Environmental Air Assessment

Fraser Surrey Canola Oil Transload Facility Project

February 17, 2023

Prepared for:

DP World Fraser Surrey
c/o DP World Canada
Suite 1500, Metrotower II
4720 Kingsway,
Burnaby, BC, V5H 4N2

Prepared by:

Stantec Consulting Ltd
#500, 4515 Central Blvd,
Burnaby, BC, V5H 0C6

Project Number: 123222054

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Prepared by: Digitally signed by April Hauk Date: 2023.02.17 16:06:56 -08'00'

Signature

April Hauk, B.Sc., EP

Reviewed by:

Signature

Sandra Hynes, B.Sc.

Approved by:

Signature

Dan Jarratt, P.Eng., EP

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ACRONYMS / ABBREVIATIONS

$\mu g/m^3$	Micrograms per cubic metre
BAT	Best Available Technique
BATEEC	Best Available Technology not Entailing Excessive Cost
BC	British Columbia
CH_4	Methane
CO	Carbon monoxide
CO_2	Carbon dioxide
CSD	Crude Super Degummed
DP World	DP World Ltd.
DWT	Deadweight Tonnage
BC ENV	British Columbia Ministry of Environment and Climate Change Strategy
HC	Hydrocarbon
L/h	Litres per hour
m	metre
m^2	Squared metres
m^3	Cubic metres
m/s	Metres per second
MDO	Marine Diesel Oil
MT	megatonne
N_2O	Nitrous Oxide
NO_X	Oxides of Nitrogen
PARY	Project Area Rail Yard

$PM_{2.5}$	Fine Particulate Matter
PM_{10}	Inhalable Particulate Matter
RBD	Refined, Bleached, and Deodorized
SO_2	Sulphur Dioxide
Stantec	Stantec Consulting Ltd.
TPM	Total Particulate Matter
VFPA	Vancouver Fraser Port Authority

1.0 INTRODUCTION

1.1 FACILITY OVERVIEW

Stantec Consulting Ltd. (Stantec) was retained by DP World Canada Inc. (DP World) to prepare the following Level 1 Environmental Air Assessment to support the planning and permitting process for the Fraser Surrey Canola Oil Transload Facility Project (the Project). DP World is proposing to develop the Project at DP World's Fraser Surrey Terminal located at 11060 Elevator Road, Surrey, British Columbia (BC). The terminal currently handles containers, steel, agri-bulk, and break-bulk cargo via marine, truck, and rail gateways. The terminal is one of the largest multi-use terminals on the west coast of North America, currently comprising seven vessel berths, three quay cranes with lifting capacities of up to 70 metric tonnes, over 190-acres (approximately 77 hectares) of terminal footprint and three sheds with 30,900 square metres (m^2) of covered warehouse storage. DP World Canada acquired operating rights for the terminal in 2020.

2.0 PROJECT DESCRIPTION

2.1 PROJECT OVERVIEW

The Project comprises the redevelopment of Berth 10 at DP World's Fraser Terminals with construction of a marine access trestle, loading platform and pedestrian catwalk to complement existing mooring infrastructure. The Project also includes the development of a canola storage facility and rail receiving and loading infrastructure on Schedule A and B federal lands and waters lots within the Vancouver Fraser Port Authority (VFPA) leased DP World Fraser Surrey area.

2.1.1 Terminal Operations

The Project has been designed to support an annual throughput capacity of 1,000,000 tonnes of canola oil per year. It is expected to be at full capacity by 2033 (horizon year). Prior to that it is estimated the Project will operate at receiving 300,000 tonnes of canola oil per year.

Once fully operational, the facility is designed to support the storage, transfer and loading of two specific grades of canola oil, including:

- Crude Super Degummed (CSD)
- Refined, Bleached, and Deodorized (RBD)

Both CSD and RBD grade canola oil will be received in rail tank cars, intermediate storage tanks will only be constructed for the CSD grade canola oil. To facilitate the handling of RBD grade canola oil, the facility will include the ability for direct transfer from rail tank cars to marine vessels via an underground loading pipeline to a marine loading arm. CSD grade canola oil will be unloaded and pumped from rail cars to the new tanks for intermediate storage before being pumped to marine vessels for export, but the CSD grade canola oil can also be loaded directly to ship (i.e., bypassing intermediate storage if this option is required).

The railcar unloading system is designed to provide the capacity to unload up to 35 cars (131,000-litres per car) per 8-hour shift. At peak delivery volumes (1,000,000 tonnes of canola oil per year) the unloading system will operating at a lower capacity of 32 cars every 25-hours. Rail cars will be unloaded via unloading piping from the bottom of each car. Discharge from the new unloading pumps will be tied into a piping system to distribute CSD grade canola oil to the intermediate oil storage tanks. RBD oil will be transferred directly on to ships with no intermediate storage required.

The canola oil storage facility will store approximately 45,000 tonnes of CSD grade canola oil prior to the load out to ships. Each of the three 15,000 megatonne (MT) intermediate storage tanks has been designed to include an agitator system which when operated will avoid product settling and gumming during storage.

The Project will be operated during the established 24/7 terminal hours and is expected to require up to ten full time employees.

2.1.2 Marine Operations

When a docked vessel is ready to load, marine loading pumps will draw canola oil from the storage tank facility and pump the oil to the marine loading arm located on the loading platform at Berth 10. The system will consist of a single marine loading arm with an expected maximum capacity of 1,200 cubic metres per hour (m^3/hr). Canola oil will be pumped from the storage tanks to the marine vessel through underground conveyance piping.

Berth 10 is already designed to receive a Handymax size product bulk liquid tanker vessel (between 35,000 and 48,000 dry weight tonne (DWT), measuring between 150 m to 200 m in length with a draft of 11 to 12 m depth).

2.2 BASELINE CASE – ACTIVITY AND THROUGHPUT SUMMARY

The Project is a new activity of transloading canola oil proposed to be commissioned in Berth 10 of DP World's Fraser Surrey Terminal. The Project consists of a new infrastructure specific for canola storage, transfer, and loading. The Project full capacity will be achieved by 2023.

Berth 10 is currently intermittently used for loading bulk cargo and log vessels. DP World estimates that there are four Handymax vessels (two log ships and two salt ships) with two salt barge transfers per year. There are no rail or truck movements associated with the Baseline Case. It is assumed that the specifications and operation activities of current Handymax vessels and associated harbor tug boats (used for the salt barge transfers) at Berth 10 (in current use) are same as the Project Case. However, the Project Case will have 33 Handymax vessels per year berthed at Berth 10. Therefore, emissions for current activity (Baseline Case) at Berth 10 have been quantified as 12% of the full capacity emissions (Project Case) based on the use of the Handymax vessels (e.g., 4/33 = 12%). This information has been included in this assessment for information purposes. The Baseline activities will continue concurrently with the Project Case.

2.3 PROJECT CASE – ACTIVITY AND THROUGHPUT SUMMARY

The Project is designed for an annual throughput capacity of 1,000,000 tonnes of canola oil per year. Canola oil will be delivered in 32 cars every 25 hours. Rail cars will be unloaded via unloading piping from the bottom of each car to three 15,000 MT storage tanks. Canola oil will then be loaded on to bulk liquid tank vessels ranging from Handy to Handymax sized, with an estimated 33 calls per year at full capacity. The Project will be operated during the established 24/7 terminal hours.

Market conditions will govern when the Project is able to be utilized at full capacity of 1,000,000 tonnes of canola oil throughput annually. At present, it is estimated that this will occur by year 2033.

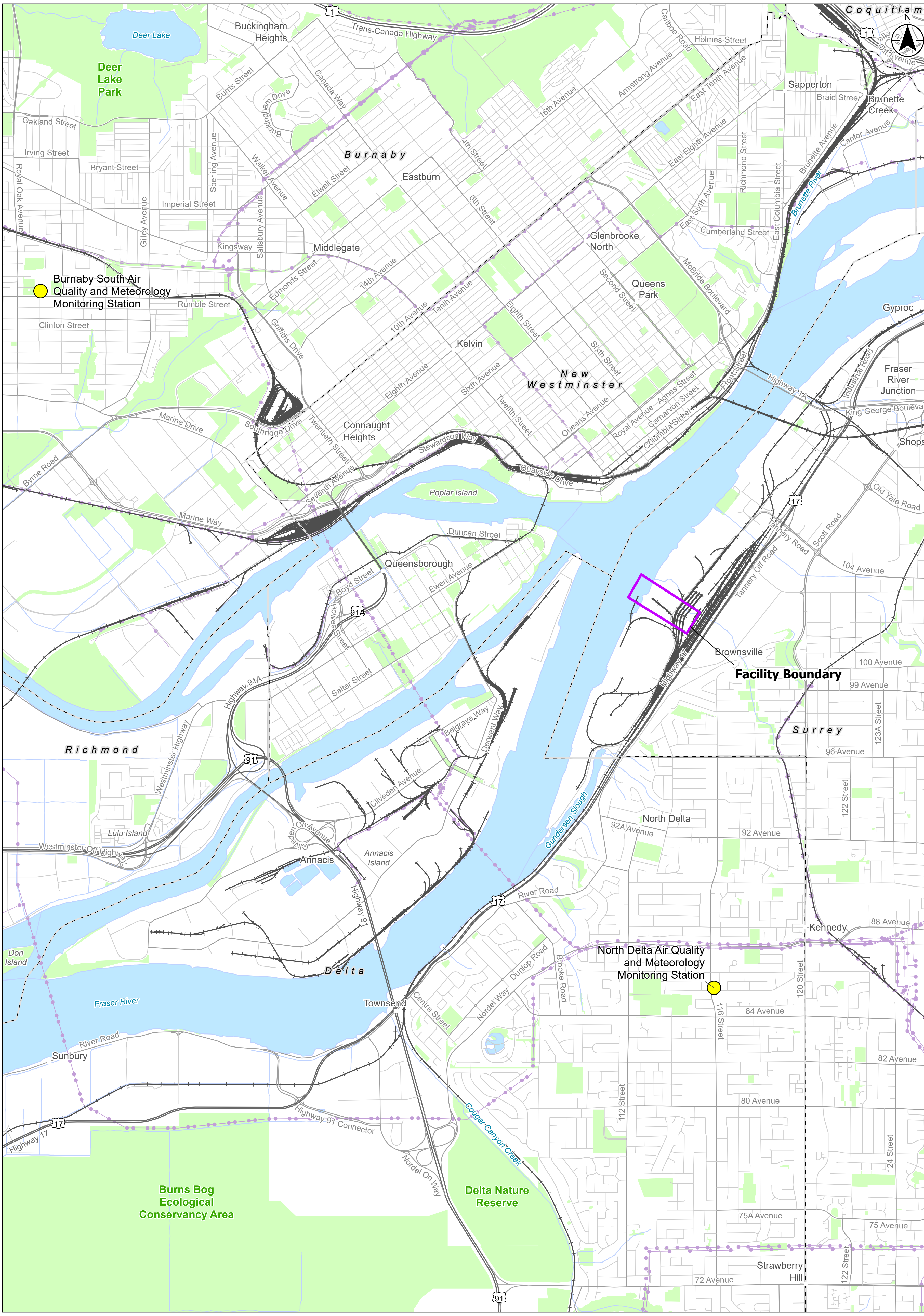
2.4 NO PROJECT CASE – ACTIVITY AND THROUGHPUT SUMMARY

A No Project Case would imply that the Project is not built. In this case, the No Project Case would equal the Baseline Case (Section 2.2)..

3.0 GEOGRAPHIC SCOPE

3.1 FACILITY

The facility boundary for the Project encompasses Berth 10, associated canola oil loading and storage infrastructure, and rail car movement within the Project Area Rail Yard (PARY). The facility boundary is shown in Figure 1. Figure 1 also shows that location of the nearest air quality and meteorology monitoring stations (*e.g.,* Burnaby South and North Delta).



Highway
Road
Local Street
Trail
Railway
Transmission Line
Watercourse
Waterbody
Municipal Boundary
Local Greenspace
Facility Boundary

Sensitive Receptors

Meteorology Monitoring Station

0 0.5 1 1.5 km

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Notes
1. Coordinate System: NAD83 UTM Zone 10N
2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada, City of Surrey, ESRI Base Data

Stantec DP WORLD Canada

Project Location
Surrey, BC

Project Number: 123222054
Prepared by EHERTZMAN on 20220912
Requested by AHAUK on 20220908
Checked by GROUSSEAU on 20230105

Client/Project/Report
DP World Canada
Fraser Surrey Canola Oil Transload Facility

Figure No.
1

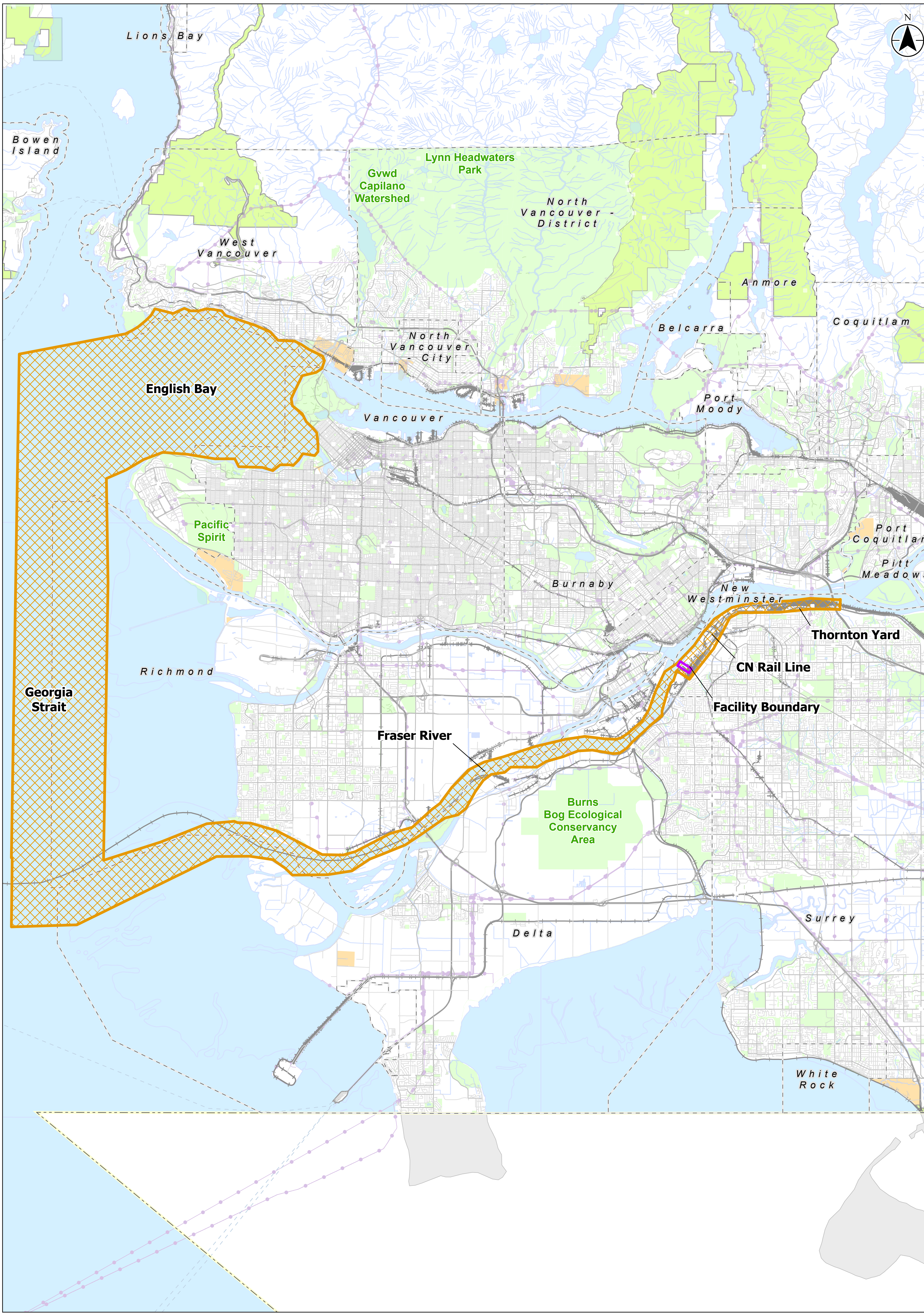
Title
Facility Boundary

3.2 SUPPLY CHAIN

The supply chain considers emissions from marine vessels and locomotives that support the Project. Marine vessels within the supply chain will transit from the boundary of Georgia Strait into English Bay, where vessels may anchor prior to proceeding to the Project site.

The rail supply chain will consider emissions of locomotives transporting cars with canola oil to site from the CN Rail Thornton Yard. Emissions include car switching and transport.

Figure 2 shows the supply chain boundary.



Supply Chain Boundary

Facility Boundary

Notes
1. Coordinate System: NAD83 UTM Zone 10N
2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada, City of Surrey, ESRI Base Data

0 2 4 6 8 km

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Figure No.
2

Title
Supply Chain Boundary

3.3 RECEIVERS OF INTEREST, IDENTIFICATION AND PROXIMITY

Receivers of interest have been identified within a two km radius of the Project site. A two km radius is used as an area where the greatest effects to air quality, as a result of the Project activities, are likely to occur.

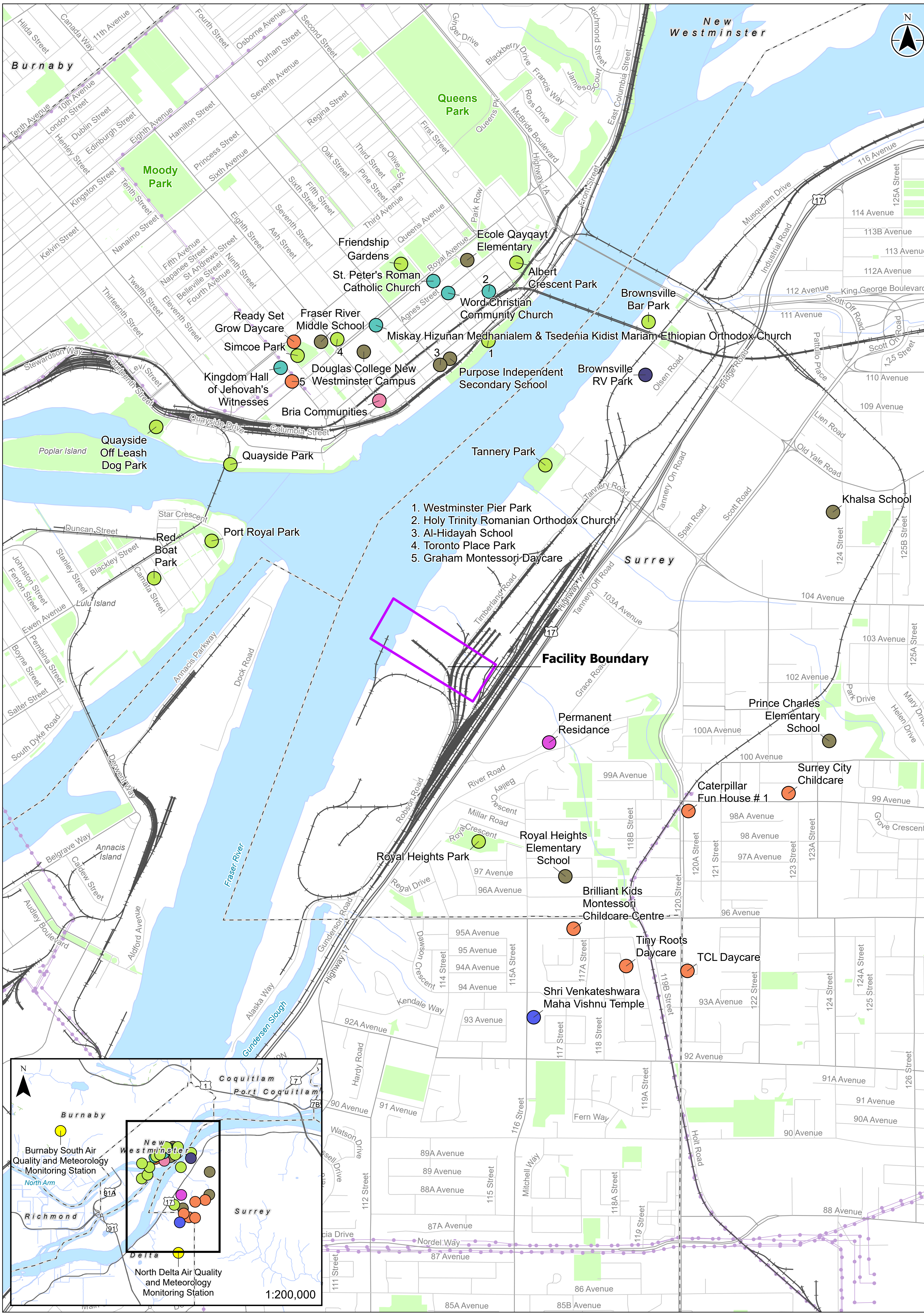
The Project site is approximately 4.5 km west of Surrey and 1.2 km south of New Westminster. The area immediately adjacent to the Project site (*i.e.,* 500 m to the south, 1.2 km to the east, west and north) is characterized as industrial. From 1.2 km to two km the area is characterized as urban, a mix of high-density housing, retail, and commercial activities. The closest residence is 680 m south of the Project site on River Road. Within the two km radius, there are a number of permanent residences, schools, daycares, churches and temples, senior housing, and parks. Table 1 and Figure 3 provides a summary of these receivers of interest

Table 1 Nearby Receivers of Interest

Receptor ID	Description	Street Address	UTM Location (Zone 10)		Distance and Direction to Berth 10
			Easting (m E)	Northing (m N)	
Closest Residence	Permanent Residence	11665 River Rd, Surrey	507315	5448066	680 m S
School 1	Royal Heights Elementary School	11665 97 Ave, Surrey	507399	5447371	995 m SSE
School 2	Khalsa School	10677 124 St, Surrey	508789	5449263	1.8 km ENE
School 3	Purpose Independent Secondary School	502 Columbia St, New Westminster	506800	5450059	1.3 km NNE
School 4	Prince Charles Elementary School	12405 100 Ave, Surrey	508769	5448074	1.7 km ESE
School 5	Douglas College New Westminster Campus	700 Royal Ave, New Westminster	506353	5450095	1.2 km NNW
School 6	Fraser River Middle School	800 Queens Ave, New Westminster	506131	5450147	1.5 km NW
School 7	Ecole Qayqayt Elementary	85 Merivale St., New Westminster	506890	5450571	1.7 km NNE
School 8	Al-Hidayah School	7 6th St, New Westminster, BC V3L 1B1	506749	5450027	1.4 km W
Daycare 1	Tiny Roots Daycare	9468 119 St., Delta	507715	5446905	1.6 km SE
Daycare 2	Surrey City Childcare	12250 100 Ave, Surrey	508558	5447803	1.6 km ESE
Daycare 3	TCL Daycare	9333B 120a St, Surrey	508033	5446880	1.8 SE
Daycare 4	Brilliant Kids Montessori Childcare Centre	11706 96 Ave, Delta	507442	5447099	1.3 km SSE
Daycare 5	Caterpillar Fun House # 1	9868 120 St #101, Surrey	508038	5447710	1.2 km SE
Daycare 6	Graham Montessori Daycare	1001 Royal Ave #2, New Westminster	505980	5449941	1.3 km NW
Daycare 7	Ready Set Grow Daycare	800 Queens Ave, New Westminster	505990	5450147	1.5 km NW
Senior	Bria Communities	11 Eighth St 10th Floor, New Westminster	506433	5449841	1.1 km S
Church 1	Kingdom Hall of Jehovah's Witnesses	120 10th St, New Westminster	505921	5450012	1.4 km SSE
Church 2	Miskay Hizunan Medhanialem & Tsedenia Kidist Mariam Ethiopian Orthodox Church	628 Royal Ave, New Westminster	506416	5450233	1.4 km S
Church 3	Word Christian Community Church	336 Agnes St, New Westminster	506791	5450400	1.6 km NNE
Church 4	St. Peter's Roman Catholic Church	330 Royal Ave, New Westminster	506714	5450462	1.6 km NNE

Table 1 Nearby Receivers of Interest

Receptor ID	Description	Street Address	UTM Location (Zone 10)		Distance and Direction to Berth 10
			Easting (m E)	Northing (m N)	
Church 5	Holy Trinity Romanian Orthodox Church	220 Carnarvon St, New Westminster	507002	5450408	1.7 km NNE
Temple	Shri Venkateshwara Maha Vishnu Temple	9316 116 St, Delta	507235	5446639	1.8 km S
Park 1	Royal Heights Park	9797 115a St, Surrey	506949	5447552	846 m SSW
Park 2	Tannery Park	10761 Dyke Rd, Surrey	507295	5449506	908 m NE
Park 3	Brownsville Bar Park	11931 Old Yale Rd, Surrey	507831	5450250	1.9 km NE
Park 4	Red Boat Park	250 Holly Ave, New Westminster	505264	5448919	1.2 km W
Park 5	Port Royal Park	215 Salter St, New Westminster	505563	5449113	961 m WNW
Park 6	Quayside Park	1260 Quayside Dr, New Westminster	505660	5449510	1.1 km WNW
Park 7	Quayside Off Leash Dog Park	1400 Quayside Dr, New Westminster	505275	5449705	1.6 km WNW
Park 8	Simcoe Park	124 McInnes St, New Westminster	506009	5450075	1.4 km NW



Sensitive Receptors

- Church
- Closest Residance
- Daycare
- Meteorology Monitoring Station
- Park
- RV Park
- School
- Senior
- Temple

- Highway
- Road
- Local Street
- Railway
- Transmission Line
- Watercourse
- Waterbody
- Municipal Boundary
- Facility Boundary
- Local Greenspace

0 200 400 600 800 m

1:20,000 (at original document size of 11x17)

Notes
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Client/Project/Report
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Fraser Surrey Canola Oil Transload Facility

Figure No.
3

Title
Nearby Receiver of Interest

4.0 EMISSION SOURCES

4.1 PRIMARY SOURCES

The primary emission sources associated with the Project are marine and rail activities. The Project sources include Handymax bulk carriers with assisting tug boats, switch locomotives and rail line haul locomotives. The emission sources are listed in Table 2.

Table 2 Primary Emission Sources

Boundary	Primary Source	Detail	Mode	Metric	Fuel	Combustion Source Type
Facility	Marine	Handymax Bulk Carrier	Maneuvering	33 vessels per year Two hours for berthing/unberthing Boiler Fuel Consumption = 70 L/h	Marine Diesel Oil (MDO)	Main Engine Tier I C3 Auxiliary Engine Tier I C2 Composite Boilers
			Loading	33 vessels per year 30 hours for loading Boiler Fuel Consumption = 70 L/h	MDO	Auxiliary Engine Tier I C2 Composite Boilers
		Tug Boat	Assisting	Two per carrier visit	Ultra-low Sulphur Diesel (ULSD)	Auxiliary Engine Tier 0 C2
	Rail	Switch Locomotive	Operations	Two engines in one switching locomotive 50 minutes per day (average 6.2 days per week) and a CN switching locomotive	Diesel	Cummins QSX15, 1200 hp, Tier IV
Supply Chain	Marine	Handymax Bulk Carrier	Travelling	33 vessels per year Travel from English Bay to Project = 57 km Travel speed = 10 knots (18.5 km/h) Travel time one way = 3.1 hours Boiler Fuel Consumption = 70 L/h	MDO	Main Engine Tier I C3 Auxiliary Engine Tier I C2 Composite Boilers
		Handymax Bulk Carrier	Anchoring	33 vessels per year Anchored for 24 hours	MDO	Auxiliary Engine Tier I C2 Composite Boilers

Table 2 Primary Emission Sources

Boundary	Primary Source	Detail	Mode	Metric	Fuel	Combustion Source Type
		Tug Boat	Assisting	two per carrier visit while travelling	ULSD	Auxiliary Engine Tier 0 C2
	Rail	CN Line Haul Locomotives	Operations	32 cars per visit, 100 trips per year from Thornton Yard	Diesel	General Electric, 6,000 hp

4.2 EMISSION VARIABILITY

The Project is set to operate 24 hours a day seven days a week. Emissions are calculated on an annual average basis based on the expected number of vessels per year and number of rail cars received. However, some variability in emissions can be expected, with higher emissions occurring while there is a ship at berth and during the operation of the locomotives on site.

4.3 POLLUTANTS OF CONCERN

All criteria air contaminants (CACs) emissions associated with the Project are from fuel combustion during operations. The CACs included in the assessment are nitrogen oxides (NO_X), sulphur dioxide (SO_2), fine particulate matter ($PM_{2.5}$), inhalable particulate matter (PM_{10}), total particulate matter (TPM), carbon monoxide (CO), and total hydrocarbon (HC). Greenhouse gas emissions such as carbon dioxide (CO_2), nitrous oxide N_2O, and methane (CH_4) are also included.

5.0 CURRENT CONDITION

5.1 AIR QUALITY

Ambient background concentrations were determined based on regional ambient air quality monitoring data. Monitoring data are derived from the Burnaby South monitoring station, located 6.5 km northwest of the Project, and the North Delta monitoring station, located 3.5 km south of the Project. These monitoring stations are owned and operated by Metro Vancouver. Monitoring data for the Burnaby South and North Delta monitoring stations are available from the British Columbia Ministry of Environment and Climate Change Strategy (ENV) annual summaries of ambient air quality data (ENV 2021) and the BC Air Data Archive (ENV 2022).

The average of the most recent three years (2018 to 2020) of ambient background concentrations are presented in Table 3, and are compared to the Metro Vancouver Ambient Air Quality Objectives (AAQO) (Metro Vancouver, 2020). The background concentrations were determined by calculating the annual maximum for each averaging period and for each of the three years, then averaged. The calculation for background NO_2 differs in that the daily 1-hour maximum is determined, then the 98th percentile value is calculated for each of the three years, then averaged.

Background concentrations are less than the Metro Vancouver AAQO, except for $PM_{2.5}$ and PM_{10}. In 2018 and 2020 Metro Vancouver air quality was heavily influenced by wildfire smoke causing the $PM_{2.5}$ and PM_{10} concentrations to be elevated. .

Table 3 Background Concentrations

Criteria Air Contaminant	Averaging Period	Background Concentration (µg/m3)		Ambient Air Quality Objective (µg/m3) a
		Burnaby South	North Delta	
NO2	1-hour b	72.6	80.2	113
	Annual c	22.8	22.6	32
SO2	1-hour d	30.3	N/A	183
	Annual e	0.8	N/A	13
PM2.5	24-hour f	**124.7**	**109.2**	25
	Annual g	5.9	6.4	8 (6 [h])
PM10	24-hour i	**115.8**	NA	50
	Annual j	9.7	NA	20
CO	1-hour k	1,587	NA	14,900
	8-hour l	589	NA	5,700

NOTES

NA indicated data is not available for that parameter at that monitoring station

Bold values indicate concentrations greater than the regulatory criteria

[a] Metro Vancouver Ambient Air Quality Objectives (Metro Vancouver, 2020)

[b] The 1-hour NO_2 AAQO is calculated using 3-year average of the annual 98th percentile of daily 1-hour maximum. This requires the extraction of the highest predicted 1-hour value at each location for each day, followed by the calculation of the 98th percentile (the eighth highest) of those 365 values for each year, then average the three annual values (2018 to 2020). This is the same method used for determined the background concentration.

[c] The annual NO_2 AAQO is based on the average of all 1-hour average concentrations over a single calendar year. For background purposes the average of the 3-year annual average was calculated for 2018 to 2020.

[c] The 1-hour SO_2 AAQO is the annual maximum 1-hour concentration. For the purpose of background, the 1-hour maximum was determined for each of three years, then averaged (2018 to 2020).

[d] The annual SO_2 AAQO is based on the average of 1-hour concentrations averaged over one year. For purpose of background the average of the 3-year annual averages was calculated for 2018 to 2020.

[e] The $PM_{2.5}$ AAQO is based on a rolling 24-hour average. For the purpose of baseline the 24-hour rolling average was determined for each year (2018 to 2020), then averaged.

[f] The $PM_{2.5}$ AAQO is based on annual average, average over one year. For the purpose of baseline, the annual average was calculated for 2018 to 2020, then averaged

[h] This AAQO for $PM_{2.5}$ is a planning objective is a long-term aspirational target to support continuous improvement.

[I] The 24-hour PM_{10} AAQO is based on a rolling 24-hour average. For the purposes of baseline the maximum 24-hour rolling average was determined for 2018 to 2020, then averaged.

[j] The PM_{10} AAQO is based on annual average, averaged over one year. For the purpose of baseline, the average of the 3-year annual average was calculated for 2018 to 2020.

[k] The 1-hour CO AAQO is based on the maximum 1-hour concentration. For the purpose of baseline, the maximum 1-hour concentrations was determined for three years (2018 to 2020) then averaged

[j] The 8-hour CO AAQO is based on a rolling 8-hour average concentration. For the purpose of baseline, the maximum 8-hour rolling average concentrations were determined for each of three years (2018 to 2020), then averaged.

5.2 METEOROLOGICAL INFLUENCES

Meteorology influences the way air emissions from industrial and natural sources disperse into the atmosphere, and hence have a direct effect on ambient air quality. Atmospheric dispersion of emissions is governed by the amount of turbulence that exists in the mixed layer of air in contact with the ground. Turbulence levels are dependent on thermal effects (*e.g.,* vertical temperature stratification) and mechanical effects caused by topography, surface roughness, and wind speed. The height of the mixing layer determines the vertical extent to which emissions can diffuse. Meteorology varies with time of day and year and can vary from location to location because of terrain and land cover influences on turbulence and wind field.

Wind and temperature are analyzed for both the Burnaby South and North Delta stations for the most recent three years of available meteorological data (2019 to 2021). The location of the Burnaby South and North Delta meteorology and air quality monitoring stations is shown in Figure 1. Figure 4 shows the frequency distributions of hourly average wind speed and wind roses for the two meteorological stations. For 84% and 91% of the time, wind speeds are less than 4.0 m/s at the Burnaby South and North Delta stations, respectively. Winds from the south, north, and northeast are the most dominant and prevailing for the Burnaby South station, while winds from the east, east-northeast, and west are the most dominant and prevailing for the North Delta station.

Monthly average temperatures are shown in Table 4 and Figure 5. Temperatures at North Delta are slightly higher than those at Burnaby South. Seasonally, July and August are the hottest months and February is the coldest.

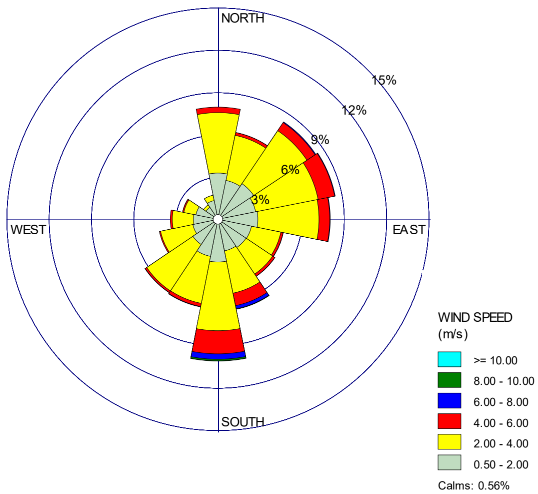
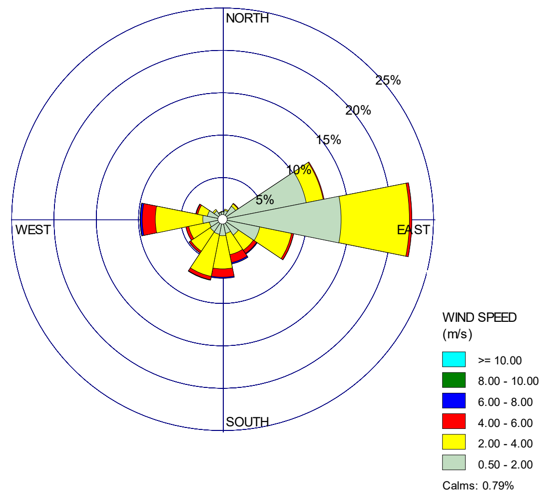
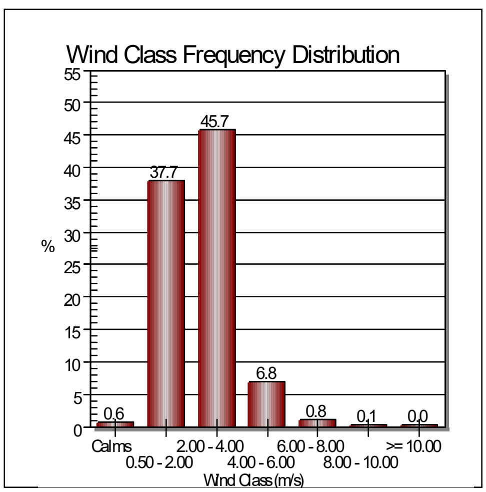
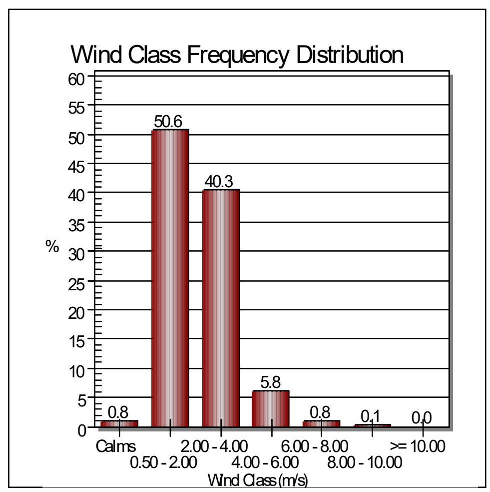
Burnaby South	North Delta
	
	

Figure 4 Measured Wind Roses and Wind Classes at two Surface Meteorological Stations (2019-2021)

Table 4 Monthly Average Temperatures at two Surface Meteorological Stations (2019-2021)

Station	Monthly Average Temperature (°C)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
North Delta	5.2	2.5	6.5	10.1	14.0	16.6	18.7	18.5	15.7	9.8	6.8	3.8
Burnaby South	4.1	2.0	5.9	9.7	13.5	16.3	18.2	18.2	15.3	9.1	6.1	3.0

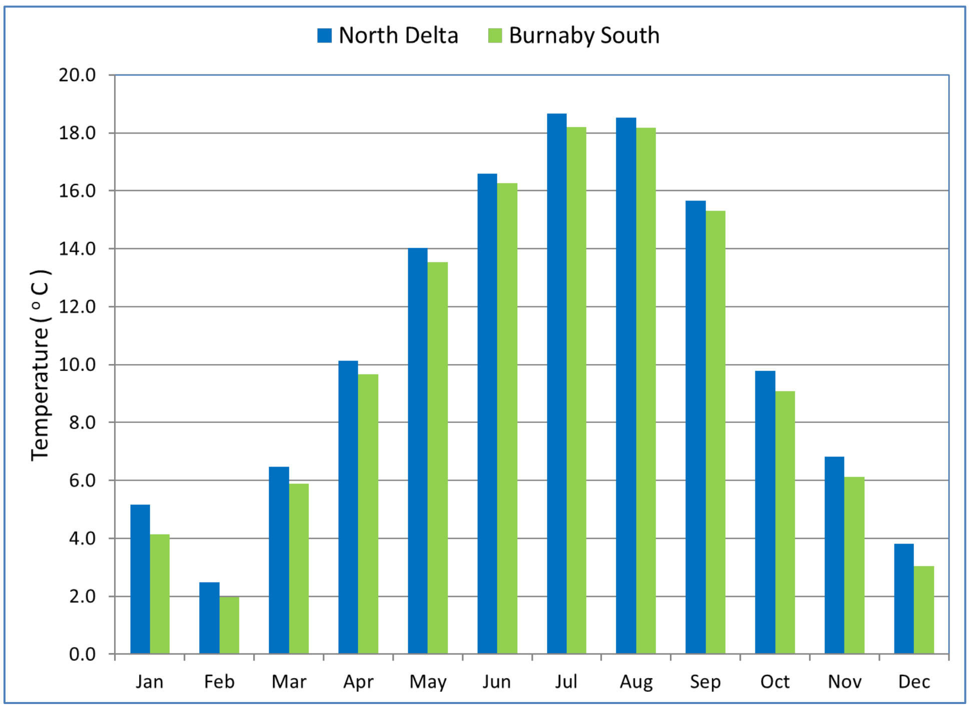


Figure 5 Monthly Average Temperatures at two Surface Meteorological Stations (2019-2021)

5.3 HISTORICAL TRENDS

There are currently no canola oil loading activities occurring at DP World Surrey Docks therefore, historical trends cannot be established.

6.0 FUTURE CONDITION

The future condition establishes the Project case emissions, taking into consideration a business-as-usual scenario (no project case), a best available techniques scenario (BAT case), and design capacity constraints.

6.1 HORIZON YEAR – RATIONALE

A future horizon year should be chosen that reflects the facility after the Project has been completed and activities are at anticipated full production/capacity levels. The Project is estimated to be at full capacity (1,000,000 tonnes of canola oil per year) by 2033.

6.2 DESIGN CAPACITY LIMITATION

The design capacity limitations for the Project include the following,

- Limited rail capacity at the Project site and within the supply chain boundary,
- Design capacity of canola oil loading system,
- Design capacity of the canola storage system.

7.0 EMISSION ESTIMATES

7.1 PROJECT CASE

The Project Case includes marine and rail emission sources. Emissions were calculated for activities at the Facility (Berth 10) and within the Supply Chain Boundary for the horizon year (*i.e.,* 2033).

7.1.1 Facility Marine Emissions

At the Facility, marine emissions are from Handymax sized cargo vessels and two tug boats while berthing, unberthing and during loading of canola oil. It is expected that there will be 33 calls to Berth 10 per year and ships will be at berth for 30 hours for canola oil loading. Table 5 summarizes the marine vessel specifications, emission factors, and calculated emission rates. The emission factors were obtained from the National Research Council Canada (NRC) Marine Emission Factors Study (NRC 2016). The detailed emission rate calculation approaches are presented in Appendix A.

7.1.2 Facility Rail Emissions

At the Facility, there will be two types of switching locomotives. One is on-site switching using a 2GS-12B locomotive, with two Cummins QSX15 engines (1,200 hp) which meets the Government of Canada's (2017) Tier IV emission criteria. Another one is a typical CN switching locomotive.

The on-site switching 2GS-12B locomotive activities are expected to be 50 minutes per day for an average of 6.7 days per week (50 minutes of switching for average 6.7 days per week = 335 operating minutes per week). For the 2GS-12B locomotive switching, it is assumed the maximum fuel consumption rate is 36.1 L/hr (annual average fuel consumption rate 1.10 L/hr) (ARB 2015). For the CN switching locomotive at the Facility,

it was assumed to operate half of time that the on-site switching 2GS-12B locomotive operates and the same average operation days per week, which is 25 minutes per day (average 6.2 days per week). The CN switching locomotive maximum fuel consumption rate is assumed to be 36.0 L/hr (annual average fuel consumption rate 0.55 L/hr) (Railserve 2013). The emission factors for switching 2GS-12B locomotive and the CN switching locomotive and calculated emission rates for rail sources are shown in Table 6. The detailed emission rate calculations are presented in Appendix A.

7.1.3 Supply Chain Marine Emissions

In the Supply Chain, emissions are included from a Handymax sized cargo vessel at anchor, and transiting from the anchorage to the Facility site with two escort tug boats. It is assumed that the Handymax vessel will anchor in English Bay for 24 hours prior to travelling to the Facility site. During this time, it is assumed the auxiliary engine and boiler will be operating. It is expected there will be 33 calls to port (Berth 10) per year. Table 7 provides marine vessel specifications and calculated emission rates for the anchoring activity.

Emissions from the Handymax vessel were calculated for the trip from the English Bay anchorage to the Facility site. For this trip, it is assumed that the main engine, auxiliary engine, and boiler will be operating. The vessel is escorted by two tug boats for the duration of the trip. It is assumed the trip length is 3.1 hours one way and the vessel speed is 10 knots (18.5 km/hr). The emission factors were obtained from the NRC Marine Emission Factors Study (NRC 2016)The marine vessel specifications and calculated emission rates for transit activity are presented in Table 8. The detailed emission rate calculation methods are presented in Appendix A.

7.1.4 Supply Chain Rail Emissions

In the Supply Chain, emissions are calculated for a CN line haul locomotive travelling from the Thornton Yard to the Facility site. This distance is 7 km. The fuel efficiency for the line haul locomotive is assumed to be 0.88 gallons per 1,000 gross ton miles (CN 2020). The annual fuel consumption for the line haul locomotive in the Supply Chain was calculated to be 14,491 L. Using this annual fuel consumption and the emission factors for CN line haul locomotive (shown in Table 6), the Supply Chain rail emissions are calculated and presented in Table 6.

7.1.5 Project Case Emission Summary

A summary of emissions for the horizon year Project Case Facility emissions are provided in Table 9. A summary of emissions for the horizon year (2033) Project Case Supply Chain emissions are provided in Table 10.

Table 5 Marine Vessel Equipment Specification and Emission Summary at the Facility Site (Berth 10)

Unit Description		Handymax Bulk Carrier					Harbor Tug Boat
		Main Engine	Auxiliary Engine		Boiler		
		Maneuvering	Maneuvering	Loading	Maneuvering	Loading	Maneuvering
Engine Power [a]	kW	8,500	2,040	2,040	Assume 1.0 t/h steam generated		1,715
Engine rpm [a]		127	1000 [b]	1000 [b]	-	-	1,600
Engine Speed		Slow	Medium	Medium	-	-	High
Engine Class		Main	Auxiliary	Auxiliary	Boiler	Boiler	Auxiliary [c]
Engine Category [b]		C3	C2	C2	-	-	C2 [c]
Load Factor		0.10 [d]	0.15 [e]	0.15 [e]	1.0 [c]	1.0 [c]	0.5 [f]
Fuel Type [g]		MDO	MDO	MDO	MDO	MDO	ULSD
Specific Fuel Consumption (SFC) [h]	g/kWh	185	227	227	-	-	227
Fuel Consumption [i]	t/h	-	-		0.06	0.06	-
Sulphur Content [g]	%	0.1	0.1	0.1	0.1	0.1	0.0015
Engine Tier [j]		Tier I	Tier I	Tier I	-	-	Tier 0
Berthing/Unberthing and Loading Hours [a]	h	2	2	30	2	30	2
Vessel Numbers Per Year [a]		33					2
Emission Factors (NRC Marine Emission Factors Study (NRC 2016))							
SO_2 [k]	g/kWh	0.36	0.44	0.44	-	-	0.01
NO_X [h]	g/kWh	16.0	12.2	12.2	-	-	13.8
CO [h]	g/kWh	1.40	1.10	1.10	-	-	1.10
HC [h]	g/kWh	0.60	0.40	0.40	-	-	0.40
TPM [l]	g/kWh	0.30	0.30	0.30	-	-	0.25
PM_{10} [l]	g/kWh	0.28	0.28	0.28	-	-	0.24
$PM_{2.5}$ [l]	g/kWh	0.26	0.26	0.26	-	-	0.22
CO_2 [h]	g/kWh	589	686	686	-	-	686
CH_4 [h]	g/kWh	0.012	0.008	0.008	-	-	0.008
N_2O [h]	g/kWh	0.029	0.029	0.029	-	-	0.029
SO_2 [m]	kg/tonne fuel	-	-	-	2.0	2.0	-
NO_X [h]	kg/tonne fuel	-	-	-	12.3	12.3	-
CO [h]	kg/tonne fuel	-	-	-	4.6	4.6	-
HC [h]	kg/tonne fuel	-	-	-	0.38	0.38	-
TPM [n]	kg/tonne fuel	-	-	-	0.53	0.527	-
PM_{10} [h]	kg/tonne fuel	-	-	-	0.51	0.51	-
$PM_{2.5}$ [h]	kg/tonne fuel	-	-	-	0.47	0.47	-
CO_2 [h]	kg/tonne fuel	-	-	-	3188	3188	-

Table 5 Marine Vessel Equipment Specification and Emission Summary at the Facility Site (Berth 10)

Unit Description		Handymax Bulk Carrier					Harbor Tug Boat
		Main Engine	Auxiliary Engine		Boiler		
		Maneuvering	Maneuvering	Loading	Maneuvering	Loading	Maneuvering
CH_4 [h]	kg/tonne fuel	-	-	-	0.290	0.290	-
N_2O [h]	kg/tonne fuel	-	-	-	0.081	0.081	-
Annual emission rates (based on 33 Carriers per year)							
SO_2	t/y	0.020 [o]	0.009	0.134	0.008	0.119	0.001
NOx	t/y	1.095 [o]	0.246	3.696	0.049	0.733	1.562
CO	t/y	0.154 [o]	0.022	0.333	0.018	0.274	0.125
HC	t/y	0.073 [o]	0.008	0.121	0.002	0.023	0.045
TPM	t/y	0.023 [o]	0.006	0.090	0.002	0.031	0.028
PM_{10}	t/y	0.022 [o]	0.006	0.086	0.002	0.030	0.027
$PM_{2.5}$	t/y	0.020 [o]	0.005	0.079	0.002	0.028	0.025
CO_2	t/y	33.04 [o]	13.85	207.82	12.67	190.00	77.65
CH_4	t/y	0.001 [o]	0.0002	0.002	0.001	0.017	0.0009
N_2O	t/y	0.002 [o]	0.001	0.009	0.000	0.005	0.003
CO_2 eq.	t/y	33.67	14.03	210.50	12.79	191.87	78.65

NOTES:
'-' denotes data not applicable
[a] Provided by DP World Fraser Surrey.
[b] Based on Canadian 2010 National Marine Emissions Inventory Table A-10 (SNC Lavalin Environment 2012).
[c] Assumed by Stantec. Note that harbor tug boat is assumed as C2 auxiliary engine so that auxiliary engine emission factors shown in NRC Marine Emission Factors Study Table 60 (NRC 2016) can be applied.
[d] Based on Canadian 2010 National Marine Emissions Inventory Table A-4 (SNC Lavalin Environment 2012).
[e] Based on Canadian 2010 National Marine Emissions Inventory Table A-11 (SNC Lavalin Environment 2012).
[f] Obtained from Ports Emissions Inventory Guidance: Methodologies for Estimating Port-Related and Goods Movement Mobile Source Emissions (U.S. EPA 2022).
[g] Based on NRC Marine Emission Factors Study (NRC 2016) accompanying file "MARINE - MEIT_2015_Emission_Factors.xlsx".
[h] Based on NRC Marine Emission Factors Study Table 60 (NRC 2016). Note that ULSD is treated as MDO when use Table 60.
[i] Assumed fuel consumption rate is 70 L/hour. The MDO density is 0.86 kg/L
[j] Tier defined based on model year described in NRC Marine Emission Factors Study Table 60 (NRC 2016).
[k] Based on NRC Marine Emission Factors Study Page 45 SOx emission factor equation provided by the IMO (NRC 2016).
[l] NRC Marine Emission Factors Study (NRC 2016) accompanying file "MARINE - MEIT_2015_Emission_Factors.xlsx" is used for PM emission factor calculation. This approach is consistent with Canadian 2010 National Marine Emissions Inventory equation (5) and related descriptions (SNC Lavalin Environment 2012).
[m] Based on NRC Marine Emission Factors Study Page 45 SOx emission factor equation provided by SNC Lavalin (NRC 2016).
[n] Based on NRC Marine Emission Factors Study Page 45 PM emission factor equation provided by SNC Lavalin (NRC 2016).
[o] Low load emission scaling factors 1.22 for NOx, 1.96 for CO, 2.18 for HC, 1.22 for N_2O, 2.18 for CH_4, 1.38 for all PM species, and 1.0 for other species were applied, based on NRC Marine Emission Factors Study Table 62 (NRC 2016).

Table 6 Switching Locomotive and Line Haul Locomotive Emission Factors and Emission Rates

Pollutant	Switching Locomotive Emission Factors (g/L) (Switching 2GS-12B locomotive /CN Switching Locomotive)	Facility Rail (t/y)	CN Line Haul Locomotive Emission Factors (g/L)	Supply Chain Rail (t/y)
SO_2	0.02 [a]/0.02 [a]	0.0003	0.02 [a]	0.0003
NO_X	4.02 [b]/57.3 [a]	0.34	34.2 [a]	0.50
CO	7.35 [b]/7.35 [b]	0.12	6.99 [a]	0.10
HC	0.32 [b]/3.34 [a]	0.021	1.34 [a]	0.02
TPM	0.06 [c]/1.18 [c]	0.007	0.69 [a]	0.01
PM_{10}	0.06 [b]/1.18 [a]	0.007	0.69 [a]	0.01
$PM_{2.5}$	0.06 [c]/1.14 [c]	0.007	0.67 [a]	0.01
CO_2	2,680.5 [d]/2,680.5 [d]	42.2	2,680.5 [d]	38.8
CH_4	0.149 [d]/0.149 [d]	0.002	0.149 [d]	0.002
N_2O	1.029 [d]/1.029 [d]	0.02	1.029 [d]	0.015
CO_2 eq.	-	47.1	-	43.3

NOTES

[a] From Locomotive Emission Monitoring Report (Railway Association of Canada 2019)

[b] From Ports Emissions Inventory Guidance: Methodologies for Estimating Port-Related and Goods Movement Mobile Source Emissions (US EPA 2022)

[c] It is assumed TPM is equal to PM_{10} and $PM_{2.5}$ emission factor is 97% of PM_{10}.

[d] From Canadian National Inventory Report (ECCC 2022)

Table 7 Marine Vessel Equipment Specification and Emission Summary during Anchoring in English Bay

Unit Description		Handymax Bulk Carrier				
		Main Engine	Auxiliary Engine		Boiler	
		Maneuvering	Maneuvering	Loading	Maneuvering	Loading
Engine Power [a]	kW	8,500	2,040	2,040	Assume 1.0 t/h steam generated	
Engine rpm [a]		127	1000 [b]	1000 [b]	-	-
Engine Speed		Slow	Medium	Medium	-	-
Engine Class		Main	Auxiliary	Auxiliary	Boiler	Boiler
Engine Category [b]		C3	C2	C2	-	-
Load Factor		0	0.15 [c]	0	1.0 [d]	0
Fuel Type [e]		MDO	MDO	MDO	MDO	MDO
Specific Fuel Consumption (SFC) [f]	g/kWh	185	227	227	-	-
Fuel Consumption [g]	t/h	-	-	-	0.06	0
Sulphur Content [e]	%	0.1	0.1	0.1	0.1	0.1
Engine Tier [h]		Tier I	Tier I	Tier I	-	-
Anchoring Hours [a]	h	24	24	24	24	24
Vessel Numbers Per Year [a]		33				
Emission Factors same as Table 5 (NRC Marine Emission Factors Study (NRC 2016))						
Annual emission rates (based on 33 Carriers per year)						
SO_2	t/y	0	0.108	0	0.095	0
NOx	t/y	0	2.957	0	0.586	0
CO	t/y	0	0.267	0	0.219	0
HC	t/y	0	0.097	0	0.018	0
TPM	t/y	0	0.072	0	0.025	0
PM_{10}	t/y	0	0.069	0	0.024	0
$PM_{2.5}$	t/y	0	0.063	0	0.022	0
CO_2	t/y	0	166.3	0	152.0	0
CH_4	t/y	0	0.002	0	0.014	0
N_2O	t/y	0	0.007	0	0.004	0
CO_2 eq.	t/y	0	168.4	0	153.5	0

NOTES:
[a] Provided by DP World Fraser Surrey.
[b] Based on Canadian 2010 National Marine Emissions Inventory Table A-10 (SNC Lavalin Environment 2012).
[c] Based on Canadian 2010 National Marine Emissions Inventory Table A-11 (SNC Lavalin Environment 2012).
[d] Assumed by Stantec.
[e] Based on NRC Marine Emission Factors Study (NRC 2016) accompanying file "MARINE - MEIT_2015_Emission_Factors.xlsx".
[f] Based on NRC Marine Emission Factors Study Table 60 (NRC 2016).
[g] Assumed fuel consumption rate is 70 L/hour. The MDO density is 0.86 kg/L.
[h] Tier defined based on model year described in NRC Marine Emission Factors Study Table 60 (NRC 2016).

Table 8 Marine Vessel Equipment Specification and Emission Summary during Transit from English Bay to the Facility Site

Unit Description		Handymax Bulk Carrier					Escort Tug Boat
		Main Engine	Auxiliary Engine		Boiler		
		Maneuvering	Maneuvering	Loading	Maneuvering	Loading	Maneuvering
Engine Power [a]	kW	8,500	2,040	2,040	Assume 1.0 t/h steam generated		1,715
Engine rpm [a]		127	1000 [b]	1000 [b]	-	-	1,600
Engine Speed		Slow	Medium	Medium	-	-	High
Engine Class		Main	Auxiliary	Auxiliary	Boiler	Boiler	Auxiliary [c]
Engine Category [b]		C3	C2	C2	-	-	C2 [c]
Load Factor		0.40 [d]	0.15 [e]	0	1.0 [c]	0	0.5 [f]
Fuel Type [g]		MDO	MDO	MDO	MDO	MDO	ULSD
Specific Fuel Consumption (SFC) [h]	g/kWh	185	227	227	-	-	227
Fuel Consumption [i]	t/h	-	-	-	0.06	0	-
Sulphur Content [g]	%	0.1	0.1	0.1	0.1	0.1	0.0015
Engine Tier [j]		Tier I	Tier I	Tier I	-	-	Tier 0
Distance from English Bay to the Terminal	km	57.0	57.0	57.0	57.0	57.0	57.0
Shipping Speed [a]	knot	10.0	10.0	10.0	10.0	10.0	10.0
Shipping Speed	km/h	18.52	18.52	18.52	18.52	18.52	18.52
Shipping Time (one way)	h	3.1	3.1	3.1	3.1	3.1	3.1
Vessel Numbers Per Year [a]		33					2
Emission Factors same as Table 5 (NRC Marine Emission Factors Study (NRC 2016))							
Annual emission rates for two ways (based on 33 Carriers per year)							
SO_2	t/y	0.250	0.028	0	0.024	0	0.002
NOx	t/y	11.05	0.758	0	0.150	0	4.808
CO	t/y	0.967	0.068	0	0.056	0	0.383
HC	t/y	0.414	0.025	0	0.005	0	0.139
TPM	t/y	0.205	0.018	0	0.006	0	0.087
PM_{10}	t/y	0.197	0.018	0	0.006	0	0.084
$PM_{2.5}$	t/y	0.181	0.016	0	0.006	0	0.077
CO_2	t/y	406.8	42.64	0	38.98	0	239.0
CH_4	t/y	0.008	0.000	0	0.004	0	0.003
N_2O	t/y	0.020	0.002	0	0.001	0	0.010
CO_2 eq.	t/y	413.0	43.19	0	39.37	0	242.1

Table 8 Marine Vessel Equipment Specification and Emission Summary during Transit from English Bay to the Facility Site

Unit Description	Handymax Bulk Carrier					Escort Tug Boat
	Main Engine	Auxiliary Engine		Boiler		
	Maneuvering	Maneuvering	Loading	Maneuvering	Loading	Maneuvering

NOTES:
'-' denotes data no applicable
[a] Provided by DP World Fraser Surrey.
[b] Based on Canadian 2010 National Marine Emissions Inventory Table A-10 (SNC Lavalin Environment 2012).
[c] Assumed by Stantec. Note that harbor tug boat is assumed as C2 auxiliary engine so that auxiliary engine emission factors shown in NRC Marine Emission Factors Study Table 60 (NRC 2016) can be applied.
[d] Based on Canadian 2010 National Marine Emissions Inventory Table A-4 (SNC Lavalin Environment 2012).
[e] Based on Canadian 2010 National Marine Emissions Inventory Table A-11 (SNC Lavalin Environment 2012).
[f] Obtained from Ports Emissions Inventory Guidance: Methodologies for Estimating Port-Related and Goods Movement Mobile Source Emissions (U.S. EPA 2022).
[g] Based on NRC Marine Emission Factors Study (NRC 2016) accompanying file "MARINE - MEIT_2015_Emission_Factors.xlsx".
[h] Based on NRC Marine Emission Factors Study Table 60 (NRC 2016). Note that ULSD is treated as MDO when use Table 60.
[i] Assumed fuel consumption rate is 70 L/hour. The MDO density is 0.86 kg/L
[j] Tier defined based on model year described in NRC Marine Emission Factors Study Table 60 (NRC 2016).

Table 9 Horizon Year Project Case Facility Emission Summary (at Berth 10) (tonnes/year) [a]

Pollutant	Facility Marine [b]			Facility Rail [c]	Total Facility
	Handymax Bulk Carrier		Harbor Tug Boat		
	Maneuvering (Main Engine, Auxiliary Engine, and Boiler)	**Loading** (Auxiliary Engine, and Boiler)	**Assisting**		
SO_2	0.04	0.25	0.001	0.0003	0.29
NO_X	1.39	4.43	1.56	0.34	7.72
CO	0.19	0.61	0.12	0.12	1.04
HC	0.08	0.14	0.05	0.021	0.29
TPM	0.03	0.12	0.03	0.007	0.19
PM_{10}	0.03	0.12	0.03	0.007	0.19
$PM_{2.5}$	0.03	0.11	0.03	0.007	0.18
CO_2	59.6	398	77.7	42.2	578
CH_4	0.003	0.02	0.001	0.002	0.03
N_2O	0.003	0.01	0.003	0.02	0.04
CO_2 eq.	60.5	402	78.7	47.1	588

NOTES
[a] Horizon year is 2033 when the Project is expected to be at full capacity.
[b] Facility marine emissions include berthing, unberthing, canola oil loading for marine vessel and tug boat.
[c] Facility rail emissions include use of onsite locomotive for rail car switching.

Table 10 Horizon Year Project Supply Chain Emission Summary (tonne/year) [a]

Pollutant	Marine Emissions during Anchoring at English Bay [b]	Marine Emissions during Transit from English Bay to the Project Site [b]		Supply Chain Rail [c]	Total Supply Chain
	Handymax Bulk Carrier	Handymax Bulk Carrier	Escort Tug Boat		
	Maneuvering (Auxiliary Engine and Boiler)	**Maneuvering** (Main Engine, Auxiliary Engine, and Boiler)	**Assisting**		
SO_2	0.20	0.30	0.002	0.0003	0.50
NO_X	3.54	12.0	4.81	0.50	20.8
CO	0.49	1.09	0.38	0.10	2.06
HC	0.12	0.44	0.14	0.02	0.72
TPM	0.10	0.23	0.09	0.01	0.43
PM_{10}	0.09	0.22	0.08	0.1	0.49
$PM_{2.5}$	0.09	0.20	0.08	0.1	0.47
CO_2	318	488	239	38.8	1,084
CH_4	0.02	0.01	0.003	0.002	0.04
N_2O	0.01	0.02	0.01	0.015	0.06
CO_2 eq.	322	496	242	43.3	1,103

NOTES

[a] Horizon year is 2033 when the project is expected to be at full capacity.

[b] Supply chain marine emissions include anchoring of marine vessel in English Bay and transit from English Bay to the Facility site.

[c] Rail emissions include use of transit canola rail car from Thornton Rail Yard to the Facility site.

7.2 BASELINE CASE

Berth 10 is currently intermittently used for loading bulk cargo and log vessels. DP World estimates that there are four Handymax vessels (two log ships and two salt ships) with two salt barge transfers per year. There are no rail or truck movements associated with the Baseline Case. It is assumed that equipment specifications and operation activities of Baseline Case vessels at Berth 10 as well as within Supply Chain are same as the Project Case. The emissions for the Baseline Case have been quantified as 12% of the full capacity emissions of the Project (e.g., 4/33 = 12%). Table 11 and Table 12 provide a summary of the emissions for the Baseline Case at Berth 10 (*i.e.,* within the Facility Boundary) and within Supply Chain, respectively. It is expected the Baseline Case to occur concurrently with Project activities.

Table 11 Emissions for the Baseline Case at Berth 10 (within Facility Boundary) (tonne/year)

Pollutant	Baseline Marine Emissions			Baseline Total
	Handymax Bulk Carrier		Harbor Tug Boat	
	Maneuvering (Main Engine, Auxiliary Engine, and Boiler)	**Loading** (Auxiliary Engine, and Boiler)	**Assisting**	
SO_2	0.005	0.03	0.0001	0.04
NO_X	0.17	0.54	0.19	0.89
CO	0.02	0.07	0.02	0.11
HC	0.01	0.02	0.01	0.04
TPM	0.004	0.01	0.003	0.02
PM_{10}	0.004	0.01	0.003	0.02
$PM_{2.5}$	0.003	0.01	0.003	0.02
CO_2	7.22	48.2	9.41	64.9
CH_4	0.0003	0.002	0.0001	0.003
N_2O	0.0004	0.002	0.0004	0.002
CO_2 eq.	7.33	48.8	9.53	65.6

NOTE
Assumed Baseline Case bulk carriers specifications and operation activities are same as the Project Case. Therefore, Baseline Case emissions were scaled from the Project Case emissions by multiplying by a ratio of Baseline Case bulk carrier number (4) to Project Case bulk carrier number (33).

Table 12 Emissions for the Baseline Case within Supply Chain (tonne/year)

Pollutant	Marine Emissions during Anchoring in English Bay	Marine Emissions during Transit from English Bay to the Project Site		Baseline Total
	Handymax Bulk Carrier	Handymax Bulk Carrier	Escort Tug Boat	
	Maneuvering (Auxiliary Engine and Boiler)	**Maneuvering** (Main Engine, Auxiliary Engine, and Boiler)	**Assisting**	
SO_2	0.02	0.04	0.0003	0.06
NO_X	0.43	1.45	0.58	2.46
CO	0.06	0.13	0.05	0.24
HC	0.01	0.05	0.02	0.08
TPM	0.01	0.03	0.01	0.05
PM_{10}	0.01	0.03	0.01	0.05
$PM_{2.5}$	0.01	0.02	0.01	0.04
CO_2	38.6	59.2	29.0	127
CH_4	0.002	0.001	0.0003	0.004
N_2O	0.001	0.003	0.001	0.005
CO_2 eq.	39.0	60.1	29.3	128

NOTE

Assumed Baseline Case bulk carriers specifications and operation activities are same as the Project Case. Therefore, Baseline Case emissions were scaled from the Project Case emissions by multiplying by a ratio of Baseline Case bulk carrier number (4) to Project Case bulk carrier number (33).

7.3 EMISSION SUMMARY

The emission summary at Berth 10 within Facility Boundary is presented in Table 13.The emission summary within Supply Chain is presented in Table 14. The Project Case will contribute 88% to 95% of total emissions at Berth 10 and 89% to 93% of total emissions within Supply Chain. It is expected that the Baseline Case activities will occur concurrently with Project activities.

Table 13 Emissions Summary at Berth 10 (within Facility Boundary) (tonne/year)

Pollutant	Baseline Case [a]	Project Case [b]	Total	Project Case/Baseline Case [c]	Project Case/Total (%)
SO_2	0.04	0.29	0.33	7.3	88%
NO_X	0.89	7.72	8.61	8.7	90%
CO	0.11	1.04	1.15	9.5	90%
HC	0.03	0.29	0.32	9.7	91%
TPM	0.02	0.19	0.21	9.5	90%
PM_{10}	0.02	0.19	0.21	9.5	90%
$PM_{2.5}$	0.02	0.18	0.20	9.0	90%
CO_2	64.9	578	643	8.9	90%
CH_4	0.003	0.03	0.03	10.0	91%
N_2O	0.002	0.04	0.04	20.0	95%
CO_2 eq.	65.6	588	654	9.0	90%
Range				7.3 to 20.0	88% to 95%

NOTES
[a] Baseline Case only includes marine emissions.
[b] Project Case includes both marine emissions and rail emissions.
[c] Project Case/Baseline Case represents the ratio of change to total emissions with the addition of Project emissions (i.e., a positive ratio indicates an increase in emissions)

Table 14 Emissions Summary within Supply Chain (tonne/year)

Pollutant	Baseline Case [a]	Project Case [b]	Total	Project Case/Baseline Case [c]	Project Case/Total (%)
SO_2	0.06	0.50	0.56	8.3	89%
NO_X	2.46	20.8	23.3	8.5	89%
CO	0.24	2.06	2.3	8.6	90%
HC	0.08	0.72	0.8	9.0	90%
TPM	0.05	0.43	0.48	8.6	90%
PM_{10}	0.05	0.49	0.54	9.8	91%
$PM_{2.5}$	0.04	0.47	0.51	11.8	92%
CO_2	127	1,084	1,211	8.5	90%
CH_4	0.003	0.04	0.04	13.3	93%
N_2O	0.005	0.06	0.07	12.0	92%
CO_2 eq.	128	1,103	1,231	8.6	90%
Range				8.3 to 13.3	89% to 93%

NOTES

[a] Baseline Case only includes marine emissions.

[b] Project Case includes both marine emissions and rail emissions.

[c] Project Case/Baseline Case represents the ratio of change to total emissions with the addition of Project emissions (i.e., a positive ratio indicates an increase in emissions)

8.0 MITIGATION POTENTIAL (BEST AVAILABLE TECHNIQUE)

8.1 USE OF BEST AVAILABLE TECHNOLOGY NOT ENTAILING EXCESSIVE COST

The design of the canola transfer system from rail to storage to marine vessel considers best available technology not entailing excessive cost (BATNEEC) in that it is designed as a fully electric operation and has no emission sources.

The switching locomotive used at the PARY is also considered the best available technology as it meets the Government of Canada's Tier IV emission standards. Tier IV emission standards are the strictest standards for off-road diesel engines. These standards apply requirements for low emissions of particulate matter (PM), black soot, and NO_X.

It is assumed that 3rd party marine vessels and locomotives meet the regulatory emission requirements for operating in Canada. DP World does not have influence over these 3rd party marine vessel or rail locomotives for further implementation of best available technology.

8.2 APPLICATION OF BEST AVAILABLE PROCEDURES

DP World follows best available procedures for the operation of the PARY switching locomotive. DP World aims to use the locomotive efficiently and avoid idle time. Therefore, while the locomotive is not switching canola cars it is being used for other operations onsite. Furthermore, if the locomotive is not needed it is shut down.

To maintain effective emission controls (Tier IV) associated with the locomotive, DP World follows the manufacturer's recommended operating and maintenance practices.

9.0 IMPACT POTENTIAL

9.1 COMPARE BASELINE CASE TO PROJECT CASE

The Baseline Case includes four Handymax vessels (two log ships and two salt ships) with two salt barge transfers per year. The Project Case includes 33 Handymax vessels per year. There are rail or truck movements associated with the Project Case. The ratios of Project Case emissions to Baseline Case emissions are in 7.3 to 20.0 at Berth 10 (see Table 13) and in 8.3 to 13.3 within the Supply Chain (see Table 14). The Project Case will contribute 88% to 95% emissions at Berth 10 and contribute 89% to 93% emissions within the Supply Chain

Ambient air quality measurements (Table 2) show that concentrations of CACs in the vicinity of the Project site and receivers of interest are below the air quality objectives and air quality is good most of the time. With the addition of the Project, ambient concentrations are expected to increase, however, changes to current air quality are likely to be negligible and current air quality is unlikely to be substantially exacerbated by the Project emissions.

9.2 COMPARE PROJECT CASE TO BEST AVAILABLE TECHNIQUE

The best available techniques and procedures proposed for the Project are considered the currently best available.

9.3 CONCLUSION

Stantec was retained by DP World to prepare the Level 1 Environmental Air Assessment to support the planning and permitting process for the Fraser Surrey Canola Oil Transload Facility Project. The Environmental Air Assessment quantified emissions from the Project facility and within the Project supply chain and current air quality conditions were reviewed.

The Project canola oil loading equipment is designed as fully electric therefore has no emissions. Emissions associated with the Project are attributed to the large marine vessel in which canola oil will be loaded onto for transport to consumers, and to a lesser extent locomotive emissions. DP World has no influence over the 3rd party marine vessels or locomotives and assume these are operating within

Canadian regulatory requirements regarding emissions. The DP World operated switching locomotive will comply with the Tier IV emission standards and DP World operates the locomotive efficiently in the effort to reduce emissions from idling.

Ambient air quality measurements (Table 2) show that concentrations in the vicinity of the Project site and receivers of interest are below the ambient air quality objectives, except for $PM_{2.5}$ and PM_{10} as a result of influence from wildfire smoke. Air quality near the Project site is good most of the time. Current activities at Berth 10 include four Handymax vessels (two log ships and two salt ships) per year. The addition of the Project will increase emissions by a factor of 7.3 to 20.0 at Berth 10 (within Facility Boundary) and by a factor of 8.3 to 13.3 within Supply Chain from the Baseline Case. With the addition of the Project, ambient concentrations are expected to increase, however, changes to current air quality near the Project site and at the nearest sensitive receptor are likely to be negligible and current air quality is unlikely to be substantially exacerbated by the Project emissions.

10.0 REFERENCES

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Appendix A EMISSIONS CALCULATIONS

The sections below describe the emission calculation methods for the Project.

A.1 FACILITY MARINE EMISSION CALCULATION

Emission rates for the Handymax marine vessel main engine are calculated using values from Table 5 following Equation 1:

Equation 1

$$
\begin{aligned}
&Emission\ mass\ rate\ \frac{tonnes}{year}\\
&\quad = Emission\ factor\ \frac{g}{kWh} \times Engine\ Power\ kW\ \times load\ factor\\
&\quad \times Main\ Engine\ Low\ Load\ Scaling\ Factor\ \times hours\ for\ maneuvering\ per\ visit\\
&\quad \times number\ of\ vessel\ calls\ per\ year\ \times conversion\ \frac{kg}{1000\ g} \times conversion\ \frac{tonnes}{1000\ kg}
\end{aligned}
$$

Emission rates for the Handymax marine vessel auxiliary engine and assist tug boats are calculated using Equation 2:

Equation 2

$$
\begin{aligned}
&Emission\ mass\ rate\ \frac{tonnes}{year}\\
&\quad = Emission\ factor\ \frac{g}{kWh} \times Engine\ Power\ kW\ \times load\ factor\\
&\quad \times\ hours\ for\ maneuvering\ or\ loading\ per\ visite \times number\ of\ vessel\ calls\ per\ year\\
&\quad \times conversion\ \frac{kg}{1000\ g} \times conversion\ \frac{tonnes}{1000\ kg}
\end{aligned}
$$

Tug Boat emissions are multiplied by two, as there are two tug boats used to maneuver the Handymax vessel into and out of Berth 10.

Emission rates for the Handymax auxiliary boiler are calculated using Equation 3:

Equation 3

$$
\begin{aligned}
&Emission\ mass\ rate\ \frac{tonnes}{year}\\
&\quad = Emission\ factor\ \frac{kg}{tonne\ fuel} \times fuel\ consumption\ \frac{tonne\ fuel}{hour}\\
&\quad \times\ hours\ for\ maneuvering\ or\ loading\ per\ visit \times number\ of\ vessel\ calls\ per\ year\\
&\quad \times conversion\ \frac{tonnes}{1000\ kg}
\end{aligned}
$$

A.2 SUPPLY CHAIN MARINE EMISSION CALCULATION

Marine anchoring emission calculations are the same as the Facility marine emission calculations.

The marine transit emissions for the main and auxiliary engines, and the tug boats are calculated using Equation 4:

Equation 4

$$\begin{aligned} Emission\ mass\ rate\ \frac{tonnes}{year} &= Emission\ factor\ \frac{g}{kWh} \times Engine\ Power\ kW\ \times load\ factor \\ &\times hours\ per\ one\ way\ trip\ per\ visit \times number\ of\ vessel\ calls\ per\ year \\ &\times conversion\ \frac{kg}{1000\ g} \times conversion\ \frac{tonnes}{1000\ kg} \times 2\ for\ return\ trip \end{aligned}$$

The tug Boat emissions are multiplied by two as there are two escort tug boats.

The marine transit emissions for the Handymax auxiliary boiler are calculated using Equation 5:

Equation 5

$$\begin{aligned} Emission\ mass\ rate\ \frac{tonnes}{year} &= Emission\ factor\ \frac{kg}{tonne\ fuel} \times fuel\ consumption\ \frac{tonne\ fuel}{hour} \\ &\times\ hours\ for\ one\ way\ trip\ per\ visit \times number\ of\ vessel\ calls\ per\ year \\ &\times conversion\ \frac{tonnes}{1000\ kg} \times 2\ for\ return\ trip \end{aligned}$$

A.3 FACILITY RAIL EMISSION CALCULATIONS

The emission rates for the on-site switching locomotives and the line haul locomotive are calculated using emission factors from Table 6. The assumed maximum fuel consumption rate of 36.1 L/hr (annual average fuel consumption rate 1.10 L/hr) is used for switching 2GS-12B locomotive. The maximum fuel consumption rate of 36.0 L/hr (annual average fuel consumption rate 0.55 L/hr) is used for CN switching locomotive. The annual fuel usage of 14,491 L is used for CN line haul locomotive. Equation 6 is used to calculate the Facility rail emissions:

Equation 6

$$\begin{aligned} Emission\ mass\ rate\ \left(\frac{tonnes}{year}\right) &= Emission\ factor\ \left(\frac{g}{L}\right) \times\ \ fuel\ consumption\ \left(\frac{L}{hr}\right) \times \frac{Locomotive\ operating\ hours}{year} \\ &\times conversion\ \frac{tonnes}{g} \end{aligned}$$