Chapter 4 Air Quality and Greenhouse Gas Emissions

4.1 Introduction

This chapter assesses the potential impacts of the proposed project, the No-Action Alternative, and related actions on air quality and greenhouse gas (GHG) emissions. This chapter describes the air quality environment at the project site and discusses general indications of air quality status and attainment status of the project vicinity. It summarizes the methods and findings of the analyses of the potential impacts of construction and operation of the proposed project, including the following: an air quality compliance assessment of facility-focused sources (i.e., stationary sources) completed in support of an application for an air discharge permit from the Southwest Clean Air Agency (SWCAA); an expanded analysis that considered vessel sources not included in the permitting process analysis; and analyses of GHG emissions and potential micro meteorological impacts from the proposed project's cooling towers.

Unless otherwise stated, project-related impacts and mitigation are based on the information contained in the application for the required air permits (Ramboll Environ 2016) as submitted to the Washington State Department of Ecology (Ecology) and SWCAA. Technical information developed as part of the air quality analysis for this environmental impact statement (EIS) is included in the Air Quality Technical Report (see **Appendix D**).

4.1.1 Facility Configurations Considered

The air quality review of the proposed project considered two methanol production technology alternatives (collectively referred to as the Technology Alternatives). These Technology Alternatives were described previously in Chapter 2 and can be summarized as follows:

- Combined Reformer (CR) Alternative - The proposed methanol manufacturing facility would use combined reforming technology, which employs a combination of a steam-methane reformer and an autothermal reformer to produce methanol.
- Ultra-Low Emissions (ULE) Alternative **-** The proposed methanol manufacturing facility would use ULE reforming technology, which employs a gas-heated reformer and an autothermal reformer to produce methanol.

The project as originally proposed and publicly announced by Northwest Innovation Works, LLC – Kalama (NWIW) was based on the CR Alternative technology. During the preliminary engineering for the facility, NWIW explored other technologies that would mitigate the GHG and other emissions that would result from the CR technology. This exploration led to consideration of the ULE technology. ULE technology has been used to produce other chemicals from natural gas, but is a new technology for methanol production. Johnson ~~Mathey~~ Matthey developed the technology at a small methanol plant in Australia through three generations of engineering and implementation. ULE technology has not been applied at any full-scale methanol production facility. NWIW conducted a detailed engineering evaluation and feasibility analysis of the ULE technology in 2015. Based on the favorable conclusions from that analysis, NWIW determined to change the proposed technology for the project from CR to ULE for the purpose of mitigating air quality impacts. Because it substantially reduces air quality impacts and is NWIW's preferred approach to methanol manufacturing for this project, the ULE Alternative configuration has been more completely developed in engineering plans, and more detailed information on it was available for the air quality dispersion modeling assessment discussed below.

4.2 General Methodology

The air quality impact assessment used standard analytical techniques and tools that included the following components:

- Consideration of existing air quality in the project area using estimates of background concentrations developed using modeling based on statewide air quality monitoring
- Estimates of emissions from project-related sources, including stationary sources that would be part of the project facility (therefore, subject to air quality permitting review), oceangoing tanker vessels that would transport the product, oceangoing general cargo vessels that would use the new dock, and escort tugs that would assist during vessel maneuvering to and from the facility dock
- Air quality dispersion modeling to consider project-related emission sources over time and estimate resulting concentrations of air pollutants in the ambient air
- Comparison of time-averaged pollutant concentrations associated with the proposed project with respective health-protective ambient air quality standards

More specifics regarding the tools and procedures used in these analyses are discussed in section 4.3.3 below and in the Air Quality Technical Report in **Appendix D**.

4.3 Affected Environment

This section describes the air quality regulatory environment and existing air quality conditions in the study area as described in this chapter and as depicted in air quality modeling.

4.3.1 Applicable Air Quality Rules

The air quality regulations that apply to the proposed project, the various methods of analysis used in evaluating potential project-related air quality impacts, and existing air quality conditions are described in the following sections.

4.3.1.1 Ambient Air Quality Standards and Attainment Status

Air quality is generally assessed in terms of whether concentrations of air pollutants are higher or lower than ambient air quality standards set to protect human health and welfare. Ambient air quality standards are set for “criteria” pollutants (e.g., CO, particulate matter [in two size ranges described later], nitrogen dioxide [NO_2], and sulfur dioxide [SO_2]). Three agencies have jurisdiction over the ambient air quality in the proposed project location: the U.S. Environmental Protection Agency (EPA), Ecology, and SWCAA. These agencies establish regulations that govern the concentrations of pollutants in the outdoor air. Applicable local, state, and federal ambient air quality standards are displayed in **Table 4-1**.

Table 4-1. Applicable Ambient Air Quality Standards for Criteria Pollutants

Pollutant	Terms of Compliance [a]	Concentration
Total Suspended Particulate		
Annual Average ($\mu g/m^3$)	Geometric mean not to exceed	60 $\mu g/m^3$
24-Hour Average ($\mu g/m^3$) WA State only; no federal standard	Not to be exceeded more than once per year	150 $\mu g/m^3$
Inhalable Particulate Matter (PM_{10})		
Annual Average ($\mu g/m^3$)	Arithmetic mean; not to be exceeded	50 $\mu g/m^3$ [b]
24-Hour Average ($\mu g/m^3$)	The 3-year average of the 98th percentile of the daily concentrations must not exceed	150 $\mu g/m^3$
Fine Particulate Matter ($PM_{2.5}$)		
Annual Average ($\mu g/m^3$)	The 3-year annual average of daily concentrations must not exceed	12 $\mu g/m^3$
24-Hour Average ($\mu g/m^3$)	The 3-year average of the 98th percentile of daily concentrations must not exceed	35 $\mu g/m^3$
Sulfur Dioxide (SO_2) [(b)]		
Annual Average (ppm)	Annual arithmetic mean of 1-hour averages must not exceed	0.02 ppm [b]
24-Hour Average (ppm)	24-hour average must not exceed	0.10 ppm [b]
1-Hour Average (ppm)	1-hour average must not exceed	0.40 ppm [b]
1-Hour Average (ppm)	The 3-year average of the 99th percentile of daily max 1-hour conc. must not exceed	0.075 ppm
1-Hour Average (ppm)	No more than twice in 7 consecutive days may 1-hour average exceed	0.25 ppm [b]
Carbon Monoxide (CO)		
8-Hour Average (ppm)	The 8-hour average must not exceed more than once per year	9 ppm
1-Hour Average (ppm)	The 1-hour average must not exceed more than once per year	35 ppm
Ozone (O_3)		
8-Hour Average (ppm)	The 3-year average of the 4th highest daily maximum 8-hour average must not exceed	0.075 ppm
8-Hour Average (ppm) Revised effective 12/28/2015 [c]	The 3-year average of the 4th highest daily maximum 8-hour average must not exceed	0.070 ppm
Nitrogen Dioxide (NO_2)		
Annual Average (ppm)	The annual mean of 1-hour averages must not exceed	0.053 ppm
1-Hour Average (ppm)	3-year avg. of 98th percentile of daily max 1 hour averages must not exceed	0.1 ppm
Lead (Pb)		
Rolling 3-month Average	Rolling 3-month average not to exceed	0.15 $\mu g/m^3$

Note: $\mu g/m^3$ = micrograms per cubic meter; ppm = parts per million

[a] All limits are federal and state air quality standards except as noted. All indicated limits represent "primary" air quality standards intended to protect human health.

[b] Washington State standards; Washington applies more stringent annual and 24-hour limits for SO_2 than in federal rules. There is also a federal 0.5 ppm 3-hour average "secondary" standard for SO_2 to protect welfare.

[c] The newly adopted 8-hour ozone standard became effective 12/28/2015 but will not wholly replace the existing standard until current standard is revoked, probably sometime in 2017.

The ambient air quality standards (**Table 4-1**) have been set at levels that EPA and Ecology have determined will protect human health with a margin of safety, including the health of sensitive individuals, such as the elderly, the chronically ill, and the very young.

Ecology maintains a network of air quality monitoring stations throughout Washington State. Based on monitoring information for criteria air pollutants collected over a period of years, Ecology and EPA designate regions as being “attainment” or “nonattainment” areas for particular pollutants. Attainment status is a measure of whether air quality in an area complies with the federal health-based ambient air quality standards for criteria pollutants. Once a nonattainment area achieves compliance with the national ambient air quality standards (NAAQSs), the area is considered an air quality “maintenance” area in perpetuity or until the NAAQSs that was the basis of the original nonattainment designation is rescinded. The methanol plant would be located in a region currently considered to be in attainment for all criteria pollutants. One aspect of the air quality study described here was to assess whether ambient air quality would continue to comply with the NAAQSs with the proposed project in operation. The findings of this review comprise the basis for determining whether the proposed project would result in any potential significant adverse air quality impacts.

4.3.1.2 Acceptable Source Impact Levels (ASILs) for Air Toxics

In addition to the health-based ambient air quality standards described above, the proposed project has the potential to emit non-criteria air pollutants that are regulated federally by CAA Section 112, and regulated in Washington by Ecology under Chapter 173-460 WAC. Some of these pollutants are deemed hazardous air pollutants under CAA Section 112; others are defined as toxic air pollutants (TAPs) under Chapter 173-460 WAC. Although there are no ambient standards for TAPs, there are risk-based screening levels ~~regulations~~ for TAPS that are known or suspected to be toxic or carcinogenic to people. These screening levels, known as Acceptable Source Impact Levels (ASILs), are applied in permitting processes for industrial pollution sources to determine whether a more detailed review and analysis is appropriate.

All TAPs emitted by proposed project stationary sources (i.e., those fixed sources subject to air permitting review) were considered during the air permitting analysis. The ~~TAPs~~ ASIL ~~screening levels, which~~ do not apply to emissions from mobile sources like vessels. Applied to stationary sources, the ASILs are ~~sometimes nonetheless~~ used as benchmarks to determine whether a more detailed review and analysis is appropriate ~~for considering concentrations of toxic air contaminants subject to permitting requirements~~. Such a review was conducted for this assessment.

4.3.1.3 Air Permitting Review

This section briefly summarizes the air quality permitting review required for the proposed project. That review, conducted separately from the SEPA environmental impact review, was necessary to prepare the permit applications described below. Results from the permitting analyses contributed to the environmental impact analyses documented in this section.

The air quality permitting process considered the appropriate levels of permitting for the proposed methanol manufacturing facility based on the maximum potential annual emissions. If such emissions of criteria pollutants[1] exceed 100 tons per year, the proposed methanol manufacturing facility would be considered a major stationary source subject to evaluation under the federal Prevention of Significant Deterioration (PSD) regulations. The PSD program

[1] See Table 4-1 for a list of criteria pollutants.

is designed to prevent the degradation of air quality in locations with very good air quality and in locations complying with applicable ambient standards.

The initial air quality permitting review considered the Combined Reforming (CR) and Ultra-Low Emissions (ULE) configurations of the proposed methanol manufacturing facility. Based on emissions calculations, the CR Alternative configuration of the facility would be a major source that would need to be considered under federal PSD regulations, while the ULE Alternative configuration would be a minor source not subject to federal PSD regulations.[2] ~~Although the ULE Alternative would not be a major source subject to the federal PSD permitting requirements, Ecology's rules incorporate an out-of-date version of EPA's PSD rules that require a PSD permit for new sources of GHGs with annual emissions greater than 100,000 tons per year.[3] Consequently, the facility with the ULE Alternative would require a state PSD permit for GHG even though it is not a major source under the federal PSD rules. The state PSD permit would require air quality impact analysis and best available control technology (BACT) for GHGs and each other pollutant that may exceed the significant emissions rate (NOx, volatile organic compounds [VOCs], PM_{10}, and $PM_{2.5}$).~~

If the project proceeds with the CR Alternative configuration, it would be subject to the federal PSD program as implemented by Ecology~~, including implementation of BACT for GHG and other pollutants that exceed significant emission rates~~. The PSD permit for the CR Alternative would require air quality impact analysis and best available control technology (BACT) for each pollutant that may exceed the significant emissions rate (NOx, CO, volatile organic compounds [VOCs], PM_{10}, $PM_{2.5}$, and GHG). If the project proceeds with the ULE Alternative configuration, it would not require a PSD permit ~~under Ecology's rules, but not under the federal PSD program (i.e.,~~ because emissions would be less than the federal PSD thresholds~~)~~. ~~The state PSD permit also would require an air quality impact analysis but might not include all the same elements as required under the federal PSD program and would require BACT for GHGs and other pollutants that exceed significant emission rates.~~ Additional requirements for the permitting review are described in **Appendix D**.

4.3.1.4 Air Quality Conformity Review

Special air quality "conformity: rules requiring additional reviews for some projects apply in areas that are designated as nonattainment or maintenance for one or more air pollutants. These rules do not apply in the project study area because the area is considered in attainment for all criteria air pollutants. Consequently, neither the "transportation" nor the "general" air quality conformity rules apply to this project.

4.3.2 Existing Air Quality Conditions

Existing sources of air pollution in the vicinity of the project site include industrial emission sources and transportation-related activities, including river marine diesel-fueled vessels and both diesel and gas vehicles on the nearby freeway. With diesel-fueled sources operating around industrial sources, the criteria air pollutants of primary concern are NO_X and particulate matter (PM_{10} [i.e., coarse particulate matter of 10 microns in diameter or less] and $PM_{2.5}$ [i.e., fine particulate matter of 2.5 microns in diameter or less]). Other pollutants include ozone

[2] Until June 2014, EPA's PSD rules required PSD review for major sources of GHG, but the U.S. Supreme Court struck down those rules. When the DEIS was published, Ecology's rules had not been updated to be consistent with EPA's rules and would have still required state PSD review for GHG emissions. Effective July 1, 2016, Ecology repealed that rule and PSD is no longer required solely for GHG emissions.

precursors (hydrocarbons and NO_x) and SO_2. Given the setting, industrial and transportation sources likely comprise the largest contributors to ambient pollutant concentrations in the vicinity of the project site. Refer to **Appendix D** for additional information.

Estimated existing background air pollutant concentrations were developed by Ecology using modeling methods to provide this information for locations at which there are insufficient data from local air quality monitoring to allow more direct estimates. The estimated existing background concentrations for all criteria air pollutants were far less than the levels allowed by the ambient air quality standards (**Appendix D**, Table 2). These background concentrations were considered in the dispersion modeling analyses of the proposed project. Several air pollutants of particular interest and their sources are described below.

4.3.2.1 Inhalable Coarse and Fine Particulate Matter

Particulate matter air pollution is generated by industrial activities, fuel combustion sources like marine vessels, residential wood burning, locomotives, motor vehicle engines and tires, and other sources. Federal, state, and local regulations set limits for particulate concentrations in the air based on the size of the particles and the related potential threat to health. When first regulated, airborne particulate matter rules were based on concentrations of “total suspended particulate,” which included all size fractions. As air sampling technology has improved and the importance of particle size and chemical composition to human health risk has become clearer, ambient standards have been revised to focus on the size fractions thought to be most dangerous to human health. Based on the most recent studies, EPA has redefined the size fractions and set more stringent standards for particulate matter based on fine (i.e., $PM_{2.5}$) and coarse (i.e., PM_{10}) inhalable particulate matter to focus control efforts on the smaller size fractions.

There are currently health-based ambient air quality standards for PM_{10}, as well as for $PM_{2.5}$ (**Table 4-1**). $PM_{2.5}$ and even smaller (ultra-fine) particles are now thought to be the most dangerous size fractions of airborne particulate matter. With the revocation of the federal annual standard for PM_{10} in October 2006, the focus of ambient air monitoring and control efforts related to particle air pollution in the region has been almost entirely on $PM_{2.5}$. The project study area has never been included in a particulate matter nonattainment area. Particulate matter concentrations associated with the proposed project were analyzed in detail as part of the air quality review reported in this section.

4.3.2.2 Ozone

Ozone is a highly reactive form of oxygen created by sunlight-activated chemical transformation of nitrogen oxides and volatile organic compounds (hydrocarbons) in the atmosphere. Ozone problems tend to be regional in nature because the atmospheric chemical reactions that produce ozone occur over a period of time, during which ozone precursors can be transported far from their sources. Transportation sources, including large marine vessels, locomotives, and trucks, are some of the sources that produce ozone precursors. Because ozone is not emitted directly, only very sophisticated air quality models are capable of considering ozone formation in the atmosphere, and such models are typically used for regional assessments of air quality plans. Thus, ozone modeling is not typically performed for project-specific reviews, and ozone was not considered in the air quality impact analysis for the proposed project.

In October 2015, EPA adopted a new primary NAAQS for ozone based on an 8-hour average concentration of 70 ppb that became effective 28 December 2015. The current standard of

75 ppb (**Table 4-1**) will remain in effect until it is revoked sometime in the next several years. The current standard and the new standard have no immediate implications for the proposed project.

4.3.2.3 Sulfur Dioxide (SO_2)

SO_2 is a colorless, corrosive gas produced by burning fuels containing sulfur like coal and oil, and by industrial facilities, such as smelters, paper mills, power plants, and steel manufacturing plants. Except near large emission sources, SO_2 levels are typically well below federal standards. The potential SO_2 concentrations associated with the proposed project were analyzed in detail as part of the air quality review reported in this section.

4.3.2.4 Nitrogen Oxides (NO_x)

The combination of nitric oxide and NO_2 is commonly called oxides of nitrogen or NO_X. Other oxides of nitrogen, including nitrous acid and nitric acid, are part of the nitrogen oxide family. Of this family of gasses, NO_2 is the only component for which ambient air quality standards have been established, and this pollutant is used as the indicator for the larger group of NOx. There is an annual average standard for NO_2 that has been in effect for many years, and EPA adopted a 1-hour standard for NO_2 that became effective in April 2010. Modeling-estimated existing background concentrations in the project vicinity are about 33 percent and 10 percent of the concentrations allowed by the hourly and the annual NAAQSs, respectively. Potential NO_2 concentrations attributable to sources associated with the proposed project were considered in detail in the air quality review documented in this section.

4.3.2.5 Toxic Air Pollutants (TAPs)

In addition to the criteria air pollutants for which health-protective air quality standards have been set, all fuel combustion sources emit a number of known or suspected TAPs that may be directly harmful due to their chemistry and/or cause cancer or other detrimental effects to human health with long-term exposure. Although there are no specific health-related air quality standards for such pollutants, EPA, Ecology, and SWCAA have established screening levels for a variety of TAPs that can be used in assessing the relative potential of adverse impacts. Three TAPs—diesel engine exhaust particulate matter (DPM), methanol, and ammonia—were considered in this analysis to account for proposed project-related emissions of these pollutants.

A common method of assessing the relative risk of exposure to TAPs is to estimate the likelihood of increases in incidents of cancer due to a lifetime of exposure (usually assumed to be 70 years) to a given contaminant. Some screening levels for assessing such potential risk are based on an increased risk of one additional cancer among one million people. Ecology has adopted this sort of conservative screening approach for TAPs using screening level ASILs. ASILs are used during air quality permitting reviews of proposed new or modified stationary emission sources, and ASILs are applied based on the incremental changes in pollutant concentrations expected to occur due to proposed projects. The Washington State ASILs are not intended for use in evaluating emissions from mobile sources; however, the ASILs were considered in the air permit application for stationary sources associated with the proposed methanol manufacturing facility. The ASILs represent very conservative benchmarks that can be used as one of several factors for assessing potential risk related to exposure to TAPs. If an air quality permitting modeling analysis indicates a predicted ambient concentration that exceeds an ASIL, the applicant has the opportunity to prepare a health impact assessment to evaluate the potential of whether the project-related emission increases would represent an unacceptable health risk. Such an assessment considers the ASIL in conjunction with several other factors (e.g., land use types, age of population, etc.) to estimate potential exposure and risk. But again, other than federally mandated emission controls for various engines, no specific air quality regulations pertain to mobile sources (i.e., vessels) operating near the project site.

Diesel Engine Particulate Matter (DPM)

The ASIL for DPM that was considered in the assessment reported here is also fundamentally different than the NAAQSs adopted to protect human health and welfare with a margin of safety. The NAAQSs (**Table 4-1**) are designed to protect against known or suspected short-term acute and long-term chronic health effects due to exposure over certain periods. The NAAQSs are based on protecting even the most sensitive populations from exposure over periods ranging from 1 hour to one year. For example, SO_2 standards are based on 1-hour, 3-hour, 24-hour, and annual average concentrations, and the ambient standards for other criteria pollutants are similarly based on time-weighted average exposure limits.

In contrast, the ASILs, such as the one for DPM considered in this analysis, are based on estimates of the possible risk of the additional incidence of cancer in a population with continuous (i.e., 24 hours per day) exposure over 70 years. So instead of standards based on relatively well-defined dose responses, the long-term TAPs screening levels are based on the estimated potential risk associated with long-term, constant exposure.

The ASIL for DPM was considered in this assessment to provide a benchmark for gauging potential impacts of DPM emissions from on-site diesel-fueled equipment and vessels maneuvering to and from the facility dock and for general cargo vessels hoteling (i.e., operating while stationary) at the dock. This Washington TAP screening impact level for DPM is based on an annual average concentration (**Table 4-2**), and it establishes a very low concentration. EPA has not adopted a similar cancer risk estimate for use at the federal level due to continuing uncertainties in the underlying data. EPA says, "[diesel exhaust] human exposure-response data are considered too uncertain to derive a confident quantitative estimate of cancer unit risk . . ." (EPA 2002). Instead, EPA uses a 5.0 $\mu g/m^3$ reference concentration to represent the exposure through inhalation to which humans may be exposed throughout their lifetime without being likely to experience adverse non-cancer respiratory effects (**Table 4-2**). The ASILs and EPA reference levels (for exposure through inhalation) for methanol and ammonia are also presented in the table.

Table 4-2. Air Toxic Impact Screening Levels for Selected TAPs

Toxic Air Pollutant	Washington ASIL [a] ($\mu g/m^3$)	Averaging Period	EPA RfC ($\mu g/m^3$)
Diesel engine exhaust particulate matter	0.00333	Annual	5.0
Methanol (Methyl Alcohol)	4,000	24-hour	2,000
Ammonia (NH_3)	70.8	24-hour	100

Sources: WAC 173-460-150 (http://apps.leg.wa.gov/WAC/default.aspx?cite=173-460-150); EPA

Notes: ASIL – acceptable source impact level, RfC – reference concentration for inhalation exposure, EPA – U.S. Environmental Protection Agency (http://www2.epa.gov/iris)

[a] ASILs represent screening levels intended to be used during permitting processes for stationary air pollution emission sources. ASILs are not intended to apply to mobile sources and are not required to be considered during environmental reviews. The DPM ASIL is used in Washington as an indicator of potential risk of an increase in cancer rates of 1 in 1 million people exposed for 70 years. EPA has not adopted a cancer risk factor for DPM due to uncertainties in the underlying data; the EPA RfC is a non-cancer risk factor representing an estimated safe level of exposure over a lifetime.

Ecology (2008) indicated it considers the ASIL concentration for DPM to represent a negligible risk, and went on to note: "even the least exposed Washingtonians are likely to be exposed to higher diesel particulate concentrations [than the ASIL]." Ecology (2008) also reported that EPA estimated the median DPM exposure in Washington to be 0.249 μg/m^3, a level about 75 times greater than the ASIL. This estimated existing common exposure level for people living in a wide variety of environments underscores the point that the DPM ASIL is a very conservative value for estimating the potential for human health effects. ~~For example, the model-calculated existing background concentration for $PM_{2.5}$ (**Appendix D**), which probably overstates DPM levels but which would be in great part comprised DPM, is more than 1,500 times higher than the DPM ASIL.~~

There are no monitoring stations in the vicinity that measure DPM, but EPA periodically prepares a National Air Toxics Assessment that can be used to estimate concentrations. Although the assessment is not intended to be used to characterize health risks at the census tract level, EPA applies dispersion models to regional emission inventories to identify DPM concentrations and exposure for each census tract. EPA estimates the existing DPM concentration in the Kalama site census tract at 0.61 μg/m^3 (EPA 2011).

Odor

Existing odors in the vicinity of the project site can likely be attributed to natural sources associated with the river, diesel-fueled vehicles, and industrial activities. This location along the Columbia River may also be subject to odors associated with marine transportation activities. The proposed project would be subject to SWCAA regulations requiring any source of emissions of odorous substances to use recognized good practice and procedures to reduce such odors to a reasonable minimum to prevent unreasonably interfering with any other property owner's use and enjoyment of his property.

4.3.2.6 Meteorological Conditions and Climate

Air quality is substantially influenced by climate and meteorological conditions, so prevalent weather patterns are a major factor in both short- and long-term air quality conditions. Regional geography affects climate in the study area. The combination of mountains and water create a regional meteorology unique to the Pacific Northwest. The climate in the proposed project study area is predominately temperate, characterized by wet, mild winters and dry, warm summers. The climate is influenced by the relative proximity of the Pacific Ocean and the Cascade and Coast ranges of Oregon and Washington.

Wind direction and wind speed are complicated by geography and terrain, so it is more difficult to represent predominant winds using more distant climatological data. A three-year data set for purposes of dispersion modeling was created using meteorological data from an on-site meteorological station operated at Noveon Chemical in Kalama. This meteorological data set was used in the air quality modeling analysis documented in later sections of this EIS.

4.3.2.7 Greenhouse Gases and Global Climate Change

The phenomena of natural and human-caused effects on the atmosphere that cause changes in long-term meteorological patterns due to global warming and other factors is generally referred to as climate change. Due to the importance of the greenhouse effect and related atmospheric warming to climate change, the gases emitted globally that affect such warming are called GHGs. The GHGs of primary importance are CO_2, methane, and nitrous oxide. Because CO_2 is the most abundant of these gases, GHGs are usually quantified in terms of CO_2 equivalents (CO_2e), based on the relative longevity in the atmosphere and the related "global warming potential" of these constituents. CO_2 is not considered an air pollutant that causes direct health-related impacts, so it is not subject to ambient standards used to gauge pollutant concentrations in the air.

The global climate changes continuously, as evidenced by repeated episodes of warming and cooling documented in the geologic record. But the rate of change has typically been incremental, with warming or cooling trends occurring over the course of thousands of years. The past 10,000 years have been marked by a period of incremental warming, as glaciers have steadily retreated across the globe. However, scientists have observed an unprecedented increase in the rate of warming over the past 150 years. This recent warming has coincided with the Industrial Revolution, which resulted in widespread deforestation to accommodate development and agriculture along with increasing use of fossil fuels. These sources have released substantial amounts of GHGs into the atmosphere and resulted in GHG levels unprecedented in the modern geologic record.

GHGs are emitted by both natural processes and human activities, and GHGs trap heat in the atmosphere. The accumulation of GHG in the atmosphere affects the earth's temperature. While research has shown that the Earth's climate has natural warming and cooling cycles, the overwhelming preponderance of evidence indicates that emissions related to human activities have elevated the concentration of GHGs in the atmosphere far beyond the level of naturally occurring concentrations and that this in turn is resulting in more heat being held within the atmosphere.

Fuel combustion used for transportation is a significant source of GHG emissions primarily through the burning of gasoline and diesel fuels. National estimates indicate the transportation sector (including on-road, construction, airplanes, and vessels) accounts for about 33 percent of total domestic CO_2e emissions from fossil fuels in 2013 (EPA 2015). In an interim tabulation of 2012 emissions within Washington, Ecology estimated transportation accounted for about 46 percent of statewide GHG emissions, in part because emissions in other sectors are reduced because the state relies heavily on hydropower for electricity, unlike other states that rely more heavily on fossil fuels (e.g., coal, petroleum, and natural gas) to generate electricity. The next largest contributors to total gross GHG emissions in Washington were about 22 percent from fossil fuel combustion for a combined residential, commercial, and industrial category and about 16.5 percent for electricity generation. Agricultural activities and specific industrial processes, such as aluminum and cement manufacturing, accounted for about 5 percent each, while solid waste management activities, including GHG emissions from landfills, contributed about 4 percent (derived from Ecology 2014).

Note that CO_2 is not subject to ambient standards used to gauge pollutant concentrations in the air in relation to potential health impacts to people. The GHG tabulations for this proposed project were developed using accepted techniques for emission inventories, but these listings are intended only to provide an approximate indication of GHG emissions related to the proposed project based on estimated direct and indirect emissions from fuel combustion sources related to the proposed project within Washington State.

No specific federal, state, or local emission reduction requirements or targets are applicable to the proposed project, and there are no generally accepted emission level thresholds against which to assess potential localized or global impacts of GHG emissions. Ecology has issued internal guidance to assist its staff in determining which projects should be evaluated and how to evaluate GHG emissions under SEPA (Ecology 2011). This guidance provides the following regarding how to assess the relative significance of project-related GHG emissions:

> *The SEPA rules also state, in defining significance, that it involves context and intensity and does not lend itself to a formula or quantifiable test (WAC 197-11-794). However, we believe that we can identify what level of greenhouse gas emissions would not be significant, especially taking into account the state's greenhouse gas reduction targets and other legal requirements to reduce or mitigate emissions.*
>
> *RCW 70.235.020 establishes greenhouse gas reduction targets for Washington. By 2020, we are to return to 1990 levels. While there are also reduction targets for 2035 and 2050, at this point we are concentrating on meeting the 2020 targets. Based on Ecology's most recent Comprehensive Plan to meet those targets, the state must reduce its emissions by 11% in order to return to 1990 levels by 2020.*
>
> *There are also some legal requirements to reduce or mitigate GHG emissions. These include:*
>
> - *Facilities subject to Prevention of Significant Deterioration (PSD) requirements under the Clean Air Act that have been determined to meet "Best Available Control Technology" for GHGs.*
> - *New fossil-fueled thermal electric generating facilities required to offset a portion of their* CO_2 *emissions under RCW 80.70.*
> - *Baseload power generation facilities subject to the state Emissions Performance Standard (RCW 80.80).*
>
> *A proposal will be presumed to be not significant for GHG emissions and thus no further mitigation for GHG emissions will be necessary if it is:*
>
> - *Expected to result in fewer than 25,000 metric tons a year;*
> - *Subject to a legal requirement to reduce or mitigate GHG emissions; or*
> - *Expected to result in emissions of 25,000 metric tons or more a year and has incorporated mitigation measures to reduce its emissions by approximately 11% below what its emissions would have been without those mitigation measures.*
>
> *These proposals should still disclose their emissions as outlined in Section D of this document and at the appropriate level of detail as outlined in Section G.*
>
> *For projects that have incorporated mitigation measures to reduce emissions by 11%, the project proponent should use a reasonable amount of effort to demonstrate that those measures will get as close to the 11% reduction as possible, however it is not necessary to mitigate emissions by exactly 11%.*
>
> *By identifying the level of emissions that would be presumed to be not significant, the agency is not taking the position that emissions exceeding those levels would be presumed to be significant. It is unlikely that a proposal would be considered significant based solely on its GHG emissions. We would expect a project with high GHG emissions to also have other environmental impacts.*

Ecology’s GHG SEPA guidance is the only State guidance document that informs project proponents or Washington permitting authorities about how determinations of significance should be made for GHG impacts and when mitigation is required. Therefore, it is applied here to inform the assessment of the project’s GHG impacts. ~~As discussed above, both the ULE Alternative and the CR Alternative would be required to obtain a PSD permit consistent with Ecology’s existing PSD rule, which would require BACT for GHGs (i.e., the project would be “subject to a legal requirement to reduce or mitigate GHG emissions”). In addition, because the ULE Alternative was investigated and selected for the very purpose of reducing air emissions that the CR Alternative would produce, the ULE technology itself is a mitigation measure as discussed in more detail in section 4.5.2.~~

4.3.3 Analytical Methods

This section summarizes the methods applied in the air quality impact analysis. Refer to **Appendix D** for additional details regarding these methods.

4.3.3.1 Criteria Air Pollutants and TAPs

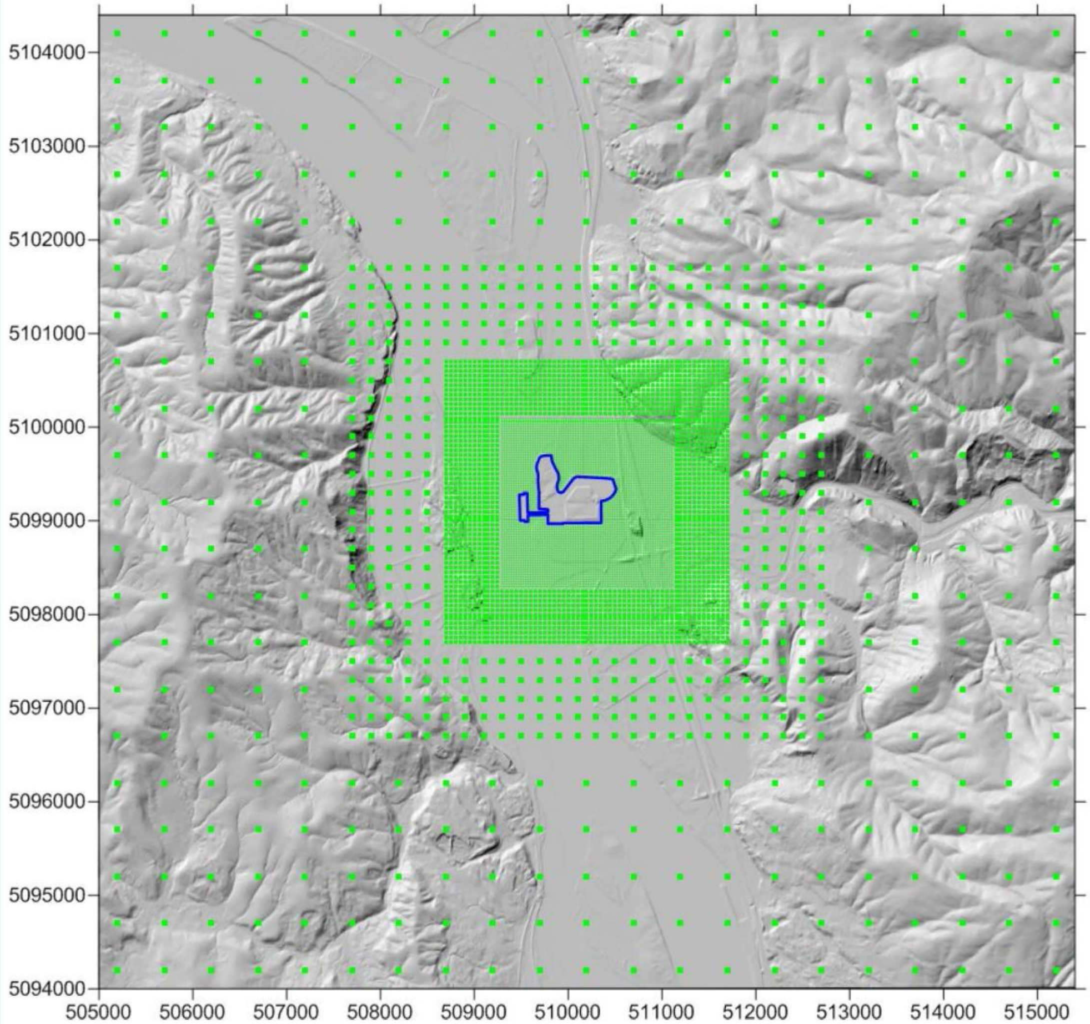
The air quality impact analysis included two basic steps: (1) emission inventory development to estimate emissions related to operation of the proposed Facility with full capacity operations, and (2) dispersion modeling to estimate air contaminant concentrations in the ambient air that would result from these emissions. The estimates of emissions and subsequent dispersion modeling employed several standard computer tools, as well as emission rate calculations using formulas published by EPA.

A separate review that considered the stationary sources that would be developed at the proposed methanol manufacturing facility was conducted for the purpose of preparing a permit application for the project. The additional analyses conducted for the EIS built onto the air quality permitting review and also considered emissions related to vessels associated with operation of the proposed project and other vessels expected to use the new marine terminal.

The air quality analysis for the proposed methanol manufacturing facility air permit application considered facility-related air pollutant emission sources subject to permitting. That analysis included the following sources: three natural gas-fired boilers, a 12-cell cooling tower, steam reforming units, flare, tanks, tank and ship vent scrubbers, emergency generators, fire pumps, and component leaks. Emissions related to vessels traveling to and from the proposed project considered methanol tanker and general cargo vessels (i.e., vessels that would use the marine terminal when it is not in use for loading methanol) in transit over about 1 nautical mile down river from the proposed project, and the combination of large vessels and tugs assisting them during docking and undocking and departure.

The proposed project would provide shore power to allow all methanol tankers to “cold iron” while docked (i.e., not have to generate their own power). Thus the vessel fleet used to transport methanol would not generate emissions once they are docked. However, other vessels unrelated to the proposed methanol plant also are expected to use the marine terminal, and these vessels may not be equipped to use shore power and would need to run fossil fuel-fired engines or auxiliary generators for power. Therefore, to consider potential worst-case, short-term (i.e., 1 hour) emissions, the air quality modeling considered hoteling emissions by general cargo vessels at the marine terminal.

The air quality modeling was conducted using approved EPA modeling tools called AERMOD. This modeling system includes preparation of a meteorological data set along with surface roughness estimates based on nearby land uses. These data are used in conjunction with detailed estimates of emissions that are both temporally and spatially distributed to simulate operation of the sources being considered. The modeling used a 10- x 10-kilometer (6.2 x 6.2 miles) “domain” with variously spaced “receptor” grids (see **Figure 4-1**). As shown, in the outer portions of the domain, the receptors were more thinly spaced, and they were more densely spaced nearer to the proposed project boundaries.



AERMOD Modeling Domain
Figure 4-1

KALAMA SEPA
Manufacturing & Marine Export Facility

Note that the air quality permitting review was based on the fence line of the property that would be controlled by the NWIW as the demarcation for where the ambient air quality standards apply. Modeling receptors, therefore, begin at the proposed methanol manufacturing facility fence line. The air quality impact modeling documented in this chapter used the same fence line boundary for upland receptors and an expanded facility footprint that incorporated the proposed marine terminal (see **Figure 4-1**).

The AERMOD assessments for compliance with long-term (i.e., annual average and daily) NAAQSs (**Table 4-1)** were based on estimated annual and daily emission rates, respectively. But the modeling for the short term (i.e., 1-hour, 3-hour, and 8-hour), NAAQSs very conservatively assumed maximum hourly emissions were occurring during every hour of every day of the three-year meteorological data set.

Additional details regarding the methods and findings of these analyses are documented in the air permit application and summarized in **Appendix D**.

4.3.3.2 Cooling Tower Effects on Ground-Level Fog and Visibility

Almost all industrial, commercial, and even multi-family residential facilities need to dispose of excess or unwanted heat. While some excess heat can be put to productive uses, in most cases it is impossible, infeasible, or impractical to capture and use all the excess heat. As a result, systems have been developed to dispose of waste heat, with the most common method being using a device/system called a cooling tower. Cooling tower systems collect waste heat in water and then cool the water with air.

Exhaust air from cooling towers has the potential to result in environmental impacts due to the high moisture content of the exhaust and the temperature differential of the exhaust and the air into which it is emitted. Air entering a cooling tower is normally at ambient temperature, but air exiting the cooling tower is usually considerably warmer. In addition, entering air contains ambient levels of water vapor, but will be nearly or completely saturated (i.e., able to contain no additional water) as it exits the cooling tower. As the exhaust air mixes with the surrounding air, it cools rapidly and can no longer carry the water vapor it held while inside the tower. The resulting condensation releases the water vapor, so most cooling towers emit a visible plume. Such water vapor is not an air pollutant, and any visible plumes of water vapor are not considered air pollution. Such plumes, however, have the potential to result in fogging, icing, and/or visible plume impacts. Additional details regarding the methods and findings of these analyses are documented in the air permit application and summarized in **Appendix D**.

Cooling Tower Plume Analytical Tool (SACTI)

Assessing potential cooling tower impacts involves estimating the expected frequencies that different exhaust plume conditions could occur within a project-specific setting. Analyzing fogging, for example, involves estimating the number of hours per year of cooling-tower related fogging at locations of interest. These results can then be plotted to provide graphical indications of the potential level of impact from the tower system.

One computer tool available for considering the potential effects of cooling towers is the Seasonal Annual Cooling Tower Impact (SACTI) model. [4] The SACTI model was used in the analysis documented here to estimate the impacts of the proposed facility cooling towers based

[4] Electric Power Research Institute (EPRI), *User's Manual: Cooling-Tower-Plume Prediction Code*, Document Number EPRI CS-3403-CCM Project 906-1, April 1984, developed by Argonne National Laboratory.

on the meteorology of the area (typically on an hourly basis for multiple years) and the specifics of the cooling tower systems, including the location, the physical dimensions, air flows, temperatures, and the heat rejection rates. Additional discussion of cooling towers and information regarding the technical details of the modeling are included in **Appendix D**.

4.3.3.3 GHG Emissions

The GHG emissions associated with operation of the proposed project were estimated using standard emission inventory techniques for the stationary and mobile sources involved in normal operations. Stationary source GHG emissions were estimated based on the sources considered in the air quality permitting review, along with vessel operation emissions associated with transport of the final manufactured product within Washington State waters. In addition, both purchased and on-site generated electricity used in the production process were considered.

4.4 Environmental Impacts

4.4.1 Combined Reformer Alternative

4.4.1.1 Potential Construction Impacts

Construction activities related to the development of the proposed project are described in Chapter 2, Proposed Project and Alternatives. Construction would include ground moving, ground improvement, and structure erection activities typical to an industrial facility. Such activities could result in temporary, localized increases in particulate concentrations due to emissions from construction-related sources. For example, dust from construction activities, such as excavation, grading, sloping, and filling, would contribute to ambient concentrations of suspended particulate matter.

Construction would require the use of heavy trucks, excavators, graders, work vessels, pile drivers, and a range of smaller equipment, such as generators, pumps, and compressors. Emissions from diesel equipment could reduce ambient air quality, resulting in potential health risks. Although construction-related emissions would be minor, pollution control agencies are nonetheless now urging that emissions from diesel equipment be minimized to the extent practicable to reduce potential health risks.

Construction of the proposed project would include some activities that would generate odors. For example, some of the site would be paved with asphalt, and asphalt odors may be perceptible for a short period during such paving. If oil-based paints were applied to structures or equipment at the site, paint odors may be perceptible nearby. These impacts are anticipated to be slight and of short duration and to occur within the area of the activity that is the source of the odor. Construction contractor(s) would be required to comply with SWCAA regulations requiring any source of emissions of odorous substances to use recognized good practice and procedures to reduce such odors to a reasonable minimum to prevent unreasonably interfering with any other property owner's use and enjoyment of his property.

Construction would require the use of a variety of machinery, including tugs, heavy trucks, cranes, excavators, graders, concrete pumps, work vessels, pile drivers, and a range of smaller equipment, such as generators, pumps, and compressors, as wells as from vehicles used by workers to commute to the site that will result in GHG emissions. In addition, GHG emissions would be generated during the creation of material used in project construction, such as steel and concrete. An accurate estimate of construction-related GHG emissions was not completed as detailed information on the construction methods is not currently available. GHG emissions from construction would be minor in comparison to GHG emissions from the operation of the facility.

4.4.1.2 Potential Operational Impacts

Criteria Air Pollutants

The CR Alternative was not evaluated with dispersion modeling because this configuration was not sufficiently engineered to allow such an analysis. To provide a means for reasonably comparing the CR Alternative with the ULE Alternative, total annual emissions of criteria pollutants and GHGs were estimated for both technology alternatives and compared.

As shown in **Table 4-3**, the CR Alternative methanol manufacturing process would result in larger quantities of all criteria pollutant and GHG emissions than the ULE Alternative methanol manufacturing process. As shown in the final row of **Table 4-3**, compared with the CR Alternative, annual emissions from the ULE Alternative methanol manufacturing process would represent large decreases in all criteria pollutants. The inclusion of emissions related to on-site power generation using two combustion turbines as would be necessary with the ULE Alternative ~~projects~~ would increase total emissions related to this alternative, but overall emissions would still be substantially less than with the CR Alternative facility.

While these ~~reductions~~ differences do not allow direct comparisons with the ULE Alternative dispersion modeling results (i.e., ambient concentrations) for the ULE Alternative discussed in the next section (because the sources are different and in some instances in different locations on the project site), this comparison suggests that the CR Alternative would have a greater potential to cause off-site air quality impacts than the ULE Alternative. If the CR Alternative were selected, it would be necessary to proceed with an air quality permitting analysis that includes complete dispersion modeling.

TAPs

TAP emissions under the CR Alternative would be greater than the ULE Alternative. Because the design ~~was~~ is not sufficiently complete, the air quality permitting analysis and the air quality impact analysis were not able to consider dispersion modeling for TAPs associated with the CR Alternative. Such modeling was conducted for the ULE Alternative and is discussed later in this section.

Odor

Based on what is likely to be a very limited potential for emission of odorous substances and the SWCAA requirements restricting offensive odors being received off site, there would be little likelihood of significant adverse odor impacts from the CR Alternative.

Cooling Tower Effects on Ground-Level Fog and Visibility

Results of the plume fogging analysis for the CR Alternative suggest limited patterns of plume fogging to the north-northwest of the cooling towers, extending out to a distance of 500 meters. This projection is consistent with the wind patterns in the area. Areas of the fogging associated with the CR Alternative would not be expected to pose a driving hazard on nearby roadways or freeways. The modeling predicted zero hours of icing due to the plumes.

Table 4-3. Total Annual Emissions from Normal Facility Operations

Emission Unit	Annual Emission Rate (tons per year)					
	NOx	CO	PM	SO_2	VOC[a]	GHG (CO_2e)[b]
Combined Reforming (CR) Alternative						
Reformer Heaters (2)	48	454	107	23	59	~~1,281,764~~ 1,280,000
Boilers (3)	26	86	18	8.8	12	~~280,136~~ 280.000
Cooling Tower	--	--	2.94	--	--	--
Flare	3.7	0.94	0.55	0.159	0.35	~~6,419~~ 6,420
Tank Vent Scrubber	--	0.72	--	--	2.5	6.22
Ship Vent Scrubber	--	--	--	--	10.3	--
Tank Fugitives	--	0.0072	--	--	2.5	0.063
Miscellaneous Component Leaks	--	--	--	--	0.55	12
Emergency Generators	2.7	0.19	0.021	0.0029	0.027	301
Emergency Fire Pumps	0.26	0.08	0.010	0.0005	0.010	50
Total CR Process Emissions	**80**	**541**	**128**	**32**	**87**	**~~1,569,000~~** **1,570,000**
Ultra-Low Emissions (ULE) Alternative						
Firebox Heaters (2)	0.422	0.429	0.0950	0.0926	0.0686	~~1,544~~ 1,540
Boilers (2 + 1 reserve)	23	18	28	0.027	12	~~606,173~~ 605,000
Cooling Tower	--	--	2.71	--	--	--
Flare Pilot	0.10	0.45	0.015	0.0052	0.20	171
Flare	6.3	9.3	0.93	0.00055	17.0	~~3,504~~ 3,500
Tank Vent Scrubber	--	0.72	--	--	2.5	~~6.2~~ 6.22
Ship Vent Scrubber	--	--	--	--	1.2	--
Tank Fugitives	--	0.0072	--	--	2.5	~~0.063~~ 0.0629
Misc Component Leaks	--	--	--	--	0.55	~~12~~ 11.5
Emergency Generators	0.40	0.19	0.018	0.0029	0.095	301
Emergency Fire Pumps	0.26	0.08	0.010	0.0005	0.010	~~50~~ 49.6
Total ULE Process Emissions	30	29	32	0.13	36	~~611,759~~ 611,000

Emission Unit	Annual Emission Rate (tons per year)					
	NOx	CO	PM	SO_2	VOC[a]	GHG (CO_2e)[b]
ULE Process Emissions Compared with CR Alt	-62%	-95%	-75%	-100%	-59%	-61%
On-Site Combustion Turbines (2)	44	43	33	14	18	~~464,569~~ **465,000**
Total ULE Emissions w/ On-Site Power Generation	75	72	64	14	54	~~1,076,329~~ 1,076,000

Source: Ramboll Environ 2016

a. Note that VOC (Volatile Organic Compound) is a general category of air contaminant and not a specific air pollutant, so there is no ambient air quality standard for VOCs. VOCs include a variety of toxic air pollutants (TAPs). All directly emitted facility TAPs were considered and found to be less than the applicable screening level for each pollutant. A complete listing of the "non-criteria" air pollutants that would be emitted by the project facility, including VOCs and TAPs, is included in Appendix D.

b. Note values for GHGs are in short tons and do not match the values in Table 4-4, which are shown in metric tons (tonnes).

The SACTI modeling analysis of the potential frequencies of visible plumes indicated relatively long plumes would be expected during conditions of high relative humidity, cooler air temperatures, and stable atmospheric conditions. Plumes that occur more than 7 percent of the time would be generally restricted to plant property itself. Some visible plumes extending north and south to a distance of 7 kilometers are projected to occur much less often. Most plumes are projected to be less than 1,000 meters high. The largest plumes have a radius of less than 500 meters, with a majority of the plumes, 63 percent or greater, projected to be less than 60 meters in radius. Modeling predicted visible plume lengths for the CR Alternative at 50, 100, 500, and 5,000 meters for 63 percent, 62 percent, 40 percent, and 17 percent of the time, respectively. Additional details are provided in **Appendix D**.

GHG Emissions

GHG emissions are often categorized by source/activity types, as follows:

- Scope 1 emissions include direct stationary combustion of fossil fuels, vehicle fleet emissions, any loss of carbon storage from the permanent conversion of forested lands, and facility emissions, such as methane emissions from new landfills, wastewater treatment plants, or manure management systems.
- Scope 2 emissions are those associated with purchased electricity or steam consumed by the project.
- Scope 3 emissions include heavy-machinery emissions during site preparation, construction, or cleanup activities, new ongoing project-related product transportation emissions within Washington State and its 3-mile nautical boundary, and project-related vehicle trips during construction and operation.

Each category was considered as described further below. In addition, indirect GHG emissions can result and are also discussed below.

Scope 1 – Manufacturing Process Emissions

GHG emissions from the proposed methanol manufacturing facility process sources were tabulated for the two Technology Alternatives and are listed in **Table 4-4**. As shown, the CR Alternative manufacturing process would be projected to result in direct emissions of about

1.4 million metric tons of GHGs annually. The ULE Alternative manufacturing process would emit substantially less GHGs, but because adequate electrical transmission capacity is not available at the site, the ULE Alternative will require on-site power generation. As shown in **Table 4-4**, the ULE Alternative would emit substantially less GHGs even when the on-site power generation emissions are considered.

Table 4-4. Facility Manufacturing Process GHG Emissions Summary

Operational Emissions	Annual CO_2e Emissions (Metric Tons) [a]
Facility Operations Stationary Sources (Scope 1)	
Combined Reforming (CR) Alternative Process Emissions [b]	~~1,423,397~~ 1,420,000
Ultra-Low Emissions (ULE) Alternative Process Emissions [b]	~~554,183~~ 554,000
Scope 1 process emissions reduction with ULE versus CR	~~-61.1%~~ -61.0%
ULE Alternative On-Site Power Generation [c]	~~421,457~~ 421,000
Total ULE Facility-Related Direct GHG Emissions	~~976,445~~ 975,000
Scope 1 total process-related emissions reduction with ULE versus CR	~~-31.4%~~ -31.3%

Source: Ramboll Environ 2016

[a] Note that these values are in metric tons (tonnes), a standard unit of measure for GHGs, so they do not match the values in Table 4-3, which are shown in short tons. Tonnes = short tons * 0.9072

[b] Direct methanol manufacturing process operations emissions based on calculations performed as part of the air quality permitting review for the two technology alternatives.

[c] The lack of electrical power available for purchase requires on-site generation using combustion turbines. But for the lack of power for purchase, this generation would not be required, so these emissions are separate from the manufacturing process emissions.

Scope 2 – Purchased Power Emissions

Both Technology Alternatives project facilities would require the use of electricity to provide power for a portion of manufacturing process. While all such electrical power needed for the CR Alternative facility could be provided by purchased power from the local utility, the ULE Alternative would require both purchased power and on-site generation to provide sufficient electricity. The CR Alternative would require about 50 megawatts of purchased electricity that would result in emissions of about 133,000 tonnes of CO_2e annually; the 100 megawatts of purchased electricity for the ULE Alternative would result in about 266,000 tonnes of CO_2e annually.[5]

Scope 3 – Product Transport Emissions

Transport of the finished methanol product would involve oceangoing vessels and assist tugs that would emit GHGs. These emissions would be the same with either Technology Alternatives. Estimated annual emissions associated with this vessel traffic within Washington State waters (to the edge of the 3-nautical mile territorial sea) are about 3,900 tonnes of CO_2e. ~~Both project construction and project employee trip GHG emissions would be minimal~~

[5] Estimated GHG emissions stemming from purchased electricity are based on EPA eGrid2012 emission rates for the northwest region of the United States.

~~compared with the other categories that were considered.~~ This estimate includes emissions from methanol ships traveling both to and from the proposed facility. Consistent with Ecology's GHG SEPA guidance (Ecology 2011), emissions from vessel traffic beyond Washington boundaries have not been estimated because the destination ports for the methanol are not yet known. However, transportation of methanol beyond Washington's boundaries will result in additional GHG emissions. The Scope 3 emission estimate also includes local emissions from vessels unrelated to the methanol plant that would use the dock as a lay berth, including emissions from maneuvering to and from the dock, tug assist emissions, and hoteling emissions while the ships are docked. Both project construction and project employee trip GHG emissions would be minimal compared with the other categories of sources that were considered.

Indirect Emissions

In addition to the Scopes 1 through 3 GHG emissions described above, the project may result indirectly in additional GHG emissions. The project will be purchasing natural gas produced in North America that must be transported to the project site via pipelines. The existing transmission pipelines in Canada and United States have fugitive losses of methane[6] to the atmosphere and emit CO_2 from the combustion of natural gas to power compressors. It is not possible to determine whether the transport of natural gas to the project will increase these GHG emissions. Adding gas volume to the existing transmission system should not affect fugitive losses of methane because these fugitive emissions are not generally a function of the volume of gas in the system. Compressor station emissions depend on the type of compressor, its maintenance level, and other factors. Some of the highest emissions have been found at compressor stations that were on standby (Subramanian 2015). Fugitive methane emissions from pipelines vary greatly depending on the pipeline material of construction (EPA 2008). If the additional demand from the proposed project required increased operation of transmission line compressors, it would subsequently increase CO_2 emissions from the combustion required to power the compressors. The additional demand from the project, however, may not require increased operation of compressors. Northwest Pipeline's transmission line in Washington is a bidirectional system, so the delivery of natural gas to the project may only change the distance or direction of flow in the system without affecting compressor operation, all of which will depend on market supply and demand for natural gas and where the supply and demand are located.

Development (drilling and completion) of natural gas wells releases GHG to the atmosphere as a result of fuel combustion and as a result of fugitive losses of methane (Allen 2013). The proposed project, however, does not include development of any natural gas wells, and new well development will not necessarily occur as a result of the project (see Chapter 7). Therefore, GHG emissions from well development are not considered an impact from the proposed project.

Once developed, natural gas wells may have fugitive releases of methane to the atmosphere. These fugitive releases, however, are not necessarily dependent on the rate at which natural gas is extracted (Brantley 2014). The rate of fugitive emissions varies greatly between wells, and not all wells have significant fugitive emissions (Allen 2014). Gathering and processing facilities also release fugitive natural gas, but these emissions also vary dramatically from facility to facility and are not necessarily proportionate to throughput (Mitchell 2015). Therefore, additional fugitive emissions of methane from natural gas wells or gathering and

[6] Natural gas consists primarily of methane, which is a GHG.

processing facilities would not be directly attributable to the project and are not considered an impact.

The CR Alternative will require a PSD permit that will impose a BACT limit for GHG. The EPA recently recognized the CR Technology as BACT for GHG for a methanol plant and established emissions limits on that basis for a new methanol plant permitted in Texas (EPA 2013)[7]. Because the CR Alternative will have a BACT limit, it is deemed not to have a significant impact from GHG consistent with Ecology's SEPA guidance for GHG emissions.

4.4.2 Ultra-Low Emissions Alternative

4.4.2.1 Potential Construction Impacts

Probable air quality impacts associated with construction of the ULE Alternative would be the same as those described for the CR Alternative.

4.4.2.2 Potential Operational Impacts

Criteria Air Pollutants

The ULE Alternative emissions were considered with detailed dispersion modeling that combined the ULE Alternative source emissions (i.e., manufacturing processes and on-site power generation) with those from vessel sources (i.e., oceangoing vessels and harbor assist tugs). This modeling considered all the operational scenarios (i.e., start-up and shutdown, normal operations, etc.) along with short-term worst-case and expected long-term vessel operations. Modeling results for typical operational scenarios are shown in **Table 4-5**. As shown, all the model-calculated off-site pollutant concentrations, including existing background concentrations, are well below the levels allowed by the NAAQSs and the Washington State standards. Complete modeling results are presented in **Appendix D**.

TAPs: Ammonia/Methanol/DEEP

All TAPs were considered in the air quality permitting analysis, and the proposed project sources were found to comply with all emission standards and to cause off-site concentrations less than the respective screening level thresholds (Ramboll Environ 2016). [8] A subset of all the TAPs evaluated in the permitting analysis are shown in **Table 4-6**, and a complete listing of the TAPs considered is provided in **Appendix D**. As noted in the table, the air toxics assessment summarized in **Table 4-6** considered diesel engine exhaust particulate matter (DEEP) based only on the filterable portion of the emissions from stationary sources as is the mandated approach in permitting analyses.

[7] In its Statement of Basis for the permit, EPA concluded that "The combined reformer has the lowest environmental impact in respect to GHG emissions of the reforming technologies evaluated." On that basis, EPA concluded that use of CR technology at the Clear Lake Plant constitutes BACT for GHG.

[8] The TAPs review process included comparing estimates of Facility emissions with the Small Quantity Emission Rates (SQERs) provided in the version of WAC 173-460 that was in effect in 1998 – because this version of the rule is still being used by SWCAA. Any TAPs that were found to exceed the respective SQERs were considered with dispersion modeling, and the modeling resulted were compared with the respective Acceptable Source Impact Levels (ASILs). All TAPs from the methanol plant were found to be less than their SQERs or less than their ASILs. A complete listing of all TAPs that will be emitted by the proposed project is included in ~~**Appendix D**~~ the air permit application.

TAPs: DPM

This air quality impact assessment ~~for the EIS also~~ considers diesel particulate matter (DPM) emissions from both on-site and mobile sources (i.e., vessels) associated with the project. This analysis indicates the ULE Alternative of the proposed project could result in DPM concentrations exceeding the Washington State ASIL. The ASIL is not intended to be applied to emissions from mobile sources or unoccupied areas like the river, but to provide a benchmark for considering this pollutant, the air quality review conservatively considered the ASIL along with mobile source emissions in estimating annual average DPM concentrations. The results of this assessment are depicted in **Figure 4-2**. As shown, the areas in which DPM concentrations exceed the ASIL are limited primarily to within the river. Note that although the DEEP (DPM) ASIL is used as a screening threshold in air quality permitting processes for considering whether additional analyses are necessary, the ASIL does **not** represent an actual indication of a health risk. Instead, it is only one factor that would be considered in a more comprehensive analysis to estimate actual likely exposure over a lifetime, and concentrations compared with the ASIL should **not** be construed to indicate risk, particularly for areas that are not continuously occupied, such as the Columbia River.

Table 4-5. ULE Alternative Modeling Results: Maximum Criteria Pollutant Concentrations

Operational Scenario	Pollutant	Period	Ambient Concentrations (µg/m^3)				% of NAAQS
			Project	Background	Total	NAAQS	
Normal Operations	CO	1-hr	~~142~~ 128	1,018	~~1,160~~ 1,145	40,000	3%
	CO	8-hr	~~43~~ 44	718	~~761~~ 762	10,000	8%
	NO_2	1-hr	~~62~~ 73	62	~~124~~ 135	188	~~66%~~ 72%
	PM_{10}	24-hr	11	27	38	150	~~26%~~ 25%
	$PM_{2.5}$	24-hr	~~5~~ 4	18	~~23~~ 22	35	~~64%~~ 63%
	SO_2	1-hr	17	21	39	196	20%
	NO_2	Annual	1	10	11	100	11%
	$PM_{2.5}$	Annual	1	6	7	12	~~59%~~ 57%
Ops w/Start-up and Shutdown	NO_2	Annual	1	10	11	100	11%
	$PM_{2.5}$	Annual	1	6	7	12	~~56%~~ 55%

Source: Ramboll Environ 2016

Table 4-6. ULE Alternative TAPs AERMOD Results – Stationary and Mobile Sources

Operational Scenario	TAP	Period	Ambient Concentrations (µg/m^3)	
			Facility Sources	Guideline
Normal Operations	NH_3	24-hr	~~20~~ 29	70.8
	Methanol	24-hr	~~21~~ 14	4,000
	DPM	Annual	~~0.01739~~ 0.01755	0.00333
Start-up Line 1	NH_3	24-hr	~~20~~	70.8

Operational Scenario	TAP	Period	Ambient Concentrations (µg/m^3)	
			Facility Sources	Guideline
			29	
	Methanol	24-hr	~~21~~ 14	4,000
Shutdown Line 1	NH_3	24-hr	~~20~~ 29	70.8
	Methanol	24-hr	~~21~~ 14	4,000
Start-up Line 2	NH_3	24-hr	~~20~~ 29	70.8
	Methanol	24-hr	~~21~~ 14	4,000
Shutdown Line 2	NH_3	24-hr	~~20~~ 29	70.8
	Methanol	24-hr	~~21~~ 14	4,000
Annual w/SUSD	DPM	Annual	~~0.01739~~ 0.01755	0.00333
Normal - EGen1 test	NH_3	24-hr	~~20~~ 29	70.8
	Methanol	24-hr	~~21~~ 14	4,000
Normal - EGen2 test	NH_3	24-hr	~~20~~ 29	70.8
	Methanol	24-hr	~~21~~ 14	4,000
Normal - FP test	NH_3	24-hr	~~20~~ 29	70.8
	Methanol	24-hr	~~21~~ 14	4,000
Upset	NH_3	24-hr	~~20~~ 29	70.8
	Methanol	24-hr	~~21~~ 14	4,000
Emergency	NH_3	24-hr	~~20~~ 29	70.8
	Methanol	24-hr	~~21~~ 14	4,000
ComTurb SU/SD	NH_3	24-hr	~~20~~ 29	70.8
	Methanol	24-hr	~~21~~ 14	4,000
Duct Firing	NH_3	24-hr	~~20~~ 29	70.8

Operational Scenario	TAP	Period	Ambient Concentrations (µg/m^3)	
			Facility Sources	Guideline
	Methanol	24-hr	~~21~~ 14	4,000
	DPM	Annual	~~0.01739~~ 0.01755	0.00333
Reserve Boiler SU	NH_3	24-hr	~~20~~ 29	70.8
	Methanol	24-hr	~~21~~ 14	4,000

Source: Ramboll Environ 2016

Note that the ASIL for ammonia (NH_3) presented in this table is based on the latest version of the ASIL adopted by Ecology. Because SWCAA has not yet updated its regulations to adopt the latest version of the Ecology ASIL, and because the SWCAA rules govern in the permitting review of this proposed facility, the NH_3 ASIL presented here (Ecology's) is not the same as the SWCAA ASIL presented in the air quality permit application (Ramboll Environ 2016).

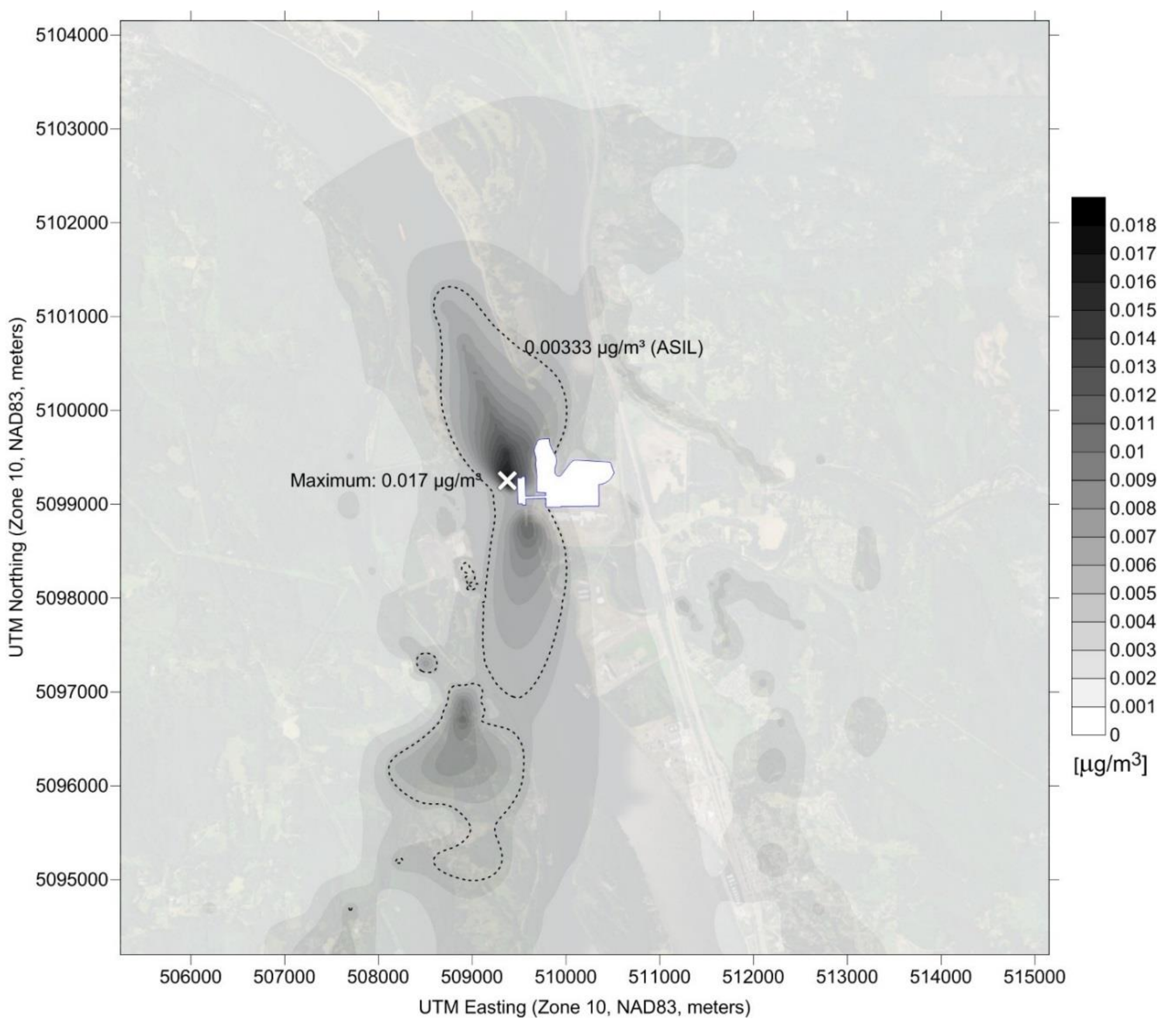


Figure 4-2. Estimated Annual Average Off-Site DPM Concentrations with the ULE Alternative

To consider the issue of project-related off-site DPM concentrations further, an additional analysis was conducted in accordance with Ecology's 2nd Tier TAPs review procedures that may be applied during permitting assessments when direct facility emissions result in predicted concentrations exceeding the ASILs.[9] For this analysis, the procedures intended for application only to direct facility emissions were adapted to consider potential increased cancer risk associated with total (i.e., direct plus mobile source) DPM emissions from the proposed project. ~~Background DPM concentrations were not considered because no data are available.~~

During permitting reviews of stationary emissions sources, if model-estimated TAP concentrations exceed an ASIL, Ecology allows a 2nd Tier analysis to more specifically consider the potential for increased cancer risk. For residential receptor locations, a 2nd Tier analysis under Ecology policy applies a criterion level of 10 times the ASIL.[10] This equates to an estimated increased cancer risk of one incidence in a population of 100,000 people – assuming continuous exposure over 70 years. This sort of assessment is intended to consider only the increased cancer risk associated with increased direct emissions from a proposed facility.

As shown in **Figure 4-2** (above), the highest model-predicted DPM annual average concentration even very near the facility was 0.017$\mu g/m^3$. Because this concentration occurs in the river, it would not result in long-term exposure to any people. In addition, because this value is less than 10 times the ASIL (i.e., < 0.033 $\mu g/m^3$), project-related DPM concentrations at all the nearest homes would all be less than allowed by the 2nd Tier criterion.

The additional modeling focused on four nearby residential areas. This modeling determined that DPM concentrations at all these nearby residences would be far less than the Ecology 2nd Tier DPM criterion. The highest model-predicted concentration occurs at a location southwest of the facility across the river, where the estimated increase in cancer risk is about three in a population of 1 million exposed continuously for 70 years, which is well below the 2nd Tier criterion. Additional details of the Tier 2 impact assessment for DPM are included in **Appendix D**.

Another approach to assessing the impact of the proposed project is to compare the DPM concentrations attributable to the project with existing DPM concentrations. As discussed in section 4.3.2.5, EPA's National Air Toxics Assessment estimates the existing DPM concentration in the Kalama site census tract at 0.61 $\mu g/m^3$ (EPA 2011). **Table 4-6** indicates the maximum predicted concentration at a residence attributable to the project is approximately 0.01 $\mu g/m^3$, or about 1.6 percent of the existing concentration. **Figure 4-2** indicates DPM concentrations decrease rapidly from the maximum impact location in the Columbia River, so project contributions to DPM concentrations are substantially less almost everywhere else near the site. DPM impacts attributable to the proposed project can be expected to decrease over time as EPA and international regulations continue to reduce ship emissions.

Cooling Tower Effects on Ground-Level Fog and Visibility

Model-projected micro meteorological effects from cooling tower plumes are even less with the ULE Alternative than with the CR Alternative. As with the CR Alternative, the analysis indicated ULE Alternative plumes also would not be expected to pose a driving hazard on nearby roadways or freeways due to fogging or local icing. In addition, the frequency of visible

[9] WAC 173-460-090

[10] Ibid.

plumes would be lower with the ULE Alternative. Refer to **Appendix D** for additional information including graphic depictions of the limited extents of potential cooling tower plume effects.

Odor

The potential for odor impacts and the applicable required control measures with the ULE Alternative would be the same as those described for the CR Alternative. Thus, no significant odor impacts would be anticipated.

GHG Emissions

GHG emissions from the alternative Facility sources, product transport, and indirect emission sources were tabulated for the two project alternatives and are provided in **Table 4-4** (above). As shown, expected GHG emissions associated with the ULE Alternative methanol manufacturing process (excluding on-site power generation) are about 61 percent lower than with the CR Alternative. And even with on-site generation of electricity, the direct (Scope 1) GHG emissions with the ULE Alternative are projected to be about 31.5 percent less than with the CR Alternative. The Scope 2 emissions from purchased power would result in approximately 266,000 tonnes of CO_2e annually. The Scope 3 emissions from ocean transport of methanol would be the same as described above for the CR Alternative—approximately 3,900 tonnes of CO_2e. In addition to the Scopes 1 through 3 GHG emissions described above, the ULE Alternative will result indirectly in the additional GHG emissions just like the CR Alternative as presented above in section 4.4.1.2, except that the impacts would be somewhat less because the ULE Alternative requires less natural gas.

The project originally proposed utilization of the CR Alternative previously discussed. Subsequently the NWIW identified and evaluated the ULE Alternative in order to reduce air emissions. The ULE technology itself would be a mitigation measure (if the ULE Alternative is selected). Under Ecology's SEPA guidance for GHG emissions, the ULE Alternative will not be considered to have a significant impact for GHG emissions because the ULE technology will reduce GHG emissions by more than 11 percent from the CR Alternative. In addition, NWIW has proposed a voluntary GHG emissions limit in its air discharge permit with SWCAA (Godley 2016). This limit would require that the ULE technology result in the GHG emissions no greater than those reflected in **Table 4-3** (above). Therefore, the ULE Alternative would be consistent with Ecology's criteria for a presumption of no significant impact for GHG because it will be "[s]ubject to a legal requirement to reduce or mitigate GHG emissions," as well as a reduction in emissions of at least 11 percent (Ecology 2011).

4.4.3 Marine Terminal Design Alternatives

As mentioned previously, in the absence of methanol transport tanker vessels hoteling and using fossil fuel-fired engines or auxiliary generators while at the proposed marine terminal (i.e., because the project would provide shore power to obviate this need), the vast majority of vessel emissions would occur while transiting to and from the dock and not at the dock. There are expected to be about 12 general cargo vessels hoteling at the dock per year. Such hoteling was considered in the worst-case modeling for the most restrictive 1-hour averaging period described previously. Because the location of the new dock would be about the same with either of the Marine Terminal Alternatives and they would receive the same type and frequency of vessel traffic, the air quality impacts of these alternatives would be the same. These potential impacts are accounted for in the dispersion modeling and presented in the discussions above as part of the overall proposed project air pollutant concentrations.

4.4.4 No-Action Alternative

Under the No-Action Alternative, the proposed project would not be constructed on the project site.

Given the project site's highway, rail, and waterfront access and the Port's Comprehensive Scheme for Harbor Improvements, it is expected that, absent the proposed project, the Port would pursue other industrial or marine terminal development of the site. If the project site were developed for water-dependent, industrial uses, it is likely that any construction-related air quality impacts would be similar to those assessed for the proposed project. No significant unavoidable adverse air quality impacts were identified for construction of the proposed project.

The No-Action Alternative could result in operational air quality impacts greater than or less than those of the proposed project, depending on the type of development ultimately pursued. For example, previous design concepts for such uses included a railroad loop for materials and product transport. A facility design that included rail uses would have locomotive emissions in addition to other project-related emissions.

4.4.5 Related Actions

4.4.5.1 Proposed Pipeline

Northwest Pipeline GP is proposing to permit, construct, and operate a 3.1-mile, 24-inch-diameter natural gas pipeline to provide a natural gas supply to the proposed project. The proposed pipeline is undergoing a separate permitting process under the jurisdiction of the Federal Energy Regulatory Commission. Potential impacts are summarized below.

Construction of the proposed pipeline-related action would involve excavation and drilling activities at a much smaller scale of disturbance than with the proposed project. Such activities could result in temporary, localized increases in particulate concentrations due to emissions from construction-related sources, though on a much smaller scale.

There are no permanent sources of operational emissions proposed for the pipeline with the exception of minor fugitive methane emissions. Fugitive emissions may result in small amounts of pollutants, while maintenance activity of the permanent right-of-way may result in small amounts of pollutants as well from mowing, cutting, and trimming. Any emissions from the operation of the proposed pipelines would not result in impacts to local or regional air quality, including fugitive methane emissions.

4.4.5.2 Electrical Service

The electrical service-related action would result in limited construction activities and would not introduce new permanent sources of air emissions. Therefore, it would not have the potential to result in significant adverse air quality impacts.

4.5 Mitigation Measures

4.5.1 Construction

Air quality impacts are not anticipated due to construction of the proposed project. Construction activities would comply with applicable federal and state air quality rules requiring minimization of construction-related emissions. No additional mitigation measures are ~~warranted or~~ proposed.

4.5.2 Operation

4.5.2.1 ULE Alternative

As discussed in section 4.3.2.7, Ecology's SEPA guidance for GHG (Ecology 2011) provides that, if certain criteria are met, a project's GHG impacts are "presumed to be not significant for GHG emissions and thus no further mitigation for GHG emissions will be necessary." Relevant to this project, a proposed project's GHG impacts are not significant if the project ~~is required to employ BACT or the project~~ will incorporate mitigation measures to reduce its emissions by approximately 11 percent below what they would be without mitigation. ~~Both the CR Alternative and the ULE Alternative would be subject to Ecology's existing PSD rule for GHG, which would require them to employ BACT.~~ The ULE technology would result in substantial reductions of GHGs compared to any other methanol manufacturing technology. ~~and is expected to constitute BACT Because both alternatives would be required to employ BACT for GHGs, their GHG impacts would not be considered significant in accordance with Ecology's SEPA guidance for GHG.In addition, b~~

Because the ULE Alternative was investigated and selected for the purpose of reducing air emissions that the CR Alternative would otherwise produce, the ULE technology itself is a mitigation measure. Assuming that the ULE Alternative is selected, this project would be the first full-scale methanol facility in the world to employ ULE technology. All other methanol plants currently proposed or recently permitted for construction in the United States are based on the CR technology or another traditional technology with GHG emissions similar to the CR technology.

Scope 1 direct emissions of GHGs (**Table 4-4**) would be 31.4 percent lower with the ULE Alternative than those with the CR Alternative. This GHG reduction exceeds the 11 percent goal recommended in Ecology guidance for mitigating project-related GHG emissions and meets Ecology's guidelines supporting the presumption that the project's impacts will not be significant for GHG emission (Ecology 2011). NWIW also has proposed to the SWCAA that the air discharge permit include a voluntary permit limit that will ensure its GHG emissions will not exceed the facility-wide emissions discussed above. Therefore, it also will satisfy that criteria in Ecology's guidance to support a presumption of no significant impact based on a GHG emissions limit.

The emission controls required as part of the stationary source air quality permitting would ensure compliance with applicable air quality regulations and minimize the potential for significant adverse air quality impacts related to operation of the proposed project. Because no significant impacts have been identified, no additional mitigation measures are ~~warranted or~~ proposed for the ULE Alternative.

4.5.2.2 CR Alternative

The CR Alternative will emit more GHG than the ULE Alternative and does not include GHG mitigation. However, the CR Alternative will be required to obtain a PSD permit and employ BACT (EPA recently determined that the CR technology actually constitutes BACT for a methanol plant in Texas). Therefore, under Ecology's SEPA guidance for GHG, the CR Alternative will be presumed to not have a significant impact for GHG.

4.6 Unavoidable Significant Adverse Impacts

The proposed project, with either Technology Alternative and either Marine Terminal Alternative, would not result in unavoidable significant adverse impacts related to air quality or GHG emissions.

4.7 References

Allen, D., et al. 2013. Measurements of methane emissions at natural gas production sites in the United States, 110 Proceedings of the National Academy of Sciences of the United States 44, 17768-73 (March 20, 2013). http://www.pnas.org/content/110/44/17768.

Brantley, H., et al. 2014. Assessment of Methane Emissions from Oil and Gas Production Pads using Mobile Measurements, 2014 Environmental Science and Technology 48, 14508-15 (2014) http://pubs.acs.org/doi/pdf/10.1021/es503070q.

Godley, M.V. 2016. Letter from Murray V. Godley III, President of NW Innovation Works to Paul Mairose, Chief Engineer at Southwest Clean Air Agency regarding Voluntary Greenhouse Gas Emissions Limit for the Kalama Manufacturing and Marine Export Facility. September 13, 2016.

Mitchell, A. 2015. Measurements of Methane Emissions from Natural Gas Gathering Facilities and Processing Plants: Measurement Results, 2015 Environmental Science and Technology 49, 3219-27 (2015) http://pubs.acs.org/doi/pdf/10.1021/es5052809.

Ramboll Environ. 2016. Prevention of Significant Deterioration and Air Discharge Permit Application: Kalama Manufacturing and Marine Export Facility. Ramboll Environ US Corporation. February 2016.

Subramanian, R., Laurie L. Williams, Timothy L. Vaughn, Daniel Zimmerle, Joseph R. Roscioli, Scott C. Herndon, Tara I. Yacovitch, Cody Floerchinger, Daniel S. Tkacik, Austin L. Mitchell, Melissa R. Sullivan, Timothy R. Dallmann, and Allen L. Robinson. 2015. Methane Emissions from Natural Gas Compressor Stations in the Transmission and Storage Sector: Measurements and Comparisons with the EPA Greenhouse Gas Reporting Protocol. Environmental Science and Technology 49, 3252-61 (2015), http://pubs.acs.org/doi/pdf/10.1021/es5060258.

U.S. Environmental Protection Agency (EPA). 2015. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2013. U.S. Environmental Protection Agency. EPA 430-R-15-004. April 15, 2015.

U.S. Environmental Protection Agency (EPA). 2013 Prevention of Significant Deterioration Permit for Greenhouse Gas Emissions, Celanese Clear Lake Plant, Pasadena, TX (EPA Region 6; December 12, 2013).

U.S. Environmental Protection Agency (EPA). 2011 National-scale Air Toxics Assessments Modeled Ambient Concentrations, Exposures and Risks Washington State Summary Files. Accessed July 25, 2016 https://www.epa.gov/national-air-toxics-assessment/2011-nata-assessment-results.

U.S. Environmental Protection Agency (EPA). 2008 Natural Gas STAR: Methane Emission Reduction Opportunities for Local Distribution Companies. 2008.

U.S. Environmental Protection Agency (EPA). 2002. *Health Assessment Document for Diesel Engine Exhaust*. National Center for Environmental Assessment, Office of Research and Development, U.S. Environmental Protection Agency, Washington, DC. EPA/600/8-90/057F. May 2002.

Washington State Department of Ecology (Ecology). 2014. Interim *GHG Emissions Inventory*, accessible at: http://www.ecy.wa.gov/climatechange/ghg_inventory.htm.

Washington State Department of Ecology (Ecology). 2011. Guidance for Ecology Including Greenhouse Gas Emissions in SEPA Reviews. 6/3/11. http://www.ecy.wa.gov/climatechange/docs/sepa/20110603_SEPA_GHGinternalguidance.pdf.