intersections.

Although the Build Alternatives would result in increased delays at some intersections or driveways, the magnitude of the decrease at a few high-volume intersections caused by shifting nonmotorized uses to the trail was large enough to compensate for any increases in delay time at other intersections and driveways under the Build Alternatives. The DEIS analysis found minor impacts for these parameters for most of the Build Alternatives as compared to the No Build Alternative, although all emissions were found to be well below the significant adverse impact thresholds. Updated analysis done since the publishing of the DEIS shows a greater decrease in delay times at these high-volume intersections than what was used to calculate GHG emissions and criteria air pollutants for the DEIS, which accounts for the difference in impacts between the DEIS and the FEIS.

9.3.4 Connector Segments

Emissions during construction and operation of any of the connector segments would be minor compared to any of the Build Alternatives, and therefore would not cause a significant adverse environmental impact.

9.4 Avoidance, Minimization, and Mitigation Measures

The following measures could apply to all of the Build Alternatives. Although construction-related emissions would be below EPA thresholds, the City would implement BMPs to minimize PM10, CO, and CO2 emissions in the project vicinity and comply with applicable regulations for air quality. The City would require contractors to comply with the following practices:

- Use measures to control dust, such as watering exposed surfaces (e.g., parking areas, staging areas, soil piles, graded areas, and unpaved access roads) and covering haul trucks transporting soil, sand, or other loose material.
- Wash mud or dirt from construction equipment to prevent it from being tracked out onto public roads.
- Limit vehicle speeds on unpaved roads.
- Pave all exposed soils in areas planned for paving as soon as possible.
- Minimize vehicle and equipment idle times by shutting off when not in use.
- Maintain all construction equipment and vehicles in accordance with manufacturer specifications.

Additionally, contractors could:

- Encourage carpooling options for employees.
- Use warm-mix asphalt.
- Use reused fly ash concrete.
- Use local building materials to reduce transport distances, when possible.