MILLENNIUM BULK TERMINALS—LONGVIEW
NEPA ENVIRONMENTAL IMPACT STATEMENT

NEPA GREENHOUSE GAS EMISSIONS TECHNICAL REPORT

PREPARED FOR:

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Acronyms and Abbreviations

°F	degrees Fahrenheit
Applicant	Millennium Bulk Terminals—Longview
BNSF	BNSF Railway Company
CARB	California Air Resources Board
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
Corps	U.S. Army Corps of Engineers
eGRID	Emissions & Generaion Resource Integrated Database
EPA	U.S. Environmental Protection Agency
FR	*Federal Register*
GHG	greenhouse gas
GWP	global warming potential
HFC	hydrofluorocarbon
hp	horsepower
IPCC	International Panel on Climate Change
$kgCO_2e$	kilograms of carbon dioxide equivalent
kWh	kilowatt hours
LVSW	Longview Switching Company
MMBtu	million British thermal units
$MMTCO_2e$	million metric tons of carbon dioxide equivalent
$MtCO_2e$	metric tons of carbon dioxide equivalent
MWh	megawatt hours
NEPA	National Environmental Policy Act
PUD	Public Utilities District
RCW	Revised Code of Washington
Reynolds facility	Reynolds Metals Company facility
UP	Union Pacific
USC	United States Code

Chapter 1
Introduction

This technical report assesses the potential greenhouse gas (GHG) emissions impacts of the proposed Millennium Bulk Terminals—Longview project (On-Site Alternative), Off-Site Alternative, and No-Action Alternative. For the purposes of this assessment, greenhouse gas emissions include the emissions from construction and operation of the On-Site Alternative or Off-Site Alternative, including the transport of the coal to and from the proposed export terminal. This report describes the regulatory setting, presents the effect of greenhouse gases, establishes the method for assessing potential greenhouse gas emissions impacts, and assesses potential impacts.

1.1 Project Description

Millennium Bulk Terminals—Longview, LLC (Applicant) proposes to construct and operate an export terminal in Cowlitz County, Washington, along the Columbia River (Figure 1). The export terminal would receive coal from the Powder River Basin in Montana and Wyoming and the Uinta Basin in Utah and Colorado via rail shipment, then load and transport the coal by ocean-going ships via the Columbia River and Pacific Ocean to overseas markets in Asia. The export terminal would be capable of receiving, stockpiling, blending, and loading coal by conveyor onto ships for export. Construction of the export terminal would begin in 2018. For the purpose of this analysis, it is assumed the export terminal would operate at full capacity by 2028. The following subsections present a summary of the On-Site Alternative, Off-Site Alternative, and No-Action Alternative.

1.1.1 On-Site Alternative

Under the On-Site Alternative, the Applicant would develop an export terminal on 190 acres (project area). The project area is located within an existing 540-acre area currently leased by the Applicant at the former Reynolds Metals Company facility (Reynolds facility), and land currently owned by Bonneville Power Administration. The project area is adjacent to the Columbia River in unincorporated Cowlitz County, Washington near Longview city limits (Figure 2).

The Applicant currently and separately operates at the Reynolds facility, and would continue to separately operate a bulk product terminal on land leased by the Applicant. Industrial Way (State Route 432) provides vehicular access to the Applicant's leased land. The Reynolds Lead and the BNSF Spur rail lines, both operated by Longview Switching Company (LVSW),[1] provide rail access to the Applicant's leased area from the BNSF Railway Company (BNSF) main line (Longview Junction) located to the east in Kelso, Washington. Ships access the Applicant's leased area including the bulk product terminal via the Columbia River and berth at an existing dock (Dock 1) operated by the Applicant in the Columbia River.

[1] LVSW is jointly owned by BNSF Railway Company (BNSF) and Union Pacific Railroad (UP).

Figure 1. Project Vicinity

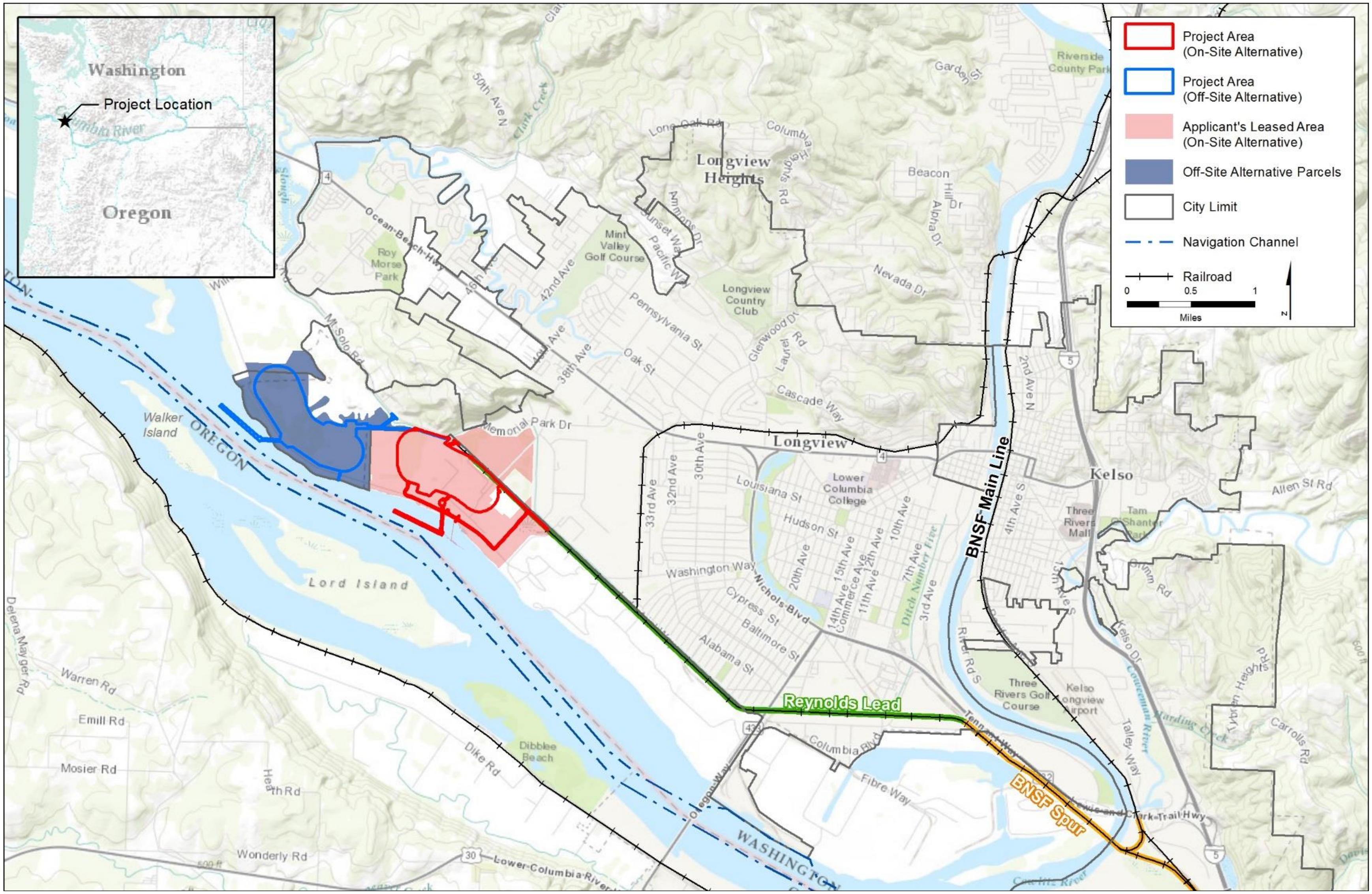
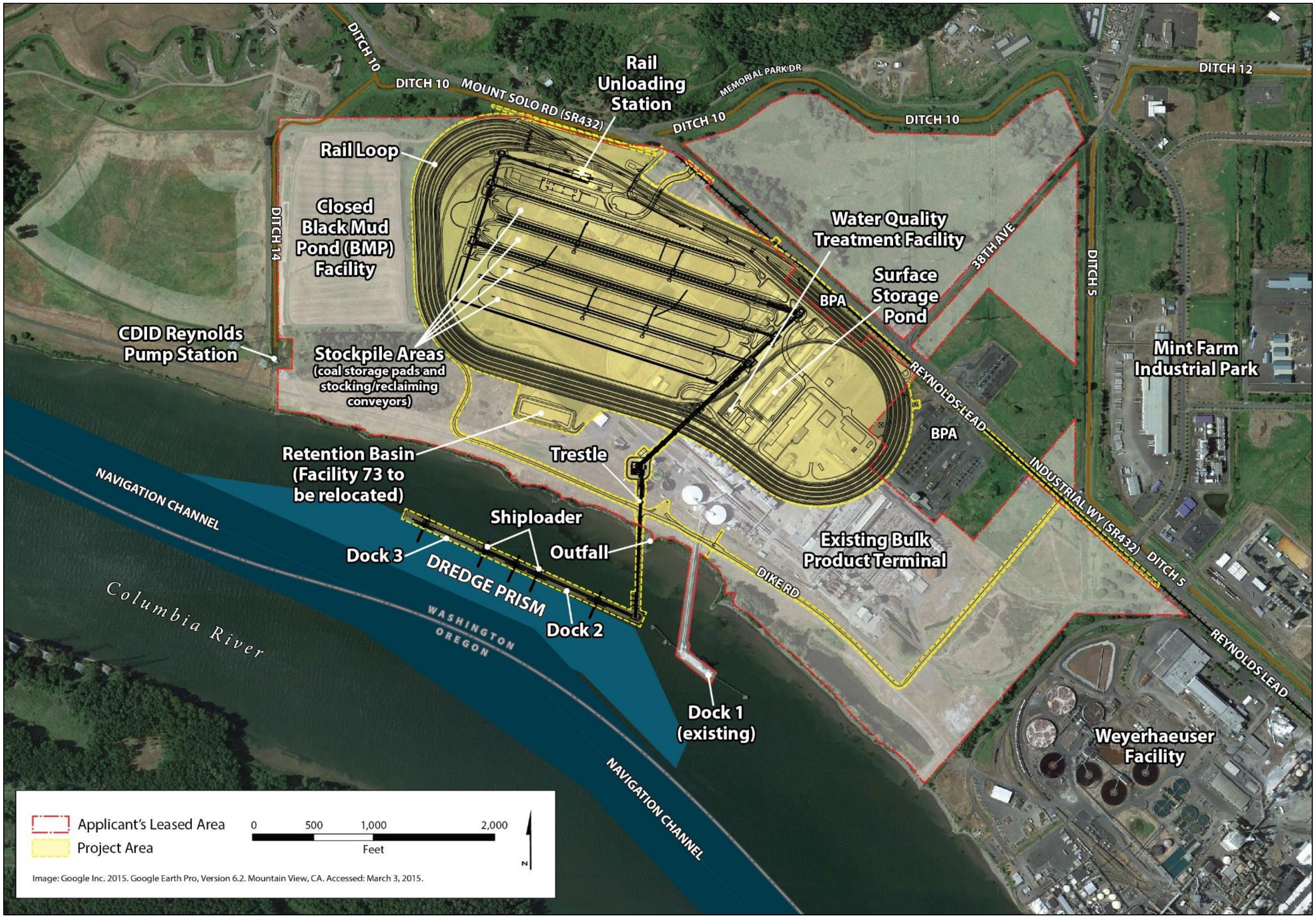


Figure 2. On-Site Alternative



Under the On-Site Alternative, BNSF or Union Pacific Railroad (UP) trains would transport coal in rail cars from the BNSF main line at Longview Junction to the project area via the BNSF Spur and Reynolds Lead. Coal would be unloaded from rail cars, stockpiled and blended, and loaded by conveyor onto ocean-going ships at two new docks (Docks 2 and 3) on the Columbia River for export to Asia.

Once construction is complete, the export terminal would have an annual throughput capacity of up to 44 million metric tons of coal.[2] The export terminal would consist of one operating rail track, eight rail tracks for the storage of rail cars, rail car unloading facilities, stockpile areas for coal storage, conveyor and reclaiming facilities, two new docks in the Columbia River (Docks 2 and 3), and ship-loading facilities on the two docks. Dredging of the Columbia River would be required to provide access to and from the Columbia River navigation channel and for berthing at the two new docks.

Vehicles would access the project area from Industrial Way (State Route 432). Ships would access the project area via the Columbia River and berth at one of the two new docks. Trains would access the export terminal via the BNSF Spur and the Reynolds Lead. Terminal operations would occur 24 hours per day, 7 days per week. The export terminal would be designed for a minimum 30-year period of operation.

1.1.2 Off-Site Alternative

Under the Off-Site Alternative, the export terminal would be developed on an approximately 220-acre site adjacent to the Columbia River, located in both Longview, Washington, and unincorporated Cowlitz County, Washington, in an area commonly referred to as Barlow Point (Figure 3). The project area for the Off-Site Alternative is west and downstream of the project area for the On-Site Alternative. Most of the project area for the Off-Site Alternative is located within Longview city limits and owned by the Port of Longview. The remainder of the project area is within unincorporated Cowlitz County and privately owned.

Under the Off-Site Alternative, BNSF or UP trains would transport coal from the BNSF main line at Longview Junction over the BNSF Spur and the Reynolds Lead, which would be extended approximately 2,500 feet to the west. Coal would be unloaded from rail cars, stockpiled and blended, and loaded by conveyor onto ocean-going ships at two new docks (Docks A and B) on the Columbia River. The Off-Site Alternative would serve the same purpose as the On-Site Alternative.

Once construction is complete, the Off-Site Alternative would have an annual throughput capacity of up to 44 million metric tons of coal. The export terminal would consist of the same elements as the On-Site Alternative: one operating rail track, eight rail tracks for the storage of rail cars, rail car unloading facilities, stockpile areas for coal storage, conveyor and reclaiming facilities, two new docks in the Columbia River (Docks A and B), and ship-loading facilities on the two docks. Dredging of the Columbia River would be required to provide access to and from the Columbia River navigation channel and for berthing at the two new docks.

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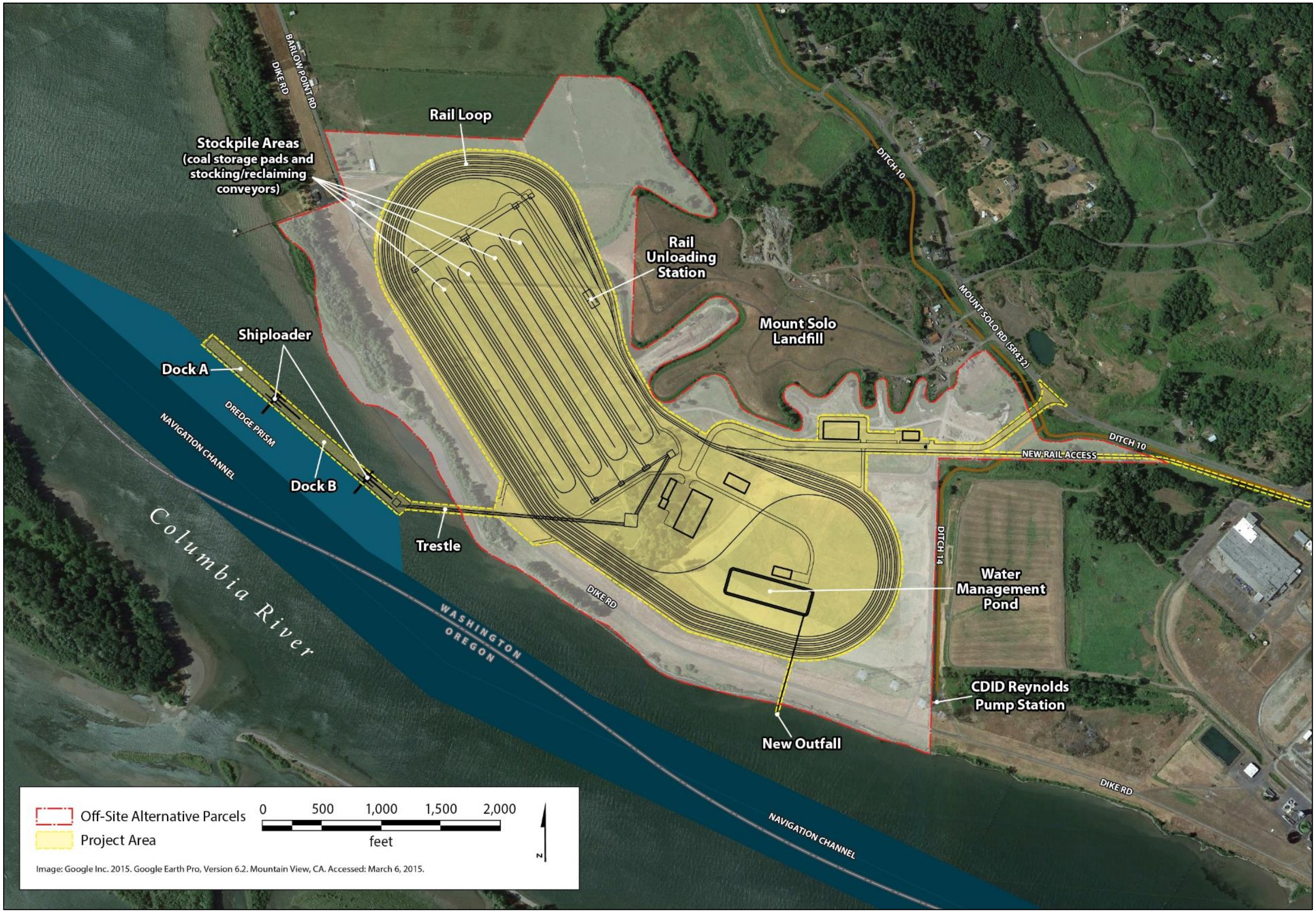
[2] A metric ton is the U.S. equivalent to a tonne per the International System of Units, or 1,000 kilograms or approximately 2,204.6 pounds.

Figure 3. Off-Site Alternative



Vehicles would access the project area via a new access road extending from Mount Solo Road (State Route 432) to the project area. Trains would access the terminal via the BNSF Spur and the extended Reynolds Lead. Ships would access the project area via the Columbia River and berth at one of the two new docks. Terminal operations would occur 24 hours per day, 7 days per week. The export terminal would be designed for a minimum 30-year period of operation.

1.1.3 No-Action Alternative

Under the No-Action Alternative, the U.S. Army Corps of Engineers would not issue the requested Department of the Army permit under the Clean Water Act Section 404 and the Rivers and Harbors Act Section 10. This permit is necessary to allow the Applicant to construct and operate the proposed export terminal.

The Applicant plans to continue operating its existing bulk product terminal located adjacent to the On-Site Alternative project area, as well as expand this business whether or not a Department of the Army permit is issued. Ongoing operations would include storing and transporting alumina and small quantities of coal, and continued use of Dock 1. Maintenance of the existing bulk product terminal would continue, including maintenance dredging at the existing dock every 2 to 3 years. Under the terms of an existing lease, expanded operations could include increased storage and upland transfer of bulk products utilizing new and existing buildings. The Applicant would likely undertake demolition, construction, and other related activities to develop expanded bulk product terminal facilities.

In addition to the current and planned activities, if the requested permit is not issued, the Applicant would intend to expand its bulk product terminal business onto areas that would have been subject to construction and operation of the proposed export terminal. In 2014, the Applicant described a future expansion scenario under No-Action Alternative that would involve handling bulk materials already permitted for off-loading at Dock 1. Additional bulk product transfer activities could involve products such as a calcine pet coke, coal tar pitch, cement, fly ash, and sand or gravel. While future expansion of the Applicant's bulk product terminal business might not be limited to this scenario, it was analyzed to help provide context to a No-Action Alternative evaluation and because it is a reasonably foreseeable consequence of a Department of the Army denial.

1.2 Regulatory Setting

The federal regulations, statutes, and guidance for determining potential impacts on greenhouse gas emissions are summarized in Table 1.

Table 1. Federal Regulations, Statutes, and Guidance for Greenhouse Gases

Regulation, Statute, Guideline	Description
National Environmental Policy Act (42 USC 4321 et seq.)	Requires the consideration of potential environmental effects. NEPA implementation procedures are set forth in CEQ's Regulations for Implementing NEPA (49 CFR 1105).
U.S. Army Corps of Engineers NEPA Environmental Regulations (33 CFR 230)	Provides guidance for implementing the procedural provisions of NEPA for the Corps. It supplements CEQ regulations 40 CFR 1500–1508.

Regulation, Statute, Guideline	Description
Clean Air Act of 1963 (42 USC 7401)	In 2007, the U.S. Supreme Court ruled GHGs are air pollutants under the Clean Air Act. *Massachusetts et al. v. Environmental Protection Agency*, 549 U.S. 497 (2007).[a]
Greenhouse Gas Reporting Program (40 CFR 98)	Owners and operators of certain facilities that directly emit GHG as well as for certain suppliers are subject to mandatory GHG reporting requirements. For suppliers, the GHGs reported are the quantity that would be emitted from combustion or use of the products supplied. In general, facilities emitting 25,000 metric tons or more of GHGs from certain sectors are subject to annual reporting.
The President's Climate Action Plan (2013)	Sets forth plan for cutting carbon pollution, preparing for the impacts of climate change, and leading international efforts to address climate change (Executive Office of the President 2013).
United States Intended Nationally Determined Contribution Submittal to the United Nations Framework Convention on Climate Change	The United States and other nations submitted Intended Nationally Determined Contribution to the United Nations in 2015. The United States intends to achieve an economy-wide target of reducing its greenhouse gas emissions by 26 to 28% below its 2005 level in 2025 and to make best efforts to reduce its emissions by 28% (United Nations Framework Convention on Climate Change n.d.).

Notes:

[a] In 2009, EPA proposed the Endangerment Finding and the Cause or Contribute Findings for Greenhouse Gases under Section 202(a) of the Clean Air Act. The Endangerment Findings determined that the current and projected concentrations for carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorinated chemicals, and sulfur hexafluoride posed a threat to the health and welfare of current and future generations (U.S. Environmental Protection Agency 2009). This sets the legal foundation for regulating GHG emissions from sources of these six well-known GHGs, such as vehicles, industrial facilities, and power plants.

USC = United States Code; NEPA = National Environmental Policy Act; CFR = Code of Federal Regulations; CEQ = Council on Environmental Quality; FR = Federal Register; GHG = greenhouse gas.

1.3 The Effect of Greenhouse Gases

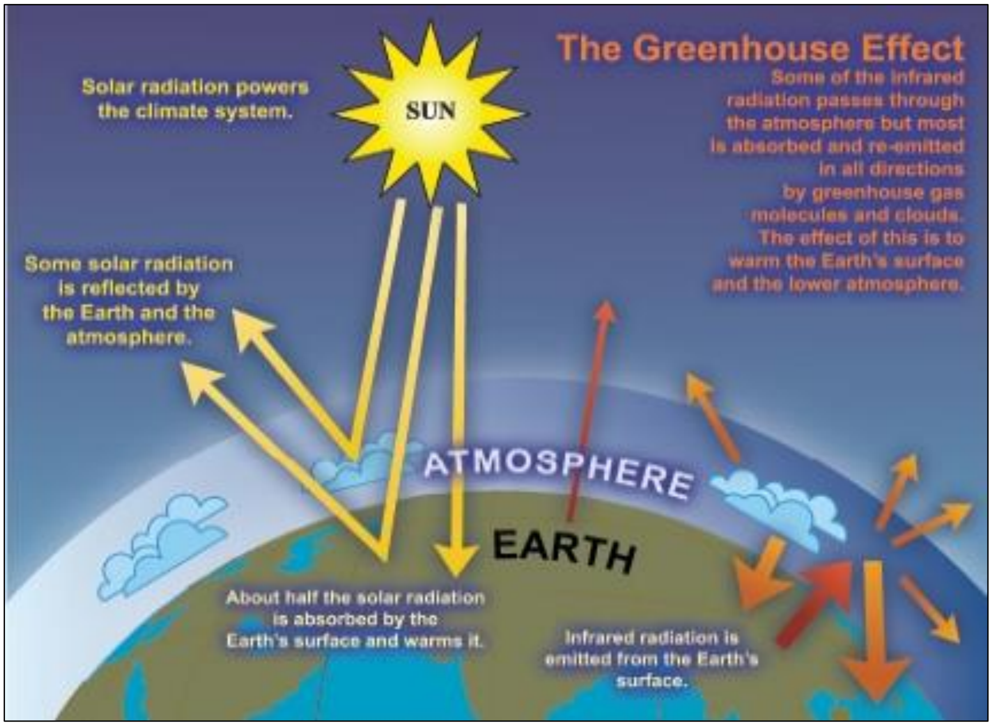
The Earth retains outgoing thermal energy and incoming solar energy in the atmosphere, thus maintaining heat temperature levels suitable for biological life. This retention of energy by the atmosphere is known as the greenhouse effect.[3] When solar radiation reaches the Earth, most of the solar radiation is absorbed by the Earth's surface, reflected by the Earth's surface and atmosphere, or—to a lesser degree—absorbed by the Earth's atmosphere. Simultaneously, the Earth radiates its own heat and energy out into the Earth's atmosphere and space. Factors such as the reflectivity of the Earth's surface, the abundance of water vapor, and the extent of cloud cover affect the degree to

[3] The Intergovernmental Panel on Climate Change (2013) defines the greenhouse effect as follows:

> The infrared radiative effect of all infrared-absorbing constituents in the atmosphere. Greenhouse gases, clouds, and (to a small extent) aerosols absorb terrestrial radiation emitted by the Earth's surface and elsewhere in the atmosphere. These substances emit infrared radiation in all directions, but, everything else being equal, the net amount emitted to space is normally less than would have been emitted in the absence of these absorbers because of the decline of temperature with altitude in the troposphere and the consequent weakening of emission. An increase in the concentration of greenhouse gases increases the magnitude of this effect; the difference is sometimes called the enhanced greenhouse effect. The change in a greenhouse gas concentration because of anthropogenic emissions contributes to an instantaneous radiative forcing. Surface temperature and troposphere warm in response to this forcing, gradually restoring the radiative balance at the top of the atmosphere.

which solar radiation may be absorbed or reflected. Figure 4 shows the energy flows to and from Earth and the role that the greenhouse effect plays in maintaining heat in the atmosphere.

Figure 4. Model of the Natural Greenhouse Effect



Source: Intergovernmental Panel on Climate Change 2007

The extent to which a given greenhouse gas[4] traps energy in the atmosphere and contributes to the overall greenhouse effect is characterized by its global warming potential (GWP).[5] Some gases are more effective at trapping heat, while others may be longer-lived in the atmosphere. The reference gas against which others are compared is CO_2, and GWP is thus expressed in terms of carbon dioxide-equivalent (CO_2e). The unit CO_2e represents both a gas's ability to trap heat and the rate at which it breaks down in the atmosphere. Most analyses use 100 years as the period of reference for GWPs, and this technical report conforms to that convention. For example, 1 unit of CO_2 has a 100-

[4] The Intergovernmental Panel on Climate Change (2013) defines greenhouse gas as follows:

> Greenhouse gases are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of terrestrial radiation emitted by the Earth's surface, the atmosphere itself, and by clouds. This property causes the greenhouse effect. Water vapour (H_2O), carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4) and ozone (O_3) are the primary greenhouse gases in the Earth's atmosphere. Moreover, there are a number of entirely human-made greenhouse gases in the atmosphere, such as the halocarbons and other chlorine- and bromine-containing substances, dealt with under the Montreal Protocol. Beside CO_2, N_2O and CH_4, the Kyoto Protocol deals with the greenhouse gases sulphur hexafluoride (SF_6), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs).

[5] The Intergovernmental Panel on Climate Change (2013) defines Global Warming Potential (GWP) as follows:

> An index, based on radiative properties of greenhouse gases, measuring the radiative forcing following a pulse emission of a unit mass of a given greenhouse gas in the present-day atmosphere integrated over a chosen time horizon, relative to that of carbon dioxide. The GWP represents the combined effect of the differing times these gases remain in the atmosphere and their relative effectiveness in causing radiative forcing. The Kyoto Protocol is based on GWPs from pulse emissions over a 100-year time frame, and this time frame has remained the standard within the scientific community.

year GWP of 1, whereas an equivalent amount of methane has a GWP of 25. Table 2 presents the 100-year GWPs from the IPCC Fourth Assessment Report (AR4) for the greenhouse gases included within the study.[6]

Table 2. Global Warming Potentials

Greenhouse Gas	IPCC AR4 100-Year Global Warming Potential
Carbon dioxide	1
Methane	25
Nitrous oxide	298
Source: Intergovernmental Panel on Climate Change 2007	

The predominant gases in the Earth's atmosphere, nitrogen and oxygen (which together account for nearly 90% of the atmosphere), exert little greenhouse effect. Some naturally occurring gases, such as carbon dioxide (CO_2), methane, and nitrous oxide, trap outgoing energy and contribute to the greenhouse effect. Additionally, manufactured pollutants, such as hydrofluorocarbons,[7] can contribute to the greenhouse effect. Most air pollutants[8] (e.g., sulfur dioxide and particulate matter) are short-lived in the atmosphere and therefore have more of a local or regional impact on air quality and the environment. Most greenhouse gases (e.g., carbon dioxide, methane, nitrous oxide) are long-lived and become globally mixed in the atmosphere, and therefore affect the atmosphere similarly regardless of where they are emitted.[9]

The composition of gases in the Earth's atmosphere determines the amount of energy absorbed and re-emitted by the atmosphere versus the amount of energy reflected back into space. Gases which absorb and reemit energy into the atmosphere are referred to as greenhouse gases. Greenhouse gas emissions occur from both natural as well as anthropogenic (i.e., resulting from or produced by human activities) sources. Examples of natural sources include decomposition of organic matter and aerobic respiration. Anthropogenic greenhouse gas emissions are predominantly from the combustion of fossil fuels, although other sources including industrial processes, land-use change (e.g., deforestation), agriculture, and waste management are also significant.

Atmospheric concentrations of greenhouse gases have increased since the Industrial Revolution, but the natural reservoirs of the climate system (e.g., oceans, soils, and forests) that remove certain greenhouse gases (e.g., carbon dioxide, methane, nitrous oxide) from the atmosphere do not have the capacity to store all of the additional emissions. Additionally, concentrations of long-lived,

[6] While additional greenhouse gases (HFCs, PFCs, SF_6) were considered for this analysis as per the Council on Environmental Quality (2014) guidance, carbon dioxide, methane, and nitrous oxide are the greenhouse gases emitted from the fossil fuel combustion and vegetation and wetland activities considered in this study.

[7] Hydrofluorocarbons are any of a class of partly chlorinated and fluorinated hydrocarbons, used as an alternative to chlorofluorocarbons in foam production, refrigeration, and other processes.

[8] Per U.S. EPA's Report on the Environment (ROE) (U.S. Environmental Protection Agency 2016a), air pollutant is defined as:

> Any substance in air that could, in high enough concentration, harm human health and the environment and cause property damage. Air pollutants can include almost any natural or artificial composition of matter capable of being airborne—solid particles, liquid droplets, gases, or a combination thereof. Air pollutants are often grouped in categories for ease in classification; some of the categories are sulfur compounds, volatile organic compounds, particulate matter, nitrogen compounds, and radioactive compounds.

[9] Some greenhouse gases like tropospheric ozone have relatively short atmospheric lifetimes and more of a local impact.

manufactured greenhouse gases —such as hydrofluorocarbons—have increased in recent decades. As the atmospheric concentrations of greenhouse gases increase, the atmosphere's ability to retain heat increases as well. Since reliable instrumental record keeping of temperatures in the U.S. began in 1895, the U.S. average temperature has risen by approximately 1.3 to 1.9 degrees Fahrenheit (°F) (U.S. Global Change Research Program 2014). Furthermore, U.S. average temperatures throughout the 21st century are expected to increase at a faster pace, by 2.5°F to 11°F above pre-industrial levels by 2100 (U.S. Global Change Research Program 2014).

Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations (Intergovernmental Panel on Climate Change 2007). Any local contribution to this observed increase in anthropogenic greenhouse gas concentration in turn contributes to the increase in global average temperature. The impacts of higher global surface temperatures include widespread changes in the Earth's climate system. This may affect weather patterns, biodiversity, human health, and infrastructure.

1.4 Study Area

The study areas are the same for both the On-Site Alternative and Off-Site Alternative. The study areas consist of the project areas, those areas in the vicinity of the project that could be affected by greenhouse gases resulting from construction and operation of the proposed export terminal, and the Lower Columbia River from the project area to the mouth of the river.

Chapter 2
Affected Environment

This chapter describes the sources of information and methods used to characterize the affected environment and assess the potential impacts of the On-Site Alternative, Off-Site Alternative, and No-Action Alternative on greenhouse gas emissions. The chapter then discusses the affected environment in the project areas of the On-Site Alternative and Off-Site Alternative.

2.1 Methods

This section presents the data sources and methods used to estimate project related greenhouse gas emissions. First, the data sources that were used are summarized. Second, the methods used to estimate each source of greenhouse gas emissions are described.

2.1.1 Data Sources

The technical reports supporting this environmental impact statement (EIS) for the Millennium Bulk Terminals—Longview project provided activity data and emissions data to support the greenhouse gas analysis in the study area. These include, but are not limited to the following reports.

- NEPA Air Quality Technical Report (ICF International 2016a)
- NEPA Energy Technical Report (ICF International 2016b)
- NEPA Vessel Transportation Technical Report (ICF International 2016c)
- NEPA Vegetation Technical Report (ICF International 2016d)
- NEPA Rail Transportation Technical Report (ICF International and Hellerworx 2016)

To estimate the greenhouse gases emitted as a result of the processes described in the above referenced reports, analysts used those reports' estimates of fuel consumption and vehicle operation, referred to as "activity data" [10], and combined that data with greenhouse gas emission factors to estimate greenhouse gas emissions for the On-Site Alternative or Off-Site Alternative. The greenhouse gas emission factors were drawn from the following sources based on representative and reputable U.S. Environmental Protection Agency (EPA), regional, and industry sources:

- California Air Resources Board (CARB). 2011. Appendix D: Emissions Estimation Methodology for Ocean-Going Vessels.
- Clean Cargo Working Group. 2014. Global Maritime Trade Lane Emission Factors.
- U.S. Environmental Protection Agency. 1996. AP-42, Section 3.4 Large Stationary Diesel and All Stationary Dual-fuel Engines.

[10] An activity is a practice or ensemble of practices that take place on a delineated area over a given period. *Activity data* are data on the magnitude of a human activity resulting in emissions or removals taking place during a given period of time (e.g., data on energy use, data on equipment used during construction of the On-Site Alternative or the Off-Site Alternative) (Intergovernmental Panel on Climate Change 2006).

- U.S. Environmental Protection Agency. 2009a. NONROAD Model (Non-road engines, equipment, and vehicles).
- U.S. Environmental Protection Agency. 2009b. Emission Factors for Locomotives.
- U.S. Environmental Protection Agency. 2014a. MOVES (Motor Vehicle Emission Simulator).
- U.S. Environmental Protection Agency. 2016c. U.S. Greenhouse Gas Inventory Report: 1990–2014.

2.1.2 Impact Analysis

This section describes the methods used to evaluate greenhouse gas emissions related to the On-Site Alternative, Off-Site Alternative, and No-Action Alternative. The method for estimating the greenhouse gas emissions from each emissions source is described, along with that source's activity data and the calculations used to estimate its associated greenhouse gas emissions. The greenhouse gas analysis addresses the same set of sources addressed in the NEPA Air Quality Technical Report (ICF International 2016a) and additional sources (e.g., rail transport on the BNSF Spur and Reynolds Lead and vessel transport to the mouth of the Columbia River).

For most emissions sources, the On-Site Alternative and the Off-Site Alternative were calculated using the same methods and were determined to be essentially comparable (the difference is less than 0.01% of the total). However, emissions from vegetation, soils, and wetlands, rail transport on the Reynolds Lead, and vessel transport were considered separately for each alternative due to the different locations.

2.1.2.1 Scope of Analysis

The On-Site Alternative or Off-Site Alternative would emit greenhouse gases during construction and operation. The emissions would come predominantly from the combustion of fossil fuels for construction and operation project phases.

This analysis includes activity data from the technical reports described in the *Data Sources* section*.*

The following sources of greenhouse gas emissions are not included in this analysis:

- Vehicle delay at rail crossings from project-related trains.
- Coal extraction in the Powder River Basin and the Uinta Basin.
- Rail transport of coal from extraction sites to on main line routes to Longview Junction (junction of the BNSF main line and BNSF Spur in Kelso, Washington), located approximately at Mile Post 101.2 of BNSF's Seattle Subdivision line, approximately 7.1 miles east of the project area for the On-Site Alternative.
- Helicopter and pilot boat trips for pilot transfers to vessels navigating the Lower Columbia River.
- Vessel transport beyond the mouth of the Columbia River.
- Burning of fossil fuels in Asia.

The greenhouse gas emissions analysis considers the following basic elements.

- **Time horizon.** To be consistent with activity data from the other technical reports, this analysis considers construction, operation, and transportation emissions from 2018 through 2038.
- **Geographic scope.** The geographic scope includes greenhouse gas emissions, occurring because of either alternative, at multiple geographic scales. These geographic scales include emissions within the project area, and emissions outside the project area. The following activities are included within the scope of this analysis:
  - Emissions in the project area
    - Site changes from construction (removal of vegetation, disturbance of soil, and loss of wetlands)
    - Equipment use and transportation during export terminal construction
    - Export terminal equipment operation
    - Vessel idling and tugboat use at terminal during operations
    - Rail operation and idling at the terminal during operations
    - Employee commuting to and from the terminal
  - Emissions outside the project area
    - Rail transport on the Reynolds Lead and BNSF Spur
    - Vessel transport to the mouth of the Columbia River
    - Export terminal electricity consumption

2.1.2.2 Method for Assembling an Emissions Time Series

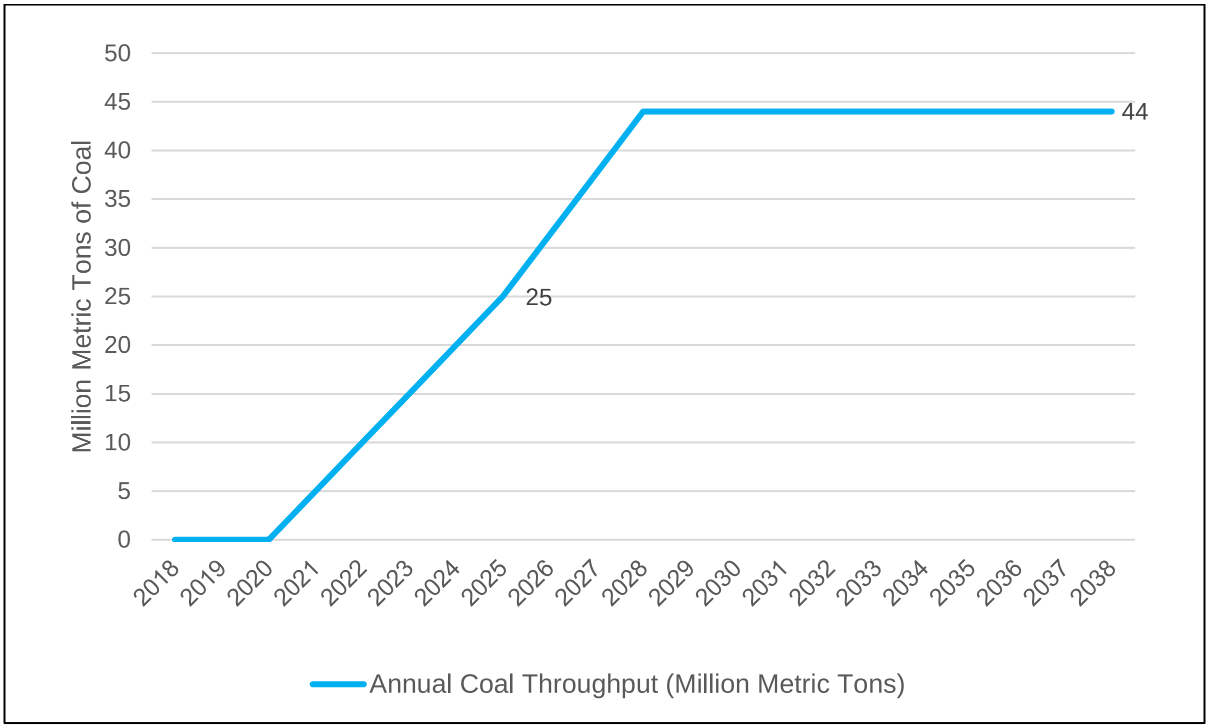
Because greenhouse gases accumulate in the atmosphere, a complete assessment of greenhouse gases associated with the On-Site Alternative or Off-Site Alternative requires a characterization of the greenhouse gases over the analysis period (2018 to 2038). The greenhouse gas analysis estimates emissions for each year during this analysis period.

Assembling a complete emissions time series for the greenhouse gas analysis required interpolation of estimates from other studies (i.e., air, and vessel). In particular, the activity data represent terminal operations and conditions in 2028, when the facility is expected to be fully operational. These data do not reflect the terminal start-up, in which the coal throughput increases from zero immediately after construction in 2020 to its full capacity of 44 million metric tons by 2028.

In order to generate estimates of greenhouse gas emissions for the full time series, the expected coal throughput was increased linearly from zero in 2020 to 25 million metric tons in 2025. Between 2025 and 2028, the throughput was increased linearly at a slightly faster rate to reach full capacity at 44 million metric tons (48.4 million short tons). The total coal exports for the analysis period add up to 627 million metric tons of coal, including 7 start-up years from 2021 to 2028 and 11 full years of operation from 2028 to 2038 (Figure 5).

Activity data and emissions estimates for the time series are derived only for 2028. It is the assumption of this data that emissions estimates are directly proportional to the throughput of either alternative and can be expressed as emissions per unit of coal throughput. The total greenhouse gas emissions from these sources are calculated by scaling the per-unit emissions by the total throughput of either alternative for the entire time series.

Figure 5. Annual Coal Throughput, 2018 to 2038



2.1.2.3 Methods for Estimating Greenhouse Gas Emissions

The International Panel on Climate Change (IPCC) outlines the method for estimating greenhouse gas emissions as follows (2006):

> *As with the 1996 Guidelines and IPCC Good Practice Guidance the most common simple methodological approach is to combine information on the extent to which a human activity takes place (called activity data or AD)*[11] *with coefficients which quantify the emissions or removals per unit activity. These are called emission factors (EF).*[12] *The basic equation is therefore:*
>
> *Emissions = Activity Data × Emission Factor*

For example, in the energy sector, fuel consumption would constitute activity data, and mass of carbon dioxide emitted per unit of fuel consumed would be an emission factor. The basic equation can in some circumstances be modified to include other estimation parameters than emission factors.

This general method has been applied to estimate greenhouse gas emissions from activities in the project area, and activities outside the project area but within the scope of analysis. Section 2.1.2.3,

[11] The Intergovernmental Panel on Climate Change (1997) defines activity data as follows; *Data on the magnitude of human activity resulting in emissions or removals taking place during a given period of time.*

[12] The Intergovernmental Panel on Climate Change (2006) defines emission factor as follows: *A coefficient that quantifies the emissions or removals of a gas per unity of activity. Emission factors are often based on a sample of measured data, averaged to develop a representative rate of emission for a given activity level under a given set of operating conditions.*

Methods for Estimating Greenhouse Gas Emissions, addresses calculation methods for each of these areas, and Section 3.1, *Activities,* describes the results.

Project Area Activities

This section includes emission factors from the following activities: upland and wetland land-cover change,[13] export terminal construction, export terminal equipment operation, vessel idling and tugboat use at the terminal, rail operation and idling at the terminal, and employee commuting.

Upland and Wetland Land-Cover Change

The removal of existing upland and wetland land cover to construct the export terminal has three potential impacts on greenhouse gas emissions: the loss of carbon already sequestered by existing biomass, dead organic matter, and soils; the loss of on-going carbon sequestration from living vegetation that would no longer be present; and the loss of carbon dioxide and methane emissions from wetlands that are permanently filled.

As discussed by IPCC (2007), greenhouse gas emissions and removals for land use includes CO_2 (based on changes in ecosystem carbon stocks) from biomass (e.g., vegetation), dead organic matter (e.g., downed branches, leaf litter), and soils, as well as non-CO_2 emissions from burning and, depending on the land-use category, emissions from other specific sources (e.g., carbon dioxide and methane emissions from wetlands). For practicality, basic (i.e., IPCC Tier 1) methods assume that all post-disturbance emissions (less removal of harvested wood products) are estimated as part of the disturbance event, in the year of the disturbance. For example, rather than estimating the decay of dead organic matter left after a disturbance over several years, all post-disturbance emissions are estimated in the year of the event.

To estimate the loss of upland carbon stocks from the net change in upland vegetation cover types as a result of construction, estimates of vegetation cover (e.g., aboveground carbon, belowground carbon, understory carbon) and soil (e.g., soil organic carbon) carbon stocks in the project area were based on average carbon stock per area estimates for Cowlitz County taken from the Carbon Online Estimator (National Council for Air and Stream Improvement and the U.S. Department of Agriculture, Forest Service 2016). The upland land cover includes forested, scrub-shrub, herbaceous, and managed herbaceous vegetation cover types. The average forested carbon stock per area value may overestimate the actual forested carbon stocks in the project area because the average estimates for Cowlitz County likely include areas with higher carbon stocks (e.g., managed production forests).

These estimates of the carbon stock per area for forested, scrub-shrub, and herbaceous[14] upland vegetation cover types were multiplied by the corresponding changes in area resulting from the construction to estimate the change in carbon stocks associated with construction (e.g., vegetation removal and surface soil disturbance) of either alternative. Given the potential high value of the forested carbon stock per area value, these emissions estimates likely overestimate the actual construction emissions in the project area but are representative for average areas in Cowlitz

[13] For the purposes of this analysis, riparian vegetation communities are limited to uplands located in the riparian zone; therefore, riparian lands are reported as part of the upland land cover class (ICF International 2016f).

[14] The same carbon stock density was applied for both herbaceous and managed herbaceous vegetation cover types because the carbon in both of these systems predominantly resides in the soil.

County. That said, in the absence of detailed site-level carbon stock surveying, these average values are likely representative and conservative—i.e., they overestimate rather than underestimate emissions.

Loss of ongoing carbon sequestration for the forested, scrub-shrub, and herbaceous[15] upland vegetation cover types were then estimated based on IPCC guidelines (Intergovernmental Panel on Climate Change 2006: Volume 4). These estimates of the lost sequestration per area for forested, scrub-shrub, and herbaceous[16] upland vegetation cover types were multiplied by the corresponding changes in area resulting from construction over the analysis period (2018 to 2038) to estimate the lost sequestration.

Table 3 shows the emission factors (lost carbon stock and lost sequestration values) derived for the upland land cover type.

Table 3. Upland Emission Factors

Land Cover Category	Vegetation Cover Type	One-time Lost Carbon Stock (metric tons CO_2e/acre)	Annual Lost Sequestration (metric tons CO_2e/acre/year)
Upland	Forested	510.5	2.8
	Scrub-shrub	325.6	2.8
	Herbaceous	140.7	0
	Managed herbaceous	140.7	0

Notes:
GHG = greenhouse gas; CO_2e = carbon dioxide equivalent
Sources:
One-time lost carbon stock values derived from Carbon On-Line Estimator search result information for Cowlitz County (National Council for Air and Stream Improvement and the U.S. Department of Agriculture, Forest Service 2016).
Annual lost sequestration values were taken from IPCC (2006).

To estimate the loss of wetland carbon stocks, estimates of vegetation cover carbon stocks in the project area were again based on average carbon stock per area estimates for Cowlitz County taken from the Carbon Online Estimator, with the soil carbon stocks taken from a study by the U.S. Department of Agriculture Forest Service (Trettin and Jurgensen 2003). These estimates of the carbon stock per area for forested, scrub-shrub, and herbaceous wetland cover types were multiplied by the corresponding changes in wetland area resulting from construction to estimate the change in carbon stocks associated with construction.

To estimate the loss of ongoing carbon sequestration for the forested, scrub-shrub, and herbaceous wetland vegetation cover types, representative estimates of annual carbon sequestration for wetlands assumed similar to those in the project area were taken from a study by Hansen (2009). Based on values reported by Trettin and Jurgensen (2003), these annual carbon sequestration

[15] The annual carbon sequestration for the forested and scrub-shrub vegetation types was based on the aboveground net biomass growth in natural temperate continental forests in North America. The annual carbon sequestration for the herbaceous vegetation type was assumed zero because the soil carbon gains and losses were assumed to have reached an equilibrium for an established herbaceous system.

[16] The same carbon stock density was applied for both herbaceous and managed herbaceous vegetation cover types since the carbon in both of these systems predominantly resides in the soil.

estimates were adjusted to include the reduction in annual carbon dioxide and methane emissions that would otherwise have been released from the changes in wetland area.

These adjusted estimates of the lost sequestration and reduction in emissions per area for forested, scrub-shrub, and herbaceous wetland vegetation cover types were multiplied by the corresponding changes in area resulting from the construction over the analysis period (2018 to 2038) to estimate the lost sequestration and reduction in emissions.

Table 4 shows the emission factors (i.e., lost carbon stock and lost sequestration and reduction in emission values) derived for the wetland vegetation cover types.

Table 4. Wetland Emission Factors

Land Cover Category	Vegetation Cover Type	One-time Lost Carbon Stock ($MtCO_2e$/acre)	Annual Lost Sequestration ($MtCO_2e$/acre/year)
Wetland	Forested	451.43	−5.51
	Scrub-shrub	266.52	−2.12
	Herbaceous	81.61	1.26

Notes:
GHG = greenhouse gas; CO_2e = carbon dioxide equivalent, $MtCO_2e$ = metric tons of carbon dioxide equivalent
Sources:
One-time lost carbon stock values were derived from Carbon On-Line Estimator search result information for Cowlitz County (NCASI and USDA Forest Service 2016), with the soil carbon stocks taken from a study by the Trettin and Jurgensen (2003)
Annual lost sequestration values were taken from a study by Hansen (2009), adjusted to include the reduction in annual carbon dioxide and methane emissions taken from Trettin and Jurgensen (2003)

Export Terminal Construction

Emission factors were applied to the maximum numbers of pieces of equipment operated, duration of use, and horsepower, to obtain annual emissions. Table 5 provides information on the emission factors for construction equipment.

The impact of construction employee commuting was calculated using the MOVES model (U.S. Environmental Protection Agency 2014a), assuming construction workers would use single-occupant vehicles with a mean round-trip travel time of 48.2 minutes (U.S. Census Bureau 2016). The analysis assumes the 200 workers would be commuting during construction. At an estimated speed of 35 miles per hour, this amounts to approximately 1.5 million miles per year traveled. This distance was multiplied by emission factors for typical commuting vehicles provided by the MOVES model to calculate annual emissions.[17]

For the construction barges (operating under their own power or pushed/towed by another vessel), emissions were calculated using the EPA's AP-42 method for large diesel engines (U.S. Environmental Protection Agency 1996). The analysis assumes the construction barges would have a positioning time of 1 hour with 1 round trip per day, 5 days per week, 52 weeks per year. Summaries of the barge activity and emission factors are available in Tables 6 and 7, respectively.

[17] The analysis assumes a 50/50 mix of gasoline and E-85 (a mixture of 85% ethanol fuel and 15% gasoline or other hydrocarbon) for construction employee commuting vehicles.

Table 5. Construction Equipment Activity Data and Emission Factors

Equipment Type	Engine Size	Fuel Type	Number of Units	Emission Factor ($MtCO_2e$/year per Unit)[c]
Crane, 50-ton	165	Diesel	2	109.3
Crane, 150-ton	280	Diesel	2	183.0
Crane, 300-ton	450	Diesel	1	195.4
Water trucks	350	Diesel	1	98.8
Dump trucks	350	Diesel	4	98.8
Dozers	185	Diesel	0.4	396.5
Excavators	230	Diesel	2	886.6
Rollers	350	Diesel	3.8	100.3
Graders	185	Diesel	1.8	132.7
Compactors	25	Diesel	3.8	0.2
Track laying machine	[a]	Diesel	0.5	416.8
Drill Rigs	(NONROAD Default)[b]	Diesel	1.2	57.1
Impact Piling Rigs	(NONROAD Default)[b]	Diesel	3	57.1
Loaders	140	Diesel	1	416.8
Generator	30	Diesel	6	108.8
Air Compressor	25	Diesel	6	0.3

Notes:

[a] Assumes track-laying machine uses one diesel locomotive and one front end loader engine. Assumes full-time locomotive used 4 hours/day, 5 days/week.

[b] Horsepower and weight estimates are based on capacity ratings and industry specifications, or average ratings per equipment type. Where horsepower could not be assumed, an average horsepower rate in NONROAD for the equipment type was used.

[c] To calculate total emissions, this emission factor is multiplied by 1.5 years to estimate the emissions for 18 months of construction.

Source: ICF International 2016b

$MtCO_2e$ = metric tons of carbon dioxide equivalent

Table 6. Barge Activity and Energy Use for Terminal Construction

Barge Activity	Energy Consumption Variables
Barges used	2
Engine size (propulsion)	3,500 hp
Positioning time	1 hour
Total power per trip	7,000 hp
Construction trips	260 trips per year
Annual power	1,820,000 MMBtu per year

Notes:

Source: ICF International 2016b

hp = horsepower; MMBtu= million British thermal units per year

Table 7. Emission Factors for Construction Barges

Greenhouse Gas	$kgCO_2e$ per MMBtu	Emission Factor ($MtCO_2e$/ 1,000 gallons)
Carbon dioxide	74.8	10.23
Methane	0.1	0.1
Nitrous oxide	0.1	0.1
Total	75.0	10.25

Notes:
Source: U.S. Environmental Protection Agency 1996
$kgCO_2e$ = kilograms of carbon dioxide equivalent; MMBtu = million British thermal units; $MtCO_2e$ = metric tons of carbon dioxide equivalent

Emissions from trucks hauling construction material to the project area were estimated by determining the annual miles traveled for trucks going to and from the construction site and then multiplying those miles traveled by a per-mile emission factor from EPA's MOVES model. The peak annual trips for either alternative are assumed to be 56,000 round trips (URS 2015). Short-haul combination tractor-trailer trucks were assumed to move construction material with 47 roundtrip miles of travel in the county. The greenhouse gas emission factor was taken from a MOVES model run for Cowlitz County, Washington, for the year 2018 (i.e., 1,561 to 1,930 grams of CO_2e per mile, depending on operating conditions).

Export Terminal Equipment Operation

Emissions from mobile combustion sources during operations were estimated by first determining the equipment necessary for typical operation and maintenance and then using the NONROAD model (U.S. Environmental Protection Agency 2009a) to estimate annual exhaust emissions from that mobile equipment (Table 8).

Table 8. Export Terminal Equipment and Emission Factors for Construction Equipment Typically Used for Industrial Site Construction.

Equipment Type	Engine Size (hp)	Fuel Type	Number of Units	Emission Factor ($MtCO_2e$/year per Unit)
Loader	300	Diesel	1	671.7
Bobcat	50	Diesel	2	16.6
10-Ton Truck	300	Diesel	2	98.8
Crane	50	Diesel	1	0.0
Forklift	40	Propane	1	0.1
Maintenance Trucks	300	Gasoline	4	0.2

Notes:
Source: U.S. Environmental Protection Agency 2009a
$MtCO_2e$ = metric tons of carbon dioxide equivalent; hp = horsepower

Vessel Idling and Tugboat Use at Terminal

Sources of greenhouse gas emissions from vessel idling and tugboat use of the terminal include current vessel operations at the terminal, as vessels use main and auxiliary motors to maneuver in and out of the loading area. Additionally, this source includes fossil fuel combustion emissions from tugboats that are used to assist in vessel maneuvering at the project area.

Greenhouse gas emissions from vessel idling and tugboat use were calculated by estimating the power consumed by idling vessels, converting the power demand into fuel consumption, and multiplying that fuel consumption by a fuel combustion emission factor. An average of 13 hours would be needed to load each vessel with coal, and during this period the vessel would be hoteling using auxiliary engines. For each vessel, the typical main and auxiliary engine size was based on Lloyd's Register of Ships Sea-web, which has a database of ship characteristics for ships over 100 gross tons (Sea-web 2015). Each vessel receiving coal is assumed to need three tugs to maneuver the ship. These tugs would operate for 3 hours to assist with docking and departing. The time spent operating the vessels in each mode multiplied by the estimated engine load and size provided the power demand for both the idling vessels and tugboats. The power demand was then multiplied by the emission factors provided in Table 9.

Table 9. Emission Factors for Idling Vessels and Tugboats

Greenhouse Gas	Main Engine Emission Factor (g CO_2e per kWh)	Auxiliary Engine Emission Factor (g CO_2e per kWh)
Carbon dioxide	588	690
Methane	1.75	2.25
Nitrous oxide	0.12	0.12
Total	590	692

Notes:
Source: California Air Resources Board 2011
gCO_2e = grams of carbon dioxide equivalent; kWh = kilowatt-hours

Rail Operation and Idling at Terminal

For rail operations that occur within the project area, the greenhouse gas analysis includes three sources of emissions: trains traveling around the 1.65 mile loop, the on-site idling of coal trains, and the operation of a switch locomotive. The analysis assumes it takes 1.85 hours to unload a 125-car unit train, each train has a 5-hour idle period prior to departing the facility, and the switch locomotive operates for 8 hours a day. This emissions source includes the sum of these three activities.

Emission factors for line-haul locomotives are based on projected changes in the locomotive fleet over the next 30 years (U.S. Environmental Protection Agency 2009b). These emission factors are based on engine load and associated fuel consumption during transport to and from the facility, time to unload coal from the train cars, and total annual coal throughput. The power demand is proportional to engine load, which varies in intensity depending on whether the locomotive is hauling freight or idling. The fuel consumption is estimated based on the power demand, which is estimated based on the engine load and duration of the activity. That fuel consumption is then multiplied by fuel combustion emission factors for locomotives as provided in Table 10.

Table 10. Emission Factors for Locomotives

Greenhouse Gas	Emission Factor (MtCO_2e/ 1,000 gallons)
Carbon dioxide	10.22
Methane	0.02
Nitrous oxide	0.08
Total	**10.31**

Notes:
Source: U.S. Environmental Protection Agency. 2009b.
MtCO_2e = metric tons of carbon dioxide equivalent

Employee Commuting

The greenhouse gas emissions from permanent employee commuting to the project area were calculated using the MOVES model (U.S. Environmental Protection Agency 2014a), assuming employees would use single-occupant vehicles with a mean round-trip travel time of 48.0 minutes (U.S. Census Bureau 2016). The analysis assumes that there will be 135 permanent employees associated with the proposed project. Over the course of the year it was estimated this amounts to approximately 1 million miles per year traveled. This distance was multiplied by emission factors for typical commuting vehicles provided by the MOVES model to calculate annual emissions.[18]

Activities Outside the Project Area

This section includes emission factors from the following activities: rail operation beyond the project area, vessel transport to the mouth of the Columbia River, and electricity consumption.

Rail Operation beyond the Project Areas

Sources of greenhouse gas emissions from rail transport of coal beyond the project area include diesel combustion emissions from the operation of locomotives between the project area and BNSF main line on the Reynolds Lead and BNSF Spur. Greenhouse gas emissions from rail transport were estimated using the same approach as for the transport within the project area and use the same emission factors as those for rail operation within the project area (Table 10).

Vessel Transport to the Mouth of the Columbia River

Sources of greenhouse gas emissions from vessel transport along the Lower Columbia River consist of fossil fuel combustion associated with current vessel transport between the project areas and mouth of the Columbia River,[19] an approximately 62.8 mile distance for the On-Site Alternative and approximately 61.3 mile distance for the Off-Site Alternative that is included twice to account for incoming and outgoing vessels. These distances include 11.3 miles within Cowlitz County for the On-Site Alternative (9.9 miles for the Off-Site Alternative). Greenhouse gas emissions from vessel transport were calculated using the same method as were air emissions, and are summarized in the NEPA Air Quality Technical Report (ICF International 2016a). This analysis assumes the export terminal would be serviced by a mix of Panamax (80%) and Handymax (20%) vessels. To incorporate this assumption, the engine size was considered a weighted average of Panamax and Handymax vessels. For each vessel, the typical main and auxiliary engine size was based on Lloyd's Register of Ships Sea-web, which has a database of ship characteristics for ships over 100 gross tons (Sea-web 2015).

Greenhouse gas emissions from vessels in transit within Cowlitz County were calculated by estimating the energy consumed by vessels exiting Cowlitz County, which was a factor of the time each ship would spend traveling, maneuvering, and hoteling within the county, the engine size, and engine load for loaded ships in transit. The annual energy demand was multiplied by an emission factor for main engine vessel use for loaded transit. The transit time within Cowlitz County was assumed to be 1.8 hours, including coming in and going out. The annual energy demand was then

[18] The analysis assumes a 50/50 mix of gasoline and E-85 for employee commuting vehicles.
[19] Emissions from vessel transport to the river mouth are included in the boundary to be consistent with other technical reports for this project.

calculated based on the engine size of the vessels and engine load and multiplied by the emission factors for vessels in transit provided in Table 11.

Table 11. Emission Factors for Vessels in Transit within Cowlitz County

Greenhouse Gas	Main Engine Emission Factor (g CO_2e per kWh)	Auxiliary Engine Emission Factor (g CO_2e per kWh)
Carbon dioxide	588	690
Methane	1.75	2.25
Nitrous oxide	0.12	0.12
Total	590	692

Notes:
Source: California Air Resources Board 2011
kgCO_2e = kilograms of carbon dioxide equivalent; kWh = kilowatt-hours

Greenhouse gas emissions from the Cowlitz County border to the mouth of the Columbia River were calculated by first calculating the ton-miles of shipping, then multiplying that amount by a per-ton-mile emission factor for cross-Pacific Ocean transport. This approach was taken due to the uncertainty of the duration of the trip over longer distances, which creates uncertainty when using estimates that rely on hours of engine operation. The emission factor for long-distance vessel transport of coal is derived from an emission factor for the unrefrigerated shipping of bulk cargo in Asia, provided in units of CO_2e per each 20-foot equivalent unit of cargo transported 1 mile. A 20-foot equivalent unit refers to a unit of cargo capacity such as an intermodal container. For coal, this unit is estimated to hold 26 short tons (Rodrigue 2012). Table 12 shows the calculation of emission factors for long-distance vessel transport.

Table 12. Calculation of the Emission Factor for Long-Distance Vessel Transport of Coal

Factor	Magnitude
Shipping emission Factor, Intra-Asia[a]	87.5 g CO_2e/TEU-km
Coal per TEU, full capacity[b]	26 short tons
Shipping emission factor, Intra-Asia	0.005 kg CO_2e/ton-mile

Notes:
[a] Clean Cargo Working Group 2014
[b] Rodrigue 2012
TEU = 20-foot equivalent unit—a unit of cargo capacity which denotes one intermodal container; CO_2e/TEU-km = carbon dioxide equivalent per 20-foot equivalent unit per kilometer

Electricity Consumption

Sources of greenhouse gas emissions for electrical generation include fuel combustion emissions at off-site power plants to produce electricity consumed at the terminal site. The local energy grid would provide electricity for operation of the terminal facilities. To derive additional greenhouse gas emissions from electricity consumption for export terminal operations, the electricity fuel mix for an average water year[20] was obtained from the Cowlitz Public Utility District (PUD). Emission factors for each fuel type were then derived from individual plant data for each fuel in the Western Electricity Coordinating Council Northwest subregion as provided in the Emissions & Generation

[20] Since Cowlitz County's fuel supply is primarily made up of hydro resources, a significantly drier or wetter year will affect the fuel mix for the region.

Resource Integrated Database (eGRID). These individual fuel emission factors were combined using the Cowlitz PUD fuel mix to obtain a weighted average emission factor to apply to electricity consumption from the On-Site Alternative or Off-Site Alternative. Table 13 provides the fuel mix and emission factors used to derive greenhouse gas emissions from electricity consumption for coal export terminal operations.

Table 13. Average Fuel Mix and Fuel-Specific Emission Factor for the Cowlitz PUD Region

Fuel Source	Share of Electricity Fuel Mix (%)	Carbon Dioxide (kg CO_2e/MWh)	Methane (kg CO_2e/MW)	Nitrous Oxide (kg CO_2e/MWh)	Total (kg CO_2e/ MW)
Hydro	84.64%	0	0	0	0
Nuclear	9.70%	0	0	0	0
Wind	2.66%	0	0	0	0
Coal	2.08%	1,095.8	0.3	5.5	1,101.5
Natural Gas	0.79%	436.8	0.2	0.3	437.3
Other[a]	0.13%	302.0	0.1	1.4	303.5
Weighted Average	**100%**	**26.6**	**0.01**	**0.1**	**26.8**

Notes:

[a] Other is made up of biomass, cogeneration, geothermal, landfill gas, petroleum, solar, and waste incineration.

Source: Cowlitz PUD 2015, U.S. Environmental Protection Agency 2015a

2.2 Affected Environment

The affected environment related to greenhouse gas emissions in the study areas is described below.

- **Project Area for the On-Site Alternative.** The project area for the On-Site Alternative is described in Section 1.1.1, *On-Site Alternative*. Existing greenhouse gas emissions in the project area are primarily related to the ongoing hazardous waste cleanup activities, emissions generated from electricity consumption for the Applicant's administration building, and emissions from on-site vehicles.

- **Project Area for the Off-Site Alternative.** The Off-Site Alternative project area is described in Section 1.1.2, *Off-Site Alternative*. Greenhouse gas emissions in the project area for the Off-Site Alternative are primarily related to the rural residential land uses and small-scale farming.

- **Reynolds Lead and BNSF Spur.** Approximately seven trains per day each consisting of approximately 78 cars typically pass between the BNSF Spur and main line (ICF International and Hellerworx 2016). Assuming the trains haul 121 metric tons of material per rail car, use two locomotives, and travel 23.4 miles through Cowlitz County to and from the north on the main line, the annual emissions from those trains are currently 7,652 metric tons of CO_2e. Baseline traffic on the Reynolds Lead at the project areas in Cowlitz County is about two trains per day. Assuming the trains traveling on the Reynolds Lead also haul 121 metric tons of material per rail car, use one locomotive, and travel the approximately 5-mile length of the Reynolds Lead, the annual emissions from those trains are currently 1,635 metric tons of CO_2e. These totals include trains delivering grain and connecting to other port facilities.

- **Columbia River.** Greenhouse gas emissions on the Columbia River are primarily related to vessel traffic. The NEPA Vessel Transportation Technical Report (ICF International 2016c) provides estimates of existing vessel traffic by vessel type.

Chapter 3
Impacts

This chapter describes activities that would emit greenhouse gases during construction and operation of the export terminal, and greenhouse gas emissions that would result from construction and operation of the On-Site Alternative, Off-Site Alternative, or No-Action Alternative.

3.1 Activities

This section describes activities in the project areas, and activities outside the project areas, that would emit greenhouse gases during construction and operation of the On-Site Alternative or Off-Site Alternative and fall within the project scope of analysis.

3.1.1 Project Area Activities

The following subsections describe activities in the project areas of the On-Site Alternative and Off-Site Alternative that would emit greenhouse gases during construction and operation.

3.1.1.1 Upland and Wetland Land-Cover Change

The removal of vegetation, disturbance of surface soil, and infilling of wetlands associated with clearing and grading during construction of the On-Site Alternative or Off-Site Alternatives would affect carbon stocks, carbon sequestration, and wetland emissions. This vegetation removal, soil disturbance, and wetland loss would result in the one-time loss of accumulated carbon stocks—resulting in a corresponding gain in CO_2 emissions—would eliminate ongoing carbon sequestration—resulting in a corresponding CO_2 emissions debt each year during the analysis period (2018 to 2038)—and would reduce carbon dioxide and methane emissions—resulting in a corresponding CO_2e emissions credit each year during the analysis period (2018 to 2038). For more information on the land cover types, vegetation cover types, and changes in area resulting from construction, see the NEPA Vegetation Technical Report (ICF International 2016d). Tables 14 and 15 summarize the changes in Upland and Wetland land cover area by vegetation cover type resulting from the construction of the On-Site Alternative or Off-Site Alternative, respectively.

Table 14. Changes in Upland and Wetland Land Cover Area by Vegetation Cover Type – On-Site Alternative

Land Cover Category	Vegetation Cover Type	Change in Area (Acres)
Upland	Forested	8.90
	Scrub-shrub	2.11
	Herbaceous	10.88
	Managed herbaceous	4.37
	Upland total	**26.26**
Wetland	Forested	6.28
	Scrub-shrub	0.57
	Herbaceous	17.25
	Wetland total	**24.10**
Total		**50.36**

Notes:
Source: ICF International 2016e

Table 15. Changes in Upland and Wetland Land Cover Area by Vegetation Cover Type – Off-Site Alternative

Land Cover Category	Vegetation Cover Type	Change in Area (Acres)
Upland	Forested	6.74
	Scrub-shrub	4.42
	Herbaceous	126.57
	Managed herbaceous	17.73
	Upland Total	**155.46**
Wetland	Forested	17.1
	Scrub-shrub	1.2
	Herbaceous	33.0
	Wetland Total	**51.28**
Total		**206.74**

Notes:
Source: ICF International 2016e

3.1.1.2 Export Terminal Construction

Sources of greenhouse gas emissions from construction would include operation of construction equipment and the vehicles to bring employees and construction materials to the project area of the On-Site Alternative or Off-Site Alternative. Fossil fuels would be combusted for the operation of construction equipment used for demolition and earthwork to prepare the site. Table 16 summarizes the required equipment and estimated duration of use.

Table 16. Major Construction Activities and Typical Equipment Fleets[a]

Construction Equipment Type	Rail Infrastructure and Rotary Car Dump Station		Conveyors, Transfer Stations and Surge Bins		Shiploader, Dock, and Trestles	
	Max Qty. per Month	Duration (months)	Max Qty. per Month	Duration (months)	Max Qty. per Month	Duration (months)
Mobile cranes (25–50 ton)	2	18	2	18	2	18
Mobile cranes (50–150 ton)	2	18	2	18	2	18
Mobile cranes (150–300 ton)	1	18	1	18	1	18
Water trucks	1	12	1	12	0	0
Dump trucks	3	12	1	12	0	0
Dozers	1	5	0	0	0	0
Excavators	1	9	2	12	1	3
Rollers	2	9	2	12	1	3
Graders	2	9	0	0	1	3
Compactors	2	9	2	12	1	3
Track laying machine	1	2	0	0	0	0
Drill rigs	1	2	2	6	0	0
Impact piling rigs	2	6	2	6	2	6
Loaders	1	12	1	12	1	9
River barge	0	0	0	0	2	18
Generator	2	18	2	18	2	18
Air compressor	2	18	2	18	2	18

Notes:
[a] Typical construction fleet may be modified with equivalent items as construction activities demand.
Sources: URS 2014; ICF International 2016b

Combustion emissions estimates were obtained from the NONROAD emissions model (U.S. Environmental Protection Agency 2009a) for the nonroad equipment. Construction activity was assumed to occur 8 hours per day, 5 days a week, 52 weeks per year, with the exception of the track- laying machine, which would operate 4 hours per day.

3.1.1.3 Export Terminal Equipment Operation

Sources of greenhouse gas emissions from equipment operation include fossil fuel emissions. Examples of equipment used for terminal operation include loaders, maintenance vehicles, and cranes. This equipment uses diesel, gasoline, and propane fuels (Table 17).

Table 17. Export Terminal Equipment

Equipment Type	Engine Size (hp)	Fuel Type	Number of Units
Loader	300	Diesel	1
Bobcat	50	Diesel	2
10-Ton Truck	300	Diesel	2
Crane	50	Diesel	1
Forklift	40	Propane	1
Maintenance Trucks	300	Gasoline	4

Notes:
Source: U.S. Environmental Protection Agency 2009a
$MtCO_2e$ = metric tons of carbon dioxide equivalent; hp = horsepower

3.1.1.4 Vessel Idling and Tugboat Use

Vessels use main and auxiliary motors to maneuver in and out of the loading area. For each vessel, the typical main and auxiliary engine size was based on Lloyd's Register of Ships Sea-web, which has a database of ship characteristics for ships over 100 gross tons (Sea-web 2015). Additionally, tugboats are used to assist in vessel maneuvering at the project areas for the On-Site Alternative and Off-Site Alternative. The greenhouse gas analysis assumes three tugboats per vessel are used, and 840 vessels travel to the project areas each year.

3.1.1.5 Rail Operation

Locomotive operations include trains traveling around the 1.65-mile loop within the project areas, on-site idling of trains, and the operation of a switch locomotive to move cars and assemble trains for departure. The analysis assumes it would take 1.85 hours to unload a 125-car unit train, each train has a 5-hour idle period prior to departing the facility, and the switch locomotive would operate for 8 hours a day.

3.1.1.6 Employee Commuting

Greenhouse gas emissions from employee commuting include the emissions from fossil fuel combustion associated with the daily commuting traffic for employees to and from the project areas. The greenhouse gas analysis assumes employees would use single-occupant vehicles with a mean round-trip travel time of 48.2 minutes (U.S. Census Bureau 2016). The analysis also assumes that there are 135 employees, with 25 commuting 5 days per week and 110 commuting 7 days per week. At an estimated speed of 35 miles per hour, this level of commuting amounts to 1,092,051 miles per year traveled.

3.1.2 Activities Ouside the Project Area

The following subsections describe activities outside the project areas of the On-Site Alternative and Off-Site Alternative that would emit greenhouse gases during operation.

3.1.2.1 Rail Transport

At the peak of operations, an average of 16 trains (8 loaded trains arriving, 8 empty trains departing) would travel between the project areas and BNSF main line on the Reynolds Lead and BNSF Spur each day (Table 18).

Table 18. Rail Transport Distances

Rail Route	Loaded Train Distance (Miles)	Empty Train Distance (Miles)
Longview Junction to project areas	7.1 (On-Site Alternative) 7.6 (Off-Site Alternative)	7.1 (On-Site Alternative) 7.6 (Off-Site Alternative)

Notes:
Source: Distances estimated via GIS mapping

3.1.2.2 Vessel Transport

Sources of greenhouse gas emissions from vessel transport along the Columbia River include fossil fuel combustion associated with current vessel transport between the project areas and the mouth of the Columbia River, an approximately 62.8-mile distance for the On-Site Alternative and approximately 61.3-mile distance for the Off-Site Alternative for 840 vessels that is included twice to account for incoming and outgoing vessels. Greenhouse gas emissions from vessel transport were calculated using the same method as were air emissions, and are summarized in the NEPA Air Quality Technical Report (ICF International 2016a). This analysis assumes that the export terminal would be serviced by a mix of Panamax (80%) and Handymax (20%) vessels. For the Panamax vessels, an engine size of 16,368 horsepower and 3,039 horsepower are used for the main engine and auxiliary engine, respectively. For the Handymax vessels, an engine size of 10,153 horsepower and 1,885 horsepower are used for the main engine and auxiliary engine, respectively (Sea-web 2015).

3.1.2.3 Electricity Consumption

Operation of the On-Site Alternative and Off-Site Alternative would consume electricity. Although electricity would be consumed within the project area, the greenhouse gas emissions resulting from this consumption would occur at power plants outside the project area. The annual energy use for the existing bulk product terminal within the Applicant's leased area is assumed similar to the power demand for the On-Site Alternative and Off-Site Alternative (Chaney pers. comm.). Table 19 presents the monthly and annual electricity demand.

Table 19. Monthly and Annual Electricity Demand

Time Period	Usage	Unit
Monthly	552,000	kWh
Annual	6,624	MWh

Notes:
Source: Chaney pers. comm.
kWh = kilowatt hour; MWh = megawatt hour

3.2 Impacts

This section presents the greenhouse gas emissions for the On-Site Alternative or Off-Site Alternative. These emissions represent the increase in emissions above existing emissions. The greenhouse gas emissions are presented in terms of the 2028 emissions (the first year of assumed full export capacity operation for the terminal) and total emissions over the analysis period (2018 to 2038). From 2021 to 2028, the coal capacity of the terminal is assumed to linearly ramp up to full capacity, and greenhouse gas emissions are scaled accordingly during this time. The total emissions are the sum of emissions for the analysis period, including construction beginning in 2018 and operation through 2038. The results are presented by emissions sources. The source emissions are then combined into an estimate of total greenhouse gas emissions.

3.2.1 Project Areas

This section presents greenhouse gas emissions in the project areas for the On-Site Alternative and Off-Site Alternative.

3.2.1.1 Upland and Wetland Land-Cover Change

The vegetation removal, soil disturbance, and wetland loss associated with construction of the On-Site Alternative or Off-Site Alternative would result in the loss of carbon stocks, the loss of ongoing carbon sequestration, and a reduction in annual emissions in the case of certain wetland vegetation cover types over the analysis period (2018 to 2038). Table 20 presents the estimated emissions associated with construction of the On-Site Alternative or Off-Site Alternative.

Table 20. Vegetation Removal, Soil Disturbance, and Wetland Loss Emissions ($MtCO_2e$)

Emissions Source	On-Site Alternative	Off-Site Alternative
Emissions During 12-Month Construction Period	11,771	35,908
Annual Emissions, 2028	17	–24
Total Emissions, 2018–2038	12,121	35,406

Notes:
$MtCO_2e$ = metric tons of carbon dioxide equivalent
Vegetation Removal, Soil Disturbance, and Wetland Loss emissions represent the total emissions resulting from the proposed project emission sources, including: (1) loss of accumulated carbon stocks during construction,; (2) lost sequestration from removed vegetation that increases emissions,; and (3) reduction in carbon dioxide and methane emissions from permanently filled wetlands.

For construction of the On-Site Alternative, carbon stocks losses are estimated to be 11,771 metric tons of CO_2e and total (2018 to 2038) emissions are estimated to be 12,121 metric tons of CO_2e (which includes GHG emissions of 350 metric tons of CO_2e from lost sequestration/wetland emissions reductions).

For construction of the Off-Site Alternative, carbon stocks losses are estimated to be 35,908 metric tons of CO_2e and total (2018 to 2038) emissions are estimated to be 35,406 metric tons of CO_2e. This estimate includes GHG emissions of –502[21] metric tons CO_2e (i.e., a reduction in emissions) that occur beyond the initial vegetation removal and surface soil disturbance. These emissions are due to

[21] -502 $MtCO_2e$ is calculated from -23.9 $MtCO_2e$ per year over the 21 year lifetime of the project.

the change in emissions from lost sequestration and the ceasing of greenhouse gas emissions from the lost wetlands. While lost sequestration results in an increase in emissions, these emissions are outweighed by the loss of wetlands and the ceasing of carbon dioxide and methane emissions associated with these wetlands.

The Off-Site Alternative would have a substantially larger change in area resulting from construction (207 versus 50 acres) than the On-Site Alternative as well as a substantially different change in wetland area (51.3 versus 24.1) and wetland area make-up. The reduction in ongoing wetlands carbon dioxide and methane emissions for the Off-Site Alternative would be larger than lost sequestration; this results in the negative annual emissions value.

3.2.1.2 Export Terminal Construction

Export terminal construction emissions, unlike the other sources evaluated, occur only during an 18-month period prior to the operation. The analysis assumes the 18-month construction period would occur between 2018 and 2020. For the purposes of estimating emissions associated with export terminal operation, the analysis assumes construction would be completed by 2021. The emissions from the operation of construction equipment (Table 21) would exceed those of the barges used for bringing construction materials to the project area.

Table 21. Export Terminal Construction Emissions ($MtCO_2e$)[22]

Emissions Source	Emissions During 12-Months of Construction Period	Total Emissions, 2018–2020[a] (On-Site Alternative and Off-Site Alternative)
Construction Equipment	5,349	8,024
Employee Commuting	465	698
Construction Trucks Carrying Materials to Project Area	1,081	1,621
Construction Barges Carrying Materials to Project Area	955	1,433
Subtotal	**7,851**	**11,776**

Notes:

[a] Construction emissions occur over an 18-month period prior to the operation of the terminal; therefore, emissions from 2021 through 2038 are zero. Given the 18-month period for construction, total construction emissions are those for the 12-month period multiplied by 1.5.

$MtCO_2e$ = metric tons of carbon dioxide equivalent

3.2.1.3 Export Terminal Equipment Operations

After the start-up period, greenhouse gas emissions from mobile equipment used for routine operation of the export terminal would remain constant throughout the time series (Table 22). The operations and maintenance equipment includes loaders, trucks, bobcats, forklifts, and cranes.

[22] Both the On-site and Off-site Alternative would result in the same amount of construction related emissions.

Table 22. Export Terminal Operation Emissions from Mobile Combustion ($MtCO_2e$)

Period	On-Site Alternative and Off-Site Alternative
Annual Emissions, 2028	903
Total Emissions, 2018–2038	12,894

Notes:
$MtCO_2e$ = metric tons of carbon dioxide equivalent

3.2.1.4 Vessel Idling and Tugboat Use

Table 23 shows that tugboats emit approximately twice as many greenhouse gas emissions as idling vessels. After the start-up period, emissions from idling vessels and tugboats would remain constant throughout the time series.

Table 23. Emissions from Vessel Idling and Tugboat Use at Terminal ($MtCO_2e$)

Emissions Source	On-Site Alternative and Off-Site Alternative
Vessel Idling at Terminal	
Annual Emissions, 2028	2,498
Total Emissions, 2018–2038	35,660
Tugboat Operation	
Annual Emissions, 2028	4,840
Total Emissions, 2018–2038	69,081
Subtotal	
Annual Emissions, 2028	7,338
Total Emissions, 2018–2038	104,740

Notes:
$MtCO_2e$ = metric tons of carbon dioxide equivalent

3.2.1.5 Rail Operation

Table 24 summarizes rail emissions in the project areas.

Table 24. Project Area Locomotive Operation Emissions ($MtCO_2e$)

Emissions Source	On-Site Alternative and Off-Site Alternative
Annual Emissions, 2028	1,414
Total Emissions, 2018–2038	20,184

Notes:
$MtCO_2e$ = metric tons of carbon dioxide equivalent

3.2.1.6 Employee Commuting

After the start-up period, greenhouse gas emissions from employee commuting during operations would remain constant throughout the time series (Table 25).

Table 25. Employee Commuting ($MtCO_2e$)

Period	On-Site Alternative and Off-Site Alternative
Annual Emissions, 2028	275
Total Emissions, 2018–2038	3,922

Notes:
$MtCO_2e$ = metric tons of carbon dioxide equivalent

3.2.2 Outside the Project Areas

This section presents greenhouse gas emissions outside of the project areas. These emissions sources include rail and vessel transport, and emissions from electricity consumption.

3.2.2.1 Rail Transport

Table 26 summarizes emissions from transport on the Reynolds Lead and BNSF Spur. Trains would need to travel approximately 0.5 mile further on the Reynolds Lead under the Off-Site Alternative, and therefore, emissions from rail transport would be higher under the Off-Site Alternative than the On-Site Alternative. After the start-up period, emissions from rail transport would remain constant throughout the time series.

Table 26. Locomotive Operation Emissions on Reynolds Lead and BNSF Spur ($MtCO_2e$)[23]

Emissions Source	On-Site Alternative	Off-Site Alternative
Annual Emissions, 2028	5,321	5,695
Total Emissions, 2018–2038	75,836	81,177

Notes:
$MtCO_2e$ = metric tons of carbon dioxide equivalent

3.2.2.2 Vessel Transport

Table 27 shows greenhouse gas emissions from vessel transport outside the project areas to the mouth of the Columbia River. Vessels would need to travel approximately 1.5 miles further upriver under the On-Site Alternative compared to the Off-Site Alternative, and therefore emissions from vessel transport would be higher under the On-Site Alternative. After the start-up period, emissions from vessel transport would remain constant throughout the time series.

[23] This table excludes on-site emissions.

Table 27. Emissions from Vessel Transport Outside the Project Areas ($MtCO_2e$)

Period	On-Site Alternative	Off-Site Alternative
Annual Emissions, 2028	47,721	46,634
Total Emissions, 2018–2038	682,202	666,540

Notes:
$MtCO_2e$ = metric tons of carbon dioxide equivalent

3.2.2.3 Electricity Consumption

Table 28 shows emissions from power plants outside the project area resulting from electricity consumption within the project areas. Electricity consumption emissions are assumed constant across all years of the time series for which the export terminal is operational (2021 to 2038).

Table 28. Emissions from Export Terminal Electricity Consumption ($MtCO_2e$)

Period	On-Site Alternative and Off-Site Alternative
Annual Emissions, 2028	177
Total Emissions, 2018–2038	3,191

Notes:
$MtCO_2e$ = metric tons of carbon dioxide equivalent
Emissions from electricity consumption are included as emissions beyond the project area. While the consumption of electricity takes place in the project area, the emissions associated with this consumption take place outside the project area.

3.2.3 Greenhouse Gas Emissions

This section presents the total emissions from the sources described above during construction and operations.[24]

Table 29 shows total project area greenhouse gas emissions for the On-Site Alternative and Off-Site Alternative. The largest contributors to emissions within the project area for the On-Site Alternative would be emissions from vessel idling and tugboat use at the terminal and emissions from rail operations. Together, these two sources contribute approximately 75% of project area emissions. Construction, employee commuting, mobile operations, vessel idling and tugboat use, and vegetation and wetlands removal make up the remaining approximately 25%.

For the Off-Site Alternative, vegetation and wetland emissions would play a larger role in emissions (18.7% compared to 7.3% in the On-Site Alternative) due to the increase in loss of carbon already sequestered by existing biomass and the loss of ongoing carbon sequestration from living vegetation that would be removed. As a result, the share of emissions from vessel idling and tugboat use and emissions from rail operations would be 66.1%.

[24] Although this analysis only looks at emissions over the 21 year time horizon specified in Section 2.1.2.1, *Scope of Analysis*, actual emissions from operating the terminal would continue throughout the lifetime of the terminal.

Table 29. Project Area Emissions ($MtCO_2e$)

Period	On-Site Alternative	Off-Site Alternative
Annual Emissions, 2028	9,947	9,907
Total Emissions, 2018–2038	165,637	188,922

Notes:
$MtCO_2e$ = metric tons of carbon dioxide equivalent

Project area emissions would contribute approximately 18% of total GHG emissions for the On-Site Alternative, and 20% of total GHG emissions for the Off-Site Alternative. Although annual emissions for 2028 would be slightly greater for the On-Site Alternative, project area emissions from the Off-Site alternative would be greater throughout the time series due to greater emissions from land clearing during the construction period.

Greenhouse gas emissions generated outside the project areas from either alternative is illustrated in Table 30.

Table 30. Emissions Generated Outside the Project Area (MtCO2e)

Period	On-Site Alternative	Off-Site Alternative
Annual Emissions, 2028	53,219	52,507
Total Emissions, 2018–2038	761,229	750,908

Notes:
$MtCO_2e$ = metric tons of carbon dioxide equivalent

Total greenhouse gas emissions, including construction beginning in 2018 and operation from 2021 through 2038, are presented in Table 31.

Table 31. Total Greenhouse Gas Emissions ($MtCO_2e$)

Period	On-Site Alternative	Off-Site Alternative
Annual Emissions, 2028	63,167	62,414
Total Emissions, 2018–2038	926,866	939,830

Notes:
$MtCO_2e$ = metric tons of carbon dioxide equivalent

3.3 Emissions in Context

To provide a frame of reference for these emissions estimates, the projected annual greenhouse gas emissions from the proposed export terminal under the On-Site Alternative and Off-Site Alternative are compared to the following emission sources and targets:

- *Equivalent additional passenger cars added to the road*. This comparison is made to put emissions in context to a common metric.
- *The Washington State GHG target under EPA's Clean Power Plan*. While the emission sources included in this analysis fall outside the scope of emissions covered under the Clean Power Plan, a comparison was made to the Clean Power Plan to provide context for emissions from the proposed project.

- *The Washington State statewide GHG reduction target, and projected statewide emissions.* Comparing emissions to statewide projected emissions puts the proposed project in a broader context and compares emissions of the proposed project to all emission sources in Washington State.
- *The U.S. Intended Nationally Determined Contribution target.* Compares emissions to a national target.

The total GHG emissions associated with the On-Site Alternative would be 926,866 $MtCO_2e$ from 2018 to 2038, while total GHG emissions for the Off-Site Alternative during this time would be 939,830 $MtCO_2e$. The additional emissions from the Off-Site Alternative are primarily due to increased emissions from vegetation and surface soil removal. Annual emissions would be nearly identical for both alternatives when the terminal reaches full export capacity in 2028. Total emissions of the On-Site Alternative would reach 63,167 $MtCO_2e$ in 2028, equivalent to adding 13,343 additional passenger cars on the road (U.S. Environmental Protection Agency 2016b).

In 2015, the EPA finalized state-specific targets to reduce CO_2 emissions in the power sector to 32% below 2005 levels by 2030. The statewide mass-based CO_2 performance goal for Washington State is approximately 10.74 million short tons (9.74 million metric tons) (U.S. Environmental Protection Agency 2016b). The 2028 total emissions for either alternative would be approximately 0.6% of that total.

Washington State legislation, Revised Code of Washington (RCW) 70.235.020, Limiting Greenhouse Gas Emissions, requires annual greenhouse gas emissions to be reduced to 1990 levels (88.4 $MMTCO_2e$) by 2020 and 25% below 1990 levels by 2035 (66.3 $MMTCO_2e$) (WA State Legislature, 2008). The emissions from the proposed terminal are 0.1% of the 88.4 $MMTCO_2e$ target emissions for 2020 and 0.1% of the 66.3 $MMTCO_2e$ target emissions for 2035. The Washington State goals for 2020 and 2035 represent a reduction of 3.3 $MMTCO_2e$ and 25.4 $MMTCO_2e$, respectively, below the 2011 state emissions levels (91.7 $MMTCO_2e$) (WA State Department of Ecology 2014). Annual GHG emissions associated with the proposed terminal under both the On-Site Alternative and Off-Site Alternative would total approximately 0.06 $MMTCO_2e$, or about 2% and 0.2% of the 2020 and 2035 emissions reduction goal.

Included in the U.S. Intended Nationally Determined Contribution, the U.S. has set an emissions reduction target to reduce emissions 26 to 28% below 2005 levels (6,680 $MMTCO_2e$) by 2025 (United Nations Framework Convention on Climate Change n.d.; U.S. Environmental Protection Agency. 2016c). This policy would therefore reduce annual emissions to a level of 4,943 to 4,810 $MMTCO_2e$ by 2025. This level of emissions in 2025 is 1,165 to 1,298 $MMTCO_2e$ below 2014 annual emissions of 6,108 $MMTCO_2e$ (U.S. Environmental Protection Agency 2016c). Greenhouse gas emissions associated with the project would be equivalent to 0.005% of this target range of reductions. If the target were reached through consistent annual reductions, the United States would have to reduce annual emissions by 106 to 118 $MMTCO_2e$ each consecutive year, beginning in 2015.

Chapter 4
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