

Appendix B

Air Quality Technical Data Report

FORTIS BC ENERGY INC. - TILBURY LNG FACILITY

DELTA, BC

UPDATED AIR QUALITY TECHNICAL DATA REPORT - V.8

RWDI # 2000436

October 20, 2025

SUBMITTED TO

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EXECUTIVE SUMMARY

As part of the original Environmental Assessment (EA) Application submitted in November 2024, FortisBC included an Air Quality Technical Data Report (TDR) prepared by RWDI. This report outlined the assessment methodology, relevant data, and modelling results to meet the requirements of both the Impact Assessment Agency of Canada (IAAC) and the BC Environmental Assessment Office (BCEAO). The modelling results submitted initially were conservative and used emissions without any mitigations for a worst-case assessment.

Following review by the EAO, Metro Vancouver (MV), and the Technical Advisory Committee (TAC), two rounds of Information Requests (IRs) were issued. In response, FortisBC was asked to quantitatively assess the effectiveness of mitigation technologies on proposed Project's impacts on air quality using air dispersion modelling based on a conceptual mitigated scenario.

To support this revised assessment, FortisBC submitted an updated MV Dispersion Modelling Plan, approved by MV on June 12, 2025 – included in AQ-Appendix A). The scope of the modelling amendment includes:

- Incorporating recent updates to MV Ambient Air Quality Objectives (MV AAQO)
- Defining conceptually achievable mitigation scenario for NO₂ and SO₂
- Developing proposed Project's emission parameters based on a conceptual mitigated design
- Quantifying the effectiveness of mitigation measures using air dispersion modelling
- Updating background concentrations for NO₂ and SO₂ using 2022–2024 data and MV's latest guidance
- Conducting modelling for a Mitigated Cumulative Case involving NO₂ and SO₂
- Providing inputs to support the human health risk assessment

FortisBC developed a preliminary conceptual mitigated scenario focused on reducing NO₂ and SO₂ emissions for the proposed Project. RWDI conducted an air dispersion modelling for this scenario, and this Updated Air Quality TDR includes both the original assessment and the updated evaluation of the mitigated scenario (with details presented in AQ-Appendix L). The Updated TDR also incorporates all clarifications and updates requested during the IR process.

The mitigation scenario presented here is intended as a proof-of-concept based on currently available technologies. It does not represent final design commitments for regulatory conditions. This flexible approach allows FortisBC to demonstrate the potential effectiveness of mitigation while maintaining adaptability during final design development when selecting mitigation technology.

Key Findings for proposed Project only Case:

- **NO₂ Reduction with Mitigation – proposed Project only:**
 - o 1-hour concentrations reduced from 38.9 µg/m³ to 6.6 µg/m³ (83% reduction)
 - o Annual concentrations reduced from 0.8 µg/m³ to 0.11 µg/m³ (88% reduction)
- **SO₂ Reduction with Mitigation – proposed Project only:**
 - o 1-hour MV AAQO: reduced from 150.8 µg/m³ to 40.5 µg/m³ (73% reduction)
 - o 1-hour CAAQS 2025: reduced from 81.1 µg/m³ to 19.7 µg/m³ (76% reduction)
 - o Annual average: reduced from 1.1 µg/m³ to 0.22 µg/m³ (80% reduction)



These results demonstrate that the proposed mitigation measures are highly effective in reducing NO₂ and SO₂ emissions from the proposed Project and their spatial impact, minimizing off-site effects under the Project-alone case. The modelling approach remains consistent with the original TDR, with all updates clearly identified to support review.

Key findings for Application and Cumulative Cases:

Based on the model results, the mitigation measures are effective in reducing predicted ambient concentrations for Application (Base Case + Proposed Project) and Cumulative Cases relative to the unmitigated scenario. In particular, the spatial extent of elevated concentrations is notably reduced with mitigation. Similar to the unmitigated scenarios, the proposed Project contribution to Application and Cumulative concentrations is low to negligible. The predicted elevated cumulative NO₂ concentrations are mainly attributed to emissions from the Tilbury Martine Jetty project, which were included based on their environmental certificate application (submitted 2019) using preliminary design information.

Updated Maximum Predicted Concentrations with Background for Base, Application (Base + Proposed Project), and Cumulative Cases - Conceptual Mitigated Scenario ¹

Air Contaminant	Averaging period	Conceptual Mitigated Scenario - Maximum over RAA ⁵			Objective or Standard		Background ⁶
		Base Case	Base Case + Proposed Project	Cumulative	Value	Name	
NO ₂ (OLM)	1-hour ²	87.3	88.2	161	79	Current MV AAQO CAAQS 2025	54.96 ⁷
		73.2	74.1	147			40.87 ⁸
		61.9	62.7	136			29.54 ⁹
	Annual	18.9	20.3	22.7	22.6		17.23
SO ₂	1-hour ³	90.6	95.1	120	183	Current MV AAQO	3.14
	1-hour ⁴	60.0	75.9	81.4	170	CAAQS 2025	
	Annual	2.0	5.7	6.0	10.5	Current MV AAQO and CAAQS 2025	0.59

Notes:

- [1] Effects are compared with the MV AAQO and CAAQS 2025, each with their respective metrics. Exceedances are highlighted in bold.
- [2] Based on 98th percentile of the daily 1-hour maximum (D1HM) predictions in one year, averaged over 2013-2015.
- [3] Based on 100th percentile of the 1-hour predictions, in one year, averaged over 2013-2015.
- [4] Based on 99th percentile of the daily 1-hour maximum (D1HM) predictions in one year, averaged over 2013-2015.
- [5] Calculated considering recent background values shown in this table.
- [6] Updated background concentrations using 2022–2024 data and MV's latest guidance.
- [7] Background concentration based on 98th percentile.
- [8] Background concentration based on 90th percentile.
- [9] Background concentration based on 75th percentile.



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NOMENCLATURE

AER	Alberta Energy Regulator
AQ	Air Quality
AQDMG	Air Quality Dispersion Model Guideline
ATB	Articulated Tub Barge
BC	British Columbia
BC AAQO	BC Ambient Air Quality Objectives
BC EAO	BC Environmental Assessment Office
BPIP-PRIME	Building Profile Input Program Plume Rise Model Enhancement
CAAQS	Canadian Ambient Air Quality Standards
CAC	Criteria Air Contaminants
CEA	Cumulative Effects Assessment
CO	Carbon Monoxide
D1HM	Daily 1-Hour Maximum
DPM	Diesel Particulate Matter
ECCC	Environment and Climate Change Canada
ENV	BC Ministry of Environment and Climate Change Strategy
FGD	Flue Gas Desulphurization
FortisBC	Fortis BC Energy Inc.
H ₂ S	Hydrogen Sulfide
ha	hectare
HRA	Hour Rolling Average
IAAC	Impact Assessment Agency of Canada
IR	Information Request
ISR	In-Stack Ratio
LAA	Local Assessment Area
LNG	Liquefied Natural Gas
MEIT	Marine Emission Inventory Tool

**UPDATED AIR QUALITY TECHNICAL DATA REPORT
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**RWDI #2000436
October 20, 2025**



MOVES	Motor Vehicle Emission Simulator
MPTA	Mega Tonnes Per Annum
MSAPR	Multi-Sector Air Pollution Regulation
MV	Metro Vancouver
MV AAQO	MV Ambient Air Quality Objectives
NO	Nitric Oxide
NO ₂	Nitrogen Dioxide
NO _x	Oxides of Nitrogen
OLM	Ozone Limiting Method
PM	Particulate Matter
PM ₁₀	PM with particle diameter of less than 10 micrometers
PM _{2.5}	PM with particle diameter of less than 2.5 micrometers
RAA	Regional Assessment Area
RBT2	Roberts Bank Terminal 2
RFP	Reasonably Foreseeable Projects and Activities
SO ₂	Sulphur Dioxide
SS	Start-up and Shutdown
TAC	Technical Advisory Committee
TDR	Technical Data Report
TMJ	Tilbury Marine Jetty
TRS	Total Reduced Sulphur
TSP	Total Suspended Particulates
U.S.	United States
US EPA	United States Environmental Protection Agency
VAFFC	Vancouver Airport Fuel Facilities Corporation
VAFD	Vancouver Airport Fuel Delivery
WRAP	Western Regional Air Partnership
WRF	Weather Research and Forecasting (Model)



VERSION HISTORY

Index	Date	Pages	Authors
1	July 6, 2022	All	Golnoosh Bizhani, Ph.D. Francoise Robe, Ph.D.
2	September 21, 2022	All	Golnoosh Bizhani, Ph.D. Francoise Robe, Ph.D.
3	January 20, 2022	All	Golnoosh Bizhani, Ph.D. Francoise Robe, Ph.D.
4	April 8, 2023	All	Golnoosh Bizhani, Ph.D. Francoise Robe, Ph.D.
5	May 8, 2023	All	Francoise Robe, Ph.D.
6	September 5, 2024	All	Golnoosh Bizhani, Ph.D.
7	September 29, 2025	All	Golnoosh Bizhani, Ph.D.
8	October 20, 2025	All	Golnoosh Bizhani, Ph.D.

REPORT SIGNATURES

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1 INTRODUCTION

Fortis BC Holdings Inc. with its regulated natural gas subsidiary Fortis BC Energy Inc. (collectively defined as FortisBC) is proposing to build the Tilbury Phase 2 Expansion Project (the proposed Project, also referred as Phase 2) at the existing FortisBC Tilbury LNG Plant location on Tilbury Island, in Delta, British Columbia (B.C.). The proposed Project includes the expansion of storage and production capacity at its existing Tilbury LNG facility on Tilbury Island (the facility) to 2.5 Million Tonnes Per Annum (MTPA) of LNG, in Delta, B.C. The proposed Project is part of the expansion of the existing LNG facility to increase the storage and production of LNG to add resilience to FortisBC's gas system (that is, to increase its ability to withstand, manage through, and recover from supply emergencies), improving the security of supply to FortisBC's approximately 1.1 million natural gas customers in B.C.

The proposed Project is subject to review by the BC Environmental Assessment Office (BC EAO) under the BC *Environmental Assessment Act*, and the Impact Assessment Agency of Canada (IAAC) under the *Impact Assessment Act*. The federal minister of Environment and Climate Change Canada has approved the Government of BC's request to substitute the provincial review process for the federal impact assessment process.

RWDI AIR Inc. was retained by Jacobs Engineering Group on behalf of FortisBC to prepare an Air Quality (AQ) Technical Data Report to support the Application for Project approval by BC EAO.

An Air Quality Technical Data Report (original TDR – Dated September 5, 2024) presenting the relevant information, assessment methodology and results from RWDI's assessment was included as part of the environmental assessment (EA) application (the original Application) addressing the requirements of both IAAC and the BCEAO.

The original Application was reviewed by the EAO, Metro Vancouver (MV) and the Technical Advisory Committee (TAC). Following two rounds of Information Requests (IRs) from the EAO/MV/TAC and responses from FortisBC, it was concluded that the effectiveness of mitigation technologies on resulting air quality effects from the proposed Project should be quantitatively assessed through air dispersion modelling based on a conceptual representation of a mitigated scenario. An updated MV Dispersion Modelling Plan for the proposed amendment was submitted to and approved by MV (dated June 12, 2025 – included in *AQ-Appendix A*). The scope of the modelling amendment includes:

- Recent updates to the MV AAQO (MV, 2024a) in assessing proposed Project effects;
- Defining a conceptually achievable mitigation technology for NO₂ and SO₂;
- Developing emission parameters for the proposed Project based on a conceptual mitigated scenario;
- Assessing the effectiveness of proposed mitigation measures in reducing Project's impacts on ambient air quality, through quantitative analysis using air dispersion modelling;
- Updating background concentrations of NO₂ and SO₂ to reflect the 2022-2024 timeframe, and applying MV's latest guidance - *Memorandum on NO₂ Background Calculation Considerations for Dispersion Modelling Purposes* (MV, 2024b)- to calculate background NO₂ concentrations for the mitigated scenario only;
- Conducting air dispersion modelling for an additional "Mitigated Cumulative Case" involving NO₂ and SO₂ emissions; and,
- Providing relevant inputs from the mitigated scenario to support the human health risk assessment.



FortisBC developed a preliminary conceptual mitigated scenario focused on reducing NO₂ and SO₂ emissions. RWDI conducted the air dispersion modelling to assess this scenario. This revised Air Quality TDR includes the methodology and results of the original assessment along with the evaluation of the mitigated scenario. It also incorporates all additional clarifications and updates requested during the IR process.

The mitigation measures evaluated in this conceptual scenario are based on technologies currently available and should be viewed as illustrative rather than definitive. They are not intended to represent finalized design choices or regulatory obligations. Instead, this scenario functions as a demonstration of how mitigation could effectively reduce air quality impacts using present-day design assumptions. It provides a foundation for understanding potential outcomes, while allowing FortisBC the flexibility to refine and optimize solutions as the Project progresses toward final design—ensuring continued alignment with applicable ambient air quality standards.

The modelling approach and methodology for the conceptual mitigated scenario are generally consistent with those used in the original TDR.

1.1 Spatial and temporal boundaries

FortisBC is proposing to expand the existing LNG facility at 7651 Hopcott Road, Delta (Delta), BC, on Tilbury Island, within the Tilbury Industrial Park, adjacent to the Fraser River. The proposed Project is located on the Traditional Territory of the Coast Salish peoples on a long-standing brownfield industrial site owned by FortisBC and zoned as I7 High Impact Industrial, for uses including natural gas and petroleum products.

Existing Tilbury LNG facilities include the original production and storage facility in operation since 1971 (Base Plant), a Phase 1A production and storage expansion in operation since 2018 (T1A), ancillary facilities, and Phase 1B production and power supply expansion (T1B) which has received approval from the B.C. government through B.C. OIC (O.C. 557/2013) Direction No. 5 to the British Columbia Utilities Commission under the Utilities Commission Act. The proposed Project consists of a Phase 2 liquification capacity expansion of a new LNG storage tank with a working volume of 142,400 cubic metres (m³) and expansion of up to 7,700 tonnes per day (t/d) of LNG production. Neighbouring properties are mainly used for industrial purposes with the nearest resident being approximately 450 meters (m) to the southwest of the proposed Project, although the closest residential area is approximately 3 km away.

The Local Assessment Area (LAA) for AQ is the maximum area within which potential environmental effects from the proposed Project activities and components can be predicted or measured with a reasonable degree of accuracy and confidence. The LAA for AQ was conservatively set to a 20 km by 20 km area centered on the proposed Project footprint.

The Regional Assessment Area (RAA) was defined to comprise of the area where the predicted residual effects from the proposed Project may act in combination with residual effects of existing (including past) and reasonably foreseeable developments (RFP) activities to cause cumulative effects. The RAA for AQ covers a 30 km by 30 km area centered on the proposed Project Site¹ and extends to the coast on the west, the United States (U.S.) border to the south, Vancouver and Burnaby to the north, and Surrey to the east.

¹ The proposed Project Site is encompassed by the existing Tilbury facility property line



The proposed Project location, LAA and RAA are shown in **Figure 1-1**.

The proposed Project includes three to six years of construction, 40 to 60 years of operational life span, and two years of decommissioning. Potential effects of the proposed Project during construction and operation on ambient air quality are studied.

Map Document: C:\GIS\2000436_Tilbury\2000436_Tilbury_LNG.aprx



Proposed Project Location, RAA and LAA

The AQ modelling domain is the same as the RAA

Map Projection: NAD 1983 UTM Zone 10N
Tilbury LNG - Delta, BC

True North
↑
Project #: 2000436

Drawn by: RCL	Figure: 1-1
Approx. Scale: 1:195,000	
Date Revised: Feb 15, 2022	



1.2 Assessment Approach

1.2.1 Scope

The primary concern related to potential air quality effects from the Tilbury LNG operations is emissions of nitrogen dioxide (NO₂) and sulfur dioxide (SO₂). These contaminants along with carbon monoxide (CO), particulate matter with particle diameter of less than 10 µm (PM₁₀) and less than 2.5 µm (PM_{2.5}), Hydrogen Sulfide (H₂S) and Volatile Organic Compounds (VOC) were included in the assessment.

The assessment is divided in the following three sections:

1- Review of existing conditions including:

- Air Quality
- Weather and Climate

2- Emissions: Quantification of air emissions using information provided by FortisBC based on conceptual and unoptimized design, published emission factors, engineering methods and vendor specifications for the following proposed Project components:

- Construction
- Commissioning
- Normal operations (unmitigated)
- Conceptual mitigated emissions (applicable to normal operations)
- Abnormal conditions
- External sources including Reasonably Foreseeable Projects and Activities (RFP)

3- Air dispersion modelling and comparison with ambient air quality objectives and standards.

Modelling was done using the CALPUFF modelling system (Version 7.2.1), and following the methods prescribed by the BC Air Quality Dispersion Modelling Guideline (AQDMG) published by the BC Ministry of Environment and Climate Change Strategy (ENV, 2022a). As required by the AQDMG, projects located within Metro Vancouver (MV) boundaries need to complete a Metro Vancouver Modelling Plan prior to commencing modelling work. A Metro Vancouver Dispersion Modelling Plan was developed through engagement with MV for the proposed Project and approved on August 4, 2022. Subsequently and updated Dispersion Modelling Plan (dated June 12, 2025 – included in Appendix A) was submitted to and approved by MV to address a conceptual mitigation scenario. This assessment follows the approved MV Dispersion Modelling Plans and is consistent with the BC AQDMG (ENV, 2022a). The approved MV Dispersion Modelling Plan is provided in AQ-Appendix A – Metro Vancouver Dispersion Modelling Plans.



Air dispersion modelling was performed for the following cases:

- **Base Case** – Including the Adjacent FortisBC Tilbury T1A sources and background concentrations (representing the effects of all other external existing sources)
- **Base Case + Proposed Project** – Including proposed Project normal operations (Phase 2 continuous sources), and Base Case
- **Cumulative Case** – Including Base Case + Proposed Project and effects of Reasonably Foreseeable Projects and Activities (RFP) that may have overlapping footprints
- **Mitigated Cumulative Case** – Including Base Case, proposed mitigated Project (Phase 2 continuous conceptual mitigated sources), and effects of RFP.

Several Abnormal Condition Scenarios were also modelled, including non-routine flaring during commissioning, start-up and shutdown (SS); upset conditions (thermal oxidizer stream rerouted to the flare) and grid power outage events.

The potential for acid and nitrogen deposition resulting from the proposed Project normal operations was also assessed.

1.2.2 Reasonably Foreseeable Projects and Activities (RFP)

For the Cumulative Effects Assessment (CEA), the residual effects of RFP within the RAA were considered. A comprehensive review of future developments in the RAA was conducted and twenty-three ongoing or planned projects were identified. Sources of information included the Canadian Impact Assessment Registry website (IAAC, 2022), the EAO Project Information & Collaboration System (EPIC - BC EAO, 2022), and other publicly available information resources.

For seventeen of the identified RFPs, air quality residual effects were either intermittent (air quality effects limited to the construction phase), or infrequent, and/or localized with minimal overlap with the potential Project residual effects. Therefore, these projects were not included in the dispersion modelling.

Five RFPs with potentially overlapping residual air quality effects with the proposed Project effects were identified. For two of these RFPs, sufficient information for explicit modelling were available and therefore they were included in the air dispersion modelling for cumulative case. These projects include the Tilbury Marine Jetty (TMJ) project and the FortisBC Tilbury proposed T1B project. The remaining three RFPs were discussed based on available published information, but not explicitly modelled due to lack of suitable detailed information. These include the proposed Delta Grinding Facility, the proposed Roberts Bank Terminal 2 (RBT2) project and the Vancouver Airport Fuel Delivery (VAFD) project, which is under construction.

A list of identified RFPs and the rationale for inclusion/exclusion in dispersion modelling is presented in *AQ-Appendix B – Review of Future Developments in the RAA*.



1.2.3 Ambient Air Quality Standards and Objectives

In the original Application, predicted concentrations for the modelled cases were compared with the Canadian Ambient Air Quality Standards (CAAQS) developed by the Canadian Council of Ministers of the Environment (CCME, 2021), effective in 2025, and the MV Ambient Air Quality Objectives (MV AAQO – MV, 2020). The BC AAQO (ENV, 2021) and previous CAAQS (2020) are also provided for reference. In 2024, MV adopted the CAAQS 2025 standards for NO₂ and annual SO₂. Accordingly, the results of the recently modelled conceptual mitigation scenario are compared against the MV's updated published objectives (MV, 2024a). A summary of these standards and objectives is provided in Table 1-1 below.



Table 1-1: Ambient Air Quality Standards and Objectives

Air Contaminant	Averaging Period	CAAQS 2025		CAAQS 2020		BC AAQO		Previous MV AAQO		Current MV AAQO		Metric
		µg/m ³	ppb	µg/m ³	ppb	µg/m ³	ppb	µg/m ³	ppb	µg/m ³	ppb	
NO ₂	1-hour	79	42	113	60	113	60	113	60	79	42	3-year avg. of the annual 98 th percentile of D1HM
	Annual	22.6	12	32	17	32	17	32	17	22.6	12	Annual avg. of hourly values over one year
SO ₂	1-hour	170	65	183	70	183	70	183	70	183	70	CAAQS/BC: 3-year avg. of the annual 99 th percentile of D1HM MV: 100 th percentile of hourly values
	annual	10.5	4	13	5	13	5	13	5	10.5	4	Annual avg. of hourly values over one year
CO	1-hour	-	-	-	-	-	-	14,900	13,000	14,900	13,000	100 th percentile of hourly values
	8-hour	-	-	-	-	-	-	5,700	5,000	5,700	5,000	100 th percentile of 8-HRA
PM _{2.5}	24-hour	-	-	27	-	25	-	25	-	25	-	MV: 100 th percentile of 24-HRA
	annual	-	-	8.8	-	8	-	8 (6) ¹	-	8 (6) ¹	-	MV: Annual avg. of hourly values over one year
PM ₁₀	24-hour	-	-	-	-	50	-	50	-	50	-	MV: 100 th percentile of 24-HRA
	annual	-	-	-	-	-	-	20	-	20	-	MV: Annual avg. of hourly values over one year
Total Reduced Sulphur ²	1-hour (acceptable)	-	-	-	-	-	-	14	10	14	10	MV: 100 th percentile of hourly values

Notes: There are no objectives or standards for VOCs.
avg. = average; D1HM = daily 1-hour maximum; 8-HRA = 8-hour rolling average; 24-HRA = 24-hour rolling average.

¹ MV's annual PM_{2.5} planning goal of 6 µg/m³ is a longer-term aspirational target to support continuous improvement

² Expressed as H₂S.



2 EXISTING CONDITIONS

As part of this assessment, the existing conditions with respect to air quality and the local climate were studied in detail to establish an understanding of the meteorology and develop background concentrations to be used in dispersion modelling. Methods and results are presented in *AQ-Appendix C – Existing Conditions*.

For the original Application, data from four air quality monitoring stations for the three-year period 2019 to 2021 were used to calculate background concentrations for this assessment. These stations include North Delta (T13), Richmond South (T17), Richmond Airport (T31) and Burnaby South (T18). Background concentrations used in the modelling are summarized in Table 2-1 and station locations are shown in Figure 2-1.

In the Application, background concentrations for the unmitigated scenarios (Base Case, Base + Proposed Project, and Cumulative Case), remain unchanged from the original Application (as shown in Table 2-1). These concentrations were derived using Metro Vancouver station data from 2019–2021 and calculated in accordance with the original background evaluation methodology.

For the mitigated scenarios, background concentrations for NO₂ and SO₂ were updated as directed by MV. Recent data (2022-2024) from the same monitoring stations were used, and background NO₂ concentrations were calculated following MV's recent guidance (MV, 2024b). These updated values are summarized in Table 2-2.

Existing local climate and meteorology conditions were established based on data from two Environment and Climate Change Canada (ECCC) meteorological stations, Delta Burns Bog and Vancouver International Airport, in addition to available wind speed and direction data recorded at T13, T17, T31 and T18 stations for the three-year period 2018 to 2020. The locations of the ECCC meteorological stations are also shown in Figure 2-1.

The climate normals are consistent with a moderate oceanic climate with mild temperatures and considerable precipitation, mostly in winter. Wind direction distributions vary substantially between stations, as expected, but the dominant patterns in the region are winds blowing from the west and east, due to land-sea breezes.

Table 2-1: Background Concentrations Calculated Using 2019-2021 Data, and Original Methodology

Contaminant	Averaging Period	Background Concentration ($\mu\text{g}/\text{m}^3$)	Metric
Applicable to: The original Application and unmitigated scenarios in the revised Application - Based on 2019-2021 data			
NO ₂	1-hour	58.1	Annual 98 th percentile of hourly values averaged over 3 years
	Annual	21.1	Average of hourly values over 3 years
SO ₂	1-hour	3.64	Annual 99 th percentile of hourly values averaged over 3 years
	Annual	0.63	Average of hourly values over three years
CO	1-hour	557	Annual 98 th percentile of hourly values averaged over 3 years
	8-hour	505	Annual 98 th percentile of 8-HRA averaged over 3 years
PM _{2.5}	24-hour	12.0	Annual 98 th perc. of 24-HRA averaged over 3 years
	Annual	4.91	Average of hourly values over three years
PM ₁₀	24-hour	18.4	Annual 98 th perc. of 24-HRA averaged over 3 years
	Annual	9.19	Average of hourly values over three years

Notes:

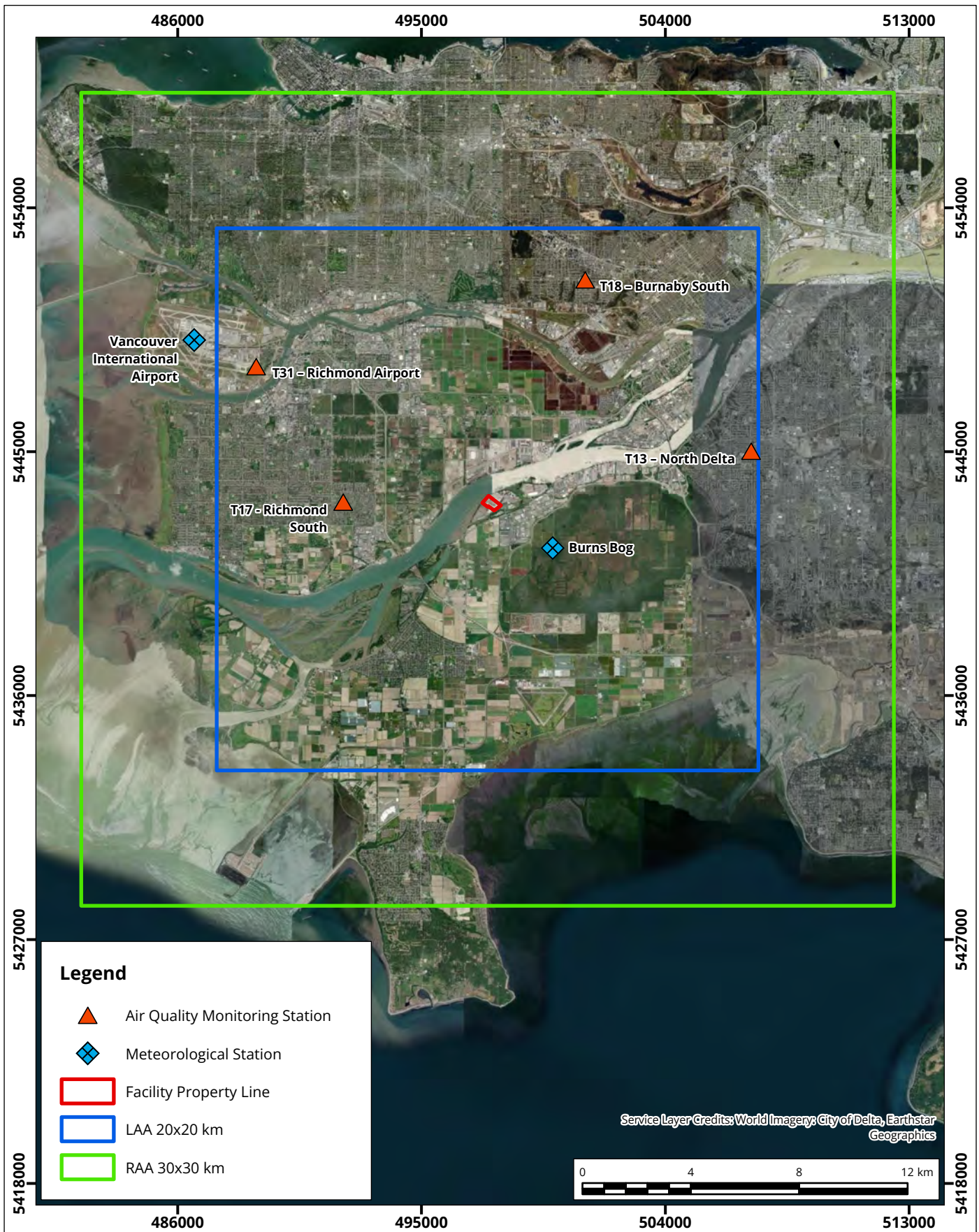
- Background values are based on MV metrics for baseline concentrations.
- Values calculated based on 2019 to 2021 data from four MV air monitoring stations: North Delta (T13), Richmond South (T17), Richmond Airport (T31) and Burnaby South (T18).
- More detail on background concentrations are provided in AQ-Appendix C – Existing Conditions.
- For total VOCs and H₂S, background concentrations were assumed to be zero.

Table 2-2: Background Concentrations Applicable for Conceptual Mitigated Scenario

Contaminant	Averaging Period	Background Concentration ($\mu\text{g}/\text{m}^3$)	Metric
Applicable to: The revised Application, mitigated scenario only - Based on 2022-2024 data			
NO ₂	1-hour 98 th percentile	54.96	Annual 98 th percentile of hourly values averaged over 3 years
	1-hour 90 th percentile	40.87	Annual 90 th percentile of hourly values averaged over 3 years
	1-hour 75 th percentile	29.54	Annual 75 th percentile of hourly values averaged over 3 years
	Annual	17.23	Annual median of the hourly values averaged over 3 years
SO ₂	1-hour	3.14	Annual 99 th percentile of hourly values averaged over 3 years
	Annual	0.59	Average of hourly values over three years

Notes:

- Background values are based on updated MV metrics for baseline concentrations.
- Values calculated based on 2022 to 2024 data from four MV air monitoring stations: North Delta (T13), Richmond South (T17), Richmond Airport (T31) and Burnaby South (T18).



Air Quality Monitoring and Meteorological Stations for Existing Conditions

Map Projection: NAD 1983 UTM Zone 10N
Tilbury LNG - Delta, BC



Project #: 2000436

Drawn by: RCL	Figure: 2-1
Approx. Scale: 1:195,000	
Date Revised: Mar 2, 2022	



3 EMISSIONS

Air emissions for contaminants of interest have been identified for all phases of the proposed Project including construction, commissioning, normal operations (mitigated and unmitigated) and abnormal conditions. An overview of these emissions is summarized in Table 3-1.

Table 3-1: Proposed Project Source Identification

Proposed Project Phase	Timeline	Activity	Description	Air Emissions
Construction	Short-term: only during construction	Non-road and On-road Engines	Vehicle exhaust from construction material deliveries and various diesel-powered on-site construction equipment and vehicles	NO _x , SO ₂ , CO, PM _{2.5} , PM ₁₀ , and VOC
		Material Handling	Processing of material such as soil, gravel, and overburden	PM _{2.5} , PM ₁₀
		Excavating	Excavating and bulldozing operations	PM _{2.5} , PM ₁₀
		Grading	Surface grading operations	PM _{2.5} , PM ₁₀
Commissioning	Short-term: only during commissioning	Totally Enclosed Ground Flare	Initial purging and flaring of nitrogen and LNG through the ground flare during cool-down/fill of the trains	NO _x , SO ₂ (Other CACs and H ₂ S are minimal)
Normal operations	Continuous: throughout Project operation (unmitigated)	Hot Oil Heater	Combustion of process gas for process heating	NO _x , SO ₂ , CO, PM _{2.5} , PM ₁₀ and VOC (H ₂ S emissions are minimal)
		Thermal Oxidizer	Incineration of excess gases extracted during the purification process	NO _x , SO ₂ , CO, PM _{2.5} , PM ₁₀ and VOC (H ₂ S emissions are minimal)
		Totally Enclosed Ground Flare	Pilot flare - On standby for combustion of process gases in case of thermal oxidizer upset	NO _x , SO ₂ , CO, PM _{2.5} , PM ₁₀ and VOC (H ₂ S emissions are minimal)
	Continuous: throughout Project operation (conceptual mitigation)	Flue Gas Desulphurization Unit	Single stack configuration redirects exhaust from both the thermal oxidizer and the hot oil heater to a flue gas desulphurization unit, to remove SO ₂ from exhaust gases	Updated emission rates applied for NO _x and SO ₂ ; all other contaminants reflect unmitigated normal operations.
		Totally Enclosed Ground Flare	Pilot flare – <i>Unchanged</i> - On standby for combustion of process gases in case of thermal oxidizer upset	
Start-up, shutdown	Intermittent: 5 times per year during Project operation	Totally Enclosed Ground Flare	Combustion of process gas – Several gas streams (for example stream into the thermal oxidizer, purge and process gas) will be rerouted to the ground flare	NO _x , SO ₂ (Other CACs and H ₂ S are minimal)
Upset	Infrequent	Totally Enclosed Ground Flare Hot Oil Heater	Combustion of process gas - Gas stream into the thermal oxidizer will be rerouted to the ground flare	NO _x , SO ₂ (Other CACs and H ₂ S are minimal)
Grid power outage	Infrequent	T1A and T2 Emergency Generators Totally Enclosed Ground Flare (pilot mode) Thermal Oxidizer (critical load)	Supply power for facility operations in case of a grid power outage	NO _x , CO, PM _{2.5} , PM ₁₀ and VOC

Note that combustion sources generate oxides of nitrogen (NO_x) comprised of nitric oxide (NO) and nitrogen dioxide (NO₂). Transformation of NO to NO₂ occurs in stack and later in the atmosphere due to reactions with atmospheric ozone and other volatile organic compounds. Therefore, emissions of total NO_x are estimated and modelled for each source. Ambient concentrations of NO₂ were then calculated using methods prescribed by the BC AQDMG (ENV, 2022a).

In addition, air quality residual effects from RFPs may overlap with potential Project effects. RFPs with sufficient publicly available emission data have been included in dispersion modelling. These are discussed in Section 3.5.

Emissions are further detailed in the following sections.

3.1 Construction Emissions

The direct emissions from construction activities including site preparation, onsite module assembly, tank construction and construction material deliveries were estimated for the primary contaminants generated by the activities taking place. The primary contaminants include criteria air contaminants (CACs) from fuel combustion and particulate matter generated during earthworks and material handling. It is acknowledged that additional indirect emissions may be associated with the construction phase, including embodied emissions from the production of concrete and other raw materials. However, these upstream emissions are beyond the defined scope of the air quality assessment and have therefore not been quantified or included in the analysis.

Activities resulting in emissions during construction include non-road and on-road engines, material handling, excavating, and grading. Emissions were determined using methodologies and emission factors from U.S. Environmental Protection Agency (US EPA) Motor Vehicle Emission Simulator (US EPA, 2018), US EPA AP-42 Compilation of Air Emission Factors (US EPA, 1998), and Western Regional Air Partnership (WRAP) Fugitive Dust Handbook (WRAP, 2006). The construction phase is expected to span approximately three to six years. The list of construction equipment and anticipated hours of operation for each equipment type over the full duration of the construction phase was provided by FortisBC. For emission estimation purposes, a conservative assumption was applied: the construction phase could extend up to a maximum of six years. This accounts for potential variability in the construction schedule, such as delays or changes in work pace, which could result in the same total equipment operating hours being distributed over a longer timeframe.

In the original Application, two alternative means emission scenarios were considered in the calculations: Scenario (i) Primarily Trucks and the Scenario (ii) Barges and Trucks, the latter includes a greater number of movements via water and a reduction in on-road movements. Reduced truck delivery would limit the existing road traffic congestion in the lower mainland, and traffic congestion near the proposed Project.

The Application assumes a single delivery scenario based on on-road truck transportation only. All marine delivery options were explicitly excluded from the revised air quality assessment.

Details on assumptions, methods and results of construction emission estimation are provided in *AQ-Appendix D – Construction Emissions*. A summary of total construction emissions is provided in Table 3-2. These include emissions estimated for the entire construction phase.

Table 3-2: Summary of Estimated Total Construction Emissions (in Tonnes)¹

Activity	NO _x	SO ₂	CO	PM _{2.5}	PM ₁₀	VOC
Non-road Engines	43.3	0.08	13.90	1.81	1.87	3.53
On-road Engines	7.23	0.013	1.99	0.42	0.66	0.45
Material Handling	-	-	-	0.003	0.02	-
Excavating	-	-	-	8.96	22.10	-
Grading	-	-	-	0.09	1.30	-
Total	50.53	0.09	15.89	11.28	25.95	3.98

Notes:

¹Total emissions were calculated based on the cumulative equipment operating hours required for liquefaction and storage activities. The construction phase was assumed to last a minimum of three years and could extend up to six years. This assumption accounts for potential variability in the construction schedule—such as delays or changes in work pace—that may spread the same total work hours over a longer period. As a result, the total emissions remain unchanged, regardless of the construction duration.

3.2 Emissions During Commissioning

Emissions from commissioning occur over a short period of time during commissioning only. The commissioning of the LNG tank will involve venting of nitrogen and LNG. The commissioning of the liquefaction train will involve flaring of nitrogen and LNG that is used to cool-down the LNG tank and to start up safely and reliably. The gas stream will be flared through the Phase 2 totally enclosed ground flare (T2_GF). Gas composition, flow rate and a combustion efficiency of 99% were provided by FortisBC.

The AERflare air dispersion modelling source preprocessor (AERflare) spreadsheet Version 3.02 recommended by the Alberta Energy Regulator (AER, 2022) was used to calculate emissions rates from the flare. Details are provided in *AQ-Appendix E – Abnormal Conditions*. Emission rates and other parameters for commissioning are summarized in Table 3-5.

Table 3-3: Source Information and Emission Rates for Commissioning used in Air Dispersion Modelling^{1,2,3}

Activity	Duration	Source	Combustion Efficiency	NO _x (g/s)	SO ₂ (g/s)	Other CACs and H ₂ S
Commissioning of the LNG tank	2 weeks	Vented	n/a	-	-	Considered minimal
Commissioning of the liquefaction train (Warm stream)	72 hours	T2_GF	99%	105	1.43	Considered minimal
Commissioning of the liquefaction train (Cold stream)	144 hours	T2_GF	99%	54.8	1.34	Considered minimal

Notes: ¹ Maximum hourly emissions

² Emission rates obtained using the AERflare spreadsheet (AER, 2022).

³ For commissioning of the LNG train, the Warm stream case was identified as the more conservative case and modelled.



3.3 Proposed Project Emissions during Normal Operations

The Proposed Project air emission sources during normal unmitigated operations include a hot oil heater (T2_HOH), a thermal oxidizer (T2_TO), and a totally enclosed ground flare (T2_GF).

Source characteristics and emissions rates were developed using conceptual unmitigated basis of assessment provided by FortisBC, incorporating vendor specifications and design basis documentation. The emission rates were calculated by either one of the following approaches, depending on the information available.

Approach 1 – Calculated from concentration limit (by mass) and flow rate provided by FortisBC, with the following equation:

$$\text{Emission rate } \left(\frac{g}{s} \right) = \text{Concentration limit } \left(\frac{mg}{Nm^3} \right) \times \text{Flow rate } \left(\frac{Nm^3}{hr} \right) \times \frac{1g}{1000mg} \times \frac{1hr}{3600s}$$

where the concentration limits and flow rates were provided by FortisBC.

Approach 2 – Calculated from emission factor provided by FortisBC, with the following equation:

$$\text{Emission rate } \left(\frac{g}{s} \right) = \text{Emission factor } \left(\frac{kg}{hr} \right) \times \frac{1000g}{1kg} \times \frac{1hr}{3600s}$$

where the emission factors were sourced from either FortisBC or vendor specifications.

Emission factors may be adjusted based on the facility's capacity, depending on the source and applicability of the emission data.

Approach 3 – Calculated from concentration (by volume), flow rate and exit temperature provided by FortisBC, with the following equations:

$$n = PV \div RT$$

where n = Molar flow of flue gas, mol/hr

P = atmospheric pressure, 101.325 kPa

V = flow rate provided by FortisBC, in m³/h

R = gas constant, 8.3145 m³-Pa/K-mol

T = exit temperature provided by FortisBC, in K

$$\text{Emission rate } \left(\frac{g}{s} \right) = \text{Concentration (ppmv)} \times \frac{1}{10^9} \times \text{Molar flow } \left(\frac{mol}{hr} \right) \times \text{MolarMass } \left(\frac{g}{mol} \right) \times \frac{1hr}{3600s}$$

Where concentration = NO_x concentration provided by FortisBC, in ppmv

Molar mass = 46.0055 g/mol

The basis of assessment assumes that the facility will operate 345 days per year; therefore, annual emission rates were scaled accordingly. Emission rates are summarized in Table 3-6 below.

Following the IR process, FortisBC developed a conceptual mitigation scenario where emissions from the T2_TO and T2_HOH are redirected to a flue gas desulphurization (FGD) unit, with treated exhaust released through a common stack (T2_FGD). This scenario incorporates enhanced combustion technologies to reduce NO_x emissions and utilizes the FGD to mitigate SO₂ emissions. FortisBC provided preliminary emission rates for the T2_FGD.

The proposed mitigation measures- including the continued use of flue gas recirculation and other combustion controls- are not expected to increase emissions of carbon monoxide (CO), particulate matter (PM₁₀ and PM_{2.5}), or volatile organic compounds (VOCs). Further details are provided in *AQ-Appendix L – Conceptual Mitigation Scenario*.

The mitigated emissions rates are summarized in Table 3-7 below.

Table 3-4: Emission Sources and Rates for the Proposed Project under the Unmitigated Operations Scenario, as Applied in Air Dispersion Modelling

Source	ID	NO _x	SO ₂	CO	PM _{2.5} ¹	PM ₁₀ ¹	VOC
Maximum Hourly Emissions (in g/s)							
Phase 2 – Hot Oil Heater	T2_HOH	6.836	0.631	1.387	0.277	0.277	0.277
Phase 2 – Thermal Oxidizer	T2_TO	1.405	3.799	0.176	0.057	0.057	0.057
Phase 2 – Totally Enclosed Ground Flare	T2_GF	0.031	0.006	0.012	0.010	0.010	0.001
Annual Emissions (in Tonnes/year)²							
Phase 2 – Hot Oil Heater	T2_HOH	203.8	18.81	41.34	8.26	8.26	8.26
Phase 2 – Thermal Oxidizer	T2_TO	41.88	113.2	5.25	1.70	1.70	1.70
Phase 2 – Ground Flare	T2_GF	0.92	0.18	0.36	0.30	0.30	0.03
Total Phase 2 Annual Emissions		246.6	132.2	46.95	10.26	10.26	9.99

Notes: ¹ Assumed all particulate matter is PM_{2.5}.

² Facility operates 345 days per year. Annual emissions were scaled accordingly from maximum hourly emissions.

Table 3-5: Emission Sources and Rates for the Proposed Project under the Conceptual Mitigated Operations Scenario, as Applied in Air Dispersion Modelling

Source	ID	NO _x	SO ₂	CO ¹	PM _{2.5} ^{1,2}	PM ₁₀ ^{1,2}	VOC ¹
Maximum Hourly Emissions (in g/s)							
Phase 2 – Hot Oil Heater	Stacks removed and emissions redirected to the T2_FGD						
Phase 2 – Thermal Oxidizer							
Phase 2 – Flue Desulphurization Unit	T2_FGD	1.269	2.473	1.563	0.334	0.334	0.334
Phase 2 – Totally Enclosed Ground Flare	T2_GF	0.031	0.006	0.012	0.010	0.010	0.001
Annual Emissions (in Tonnes/year) ³							
Phase 2 – Hot Oil Heater	Stacks removed and emissions redirected to the T2_FGD						
Phase 2 – Thermal Oxidizer							
Phase 2 – Flue Desulphurization Unit	T2_FGD	37.83	73.72	46.59	9.96	9.96	9.96
Phase 2 – Ground Flare	T2_GF	0.92	0.18	0.35	0.30	0.30	0.03
Total Phase 2 Annual Conceptual Mitigated Emissions		38.75	73.90	46.95	10.26	10.26	9.99

Notes: ¹ No change to emissions occur as a result of mitigation measures. i.e. T2_FGD emissions equals the sum of T2_HOH and T2_TO unmitigated emissions.

² Assumed all particulate matter is PM_{2.5}.

³ Facility operates 345 days per year. Annual emissions were scaled accordingly from maximum hourly emissions.

3.3.1 Compliance with NO_x Emission Intensity Regulations

According to the federal Multi-Sector Air Pollution Regulations (MSAPR, 2021), NO_x emissions from boilers and heaters in regulated facilities require compliance with emission intensities laid out in Part 1 of the MSAPR regulation:

- Per section 4 of the regulation, the proposed Project T2-HOH is classified as a 'Modern Heater', using 'alternative gas'.
- Per section 5, T2_HOH is subject under heaters designed to combust gaseous fossil fuels with rated capacity of at least 10.5 GJ/h.
- Per section 7, T2_HOH is subject to comply with an emission intensity threshold of 20.8 – 25 g/GJ of NO_x emissions at the time of commissioning.
- Post commissioning, an initial report (per section 40), a compliance report (per section 42, for heaters with capacity > 105 GJ/h) and a change report (per section 43, if reported information change) need to be submitted.

Information related to MSAPR for T2_HOH is summarized in Table 3-8.

Table 3-6: Phase 2 Hot Oil Heater NO_x Emission Information for MSAPR – Unmitigated Scenario

Source	ID	Fuel ^[1]	Rated Capacity	Classification	Emission Rate	Emission Intensity	MSAPR Requirement
Phase 2 – Hot Oil Heater	T2_HOH	Alternative Fuel (<90% CH ₄)	72 MW 259.2 GJ/h	Modern	6.836 g/s	94.9 g/GJ	20.8 - 25 g/GJ

Note:

[1] The reference to alternative fuel/gas for the hot oil heater relates to the federal Multi-Sector Air Pollution Regulations (MSAPR, 2021). Part 1 of the MSAPR requires regulated facilities to comply with specific NO_x emission intensities for boilers and heaters.

3.4 Proposed Project Abnormal Conditions

During start-up and shutdown (SS), gas streams (for example, stream into the thermal oxidizer, purge and process gas) will be rerouted to the totally enclosed ground flare (T2_GF). SS events are expected to last less than 5 hours and occur 5 times per year. Gas composition, flow rate and a combustion efficiency of 99% for SS were provided by FortisBC (conceptual basis of assessment). AERflare air dispersion modelling source preprocessor spreadsheet Version 3.02 recommended by the AER (AER, 2022) was used to calculate emissions rates from the flare. Details are provided in *AQ-Appendix E – Abnormal Conditions*.

Upset events are expected to be infrequent, and last no more than a few hours. A representative upset scenario was identified by FortisBC and modelled in the same manner as the SS events. In this scenario, the thermal oxidizer (T2_TO) goes offline and the gas stream is rerouted to T2_GF. In such an event, T2_HOH would remain operational, and its emissions are included in modelling. Details are provided in *AQ-Appendix E*.

In case of a grid power outage, the 2,200 KW Phase 2 emergency diesel generator (T2_EG) along with the existing T1A emergency generator (T1A_EG) will provide power to the facility. Under these conditions T2_GF would operate in pilot mode, the T2_TO at critical load, and T2_HOH would not operate. Emission rates for these sources were provided by FortisBC, and modelling details and results are presented in *AQ-Appendix E*.

Modelled emission rates for SS, upset, and grid power outage conditions are summarized in .

Table 3-7: Emission Rates during SS, Upset and Grid Power Outage Conditions used in Air Dispersion Modelling¹

Event	Frequency	Source	Combustion Efficiency	NO _x (g/s)	SO ₂ (g/s)
Start-up/ Shutdown	5 times per year, each lasting 5 hours	T2_GF	99% (weight)	58.7	1.43
Upset	Once per year lasting less than 5 hours	T2_GF	99% (weight)	10.1	4.92
		T2_HOH	-	Same as normal operations	
Grid Power Outage	Unknown. The generator is expected to run 10 hours per year	T1A_EG	n/a	3.106	-
		T2_EG	n/a	8.914	-
		T2_GF (Pilot mode)	n/a	Same as normal operations	
		T2_TO (Critical load)	n/a	0.836	-

Notes: n/a = not applicable;
¹ Maximum hourly emissions.

3.5 Emissions from External Sources

3.5.1 Existing External Sources

Air quality effects from all existing facilities in the vicinity of the proposed Project are captured by the nearby monitoring stations and included in the calculated ambient background concentrations, with the exception of the existing Tilbury Phase T1A sources which were modelled explicitly.

3.5.2 Sources from Reasonably Foreseeable Developments

The effects of RFPs were considered as part of the cumulative effects assessment. A comprehensive review of future developments in the RAA was conducted and summarized in *AQ-Appendix B – Review of Future Developments in the RAA*.

From this list, five developments were identified with potential overlapping air quality effects with potential Project residual effects. These projects include:

- **Tilbury phase 1B (T1B)** – This project includes the construction and operation of facilities for additional LNG production (increased capacity to 0.65 MT) and power supply expansion at the existing Tilbury facility on Tilbury Island. Tilbury T1B is not constructed yet, but has received approval from the BC government through B.C. OIC (O.C. 557/2013) Direction No. 5 to the BC Utilities Commission under the Utilities Commission Act. Emission sources for T1B are scaled based on conceptual basis of assessment information for Phase 2 and therefore explicitly included in the cumulative air dispersion modelling.



- **Tilbury Marine Jetty (TMJ)** – This project includes the construction and operation of a Marine Jetty at Tilbury Island on the Fraser River in Delta, B.C. The TMJ project consists of the berthing and transferring of LNG to marine barges and carriers for delivery to local fuel markets and offshore export markets. This project has been undergoing a federal environmental review with a draft assessment report issued by the BC EAO (BC EAO. 2021). Sufficient information is available on TMJ emission sources; therefore, they were explicitly included in the cumulative air dispersion modelling.
- **The Delta Grinding Facility** – This project includes the construction, operation and decommissioning of a grinding facility with a marine terminal adjacent to the existing cement plant located on Tilbury Island within one kilometer of the Phase 2 Project. The facility will manufacture supplementary cementitious material (SCM). The project includes the construction of a grinding facility and associated dust-collection equipment, raw-material stockpiles, storage silos, pneumatic piping connecting to the cement plant, and a covered conveyor leading to a newly constructed vessel berth. The facility, once fully operational, is expected to have an average annual production capacity of 650,000 tonnes of SCM. Potential major air emission sources from this project will include fugitive dust from stockpiles and various stages of grinding (Delta Grinding Facility, 2019, 2022). Based on the project description, air contaminants of concern from this project will be particulate matters, including Diesel Particulate Matter (DPM), as well combustion by-products including NO_x, SO₂, CO and VOCs. This project is in pre-application stage and insufficient detailed information on air emission sources are available; therefore, it was not included in the cumulative air dispersion modelling.
- **Roberts Bank Terminal 2 (RBT2)** – This is a proposed new container terminal on Canada's west coast proposed by Vancouver Fraser Port Authority at Roberts Bank in Delta, BC., and involves the construction and operation of a new three-berth marine container terminal, a widened causeway to the mainland to accommodate additional road and rail infrastructure, and an expanded tug basin to accommodate a second tug operations contractor. The terminal will be located in deep, subtidal waters to minimize potential environmental effects (RBT2, 2022). This project is located in the southwest corner of the RAA, approximately 16 km from the Phase 2 Project. RBT2 has been undergoing a federal environmental panel review since 2013 and is at the federal decision-making stage. Public comment period on the project is closed and the IAAC is now considering comments received in order to finalize the environmental assessment conditions for the project (IAAC, 2022). The Technical Report for the Air Quality assessment included in the RBT2 Environmental impact statement (SENES Consultants, 2014) shows that the air quality impacts of RBT2 are mainly localized (limited to south Delta and south Richmond) and, are not likely to overlap with the proposed Project residual effects; therefore, RBT2 sources were not included in the cumulative effects modelling.
- **The Vancouver Airport Fuel Delivery (VAFD)** – This project is proposed by the Vancouver Airport Fuel Facilities Corporation (VAFFC) and includes a marine terminal and fuel receiving facility on the south arm of the Fraser River and a 13-kilometer underground pipeline to the Vancouver International Airport. VAFD received an environmental approval in December 2013 from the provincial and federal governments and is currently in construction stage. It is scheduled to be fully operational by 2023. Once in operation, the marine terminal is expected to receive fuel deliveries from barges (once every two weeks) with an unloading time of approximately 12 hours and from Panamax vessels (once or twice per month) with an unloading time of 24 to 36 hours. The fuel receiving facility will be adjacent to the marine terminal and will include six above ground storage tanks with a total capacity of 80 million litres (VAFFC, 2022). Based on the VAFD's Environmental Assessment Certificate Application (VAFFC, 2011), VAFD operations will result in a

reduction of NO₂ and particulate matter, and slight increase in SO₂ concentrations, which is mainly due to the use of emission control and leak detection systems, NO₂ reduction technologies and use of low sulphur fuels. VAFD is located within the LAA, approximately 2 km west of Phase 2 Project, however air quality effects of VAFD are expected to be short-term and minimal due to low frequency of fuel delivery, and overall NO₂ emission reductions; therefore, emissions from the VAFD are not included in the cumulative air dispersion modelling.

3.5.3 Sources included in Cumulative Air Dispersion Modelling

In addition to Phase 2 sources, emission sources from the T1A, T1B and TMJ projects were included in the cumulative air dispersion modelling.

Hourly emission rates from the Tilbury T1A and T1B project sources were obtained directly from FortisBC and summarized in Table 3-10 below. These sources operate 345 days a year and annual emissions were scaled accordingly to compute their annual contributions. T1B project emissions were scaled based on conceptual basis of assessment information for Phase 2 and emissions were adjusted to reflect proposed Project production capacity of 0.65 MT.

Table 3-8: Emission Rates for Tilbury T1A and T1B used in Air Dispersion Modelling (in g/s)^{1,2,3,4}

Source Description	ID	NO _x	SO ₂	CO	PM _{2.5} ³	PM ₁₀ ³	VOC
T1A regenerator	T1A_REGE	0.031	0.001	0.052	0.005	0.005	0.003
T1A incinerator	T1A_INCI	0.477	0.889	0.116	0.057	0.057	0.056
T1A heater	T1A_HEAT	0.065	0.002	0.109	0.010	0.010	0.007
T1B hot oil heater	T1B_HOH	0.534	0.081	0.194	0.039	0.039	0.029
T1B thermal oxidizer	T1B_TO	0.294	0.789	0.049	0.015	0.015	0.016
T1B ground flare	T1B_GF	0.040	0.078	0.006	0.006	0.006	0.001

Notes: ¹ Maximum hourly emissions.

² All sources are operating continuously (24/7 for 345 days).

³ T1B project emissions reflect project production capacity of 0.65MT.

⁴ All PM was assumed to be in the PM_{2.5} size range.

Emissions for the TMJ project were adopted from their EA Certificate Application (Golder, 2018) and supporting assessments including (Golder, 2019) and (Golder, 2022). Representative emissions and sources for each averaging period were developed. The model scenarios are summarized in Table 3-11 and emission rates are summarized in Table 3-12 below. More details on these emissions are provided in *AQ-Appendix F – Tilbury Marine Jetty*.

Table 3-9: Normal Tilbury Marine Jetty Operation Scenario Summary

Equipment	Specifications	Assumption
1-hour Scenario		
Diesel Powered Articulated Tub Barge (ATB) Bunker Vessels	4,000 m ³ LNG capacity	- Auxiliary engine operates for 0.4 hours during loading - The main and auxiliary engines of the diesel-powered ATB bunker vessel operate for 0.6 hours during berthing/departing
Security Vessel	N/A	Main engine operating for 1 hour
8-hour ¹		
Diesel Powered ATB Bunker Vessels	4,000 m ³ LNG capacity	- Auxiliary engine operates for 6.5 hours during loading - The main and auxiliary engines of the diesel-powered ATB bunker vessel operate for 0.6 hours during berthing/departing
Diesel Powered LNG Carrier	100,000 m ³ LNG capacity	The main and auxiliary engine plus boiler operating for 0.9 hours during berthing/departing
Security Vessel	N/A	Main engine operating for 8 hours
24-hour Scenario ¹		
Diesel Powered ATB Bunker Vessels	4,000 m ³ LNG capacity	- Auxiliary engine operates for 6.5 hours during loading - The main and auxiliary engines of the diesel-powered ATB bunker vessel operate for 0.6 hours during berthing/departing
Diesel Powered Carrier	100,000 m ³ LNG capacity	The main and auxiliary engine plus boiler operating for 2 hours during berthing/departing, and the auxiliary engine operating for 14.9 hours during loading
Security Vessel	N/A	Main engine operating for 24 hours
Annual Scenario		
Diesel Powered ATB Bunker Vessels	4,000 m ³ LNG capacity	307 LNG bunker vessel calls per year, where 100% of the bunker vessels are assumed to be the 4,000 m³ diesel powered ATBs without assistance of diesel-fueled tugs
Diesel Powered LNG Carrier	100,000 m ³ LNG capacity	6 diesel powered LNG carrier calls per year (10% of the carriers), with assistance of three diesel-fueled tugs per call
LNG Powered Carrier	100,000 m ³ LNG capacity	52 LNG powered carrier calls per year (10% of carriers), with assistance of three diesel-fueled tugs per call
Three Tug Vessels	3,728 kWh Diesel Powered Engine	174 tugs assisting (three for each call), assisting 58 LNG carrier calls
Security Vessel	N/A	25 days per year of security vessel patrol
Dredger	Main & Auxiliary Engines, Thrusters and Pumps	14 days per year of 24-hour dredger work
Shipping emissions	N/A	Shipping emissions based on average annual emissions scaled down to Fortis, BC, Tilbury LNG facility modelling domain.

Notes: ¹ Tug vessels assisting diesel powered LNG carrier during berthing/departing were not included



Table 3-10: Emission Rates for Tilbury Marine Jetty used in Air Dispersion Modelling

Source Description	NO _x (g/s)	SO ₂ (g/s)	CO (g/s)	PM _{2.5} (g/s)	PM ₁₀ (g/s)	VOC ¹ (g/s)
1-hour Averaging Period						
Diesel Powered ATB Bunker ²	0.654	0.0050	0.118	0.020	0.021	0.053
Security Vessel ³	0.287	0.0001	0.023	0.005	0.005	0.008
8-hour Averaging Period²						
Diesel Powered LNG Carrier ²	n/a	n/a	0.051	n/a	n/a	n/a
Diesel Powered Bunker Vessel ²	n/a	n/a	0.024	n/a	n/a	n/a
Security vessels ³	n/a	n/a	0.023	n/a	n/a	n/a
24-hour Averaging Period²						
Diesel Powered LNG Carrier ²	n/a	n/a	n/a	0.029	0.031	n/a
Diesel Powered Bunker Vessel ²	n/a	n/a	n/a	0.002	0.002	n/a
Security vessels ³	n/a	n/a	n/a	0.005	0.005	n/a
Annual Averaging Period						
Diesel Powered LNG Carrier ²	0.032	0.001	0.003	0.001	0.001	0.001
3 Tugs ⁴	3 x 0.054	3 x 2.7E-05	3 x 0.007	3 x 0.001	3 x 0.001	3 x 0.003
Dredger ²	0.336	1.7E-04	0.047	0.007	0.008	0.018
LNG Powered Carrier ²	0.008	0	0.008	5.2E-05	5.2E-05	0.002
Diesel Powered ATB Bunker Vessel ²	0.053	0.001	0.007	0.001	0.001	0.003
Security vessels ³	0.020	9.0E-06	0.002	3.2E-04	3.4E-04	0.001
Shipping Emissions ⁵	1.126	0.007	0.623	0.024	0.024	0.144

Notes: ¹ RWDI did not include VOC emissions from pipeline fugitive losses.

² Modelled as one point source.

³ Modelled as an area source.

⁴ Tugs were modelled as three separate point sources.

⁵ Modelled as series of 10 area sources.

Table 3-13 summarizes the annual emissions from Tilbury 1A, Tilbury 1B, the proposed unmitigated Tilbury Phase 2 Project (T2), and the TMJ projects. It also highlights the relative contribution of the proposed Project in comparison to other nearby facilities.



Table 3-11: Contribution of the Proposed Project Relative to the Nearby Facilities

Project		NOx Emissions (tonnes/year)	SO ₂ Emissions (tonnes/year)
Tilbury 1A		17.08	26.59
Tilbury 1B		25.87	28.26
Tilbury Marine Jetty		54.76	0.31
Cumulative with Tilbury Phase 2 – Unmitigated Scenario	Emission from the proposed Project	246.6	132.2
	Total Emissions	344.29	187.38
	Unmitigated Phase 2 Contribution to Total	72%	71%
Cumulative with Tilbury Phase 2 – Mitigated Scenario	Emission from the proposed Project	38.8	73.9
	Total Emissions	136.47	129.05
	Mitigated Phase 2 Contribution to Total	28%	57%

Notes: ¹ Existing facilities—excluding Tilbury 1A—are assumed to contribute to background concentrations as measured at Metro Vancouver monitoring stations. However, due to the lack of detailed emissions data for these facilities, they are not included in this table.



4 DISPERSION MODELLING METHODOLOGY

Dispersion modelling was conducted with the CALPUFF model (Version 7.2.1) for the three-year modelling period 2013 to 2015. CALPUFF is a multi-layer, multi-species non-steady-state puff dispersion model that simulates the effects of time- and space-varying meteorological conditions on pollution transport, transformation and removal, and is capable of simulating varying wind flow patterns and varying land use. The rationale for choosing CALPUFF include the following:

- The proposed Project is located in Delta B.C., adjacent to the Fraser River on Tilbury Island, with urban areas nearby.
- The modelling domain is too large to assume constant meteorological conditions throughout.
- The use of CALPUFF is recommended by the BC AQDMG (ENV, 2022a) and MV for a refined assessment.

The modelling approach and technical details are consistent with the BC AQDMG (ENV, 2022a) and the MV Dispersion Modelling Plan developed for the proposed Project through engagement with MV, and approved on August 4, 2022 (AQ-Appendix A).

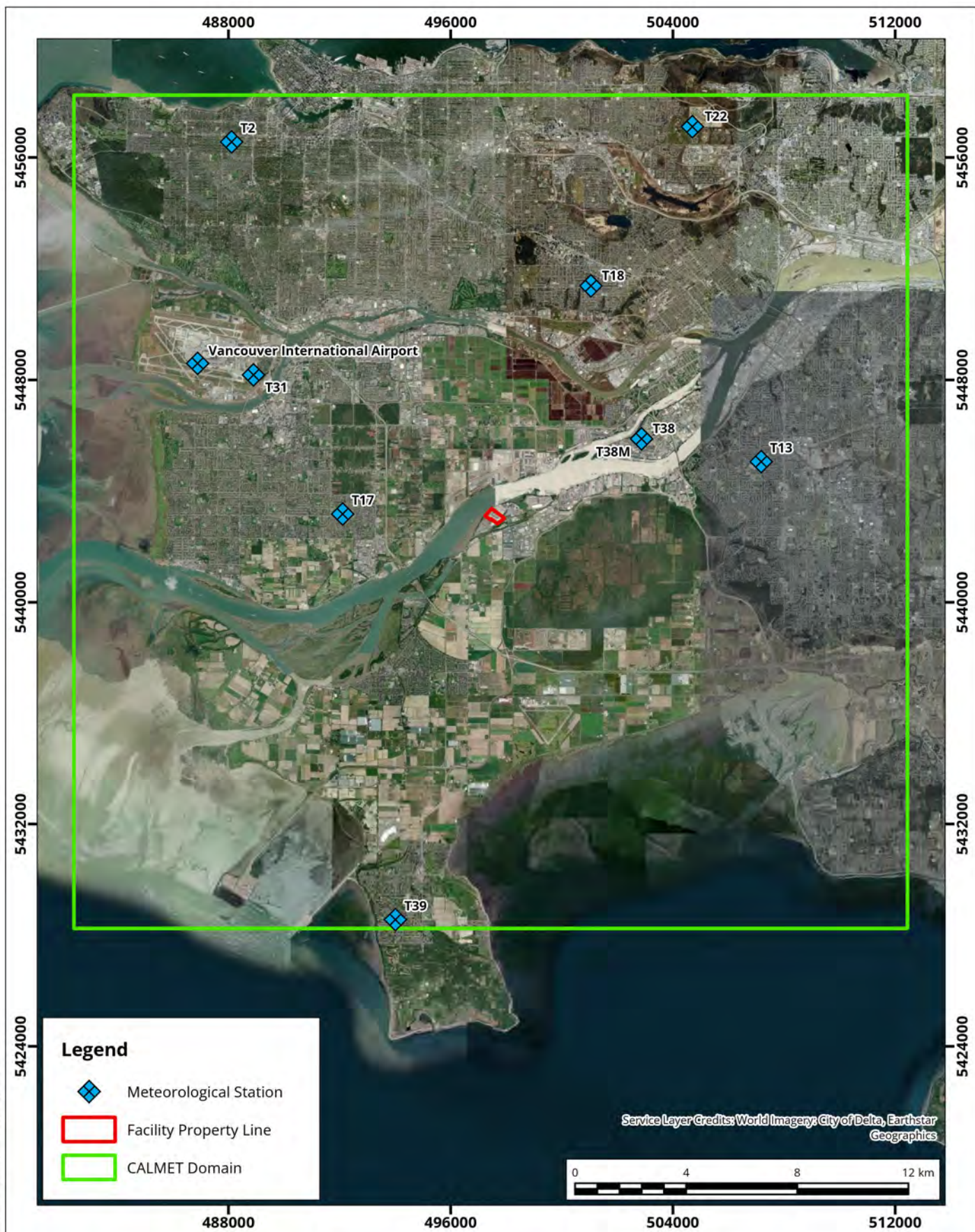
4.1 Meteorology

Three-dimensional hourly meteorological fields were provided to CALPUFF by CALMET (version 6.5.0), which is the meteorological diagnostic model of the CALPUFF modelling suite. CALMET can simulate the changes in boundary layer dynamics that result from changing synoptic conditions and variable land cover and terrain in the air quality dispersion modelling study area.

CALMET was run with input from hourly surface observations at nine nearby monitoring stations (displayed in Figure 4-1) and hourly prognostic fields from the Weather Research Forecast (WRF) model at 4 km resolution obtained from ENV for the years 2013-2015.

Detailed information about the CALMET setup and results is provided in *AQ-Appendix G – Meteorological Modelling*.

Map Document: C:\GIS\2000436_Tilbury\2000436_Tilbury_LNG.aprx



Meteorological Stations used in CALMET

Map Projection: NAD 1983 UTM Zone 10N
Tilbury LNG - Delta, BC



Project #: 2000436

Drawn by: RCL	Figure: 4-1
Approx. Scale: 1:190,000	
Date Revised: Feb 28, 2022	



4.2 CALPUFF Model Setup

The CALMET output (three years of hourly three-dimensional meteorological fields) was used as input to the CALPUFF dispersion model (version 7.2.1). CALPUFF was run over the full CALMET domain (30 km by 30 km study area, shown in Figure 1-1). All modelled sources at the facility emit their exhaust through stacks and were modelled as point sources in CALPUFF.

Additional details on the modelling methodology are provided in this section and in *AQ-Appendix H – CALPUFF Details*.

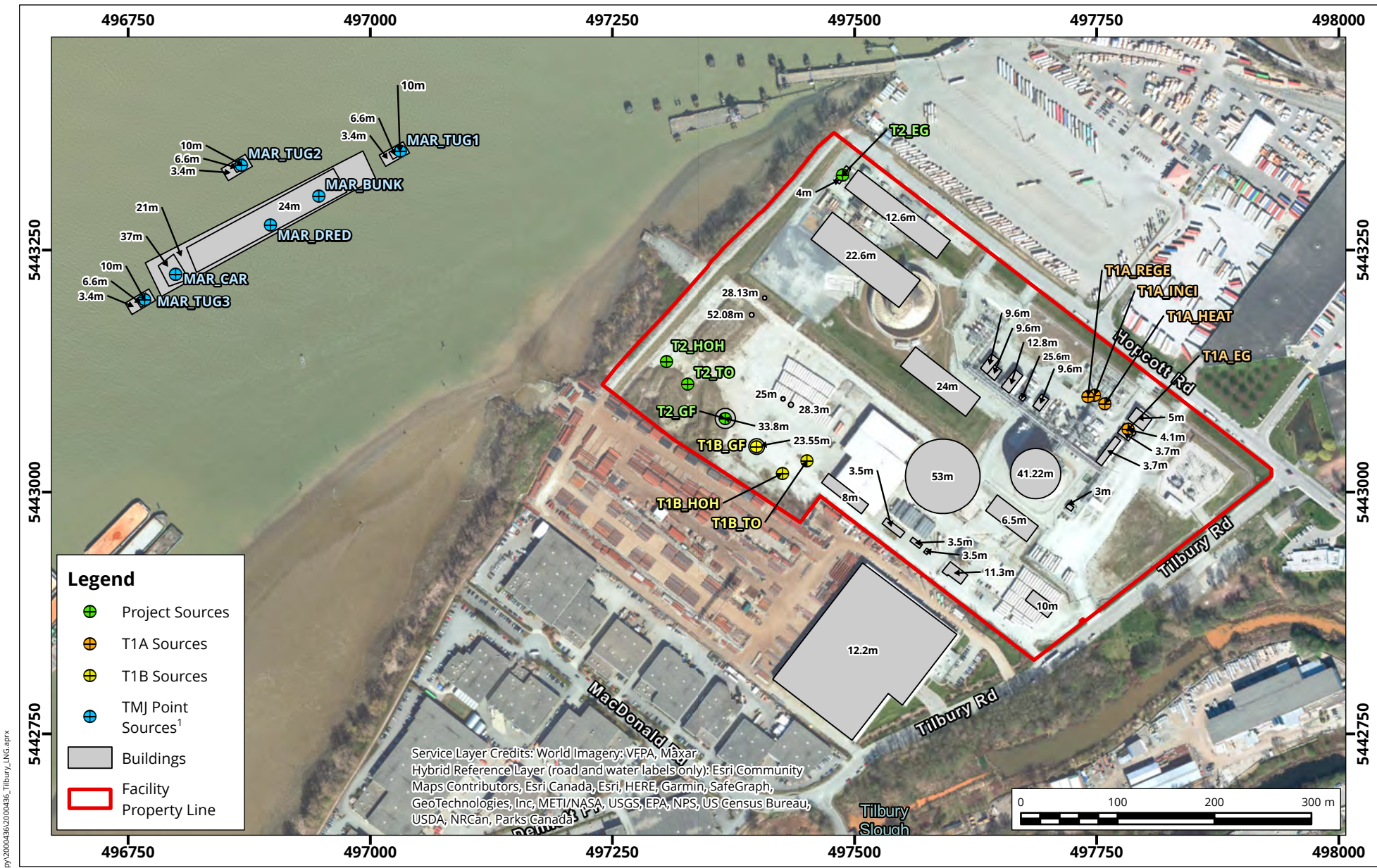
4.2.1 Emission Sources

Emissions from the sources discussed in Section 3 were included in the model. *AQ-Appendix H* provides a list of the emission sources discussed in Section 3. Source location coordinates for T1A and T1B sources are provided in *AQ-Appendix H*. Details on TMJ sources are provided in *AQ-Appendix F*. Source locations along with modelled buildings are shown in Figure 4-2. Note that the area sources representing emissions from TMJ security vessels and TMJ shipping emission along the Fraser River are not shown in Figure 4-2. These area sources are shown in Figure F.1 of *AQ-Appendix F*.

Figure 4-3 illustrates the conceptual source locations and modelled buildings for the mitigated scenario. Note that the building layout and all external sources remain unchanged from the unmitigated scenario.

For the assessment of the existing baseline, T1A sources were modelled along with the background concentrations. For the potential proposed Project effects, the baseline and proposed Project sources were included in the modelling. For the assessment of cumulative effects, all sources and background were included in the modelling.

Modelled emission rates for normal operation -unmitigated and mitigated are provided in Table 3-6 and Table 3-7, respectively. Source characteristics for normal operations were developed based on the conceptual basis of assessment information provided by FortisBC and vendor specifications and summarized in Table 4-1 below. FortisBC provided the source parameters for the conceptual mitigated scenario, which are summarized in Table 4-2 below. Additional information on the scenario is available in *AQ-Appendix L*. Modelled source parameters for commissioning, start-up, shutdown, upset and grid power outage conditions are summarized in Table 4-3 with additional details provided in *AQ-Appendix E*. Modelled source parameters for sources external to the proposed Project are provided in Table 4-4. Source coordinates are provided in *AQ-Appendix H*.



Facility Layout, Modelled Buildings and Source Locations- Unmitigated Scenario

¹ Area sources representing emissions from security vessels and shipping emissions along the Fraser River are not shown here.

Map Projection: NAD 1983 UTM Zone 10N
Tilbury LNG - Delta, B.C.

True North

Drawn by: DJH
Figure: 4-2

Approx. Scale: 1:5,500

Date Revised: Sep 24, 2025

Project #: 2000436

Map Document: E:\GIS\Work\2000436\2000436_Tilbury_LNG.aprx



Facility Layout, Modelled Buildings and Source Locations- Conceptual Mitigated Scenario

¹ Area sources representing emissions from security vessels and shipping emissions along the Fraser River are not shown here.

Map Projection: NAD 1983 UTM Zone 10N
Tilbury LNG - Delta, B.C.

True North ↑	Drawn by: DJH	Figure: 4-3	
	Approx. Scale: 1:5,500		
	Date Revised: Sep 24, 2025		

Project #: 2000436

Table 4-1: Modelled Source Parameters for Unmitigated Normal Operations Scenario

Source	ID	Height (m)	Stack Diameter (m)	Flow Rate (Nm ³ /h)	Exit Velocity (m/s)	Exit Temperature (K)	ISR ¹	Release Orientation
Hot Oil Heater	T2_HOH	61.5	4.15	99,892	4.18	556	0.4	Vertical, No rain cap
Thermal Oxidizer	T2_TO	22.3	2.57	20,533	4.38	1,089	0.4	Vertical, No rain cap
Totally Enclosed Ground Flare	T2_GF	33.8	20.7	894,244	0.82	304	0.4	Vertical, No rain cap

Notes: ¹ In-stack-ratio of NO₂/NO_x for process gas combustion.

Table 4-2: Modelled Source Parameters for Mitigated Normal Operations Scenario

Source	ID	Height (m)	Stack Diameter (m)	Flow Rate (Nm ³ /h)	Exit Velocity (m/s)	Exit Temperature (K)	ISR ¹	Release Orientation
Hot Oil Heater	T2_HOH	Not present in this scenario						
Thermal Oxidizer	T2_TO							
Flue Gas Desulphurization Unit	T2_FGD	61.5	1.7	148,402	30	453	0.1	Vertical, No rain cap
Totally Enclosed Ground Flare	T2_GF	33.8	20.7	894,244	0.82	304	0.4	Vertical, No rain cap

Notes: ¹ In-stack-ratio of NO₂/NO_x for process gas combustion.

Modelled emission rates for commissioning are provided in Section 3.2. Emission rates for start-up, shutdown, upset and grid power outage conditions are provided in Table 3-9. Emission rates for sources external to the proposed Project are provided in Section 3.5. Modelled source parameters for abnormal conditions are summarized in Table 4-3 with additional details provided in *AQ-Appendix E*.

Table 4-3: Modelled Source Parameters for Proposed Project Abnormal Conditions

Condition	Source	Height (m)	Stack Diameter (m)	Exit Velocity (m/s)	Exit Temperature (K)	ISR ¹
Commissioning	T2_GF	33.8	20.7	3.03	303.5	0.4
Shutdown/Start-up	T2_GF			3.03		
Upset	T2_GF			0.97		
	T2_HOH	Same as normal operation				
Grid Power Outage	T2_EG	5.944	0.457	33.84	758	0.083
	T1A_EG	5.944	0.457	44.48	750	0.083
	T2_GF (pilot)	Same as normal operation				
	T2_TO (critical load) ²	22.31	2.57	2.61	1089	0.4

Notes: ¹ In-stack-ratio of NO₂/NO_x for process gas combustion (0.4) and diesel combustion (0.083).

² Only pilot burner is active. Fuel demand for critical load is 361.4 kg/hr.

Emission rates for sources external to the proposed Project are provided in Section 3.5. Source parameters for sources external to the proposed Project are provided in Table 4-4. Source parameters for Tilbury T1A and T1B projects were taken from the air quality study report to support an air emissions permit amendment application for Tilbury (RWDI, 2022). Source parameters for the TMJ project were adopted from their Environmental Assessment Certificate Application (Golder, 2018) and supplemental assessments (Golder, 2019, 2022). Additional details for Tilbury Marine Jetty are provided in *AQ-Appendix F – Tilbury Marine Jetty*.

Table 4-4: Modelled Source Parameters for Sources External to the Proposed Project

Facility	Source	Height (m)	Stack Diameter (m)	Flow Rate (N m ³ /h)	Exit Velocity (m/s)	Exit Temperature (K)	ISR ¹	Release Orientation
Tilbury T1A (Existing)	T1A regen heater	5.63	0.46	1,603	5.69	573	0.1	Vertical, No cap
	T1A incinerator	16.8	1.05	5,357	7.93	1,255	0.4	Vertical, No cap
	T1A heater	6.10	0.51	4,348	12.5	573	0.1	Vertical, No cap
Tilbury T1B 0.65 MT (RFP)	T1B hot oil heater	29.0	1.56	10,400	3.14	568	0.4	Vertical, No cap
	T1B thermal oxidizer	19.2	1.39	5,721	4.41	1,144	0.4	Vertical, No cap
	T1B ground flare	23.5	16.2	499,647	0.74	304	0.4	Vertical, No cap
Tilbury Marine Jetty (RFP)	Diesel Powered Carrier	47.0	1.00	56,549	20.0	655	0.1	Vertical, No cap
	Tug Vessels ²	10.0	0.30	5,089	20.0	573	0.1	Vertical, No cap
	Dredger ³	17.0	0.30	5,089	20.0	655	0.1	Vertical, No cap
	LNG Powered Carrier ³	47.0	1.00	56,549	20.0	655	0.1	Vertical, No cap
	Diesel Powered Bunker Vessel ⁴	18.0	0.50	14,137	20.0	655	0.1	Vertical, No cap
	Security Vessels	Area source – Effective height = 1.5 m; σ_z = 1.4 m; Area = 164,848 m ² ;						
	Shipping Emissions	Area source – Effective height = 10 m; σ_z = 4 m; Area = 3,067,214 m ² ;						

Notes: ¹ In-stack-ratio of NO₂/NO_x.

² Three tug vessels were considered in the model.

³ These sources were only considered for the annual averaging period.

⁴ This source was considered for the 24-hour and annual averaging periods.

4.2.2 Receptors

In the CALPUFF model, a discrete set of receptor points are specified at which pollutant concentrations are predicted. A Cartesian nested grid of receptors was defined within the study area, as per the BC modelling guideline, with additional receptors within residential areas throughout the RAA. All receptors were modelled at a flagpole height of 1.5 metres above ground for ambient air concentration modelling.



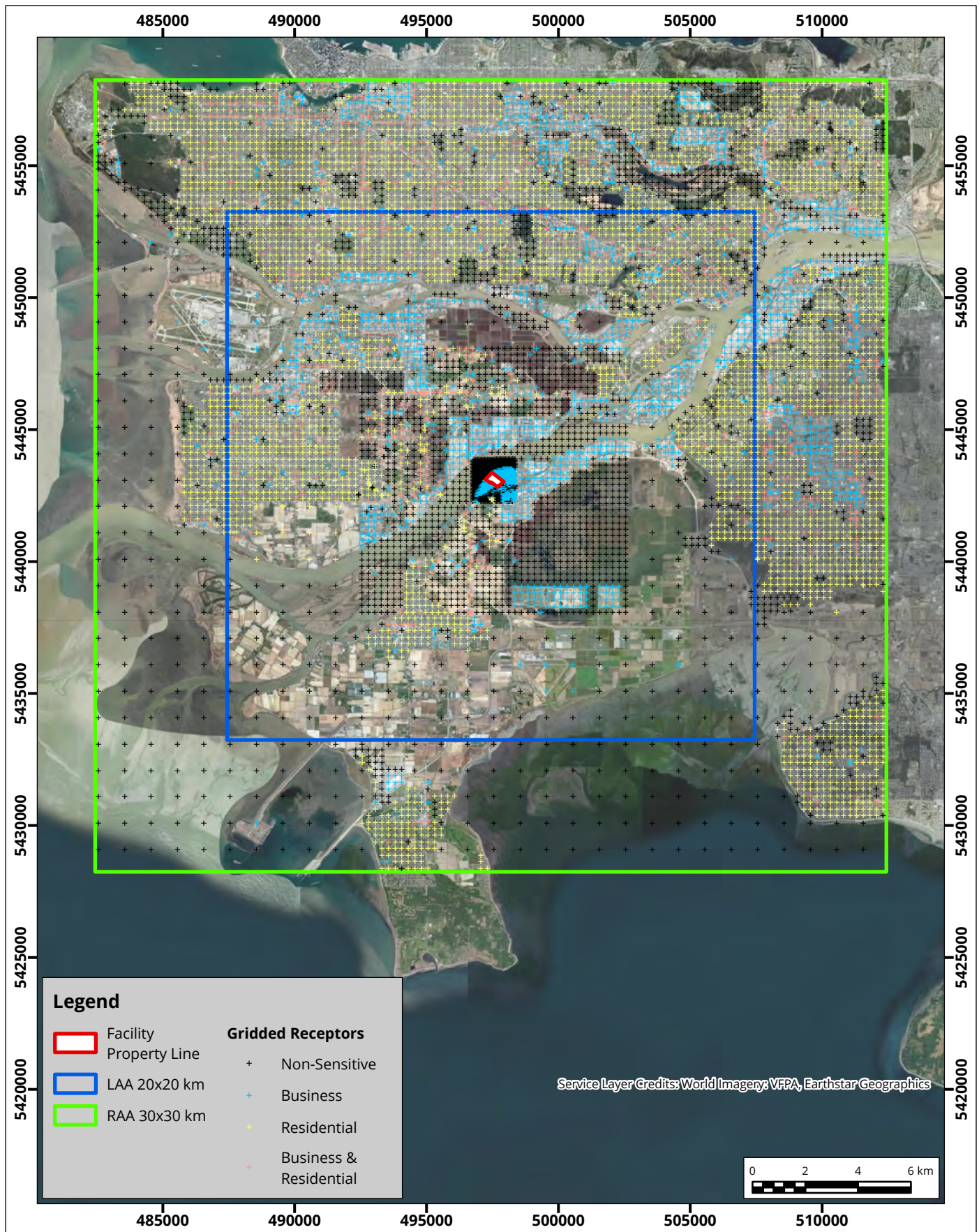
Receptor spacing for the Cartesian grid is as follows:

- 20-m spacing along the Tilbury LNG facility fenceline.
- 50-m spacing within 500 m of the facility.
- 250-m spacing within 5 km of the facility and over all residential areas within the model domain.
- 1,000-m spacing for the remainder of the study area.

All childcares, schools and seniors' facilities within a 5 km radius were explicitly modelled as discrete sensitive receptors. The historic Indigenous village site across the Fraser River was also included as a sensitive receptor. As most of the RAA is a heavily populated urban environment, all gridded receptors located in a residential or business area (i.e., over 9,000 receptors) were identified as residential and/or business sensitive receptors, and, considered when reporting maximum values for their respective category. The nested grid of receptors for the CALPUFF model and their respective categories are shown in Figure 4-4. Discrete sensitive receptors are shown in Figure 4-5, with more details provided in *AQ-Appendix H*.

Terrain elevations were extracted from Canadian Digital Elevation Model (Natural Resources Canada) for all receptors included in the CALPUFF model and for the geophysical data in CALMET.

Map Document: C:\GIS\Temp - Copy\2000436\200436_Tilbury_LNG.aprx



Gridded Receptors and Classifications

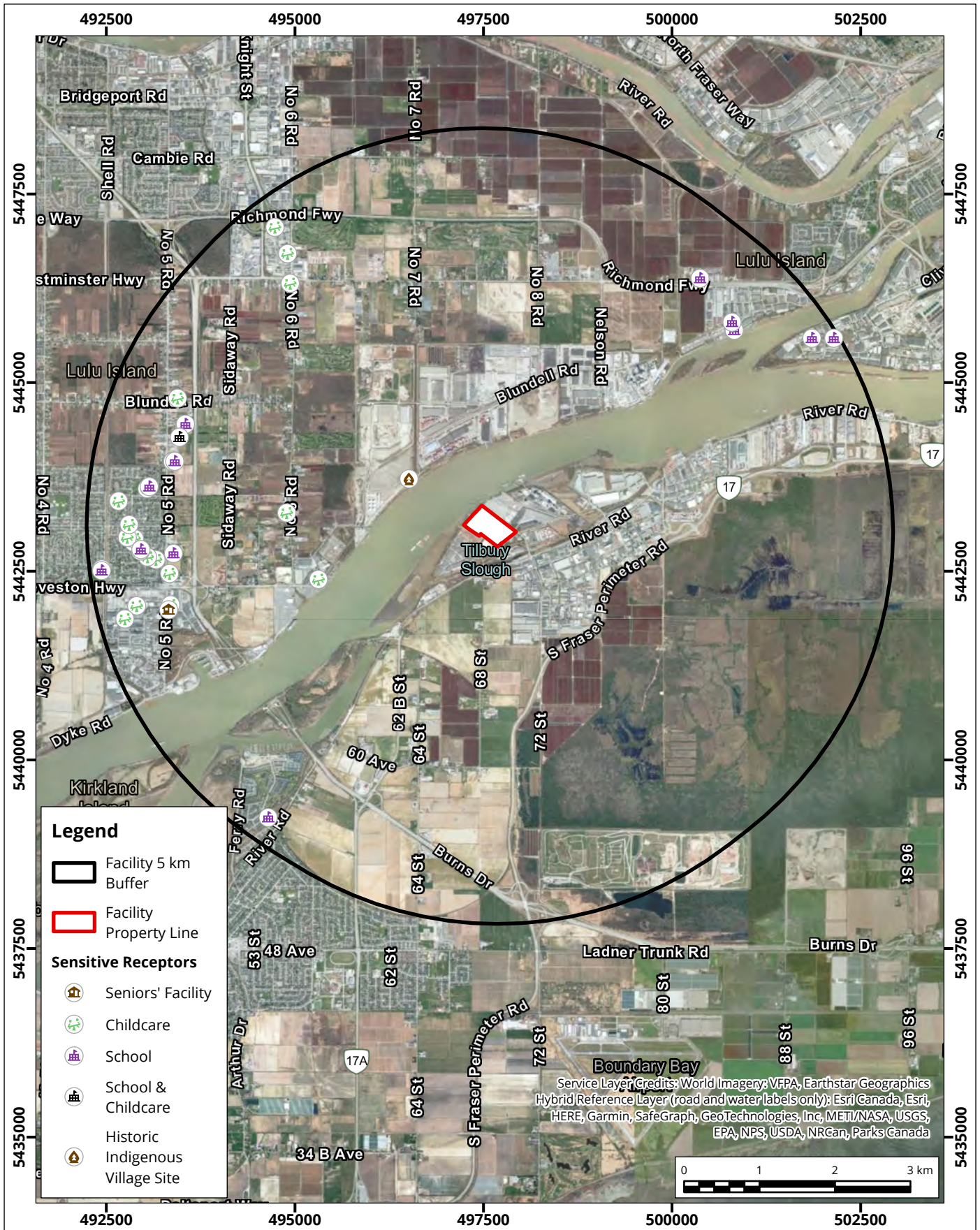
Map Projection: NAD 1983 UTM Zone 10N
Tilbury LNG - Delta, B.C.



Project #: 2000436

Drawn by: DJH	Figure: 4-4
Approx. Scale: 1:200,000	
Date Revised: Sep 24, 2025	





Additional Sensitive Receptors within 5 km of the Facility

Map Projection: NAD 1983 UTM Zone 10N
Tilbury LNG - Delta, B.C.



Project #: 2000436

Drawn by: DJH	Figure: 4-5
Approx. Scale: 1:70,000	
Date Revised: Sep 24, 2025	



4.2.3 Building Effect

Buildings located close to stacks may influence the dispersion of emissions. The effect of all large buildings and structures on the modelled point sources was incorporated using the Building Profile Input Program Plume Rise Model Enhancement (BPIP-PRIME) algorithm. The algorithm explicitly treats the trajectory of the plume near the building and uses the position of the plume relative to the building to calculate interactions with the building wake.

Building dimensions for use in BPIP-PRIME were provided by FortisBC. Modelled buildings are shown in Figure 4-2. Building coordinates are provided in *AQ-Appendix H*.

4.2.4 Technical Dispersion options

All technical options relating to the CALPUFF dispersion model were set according to the BC AQDMG (ENV, 2022a) or to the model defaults. These include parameters and options such as the calculation of plume dispersion coefficients, the plume path coefficients used for terrain adjustments, plume rise options and the use of puff. A list of the technical options for CALPUFF is provided in *AQ-Appendix H*.

4.3 Postprocessing of CALPUFF Outputs

Hourly concentrations of the contaminants were predicted at each flagpole receptor. Post-processing of hourly model results was conducted to determine required metrics for comparison with ambient air quality objectives and standards over various averaging periods.

The 8-hour CO and 24-hour PM_{2.5}/PM₁₀ ambient air quality objectives developed by MV are intended to be compared against concentrations calculated as a rolling average. Therefore, predicted concentrations for these averaging periods were calculated as rolling averages at all receptors.

Representative background concentrations were added to modelled concentrations for all modelling cases to account for existing emission sources in the study area besides T1A sources which were modelled explicitly.

Note that for the recently modelled mitigated scenarios, updated background concentrations per MV's guidance were applied. For the previously modelled unmitigated scenarios, background concentrations remained unchanged from the original Application. Background concentrations used for all contaminants and relevant averaging periods are presented in Table 2-1 for the unmitigated scenarios, and in Table 2-2 for the mitigated scenario.



4.3.1 NO_x to NO₂ conversion

Total oxides of nitrogen (NO_x) are comprised of nitric oxide (NO) and nitrogen dioxide (NO₂). Transformation of NO to NO₂ continues in the atmosphere due to reaction with atmospheric ozone and other volatile organic compounds. The Ozone Limiting Method (OLM) with hourly ozone concentrations and source-specific In-Stack Ratio (ISR) was used to calculate conversion of NO_x to NO₂. As directed by the BC AQDMG (ENV, 2022a) and the *Guidance for NO₂ Dispersion Modelling in British Columbia* (the NO₂ Guidance - ENV, 2022b), in OLM, NO₂ concentration can be determined using the following equation (summing over contributions from all sources “i” to be considered):

$$\text{NO}_2 = \sum (\text{ISR}_i \times \text{NO}_{x_i}) + \min [\text{O}_3, \sum (0.9 - \text{ISR}_i \times \text{NO}_{x_i})] + \text{background NO}_2$$

where ISR_i is the In Stack Ratio for Source i and NO_{x_i} concentrations created by Source i

Hourly ozone data at the nearby Richmond South (T17) MV station, located only 5 km west of the facility, and North Delta station (T13) MV station, located 10 km east of the facility, were used to develop ozone concentrations for OLM. For each hour of modelling, the maximum of the hourly ozone concentrations observed at T17 or T13 was selected to provide conservative ozone concentrations near the facility that were consistent and concurrent with the modelled meteorology. Source-specific ISR values are listed in Table 4-1 through Table 4-3.



5 DISPERSION MODELLING RESULTS – UNMITIGATED SCENARIOS

Modelling was performed for three years (2013-2015), and percentile values were computed for each year separately. Individual year results were then averaged over the three modelling years to compare with the CAAQS/MV metrics. Three-year average results are presented in this section, while Individual annual results, showing year over year variability of maximum predicted concentrations, are provided in *AQ-Appendix J – Results Tables*.

The overall results for the Base Case, Base Case + Proposed Project Normal Operation, and Cumulative Case are summarized in *AQ-Appendix J – Results Tables*, Tables J1 and J2. Results for each of those scenarios, as well as for the abnormal conditions are further discussed hereafter.

Model results for the conceptual mitigated scenario are presented in Section 7 below, and *AQ-Appendix L – Conceptual Mitigated Scenario*.

5.1 Base Case

Overall maximum predicted concentrations over the RAA are tabulated in Table 5-1. Contour plots are provided in *AQ-Appendix I – Contour plots* (Figures I.1 to I.14). Maximum predicted concentrations at each sensitive receptor category, along with year over year variability of maximum predicted concentrations are provided in *AQ-Appendix J – Results Tables* (Tables J.3 to J.8). Results are dominated by ambient background concentrations with very localized effects from the T1A sources on the northeastern boundary of the facility.

Table 5-1: Maximum Predicted Concentrations for Base Case¹

Air Contaminant	Averaging Period	Background Concentrations (µg/m ³) ⁵	Maximum Predicted Concentration (incl. background)	Ambient Air Quality Objective or Standard	
			Base Case (µg/m ³)	Value (µg/m ³)	Name
NO ₂ (Total conversion)	1-hour ²	58.1	94.6	113	Previous MV AAQO
	Annual	21.1	23.0	32	
	1-hour ²	58.1	94.6	79	Current MV AAQO and CAAQS 2025
	Annual	21.1	23.0	22.6	
NO ₂ (OLM)	1-hour ²	58.1	90.5	113	Previous MV AAQO
	Annual	21.1	22.8	32	
	1-hour ²	58.1	90.5	79	Current MV AAQO and CAAQS 2025
	Annual	21.1	22.8	22.6	
SO ₂	1-hour	3.64	91.1	183	MV AAQO
	Annual	0.63	2.02	13	Previous MV AAQO
	1-hour ³	3.64	60.5	170	CAAQS 2025
	Annual	0.63	2.02	10.5	Current MV AAQO and CAAQS 2025
CO	1-hour	557	602	14900	MV AAQO
	8-hour ⁴	505	536	5700	
PM _{2.5}	24-hour ⁴	12.0	13.8	25	MV AAQO
	Annual	4.91	5.19	8 (6) ⁶	
PM ₁₀	24-hour ⁴	18.4	20.2	50	MV AAQO
	Annual	9.19	9.47	20	
VOC	1-hour	150	158	-	-
	24-hour ⁴	90.2	91.6	-	
	Annual	32.8	33.0	-	

Notes: ¹ Effects are compared with the MV AAQO and CAAQS 2025, each with their respective metrics. Exceedances are highlighted in **bold**.

² Based on 98th percentile of the daily 1-hour maximum (D1HM) predictions.

³ Based on 99th percentile of the daily 1-hour maximum (D1HM) predictions.

⁴ Based on rolling average.

⁵ Originally calculated values based on 2019-2021 data and using metrics discussed in Table 2-1.

⁶ MV's annual PM_{2.5} planning goal of 6 µg/m³ is a longer-term aspirational target to support continuous improvement.

5.1.1 NO₂

Ambient background NO₂ concentrations in the MV airshed are elevated, and very close to the hourly and annual current MV AAQO and CAAQS 2025 in the LAA. Predicted hourly NO₂ concentrations using OLM for the Base Case do not exceed the previous 1-hour MV AAQO but are predicted to potentially exceed the current MV AAQO and CAAQS 2025 within 50 m of the facility to the east of the facility, over the adjacent industrial site (Figure I.1). This is mostly due to the large existing background NO₂ concentrations in the MV airshed, and the localized effects of T1A sources.



Similarly, the predicted annual NO₂ concentrations for the Base Case are below the previous MV annual AAQO but are predicted to potentially exceed the current MV AAQO and CAAQS 2025 within 80 m of the facility to the east of the facility (Figure I.2); the existing background NO₂ annual concentrations alone reach 93% of the current MV AAQO and CAAQS 2025

5.1.2 SO₂

Predicted maximum hourly SO₂ concentration (99th percentile of the daily maximum 1-hour (D1HM)), is only a fraction of the CAAQS 2025, owing to the low background SO₂ concentrations in the area and localized effect of the T1A sources.

Similarly, the predicted maximum 1-hour concentrations (100th percentile) are well below 1-hour MV AAQO. The predicted annual average concentrations of SO₂ remain below the CAAQS 2025 and the MV AAQO (Figures I.3 to I.5).

5.1.3 CO, PM and VOC

Predicted 8-hour and 24-hour (rolling) average concentrations of CO (Figures I-6 and I-7) are well below their respective MV AAQO.

24-hour (rolling) and annual average concentrations of PM_{2.5} and PM₁₀ (Figures I-8 to I-11) are largely dominated by ambient background, which is half the MV AAQO, with small, localized effect from the T1A sources.

There are no objectives for VOC concentrations. The Base case concentration mostly reflect ambient total VOC concentrations. Isopleths for predicted VOC concentrations are shown in Figures I-12 to I-14.

5.2 Base Case + Proposed Project

Overall maximum predicted concentrations over the RAA are tabulated in Table 5-2. Contour plots are provided in *AQ-Appendix I – Contour plots* (Figures I.15 to I.29). Maximum predicted concentrations at each sensitive receptor category, along with year over year variability of maximum concentrations, are provided in *AQ-Appendix J – Results Tables* (Tables J.9 to J.14).

Table 5-2: Maximum Predicted Concentrations for Base Case + Proposed Project¹

Air Contaminant	Averaging Period	Background Concentrations (µg/m ³) ⁵	Maximum Predicted Concentration (incl. background)		Ambient Air Quality Objective or Standard	
			Base Case (µg/m ³)	Base Case + Proposed Project (µg/m ³)	Value (µg/m ³)	Name
NO ₂ (Total conversion)	1-hour ²	58.1	94.6	112	113	Previous MV AAQO
	Annual	21.1	23.0	23.5	32	
	1-hour ²	58.1	94.6	112	79	Current MV AAQO and CAAQS 2025
	Annual	21.1	23.0	23.5	22.6	
NO ₂ (OLM)	1-hour ²	58.1	90.5	101	113	Previous MV AAQO
	Annual	21.1	22.8	24.5	32	
	1-hour ²	58.1	90.5	101	79	Current MV AAQO and CAAQS 2025
	Annual	21.1	22.8	24.5	22.6	
SO ₂	1-hour	3.64	91.1	157	183	Current MV AAQO
	Annual	0.63	2.02	6.37	13	Previous MV AAQO
	1-hour ³	3.64	60.5	89.6	170	CAAQS 2025
	Annual	0.63	2.02	6.37	10.5	Current MV AAQO and CAAQS 2025
CO	1-hour	557	602	602	14900	MV AAQO
	8-hour ⁴	505	536	536	5700	
PM _{2.5}	24-hour ⁴	12.0	13.8	15.0	25	MV AAQO
	Annual	4.91	5.19	5.43	8 (6) ⁶	
PM ₁₀	24-hour ⁴	18.4	20.2	21.4	50	MV AAQO
	Annual	9.19	9.47	9.71	20	
VOC	1-hour	150	158	158	-	-
	24-hour ⁴	90.2	91.6	92.9	-	
	Annual	32.8	33.0	33.3	-	

Notes: ¹ Effects are compared with the MV AAQO and CAAQS 2025, each with their respective metrics. Exceedances are highlighted in **bold**.

² Based on 98th percentile of the daily 1-hour maximum (D1HM) predictions.

³ Based on 99th percentile of the daily 1-hour maximum (D1HM) predictions.

⁴ Based on rolling average.

⁵ Originally calculated values based on 2019-2021 data and using metrics discussed in Table 2-1.

⁶ MV's annual PM_{2.5} planning goal of 6 µg/m³ is a longer-term aspirational target to support continuous improvement.

5.2.1 NO₂

Predicted hourly NO₂ concentrations based on OLM for the Base Case + proposed Project do not exceed the previous 1-hour MV AAQO but are predicted to potentially exceed the 1-hour current MV AAQO and CAAQS 2025 for NO₂ within 500m of the facility to the east and west and within 1.2 km to the southeast of the facility, over farmland, a farm and business areas in Delta (Figure I.15). There are no predicted exceedances across the Fraser River.



The predicted number of exceedances per year for receptors exceeding the 1-hour current MV AAQO and CAAQS 2025 for NO₂ are presented in Figure I.16. Such exceedances occur fewer than 20 per year with the exception of a few receptors within 100m of the facility close to the Phase 2 and T1A source.

On an annual basis, predicted hourly NO₂ concentrations based on OLM are below the previous MV AAQO and slightly exceed the annual current MV AAQO and CAAQS 2025 within a few meters of the facility fenceline to the east and west (Figure I-17). The exceedances of current MV AAQO and CAAQS 2025 are mainly attributed to the large existing NO₂ background which is already within less than 10% of the current MV AAQO and CAAQS 2025 in the vicinity of the proposed Project, based on 2019 to 2021 observations. Background concentrations accounts for 86% of the maximum predicted annual NO₂, however, background NO₂ in the Metro Vancouver airshed has shown a decreasing trend in the past couple of years.

5.2.2 SO₂

There are no predicted exceedances of the 1-hour SO₂ MV AAQO for or 1-hour CAAQS 2025 for SO₂. (Figures I.18 and I.19).

The predicted annual average concentrations of SO₂ remain well below the annual CAAQS 2025 and the MV AAQO (Figure I.20).

5.2.3 CO, PM and VOC

The proposed Project normal operation have minimal predicted effect on CO (Figures I-21 and I-22) or PM (Figures I.23 to I.26) and predicted concentrations remain well below their respective MV AAQO and CAAQS 2025.

There are no objectives for VOC concentration. Isopleths for predicted VOC concentrations are shown in Figures I-27 to I-29.

5.3 Abnormal Conditions

Proposed Project SO₂ and NO₂ effects during abnormal conditions were assessed. These events should be infrequent and short-term; therefore, the modelling results were compared to relevant short-term (hourly) standards. Modelling results and isopleths are provided in *AQ-Appendix E – Abnormal Conditions*. Modelling results are tabulated in Table E.5.

Modelling was performed with continuous upset emissions for three-years to assess the worst-case effects of such abnormal occasional events. Maximum modelled results occur under adverse meteorological conditions during the course of the years. The likelihood of a short-term upset event or power outage occurring during the most adverse meteorological conditions is very small.



5.3.1 Flaring during Start-up and Shutdown and Commissioning

During non-routine flaring, at commissioning or during start-up and shutdown (SS), exceedances of the previous 1-hour MV AAQO for NO₂ could be generated up to 4 km from the facility and to an even larger area (~11km) for the respective current MV AAQO and CAAQS 2025 (Figure E.1)

SO₂ however, is not predicted to exceed the 1-hour MV AAQO or CAAQS 2025 during commissioning and SS conditions (Figures E.2 and E.3).

5.3.2 Upset Scenario

During upset conditions, when the feed to the thermal oxidizer is rerouted to the flare and the hot oil heater continues to operate, hourly NO₂ could exceed the previous MV AAQO within about 1.2 km of the facility and could exceed the current MV AAQO and CAAQS 2025 up to 4.5 km from the proposed Project (Figure E.4).

During such an event, SO₂ could also exceed its MV AAQO (Figure E.5) and CAAQS 2025 (Figure E.6) in a very localized area near the northwest corner of the facility over industrial land and the Fraser River.

5.3.3 Power Outage

During a grid power outage, T1A and Phase 2 backup generators will operate, T1A and the Phase 2 hot oil heater will not operate, the flare will be in pilot mode, and the thermal oxidizer will only run at critical (minimal) load. Exceedances of the previous 1-hour NO₂ MV AAQO might occur up to 2 km from the facility and exceedances of the 1-hour NO₂ current MV AAQO and CAAQS 2025 might occur up to 7 km from the facility (Figure E.7). Maximum effect would be close to the facility and would not exceed twice the AAQO in the most adverse case. However, such outages are infrequent (on average five times a year) and the likelihood that they occur during weather conditions leading to an exceedance is very small.

5.4 Cumulative Effects

This section discusses modelling results for the Unmitigated Cumulative Case. The results of the Mitigated Cumulative Case are presented in Section 7.

The cumulative case includes emissions from the proposed Project normal operation, the T1A and T1B project continuous sources, and emissions from the TMJ project. For the TMJ project, the representative hourly, 8-hour, 24-hour and annual average scenarios are described in Table 3-12 and *AQ-Appendix F – Tilbury Marine Jetty*.

Overall maximum predicted concentrations over the RAA are tabulated in Table 5-3. Contour plots are provided in *AQ-Appendix I – Contour plots* (Figures I.30 to I.46). Maximum predicted concentrations at sensitive receptors are provided in *AQ-Appendix J – Results Tables* (Tables J.15 to J.20).

Table 5-3: Maximum Predicted Cumulative Concentrations during Unmitigated Normal Operations¹

Air Contaminant	Averaging Period	Background Concentrations (µg/m ³)	Maximum Predicted Cumulative Concentration (incl. background) (µg/m ³)	Ambient Air Quality Objective or Standard	
				Value (µg/m ³)	Name
NO ₂ (Total conversion)	1-hour ²	58.1	419	113	Previous MV AAQO
	Annual	21.1	27.8	32	
	1-hour ²	58.1	419	79	Current MV AAQO and CAAQS 2025
	Annual	21.1	27.8	22.6	
NO ₂ (OLM)	1-hour ²	58.1	165	113	Previous MV AAQO
	Annual	21.1	26.7	32	
	1-hour ²	58.1	165	79	Current MV AAQO and CAAQS 2025
	Annual	21.1	26.7	22.6	
SO ₂	1-hour	3.64	193	183	Current MV AAQO
	Annual	0.63	6.62	13	Previous MV AAQO
	1-hour ³	3.64	113	170	CAAQS 2025
	Annual	0.63	6.62	10.5	Previous MV AAQO and CAAQS 2025
CO	1-hour	557	606	14900	MV AAQO
	8-hour ⁴	505	536	5700	
PM _{2.5}	24-hour ⁴	12.0	15.0	25	MV AAQO
	Annual	4.91	5.47	8 (6) ⁵	
PM ₁₀	24-hour ⁴	18.4	21.4	50	MV AAQO
	Annual	9.19	9.75	20	
VOC	1-hour	150	167	-	-
	24-hour ⁴	90.2	92.9	-	
	Annual	32.8	33.4	-	

Notes: ¹ Effects are compared with the MV AAQO and CAAQS 2025, each with their respective metrics. Exceedances are highlighted in **bold**.

² Based on 98th percentile of the daily 1-hour maximum (D1HM) predictions.

³ Based on 99th percentile of the daily 1-hour maximum (D1HM) predictions.

⁴ Based on rolling average.

⁵ MV's annual PM_{2.5} planning goal of 6 µg/m³ is a longer-term aspirational target to support continuous improvement.

5.4.1 NO₂

Cumulative effects are dominated by the contributions from the TMJ project, causing predicted hourly NO₂ concentrations to exceed both previous and current MV AAQO and CAAQS 2025, with an exceedance footprint centered on the TMJ project. The maximum 1hr- NO₂ concentration isopleths are displayed in Figure I-30 and frequency of exceedance of the MV AAQO and CAAQS 2025 are shown in Figures I.31 and I.32, respectively.



On an annual basis, cumulative NO₂ concentrations do not exceed the current and previous MV AAQO anywhere in the RAA. Predicted potential exceedances of the annual NO₂ CAAQS 2025 remain small in intensity (at most 4 µg/m³ above the CAAQS 2025) but extend over a large area, around the TMJ project, and down the Fraser River along the TMJ shipping route (Figure I-33). Ambient background NO₂ accounts for 80% of the predicted maximum annual effects.

Note that TMJ emissions were estimated based on conservative assumptions and the preliminary design of TMJ as presented in their EA. Since then, the TMJ design and operations factors have evolved substantially, with a reduced facility footprint and lower anticipated emissions from LNG vessels. These refinements are anticipated to result in significantly lower contributions to ambient NO₂ concentrations than those considered in the current report.

5.4.2 SO₂

There are no predicted exceedances of the hourly or annual SO₂ CAAQS 2025 (Figures I.36 and I.37), nor any exceedance of the annual SO₂ MV AAQO.

The predicted maximum hourly concentrations exceed the current 1-hour SO₂ MV AAQO (Figure I.34) west of the Project, over neighbouring industrial land. However, exceedances of the MV AAQO remain localized and the frequency of exceedance is at most once a year (Figure I.35). The MV AAQO metric is based on 100th percentile (not the 99th percentile of D1HM as for the CAAQS) and does not account for any meteorological anomaly that may induce the odd anomalous predictions.

5.4.3 CO, PM and VOC

The cumulative CO and PM maximum footprints reflect the effects of the TMJ project, and the associated marine traffic, but the cumulative concentrations remain well below their respective MV AAQOs (Figures I-18 to I-23).

5.4.4 Effects of other RFP

Vancouver Airport Fuel Delivery (VAFD): Combined net emissions for tanker delivery trucks, marine vessel deliveries and fuel receiving tanks show a net decrease of NO_x emissions overall, and local NO₂ impacts related to marine emissions were not reported in the Assessment Report (BC EAO & Port Metro Vancouver, 2012). The potential effects of two types of marine vessels were assessed by the VAFFC for SO₂ and CO: articulated tug-barges and Panamax-class vessels. Maximum 1hr-SO₂ concentrations linked to emissions from the vessel hoteling at the marine terminal berth were estimated at 8 µg/m³, and maximum 24-hour PM_{2.5} at 0.9 µg/m³, close to the VAFFC terminal (BC EAO & Port Metro Vancouver, 2012). These estimated impacts were linked to the assumed use of high-sulphur diesel fuel during hoteling back when the assessment was done. Actual emissions, when the Project is operational are expected to be lower with the foreseeable use of low-sulphur diesel and shore power. Furthermore, berthing will only occur periodically, as only 6 to 10 vessels per month are planned to deliver aviation fuel at the location and the cumulative impact with the Project in the area is deemed negligible.



Delta Grinding: This project includes construction, operation and decommissioning of a grinding facility with a marine terminal adjacent to the existing cement plant located on Tilbury Island within one kilometer of the T2 Project. Based on the project description, air contaminants of concern from this project will be particulate matters (PM), including DPM, CO and NO_x (Delta Grinding Facility, 2022). The latter may substantially overlap with the NO₂ footprint of the Project; however, it is expected that NO_x emissions from the nearby existing cement facility will decrease compared to its current emission levels which are accounted for in the Base Case. This project is in pre-application stage and sufficient detailed information on air emission sources are not available yet to quantify its potential contributions to the airshed.

Roberts Banks Terminal 2 (RBT2): This is a proposed new container terminal to be located in the southwest corner of the RAA, approximately 16 km from the T2 Project. Review of the RBT2 Air Quality Study (SENES Consultants, 2014; AQ-Appendix 9.2-A) shows that the RBT2 projected effects on peak hourly and annual NO₂ and SO₂ ambient concentrations will be centered around the RBT2 project itself. The Local Study Area for the RBT2 project does not extend to Tilbury Island (Figure 2.1 of AQ-Appendix 9.2-A) emphasizing that its expected effects in the vicinity of the T2 Project are deemed insignificant.



6 NITROGEN ACID DEPOSITION CONSIDERATION

Air emissions of SO₂ and NO_x can lead to nitrogen and acid deposition which potentially indirectly effect the health of terrestrial and aquatic ecosystems. The potential for acidification and eutrophication of ecosystems must be assessed as part of an environmental assessment application as prescribed by the BC ENV guidance documents *Guidance for the Assessment of Acidification and Eutrophication of Aquatic Ecosystems* (ENV, 2015) and *Critical Load Screening Guidance for Acidification and Eutrophication of Terrestrial Ecosystems* (ENV, 2014). The use of the critical load approach to assess the potential effects of acidic deposition is recommended by these guidelines. Additional information and context regarding the susceptibility of nearby surface waters and soils are provided in the Nitrogen and Acid Deposition Receiving Environment Report (Jacobs, 2022) as part of the Application.

Annual nitrogen and acid deposition fluxes associated with the SO₂ and NO_x emissions from the proposed Project normal operations were modelled with CALPUFF (Version 7.2.1) for the three-year modelling period 2013-2015. Meteorology, model domain and receptors were consistent with the air dispersion modelling discussed in Section 4.2. For modelling atmospheric chemistry and nitrogen and acid deposition, CALPUFF was run with the RIVAD-ISOROPPIA chemistry module, with representative H₂O₂, O₃ and NH₃ background concentrations, dry and wet deposition with default CALPUFF deposition parameters and ground level receptors, as per the BC AQDMG for acid deposition studies (ENV, 2022a). *AQ-Appendix K – Nitrogen and Acid Deposition Considerations*, expands on the modelling approach, emission parameters, and modelling results.

Proposed Project emission rates and source parameters were consistent with air dispersion modelling for normal operations presented in Table 3-6 and Table 4-1. However, NO_x emissions were explicitly split between NO and NO₂, using source specific in stack ratio (ISR), as required for the RIVAD-ISOROPPIA chemistry module.

Further postprocessing of the deposition fluxes included summing dry and wet deposition fluxes, and tallying up the nitrogen deposition (from sulfates, nitrates, HNO₃, NO and NO₂), sulfur (from SO₂ and SO₄), and H⁺ equivalent (from SO₄, HNO₃, and NO₃). Results were averaged over the three-year modelling period.

Modelled annual nitrogen and acid deposition fluxes were then averaged over 1-hectare (1-ha) cell grids for comparison with the terrestrial and aquatic BC threshold values established by the ENV (expressed in kg/ha/year and H⁺eq/ha/yr). Results and isopleths are displayed in *AQ-Appendix K*.

Based on the modelling results, the maximum deposition effect occurs within 100m of the facility. Water threshold value for nitrogen is exceeded in a small area halfway across the river. Also, water threshold value for H⁺eq is exceeded throughout the width of the river directly west of the facility.

Soil nitrogen threshold value is not exceeded. Soil sulfate and H⁺eq threshold values are only exceeded in a couple of 1-ha cells on industrial land to the southwest of the proposed Project facility.

7 CONCEPTUAL MITIGATION SCENARIO

Model results for the unmitigated scenarios were presented in the original TDR (Dated September 5, 2024), and the original Application, which was reviewed by the EAO, Metro Vancouver (MV) and the Technical Advisory Committee (TAC). These results predicted elevated concentrations of NO₂ primarily due to high background concentrations, and emissions from other existing and future nearby projects.

For SO₂, the modelling showed a substantial increase compared to the Base Case, directly attributed to the emissions from the unmitigated proposed Project. In the original Application, FortisBC indicated that these adverse effects could be addressed through the implementation of emission mitigation measures, which were planned for inclusion in the proposed Projects final design.

Following two rounds of IRs from the EAO/MV/TAC and responses from FortisBC, it was concluded that the effectiveness of mitigation technologies on resulting air quality effects from the proposed Project should be assessed quantitatively via air dispersion modelling of a conceptual mitigated scenario for NO₂ and SO₂. Modelling results for this recently modelled conceptual mitigation scenario are discussed in detail in *Appendix L – Conceptual Mitigation Scenario* and summarized in this section. The methodology used for this modelling is generally similar to the methodology used in the original assessment with the exception of:

- Only **NO₂** and **SO₂** were assessed;
- A conceptual mitigation scenario including a Cumulative Mitigated Case was assessed. Under this scenario, mitigation measures were applied to T2_HOH and T2_TO during normal Project operations;
- Background concentrations for NO₂ and SO₂ were updated using measurements from 2022–2024 and applying MV's updated guidance for calculating NO₂ background values (MV, 2024b); and
- Updated MV AAQOs for NO₂ (1-hour and annual) and SO₂ (annual)—in line with CAAQS 2025, are reflected in the assessment.

All other methodology including model versions, meteorological modelling, model technical options and switches, modelled buildings, receptors and NO_x to NO₂ conversion method remained unchanged from the original TDR and Application. Assessment methodology is explained in detail in this TDR. Methodology and results for the conceptual mitigated scenario are also detailed in *AQ-Appendix L – Conceptual Mitigated Scenario* of this TDR.

Effects of Mitigation on Project Contribution to Ambient Concentrations:

Predicted NO₂ and SO₂ concentrations from the Project sources alone are compared for the unmitigated vs mitigated scenario in Table 7-1.

Based on the model results, the conceptual mitigation measures are predicted to reduce the proposed Project contribution to maximum predicted ambient NO₂ concentration by more than 80%, for both 1-hour and annual averaging periods. Model results also show that these measures are expected to reduce the maximum predicted proposed Project-only SO₂ concentration by over 70% across all criteria and averaging periods.

In addition, the spatial extent of the proposed Project only NO₂ and SO₂ concentration contours is substantially reduced for all metrics and timeframes, indicating a substantial decrease in the proposed Project's air quality impact.

Additional details are provided in *AQ-Appendix L – Conceptual Mitigated Scenario*.

Table 7-1: Maximum Predicted Concentrations from Project only, for the Unmitigated and Mitigated Scenario (in µg/m³)

Air Contaminant	Averaging Period	T2 Unmitigated (w/o BG) ^[1]	T2 Mitigated (w/o BG) ^[2]	% Change in Project-Only Maximum Concentration with the Implementation of Mitigation
NO ₂ (OLM)	1-hour ^[3]	38.9	6.6	83% reduction
	Annual	0.8	0.11	88% reduction
SO ₂	1-hour ^[4]	150.8	40.5	73% Reduction
	1-hour ^[5]	81.1	19.7	76% Reduction
	Annual	1.1	0.22	80% Reduction

Notes:

¹ Including emissions from T2_HOH, T2_TO and T2_TEGF.

² Including emissions from T2_FGD and T2_TEGF.

³ Based on 3-year average of 98th percentile of the D1HM predictions in one year.

⁴ Based on 100th percentile of the hourly predictions in each year, averaged over 2013-2015.

⁵ Based on 99th percentile of the D1HM predictions in each year, averaged over 2013-2015.

Mitigated Application and Cumulative Case:

Maximum predicted concentrations over the RAA for the Base Case, Application (Base +mitigated Project) and Mitigated Cumulative Case are tabulated in Table 7-2. Maximum contributions from proposed mitigated Project alone, ambient background concentrations and applicable MV AAQO and CAAQS 2025 are also provided in Table 7-2 for reference. Additional details are provided in *AQ-Appendix L – Conceptual Mitigated Scenario*.

Model results show that the mitigated proposed Project has minimal effect on existing ambient NO₂ concentrations. Predicted concentrations for the Application Case, are only slightly greater than the modelled Base Case concentrations across the modelling domain. The increase in modelled ambient NO₂ concentrations due to the proposed mitigated Project remain below 5% of the MV AAQO across the LAA, except for a few receptors located on or near the southwest fenceline of the proposed Project.

For the Mitigated Cumulative Case, exceedances of the MV AAQO for NO₂ were predicted when accounting for all background metrics prescribed by MV. However, the spatial extent of elevated concentrations is significantly reduced with mitigation measures. Areas south of River Road show minimal exceedance of Metro Vancouver's 1-hour NO₂ objective. The remaining exceedance footprint is concentrated near the TMJ project, consistent with the unmitigated scenario. However, the footprint is notably more confined under the mitigated scenario, reducing the number of potentially affected off-site receptors.



On an annual basis, cumulative NO₂ concentrations slightly exceed the current Metro Vancouver Ambient Air Quality Objective (MV AAQO) by approximately 0.1 µg/m³ at a limited number of receptors near the TMJ project.

As observed in the unmitigated scenario (Section 5.4), the cumulative effects assessment for NO₂ continues to be primarily influenced by emissions from the TMJ project, resulting in predicted 1-hour concentrations that exceed the MV AAQO. This outcome remains unchanged under the mitigated scenario. TMJ emissions were initially estimated using conservative assumptions based on a preliminary understanding of the project's design and operations as outlined in its environmental certificate application (submitted 2019). Since then, the TMJ design and operational factors have evolved substantially with a reduced facility footprint and lower anticipated emissions from LNG vessels. These refinements are predicted to substantially lower TMJ's contribution to ambient NO₂ concentrations compared to levels reflected in both the original and revised air quality modelling assessments.

For SO₂, model results show that the effect of the proposed Project on ambient concentrations is notably reduced with the application of the mitigation measures. While it is predicted that the proposed Project will result in increased SO₂ concentrations across the modelling domain, this increase is expected to remain below 10% of the objectives except for a few receptors located on or within 100 m of the southwest fenceline of the proposed Project for all modelled averaging periods and metrics.

Predicted cumulative SO₂ concentration are below applicable MV AAQO and CAAQS and mitigation measures result in smaller air quality footprint attributed to the proposed Project.

Table 7-2: Maximum Predicted Concentrations with Background for Base, Application (Base + Proposed Project), and Cumulative Cases - Conceptual Mitigated Scenario ¹

Air Contaminant	Averaging period	Conceptual Mitigated Scenario - Maximum over RAA ⁵				Objective or Standard		Background ⁶
		Base Case	Project Only (no BG)	Base Case + Proposed Project	Cumulative Case	Value	Name	
NO ₂ (OLM)	1-hour ²	87.3	6.6	88.2	161	79	Current MV AAQO CAAQS 2025	54.96 ⁷
		73.2		74.1	147			40.87 ⁸
		61.9		62.7	136			29.54 ⁹
	Annual	18.9	0.11	20.3	22.7	22.6		17.23
SO ₂	1-hour ³	90.6	40.5	95.1	120	183	Current MV AAQO	3.14
	1-hour ⁴	60.0	19.7	75.9	81.4	170	CAAQS 2025	
	Annual	2.0	0.22	5.7	6.0	10.5	Current MV AAQO and CAAQS 2025	0.59

Notes:

- [1] Effects are compared with the MV AAQO and CAAQS 2025, each with their respective metrics. Exceedances are highlighted in bold.
- [2] Based on 98th percentile of the daily 1-hour maximum (D1HM) predictions in one year, averaged over 2013-2015.
- [3] Based on 100th percentile of the 1-hour predictions, in one year, averaged over 2013-2015.
- [4] Based on 99th percentile of the daily 1-hour maximum (D1HM) predictions in one year, averaged over 2013-2015.
- [5] Calculated considering recent background values shown in this table.
- [6] Updated background concentrations using 2022-2024 data and MV's latest guidance.
- [7] Background concentration based on 98th percentile.
- [8] Background concentration based on 90th percentile.
- [9] Background concentration based on 75th percentile.



8 STATEMENT OF LIMITATIONS

This report entitled Updated Air Quality Technical Data Report was prepared by RWDI Air Inc. ("RWDI") for Fortis BC Energy Inc., Tilbury LNG Facility ("Client"). The findings and conclusions presented in this report have been prepared for the Client and are specific to the project described herein ("Project"). The conclusions and recommendations contained in this report are based on the information available to RWDI when this report was prepared. Because the contents of this report may not reflect the final design of the Project or subsequent changes made after the date of this report, RWDI recommends that it be retained by the Client during the final stages of the project to verify that the results and recommendations provided in this report have been correctly interpreted in the final design of the Project.

The conclusions and recommendations contained in this report have also been made for the specific purpose(s) set out herein. Should the Client or any other third party utilize the report and/or implement the conclusions and recommendations contained therein for any other purpose or project without the involvement of RWDI, the Client or such third party assumes any and all risk of any and all consequences arising from such use and RWDI accepts no responsibility for any liability, loss, or damage of any kind suffered by the Client or any other third party arising therefrom.

Finally, it is imperative that the Client and/or any party relying on the conclusions and recommendations in this report carefully review the stated assumptions contained herein and to understand the different factors which may impact the conclusions and recommendations provided.

9 REFERENCES

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AQ-APPENDIX A METRO VANCOUVER DISPERSION MODELLING PLAN

Metro Vancouver Dispersion Modelling Plan

Version 2.1



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Part 1: Information for All Levels of Assessment

1.1 General Information

Date	June 17, 2022 – Revised Draft
Facility Name	Fortis BC Energy Inc - Tilbury LNG Facility
Company Name	Fortis BC
GVRD Air Quality Permit Number	
Facility Address	7555 Hopcott Road, Delta, BC V46 1B7

1.2 Primary Contact Information

Information	Company	Air Quality Consultant
Name	Wai Chi Kwan	Francoise Robe
Title	Environmental Program Lead	Technical Director - Air Quality
Telephone	778-578-3859	T: (403) 232-6771 ext. 6262 Cell: 403-606-7708
E-mail	Waichi.kwan@fortisbc.com	Francoise.Robe@RWDI.com

1.3 Purpose of Dispersion Modelling

Describe the purpose of the dispersion modelling study (e.g., in support of an application for a new permit or a permit amendment; in support of registration under Bylaw 1087; to fulfill a permit reporting requirement):

The purpose of this modelling study is to support the air quality portion of the environmental assessment for Tilbury Phase 2 LNG Expansion, and eventually the application for an air emission permit amendment for the Phase 2 Expansion of the operations at Tilbury LNG ("T2 Sources").

If the dispersion modelling study is in support of an application for a new permit or permit amendment, a draft application should be submitted with the draft model plan. Has a draft application been submitted? (Y/N): N

What level of assessment is proposed – 1, 2 or 3? (*Section 1.5¹*): Level 3

Provide the rationale for the proposed level of assessment (e.g., exceedances predicted for a Level 1 assessment):

Multiple sources and facilities: Multiple sources are to be permitted and planned external operations in the vicinity of the Project that are not yet affecting MV monitoring stations but might be operating during the permit term, are to be considered as well (reasonably foreseeable projects)
Additionally, dispersion conditions and plume trajectories are not expected to be uniform/straight over the 30km x 30km modelling domain; 3D meteorology and CALPUFF will provide more realistic results.

1.4 Geographic Setting

Will complex flow (i.e., meteorology) need to be considered? Justify your response based on the terrain and land use characteristics within at least 5 km of facility location (e.g., flat, rolling, river valley, mountainous).

Yes.

Although the area within 5 km of the facility is mostly flat, the facility is located in Delta B.C., adjacent to the Fraser River on Tilbury Island, Delta, BC, with urban areas nearby. Furthermore, the domain is too large to assume constant meteorological conditions throughout.

What is the dominant land cover within 5 km of the facility location (e.g., urban, rural, forest, agricultural, industrial, water)?

Mostly urban, mixed with agriculture, water (river), and rangeland. See **Figure 1** and **Figure 2**

To provide context, provide the minimum distance to the nearest (note that for Level 2 and 3 assessments, several receptors for each category that span a range of potential wind directions should be modelled to ensure the maximum for each category is captured):

➤ Business	71 m (Seaspan Ferries Corporation)
➤ Residence	440 m (7180 68 St, Delta, BC)
➤ School	4.05 km (Fawkes Academy)
➤ Child care facility	2.63 km (Mustard Seed Children's Centre)
➤ Seniors facility	4.44 km (Diversicare Canada Management Services)
➤ Hospital	6.55 km (Delta Hospital)

¹ Numbers in italics refer to applicable sections or tables of the *British Columbia Air Quality Dispersion Modelling Guideline, 2015*.

Are there any other nearby receptors of concern?

Sensitive receptors within a radius of 5km of the facility will be explicitly considered and are shown in **Figure 3**.

Sensitive receptors further away are well represented with the 250m receptor grid covering all residential areas within the domain (**Figure 4**).

1.5 Air Contaminants and Averaging Periods to be Modelled

Table 1.5 (add/delete rows as needed)

Air Contaminant	Averaging Period	Metro Vancouver Objective	Other Criteria ¹	Jurisdiction of Other Criteria
NO ₂	1-hr	113 µg/m ³	42 ppb (79 µg/m ³)	CAAQS-2025
	Annual	32 µg/m ³	12 ppb (23 µg/m ³)	
SO ₂	1-hr	183 µg/m ³	65 ppb (170 µg/m ³)	CAAQS-2025
	Annual	13 µg/m ³	4ppb (10 µg/m ³)	
CO	1-hr	14,900 µg/m ³	N/A	N/A
	8-hr	5,700 µg/m ³		
PM _{2.5}	24-hr	25 µg/m ³	N/A	N/A
	Annual	8 µg/m ³		
PM ₁₀	24-hr	50 µg/m ³	N/A	N/A
	Annual	20 µg/m ³		
VOC ²	1-hr	N/A	N/A	N/A
	24-hr	N/A	N/A	N/A
	Annual	N/A	N/A	N/A

¹ If there are no Metro Vancouver objectives for the air contaminant to be modelled, then criteria from other jurisdictions (e.g., Alberta, Ontario, California or Texas) should be used to put predicted ambient contaminant concentrations in perspective. For odorous air contaminants, the Yoshio Nagata “Measurement of Odor Threshold by Triangle Odor Bag Method” reference should be used.

² There are no Total VOC ambient air quality objectives in any jurisdictions (Canada, USA, EU, or AUS). Total VOC ambient concentrations however are monitored in MV and predicted concentrations will be compared to existing background. They will also be passed to the Human Health Assessment team

1.6 Baseline Air Quality

What metric will be used to determine baseline air quality for short-term averaging periods (98th, 99th or 100th percentile²)?

98th percentile for NO₂, CO, PM₁₀, and PM_{2.5}

99th percentile for SO₂

Baseline values for 24-hr and 8-hr averages will be calculated as rolling averages

Baselines values will be calculated using the hourly values, not the daily maximum 1hr values (DH1M)

For VOC, only non-continuous measurements are available (24hr samples, every 6 days. Maximum 24hr will be used for 24hr background, and an AERSCREEN-like scaling to go from 24hr to 1hr values)

² Metro Vancouver's ambient air quality objectives for SO₂ and NO₂ are "not to be exceeded" values and therefore the percentiles used to calculate the baseline values should be based on the hourly data set and not the daily maximum one-hour values indicated in *Section 8.1.4*. Baseline values for 24-hour averages should be calculated as rolling averages and not daily averages indicated in *Section 8.1.4*.

Table 1.6 Monitoring Data that will be used to Develop Baseline Concentrations
(add/delete rows as needed)

Air Quality Stations	Source of Data ¹	Air Contaminants	Years	Will any wind directions be excluded? (If yes, provide wind directions and justification) ²
T17 - Richmond South	Metro Vancouver	NO ₂ , NO _x , SO ₂ , CO, PM _{2.5}	2019-2021 *	No
T13 – North Delta	Metro Vancouver	NO ₂ , NO _x , PM _{2.5}	2019-2021 *	No
T18 – Burnaby South	Metro Vancouver	NO ₂ , NO _x , SO ₂ , CO, PM ₁₀ , PM _{2.5} , VOC	2019-2021*	No
T31 – Richmond Airport	Metro Vancouver	NO ₂ , NO _x , SO ₂ , CO, PM ₁₀ , PM _{2.5} , VOC	2019-2021 *	No

¹. It is recommended that data are obtain directly from Metro Vancouver to ensure that data are verified.

². For excluding air quality data during certain wind directions, see *Section 8.1.4*.

*** List of MV smoke advisory periods, which will be excluded from CO, PM_{2.5} and PM₁₀ baseline calculations:**

- ³. 2019: n/a (no advisories)
- ⁴. 2020: Sep 08-19
- ⁵. 2021: To be assessed

1.7 NO to NO₂ Conversion (Section 8.2)

Results assuming 100% conversion of NO_x to NO₂ must be provided.

If exceedances are predicted using 100% conversion, what alternative method and ambient data will be used?

The Ozone Limiting Method with hourly representative ozone concentrations from South Richmond (T17) and Delta (T13) monitoring stations (maximum thereof) and source-specific In-Stack-Ratio (ISR) will be used in combination with the concurrent meteorology (2013-2015), as per the *GUIDANCE FOR NO₂ DISPERSION MODELLING IN BRITISH COLUMBIA* (October 21, released in November 2021). Additionally, NO₂ results assuming total conversion will also be provided.

If the Ambient Ratio Method is proposed, what NO_x and NO₂ monitoring data will be used?

N/A –

Note: If the Ambient Ratio Method is proposed, predicted NO_x should be converted to NO₂ first and then a baseline NO₂ value should be added. This differs from the guidance provided in *Section 8.2.2*.

If OLM or PVMRM is proposed:

- Specify O₃ concentration and how it was selected:
-

Hourly ozone data are recorded at the nearby Richmond South station (T17), only 5km west of the facility, and Delta station (T13), 10km east of the facility, stations. Conservatively, the maximum concentration of T13 and T17 will be selected for each hour of the modelling period as representative of the ozone concentration occurring at the Project for that hour

A single 3-year hourly ozone concentration timeseries, based on the maximum of concentrations observed at T17 and T13 for each hour of the modelling period, will be used throughout the modelling domain as per Option 1 of the BC NO₂ Modelling guidance (Appendix C)

Specify and provide rationale for any non-default in-stack ratio or equilibrium ratio:

Source specific ISR values will be used, as per Appendix B of the *GUIDANCE FOR NO₂ DISPERSION MODELLING IN BRITISH COLUMBIA*.

1.8 Building Downwash

Table 1.8 (add/delete rows as needed) See buildings locations/dimensions/heights in **Figure 5**

Emission Source ID	Source Height (m)	Is Emission Source on a Building? If no, provide distance to nearest building (m)	Height of Building (m)	Width of Building (m)
PROJECT (T2)				
Hot Oil Heater (T2-HOH)	61.5	No		
Thermal Oxidizer (T2-TO)	22.3	No		
Enclosed Ground Flare-T2 (T2-EGF)	33.8	It is a building in itself (the ground flare is enclosed in a tower)		
Emergency Generator (T2-EMG)	5.9	yes		
CUMULATIVE ASSESSMENT				
Existing Facility Sources T1A				
Incinerator T1A-Incin	16.8	No		
Regen gas Heater – T1A-Regen	5.63	No		
HO Heater-T1A-Heat	6.1	No		
Planned Facility Sources T1B-0.65				
Hot Oil Heater (T1B-HOH)	29.0	No		
Thermal Oxidizer (T1B-TO)	19.2	No		
Enclosed Ground Flare (T1B-EGF)	23.6	It is a building in itself (the ground flare is enclosed in a tower)		
Tilbury Marine Jetty (TMJ)				
Bunkering vessels	18	Yes (source on a vessel)		
LNG Carriers	47	Yes (source on a vessel)		
Tug Boats	10	Yes (source on a vessel)		
Dredger	17	Yes (source on a vessel)		
Lehigh Hanson Delta Grinding Facility				
No details are publicly available yet				

Will building downwash be modelled?

If no, provide rationale.

YES . all buildings within the Tilbury facility and nearby structures will be included in BPIP-PRIME (that includes the vessels at the TMJ, although they only influence the TMJ sources, not the Fortis LNG sources (and vice versa))

Figure 4 shows the locations of the facility buildings, LNG tanks, Enclosed Flares, the Project T2 stack locations, and the T1A and T1B stack locations.

1.9 Emission Sources and Characteristics

Are there any liquid storage tanks?

If yes, indicate whether they are fixed or floating roof tanks. Follow the guidance provided in *Section 10.5*.

LNG1: LNG storage tank (fixed roof) - existing

LNG3: LNG storage tank (fixed roof) – to be built for Tilbury LNG Storage Expansion (TLNE)

Note: old tank LNG2 is no longer in use and will be taken down

The tanks will be considered for building downwash, not as sources, in the air quality modelling study.

Fugitive emissions will be reported by Fortis BC separately

There are also drums and smaller tanks containing gas odorants (not included in dispersion modelling)

Table 1.9 Emission Sources and Characteristics (add/delete rows as needed) See **Figure 5** and **Plot Plan (Figure 6)**

Emission Number ²	Description	Type: Point (P), Area (A), Line (L), Volume (V)	Contaminants (SO ₂ , NO _x , PM _{2.5} ³ . . .)	Basis of Emissions ⁴ (Section 3.3)	Stack Orientation (Vertical, Horizontal, Angled)	Raincap (Section 10.4) (Y/N)
PROJECT						
T2-TO	Thermal Oxidizer	Point	SO ₂ , NO _x , PM _{2.5} , PM ₁₀ , CO, VOC	___current emission limits _x_proposed emission limits ___other (specify & justify)	Vertical	N
T2-HOH	Hot Oil Heater	Point	SO ₂ , NO _x , PM _{2.5} , PM ₁₀ , CO, VOC	___current emission limits _x_proposed emission limits ___other (specify & justify)	Vertical	N
T2-EGF	Enclosed Ground Flare-	Point	SO ₂ , NO _x , PM _{2.5} , PM ₁₀ , VOC	_other Pilot flame + upset scenarios	Vertical	N
T2-EMG	Emergency Generator	Point	NO _x , CO, PM ₁₀ , PM _{2.5} VOC	___other (specify & justify) Very infrequent use, separate upset scenario for NO ₂ -1hr modelling only	Vertical	Ad hoc

² Emission numbers should be the same as in existing permit or permit application.

³ For PM emissions indicate whether it is filterable, or filterable + condensables, or if unknown (see Section 3.6)

⁴ If dispersion modelling is being conducted in support of an application for an air quality permit or permit amendment then current or proposed emission limits should be modelled. If it is being conducted for a registration under Bylaw 1087, the emission concentrations listed in Appendix 1 or 2 of the Bylaw should be modelled.

				less than 10hrs per year for power outages and tested monthly (2hr/month)		
Cumulative impact assessment						
Existing Facility Sources (T1A)						
T1A-INC	Amine and Incinerator Stack	P	NO _x , SO ₂ , CO, VOC, PM ₁₀ , PM _{2.5}	Current emission limits	Vertical	N
T1A-HEA	Heater	P	NO _x , SO ₂ , CO, VOC, PM ₁₀ , PM _{2.5}	Current emission limits	Vertical	N
T1A-REG	Regen gas heater ("regen")	P	NO _x , SO ₂ , CO, VOC, PM ₁₀ , PM _{2.5}	Current emission limits	Vertical	N
T1A-EMG	T1A Emergency Generator	P	NO _x , CO, PM ₁₀ , PM _{2.5}	Very infrequent use (less than 10hrs per year for power outages, and tested monthly (1hr/month); will be modelled for power outage scenario only	Vertical	N
Planned Facility Sources (T1B-0.65)						
T1B-T0	T1B Thermal oxidizer	P	NO _x , SO ₂ , PM ₁₀ , PM _{2.5} , CO	Planned maximum annual emissions for 0.65 MTPA capacity	Vertical	N
T1B-HOH	T1B Hot Oil Heater	P	NO _x , SO ₂ , PM ₁₀ , PM _{2.5} , CO	Planned maximum annual emissions for 0.65 MTPA capacity	Vertical	N
T1B-EGF	T1B Enclosed Ground Flare	P	SO ₂ , NO _x , PM _{2.5} , PM ₁₀ , VOC	_other Pilot flame	Vertical	N
Other Fortis BC sources (infrequent use and therefore won't be modelled)						

VAP-A,B,C,D	New Vaporizers	P	NOx, CO, PM ₁₀ , PM _{2.5}	Very infrequent use : will be used for peak shaving and resilience (gas send off), less than once a year for up to 3 days at a time.	Vertical	N
T1B-EMG	Back up Generator- T1B	P	NOx, CO, PM ₁₀ , PM _{2.5}	Very infrequent use : less than 10hrs per year for power outages and tested monthly (2hr/month)	Vertical	N
T1B-EGF	T1B Enclosed Flare	P	NOx, SO2	Very infrequent use - TBD during T1B plant shutdown	Vertical	N
Tilbury Marine Jetty: the most representative scenarios will be modelled i.e - bunkering vessel berthing for the for 1hr, 24hr scenarios - annual mix of ships (bunkering vessels, LNG carriers and their tugboats, dredger) as per TMJ assessment) for the annual scenario						
Lehigh Hanson Grinding Facility: emission info is not yet available (as of June 17, 2022)– Facility won't be explicitly modelled.						

CALPUFF MODELLING SCENARIOS:

BASECASE: (on Local Assessment Area: 20km x 20km)

- ***Background concentrations + existing sources not captured by background i.e. T1A continuous sources: regen, incinerator, and heater***

BASECASE + PROJECT (on Local Assessment Area: 20km x 20km)

- Basecase + continuous T2 sources during normal operations: T2 thermal oxidizer, T2 hot oil heater, and T2 pilot flare

CUMULATIVE IMPACT (on Regional Assessment Area: full 30km x 30km)

- BaseCase
 - + Project (T2) Normal operations
 - + Planned T1B Facility Continuous Sources during normal operations: T1B Thermal oxidizer, T1B hot oil heater and T1B pilot flare
 - + Reasonably Foreseeable Projects with publicly available emissions information as of June 17, 2022 where projects' effects could potentially overlap (i.e. TMJ)

Additionally, cumulative effects from Reasonably Foreseeable Projects with available ambient air quality modelling results as of June 17, 2022 will be quantitatively assessed where projects' effects could potentially overlap (RBT2 and VAFCC YVR Fuel Delivery Terminal)

Other Foreseeable Projects within the RAA will be qualitatively discussed.

UPSET SCENARIOS:

- ***Power outage:*** T2 emergency generator+ T1A emergency generator + T2 pilot flare + T2 thermal oxidizer@critical load
- ***Startup-Shutdown ("SS"):*** T2 flare only
- ***Upset Flaring*** (T2-TO flow rerouting to flare): T2Flare + T2-HOH

ACID and NITROGEN DEPOSITION:

- Acid and nitrogen deposition load added by Project continuous sources: T2 thermal oxidizer, T2 hot oil heater and T2 pilot flare

Source Emission Rate Variability (*Section 3.4*)

Are there any batch processes? If yes, provide plots of emission rate vs. time for each batch process. NO
Are emissions expected to vary with load? If yes, describe how this will be modelled. Possibly but maximum emissions will be considered in the modelling
Will actual emissions or flow rates be less than 75% of permitted levels? If yes, describe how this will be modelled (e.g., additional scenarios) no
Describe anticipated abnormal emission scenarios (e.g., start-up, shut-down, maintenance of control works) and their anticipated frequency: T2 Flaring scenarios : - Start-up/Shutdown: 5 times per year each lasting approx. 5 hours: T2 flare only - Upset Flaring: T2-TO rerouting – once per year (if T2-TO shutdown): T2 flare and T2 HOH - Emergency Case: hopefully never- duration 1hr : T2 flare only – not modelled Power Outage: - up to 10hrs per year (1-2hr events). T2 and T1A emergency generators would be operating, as well as pilot flame for T2flare, and T2-TO at minimum load All upset scenarios (with the exception of flaring related commissioning) should last much less than a day (typically <5hrs) and as such only 1hr NO₂ and SO₂ impacts will be computed. The emergency scenarios will be modelled as short- term events that can be started on any hour of the year (typically 8 independent scenarios with 3 daily 5hr-long events separated by 3 hours of zero emissions; maximum impact of all scenarios is computed) Under normal operations, T2 flare will only have a pilot flame and will be modelled as a continuous emission source
Does the proposed permit emission limit scenario represent the worst case scenario, in terms of ambient air quality concentrations, that can be anticipated (<i>Section 3.4.2 and 10.1.2</i>)? Yes

1.10 Dispersion Model

List model(s) and version(s) to be used (<i>Section 2</i>): Calmet V6.5.0 Calpuff V7.2.1 Calpuff processors that are associated with Calpuff V7.2.1.
If modifications to any of the models are planned, provide a description and the rationale (<i>Section 2.3.2</i>): No modification to CALMET or CALPUFF are planned.
If AERSCREEN is proposed, will it be run using: 1) The stand-alone MAKEMET program to generate the matrix of meteorological conditions and running AERMOD directly with the SCREEN option (preferred) or 2) The AERSCREEN command prompt interface? Please justify your response. N/A – AERSCREEN is not proposed
If a Level 1 assessment is proposed, indicate whether a standard screening dataset will be used or whether a project-specific dataset will be developed: N/A – Level 1 assessment is not proposed.
If a project-specific dataset will be developed for a Level 1 assessment, describe the proposed inputs (source and period of meteorological data, range of wind speeds and stability classes, range of wind directions, seasonal values of surface characteristics etc.): N/A – Level 1 assessment is not proposed.
If any of the emission sources have ambient exit temperatures, please explain how this will be modelled (e.g., buoyancy will be turned off, variable emission file with actual ambient temperature, exit temperature set to annual average ambient temperature). N/A

1.11 Planned Model Output

Model results for all levels of assessment should include a table comparing overall maximum predicted concentrations as well as maximum concentrations predicted for each sensitive receptor type (e.g., school, hospital, daycare) to Metro Vancouver ambient air quality objectives or other relevant criteria. Please confirm the planned model output (*Section 8.3.1*).

Table(s) comparing overall maximum predicted concentrations and maximum concentrations predicted for each sensitive receptor category will be presented and compared to MV AAQO and CAAQS-2025. Overall maximum predicted concentrations and maximum concentrations predicted for all gridded and sensitive receptors located in residential areas will be presented.

As to the other sensitive receptor categories, it is not practical to list all businesses, schools, etc, beyond a 5km radius, however the predicted concentrations should be significantly lower than maximum impacts beyond that 5km radius and maximum over the proposed set of sensitive receptors should be representative of the maximum incurred by those sensitive receptor categories; Furthermore, concentration contour plots will provide further evidence and convey the requested information visually over the whole LAA/RAA

Discussion of Significance:

As per the EAOs' User Guide "Introduction to Environmental Assessment under the Provincial Assessment Act" V1.0 (March 30th, 2020), "the proponent is not required to evaluate or make significance determination on potential project effects". Therefore, FortisBC won't formally assign significance levels and/or criteria.

However, FEI has addressed the issue of significance when determining the size of the modelling domain for air quality: namely, the LAA modelling domain will be large enough to include predicted Project Impacts larger than 10% of the relevant AAQOs.

Furthermore, FEI will discuss the AQ impacts in light of the MV AAQOs, CAAQS-2025, and existing background concentrations, and might also comment on significance based on location and frequency of modelled exceedances, if any.

Part 2: Information for Level 2 and 3 Assessments Only

2.1 Planned Model Domain and Receptor Grid

Dimensions of proposed model domain (*Section 7.1*):

The proposed study area is a 30 km by 30 km square centred on the facility

Proposed receptor spacing (*Section 7.2*):

- 20-m spacing along fenceline
- 50-m spacing within 500 m of the facility
- 250-m spacing within 5 km of the facility and over all residential areas within the model domain
- 1,000-m spacing for the remainder of the study area.

Provide a map of the proposed model domain and receptor grid that also shows the locations of all schools, hospitals, daycares and senior facilities within the study domain (**Figure 5**).

Sensitive receptors within 5 km are shown in **Figure 3**

Please use a flagpole receptor height of 1.5 m. If a different height is proposed, please provide the height and rationale.

A flagpole receptor height of 1.5 m will be used in the ambient air quality modelling. (surface receptors will be used for acid/nitrogen deposition modelling for T2 sources only)

2.2 Default Switch Settings

For AERMOD identify any switch settings that could be different than the recommended defaults (see *Section 7.7*). Provide rationale.

N/A – AERMOD is not proposed.

For CALPUFF/CALMET identify any switch settings in CALMET Input Groups 4 & 5 and CALPUFF Input Groups 2 & 12 that could be subject to deviation from the “black (do not touch)” defaults as per *Tables 6.2 and 7.1*. Provide rationale.

No deviations from the “black (do not touch)” defaults in the BC Modelling guideline (December 2015) are planned for CALMET or CALPUFF

Note that there will be 2 sets of CALPUFF settings:

- one for the modelling of ambient air concentrations (without deposition or explicit chemical transformation) for the basecase, project and cumulative assessments;
- one for acid and nitrogen deposition (with wet and dry deposition, and RIVAD ISORROPIA Chemistry)

2.3 CALMET Parameters

If CALMET is planned to be used, provide (*Section 6.4.2*):

- a domain map (**Figure 1**)
- anticipated grid resolution: __200__ (m)
- number of grids in X and Y direction (NX = __150__, NY = __150__)
- vertical levels (m): 10, 30, 50, 80, 125, 175, 250, 400, 750, 1250, 1750, 2500_

2.4 Planned Geophysical Data Input (*Section 4*)

Source of terrain data: <https://open.canada.ca/data/en/dataset/7f245e4d-76c2-4caa-951a-45d1d2051333>

Source of land use data:
<https://catalogue.data.gov.bc.ca/dataset/baseline-thematic-mapping-present-land-use-version-1-spatial-layer>

Is modification of the land use data necessary? If so, please describe the proposed modification and provide the rationale⁵.

Yes, land use will be corrected for known issues in the BC dataset over the modelling area (urban vs. forest coverage and waterways) + continuity of waterways

Provide a land use map (**Figure 2**) plotted from the dispersion model input data (e.g., GEO.DAT).

If AERMOD is proposed, will land use surrounding the meteorological station or the location of emissions be used? Provide rationale.

N/A – AERMOD is not proposed.

⁵ Modification of land use may be necessary to appropriately represent features such as a continuous Fraser River or large forested parks that may be absent from the land use data.

If surface characteristics are required, use *Tables 4.8, 4.9, 4.10 and 4.12* for summer, autumn, winter and spring, respectively. If these Tables are not used, indicate source of data.
AQMG Tables will be used

If CALMET is proposed, it is recommended that four GEO.DAT files be used to represent different seasons (*Section 4.4*) as outlined below⁶:

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3	3	3	5	5	1	1	1	2	2	3	3

If this is not followed, please indicate an alternative approach and rationale.
The recommended seasons will be used.

If building downwash is applicable, use BPIP-PRIME. If not BPIP-PRIME, indicate method used to specify downwash parameters.

BPIP-PRIME will be used for building downwash of point sources.

2.5 Planned Meteorological Data Input and Processing

Table 2.5a Surface Meteorological Data (add/delete rows as needed)

Station ID	Location (lat/long or indicate on map)	Data Source MOE, MV, MSC, Site Specific, other (specify) ¹	Parameter(s) ²	Years	% of Wind Speeds = calm ³	Anemometer Height (m) ⁴
T02	49.2617, -123.1635	Metro Vancouver	Wind speed wind direction temperature RH	2014	0.30	12.5
T13	49.1583, -122.9017	Metro Vancouver	Wind speed wind direction temperature RH	2014	0.21	18.2
T17	49.1414, -123.1082	Metro Vancouver	Wind speed wind direction temperature	2014	0.02	12.5
T18	49.2152, -122.9857	Metro Vancouver	Wind speed	2014	0.03	19.9

⁶ This differs from guidance in the British Columbia Air Quality Dispersion Modelling Guideline (2015) since the climate in Metro Vancouver is different than the rest of BC.

			wind direction temperature pressure RH			
T22	49.2667, -122.9355	Metro Vancouver	Wind speed wind direction temperature	2014	0.24	10.0
T31	49.1863, -123.1524	Metro Vancouver	Wind speed wind direction temperature pressure RH	2014	0.00	10.3
T38	49.1657, -122.9607	Metro Vancouver	Wind speed wind direction temperature RH	2014	0.41	10.0
T39	49.0099, -123.082	Metro Vancouver	Wind speed wind direction temperature RH	2014	2.94	10.8
YVR Airport	49.1947, - 123.1839	Environment Canada	pressure cloud cover celling height temperature	2014	Wind data excluded	10.0

1. If data from a non - ministry, MV or MSC station is proposed, follow guidance in *Section 5.8 or 5.9*
2. List all meteorological parameters that will be used from each station (e.g., wind speed, wind direction, air temperature, relative humidity, cloud cover)
3. For light wind/calm treatment of Metro Vancouver data consult with Metro Vancouver. For other data sources, follow guidance in *Section 5.8.2*.
4. Not all meteorological stations measure winds at the standard 10 m height (e.g., some MV observations are different heights). <http://www.metrovancouver.org/services/air-quality/AirQualityPublications/LowerFraserValleyAirQualityMonitoringNetwork2012StationInformation.pdf>

Table 2.5b Upper-Air Meteorological Data (add/delete rows as needed)

Station Name	Years	Distance between the Upper Air Station and Project (km)
N/A - upper air stations will not be used along with WRF	N/A	N/A

Table 2.5c Mesoscale Meteorological Model Output (attach map of domain)

Model (name, version, configuration)	Model Output Provider	Horizontal Grid Resolution (km)	Height of Vertical Levels (m)	Years	Planned Model Output Use ¹
British Columbia Ministry of Environment WRF dataset (http://www.src.com/calpuff/data/bc_wrf.html)	Exponent	4km	0.0, 10.9, 34.1, 60.3, 89.6, 122.5, 160.0, 202.1, 249.6, 303.7, 364.8, 433.5, 511.5, 600.1, 700.4, 814.4, 944.1, 1092.1, 1261.5, 1455.3, 1677.7, 1934.1, 2230.9, 2576.1, 2980.0, and 3455.7 m	2014	___CALMET No-Ob mode _X_CALMET Hybrid mode ___AERMET/AERMOD pseudo surface station and pseudo upper air sounding ___AERMOD .SFC a .PFL files

^{1.} Sections 6.1 & 6.4.1.

If CALMET Hybrid mode is proposed, describe in detail the choice of R1, RMAX1 and TERRAD.

R1: 4 km

RMAX1: 8km

TERRAD: 4 km

Values are selected for seamless blending of surface observations (dense MV monitoring network), over a local area surrounding the facility that is mostly flat. TERRAD is set so as not to overestimate terrain effects already modelled by WRF (which has a spatial resolution of 4km)

2.6 Special Topics

Indicate the conditions that are planned to be considered as part of the assessment.

Stagnation Conditions

Provide an estimate of the frequency of stagnation based on local meteorological data. If AERMOD is proposed, provide methodology on how stagnation periods will be treated (see *Section 10.2*)

N/A – AERMOD is not proposed

Shore/Coastal Effects

Y or N If Yes, indicate whether sub-grid-scale Thermal Internal Boundary Layer option is selected along with the required input coastline coordinate data (see *Section 10.3*)

N – Coast is over 10km from facility. River is resolved by 200m gridcells

Plume Condensation (Fogging) and Icing

Y or N If Yes follow guidance in *Section 10.6*

N – Plume condensation and icing not considered.

Chemical Transformation

Y or N If Yes, specify transformation method and provide details on inputs if Secondary PM_{2.5}, Acid Deposition or Visibility effects are to be estimated. Depending on the transformation method, this could include ammonia, ozone, hydrogen peroxide concentrations, nighttime loss and formation rates for nitrates and sulphates.

N for ambient concentrations (Project and Cumulative)

Y for acid/nitrogen deposition (RIVAD/ISORROPIA) (Project only)., with monthly ammonia background concentrations recommended in the *Alberta Air Quality Model Guideline* (2021) for acid deposition modelling in the absence of NH₃ monitoring in the RAA; hourly varying ozone at Richmond South and Delta (consistent with the approach for OLM i.e. maximum of T13 and T17 O₃ concentrations for each hour), and default model monthly HOH

Particle Deposition

Y or N If Yes follow guidance in *Section 3.7*. If non-recommended particle size distributions are used, provide table of particle (including heavy metals) emission size/density distribution and indicate the basis for the table.

N – Particle deposition will not be considered for ambient concentrations

Y – Wet and dry deposition will be turned on for acid/nitrogen deposition

Important: a separate model run should be conducted with deposition turned on. Maximum predicted concentration results should be presented with deposition turned off.

2.7 Quality Management Program

Geophysical and Meteorological Input Data

~~Strikeout~~ the tests that will not be undertaken to assure the quality of the inputs and provide rationale.

Geophysical input data: ♦ contour plot of topography ♦ plots of land use and land cover
Meteorological data: ♦ wind rose (annual and/or seasonal) ♦ frequency distribution of surface wind speeds ♦ average hourly temperature plot (annual and/or seasonal)
NWP output (<i>Section 6.1</i>) ♦ wind rose at selected locations and heights (annual and/or seasonal) ♦ average hourly temperature plot at selected locations and heights (annual and/or seasonal) ♦ wind field plots for selected periods that indicate topographic influences such as channeling and thermally generated flows

AERMOD QA/QC

List the tests that will be conducted to confirm the quality of the model input and output

♦ N/A – AERMOD not proposed

CALMET/CALPUFF QA/QC

~~Strikeout~~ the tests that will not be conducted and provide justification (*Section 9.1*). All plots or other proof that the tests have been conducted should be provided in an appendix to the dispersion modelling report. We recommend that you provide a draft of this appendix to Metro Vancouver for review prior to commencing CALPUFF modelling to limit the need to remodel; however, this review should not be considered final approval of the CALMET. Metro Vancouver may have additional comments on the CALMET methodology once it reviews CALPUFF model results.

CALMET/CALPUFF QA Files: ♦ Plot the locations of the grid, NWP grid points, and source locations and compare to Google Earth or aerial photographs ♦ Check for blanks, comma instead of period, wrong UTM zone etc.
CALMET Input data: ♦ Plot of terrain and land use from the GEO.DAT input files to ensure they match with other maps of the area. ♦ Plot the locations of the meteorological observation stations to check whether they are located properly in the horizontal and vertical. ♦ Compare all the CALMET-ready input files with the raw data to ensure no errors in data conversion to CALMET-ready files (reformatting, unit conversions, etc.). ♦ Compare each month of CALMET input meteorological files with each other to ensure all parameters are consistent from month to month.

- ♦ Review all source information (values, formats, units) associated with Input Group 13-16 of the CALPUFF.INP file to ensure emission information is correct.
- ♦ Plot the source locations to ensure that they are located properly and ensure that their vertical location (stack base relative to terrain height for that location) is correct.
- ♦ Review locations (horizontally and vertically) of all specified receptors.

CALMET Output data:

- ♦ For a few representative periods where thermally driven flows would be expected, plot the wind vector fields at various levels to confirm that the wind fields are reasonable given the terrain and the meteorological conditions.
- ♦ For a few representative periods, when thermally driven flows would be expected, plot wind speed isopleths, derived from all grid cells in CALMET.
- ♦ Plot the frequency distribution of surface wind speeds for different locations in the domain and at the surface station locations and check for reasonableness.
- ♦ Plot annual and seasonal surface wind roses for different locations as well as the surface station locations and check for realism (compare with observations, consider the location, and what might be expected based on topography).
- ♦ For different 24-h periods within a summer and winter season, plot a surface, mid-level and upper-level wind field every hour for a 24-h period with light winds and stable conditions. Check for reasonableness of the wind fields in the domain (extent of terrain effects and the appropriateness of the settings that require expert judgment). Surface vector plot will be provided for night light wind stable conditions (when terrain effects are to be expected)
- ♦ Plot time series of average surface temperature by month for the source location as well as surface station locations. Compare with observations/climate normals. Check for reasonable monthly variation for the given locations.
- ♦ Plot time series of average surface temperature by hour-of-day for the source location as well as surface station locations. Compare with observations/climate normals. Check for reasonable diurnal variation for the given locations.
- ♦ Plot time series of average precipitation by month (if precipitation is an input) for one location as well as surface station locations. Compare with observations. Check for reasonable monthly variation for the given locations.
- ♦ Plot the frequency distribution of mixing heights for different locations. Check for reasonableness.
- ♦ Plot a time series of mixing heights for a 24-h summer and winter period during a light wind, and a clear sky period. Examine the diurnal behaviour for reasonableness.
- ♦ Plot the frequency distribution of P-G stability class for the source location as well as surface station location. Compare to the airport observation P-G class frequency distribution (if available). Check for reasonableness for the given locations.
- ♦ ~~If NWP model output is used, examine CALMET-generated wind fields for a 24-h period of light winds, and clear skies at surface, mid and upper levels with and without NWP output and check for reasonableness.~~

Note: Metro Vancouver may request submission of all computer files associated with the modelling.

2.8 Additional Model Output for Level 2 and 3 Assessments

~~Strike out~~ model output that will not be included in the report and provide justification:

- documentation (text and plots) of tests conducted as part of the QA/QC program,
- spatial distribution maps of air quality parameters including baseline values (maximums, exceedance frequencies, annual averages),
- tables of maximum short- and long-term average air quality parameters with and without baseline values (locations and associated meteorological conditions),
- tables of maximum predicted concentrations at any (not just the closest) residence, business, hospital, school, daycare, senior facility or other type of sensitive receptor ~~within the study domain~~ *within 5km of the facility* with and without baseline values,
- if exceedances are predicted, tables and spatial distributions of the frequency of exceedance both with and without baseline values,
- tables of air quality parameters under certain emission situations (upsets, start-up),
- special output required for vegetation or health risk assessments,
- ~~other (specify):~~

Metro Vancouver Acceptance of Original Plan: Derek Jennejohn, Lead Senior Engineer
Parks and Environment
(Name, title):

Date: August 4, 2022

Metro Vancouver accepts this dispersion modelling plan, with the following caveats:

- Acceptance of the dispersion modelling plan is for the BC Environmental Assessment (EA) review process only. It does not constitute approval for a Metro Vancouver permit application.
- Please note that if a permit application is submitted to Metro Vancouver (Environmental Regulation and Enforcement), a draft model plan may be requested, and may be subject to additional or alternate requirements than the EA process. For more information on Metro Vancouver's permitting process, please visit <http://www.metrovancouver.org/services/Permits-regulations-enforcement/air-quality/apply-permit>.



RWDI#2000436
March 18, 2022

FIGURES

Map Document: C:\GIS\2000436_Tilbury\2000436_Tilbury_LNG.aprx



Project Location, RAA and LAA

The AQ modelling domain is the same as the RAA

Map Projection: NAD 1983 UTM Zone 10N
Tilbury LNG - Delta, BC



Project #: 2000436

Drawn by: RCL	Figure: 1
Approx. Scale:	1:195,000
Date Revised:	Feb 15, 2022



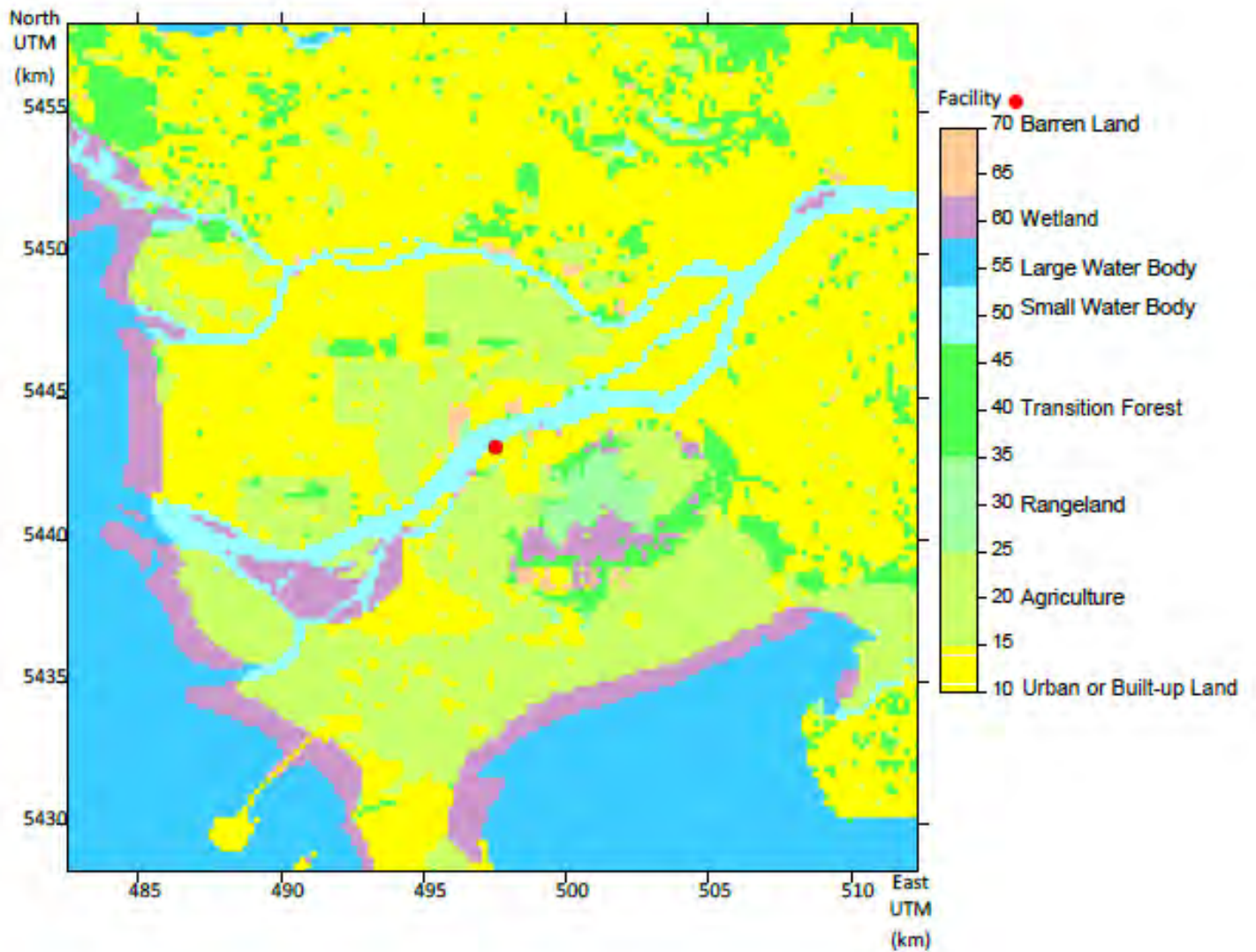
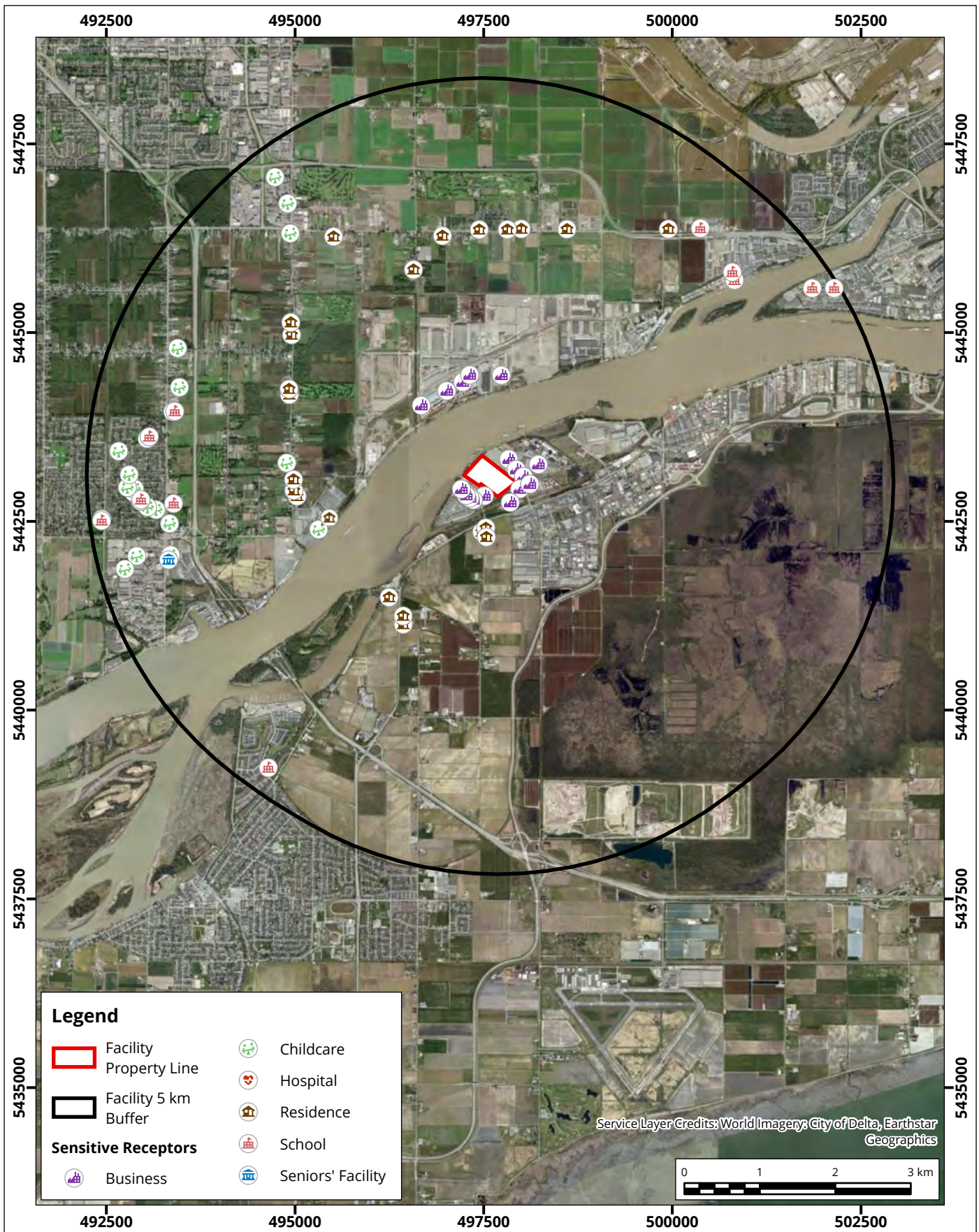


Figure 2 - Dominant Land Use over the 30km x 30km CALMET Domain

Map Document: C:\GIS\Temp - Copy\2000436\2000436_Tilbury_LNG.aprx



Sensitive Receptors within 5 km of the Facility



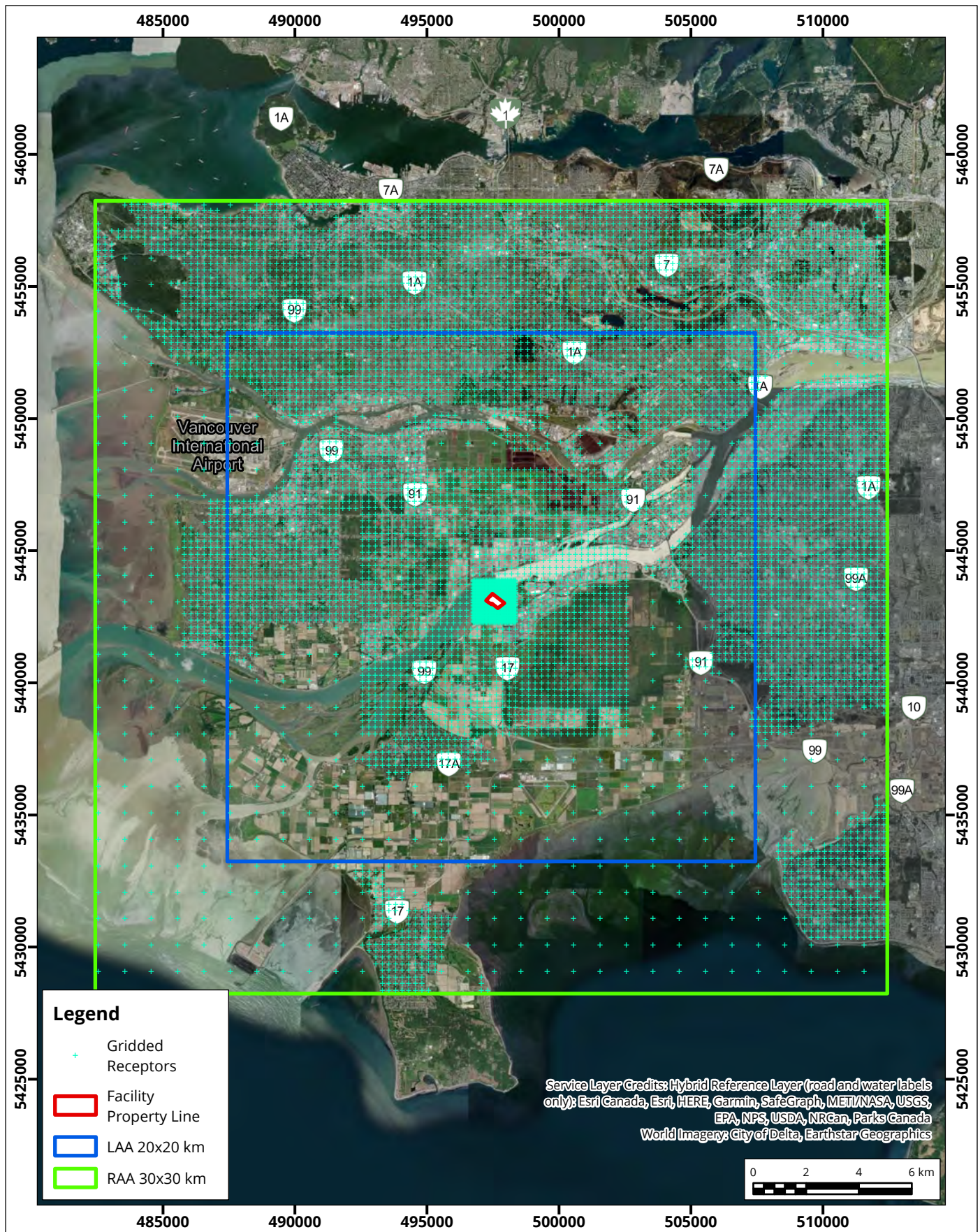
Drawn by: DJH	Figure: 3
Approx. Scale: 1:70,000	
Date Revised: Mar 8, 2021	

Map Projection: NAD 1983 UTM Zone 10N
Tilbury LNG - Delta, B.C.

Project #: 2000436



Map Document: C:\GIS\Temp - Copy\2000436\2000436_Tilbury_LNG.aprx



Gridded Receptors

Map Projection: NAD 1983 UTM Zone 10N
Tilbury LNG - Delta, B.C.



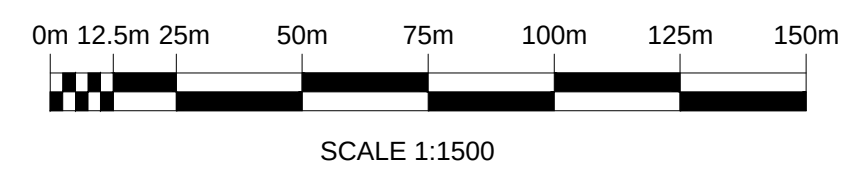
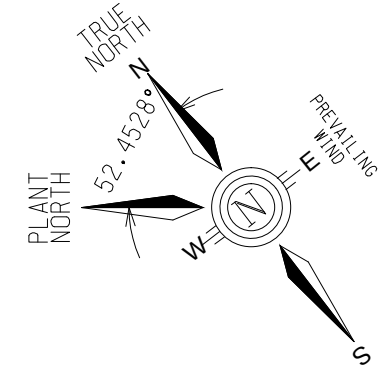
Project #: 2000436

Drawn by: DJH	Figure: 3
Approx. Scale: 1:200,000	
Date Revised: Mar 3, 2022	





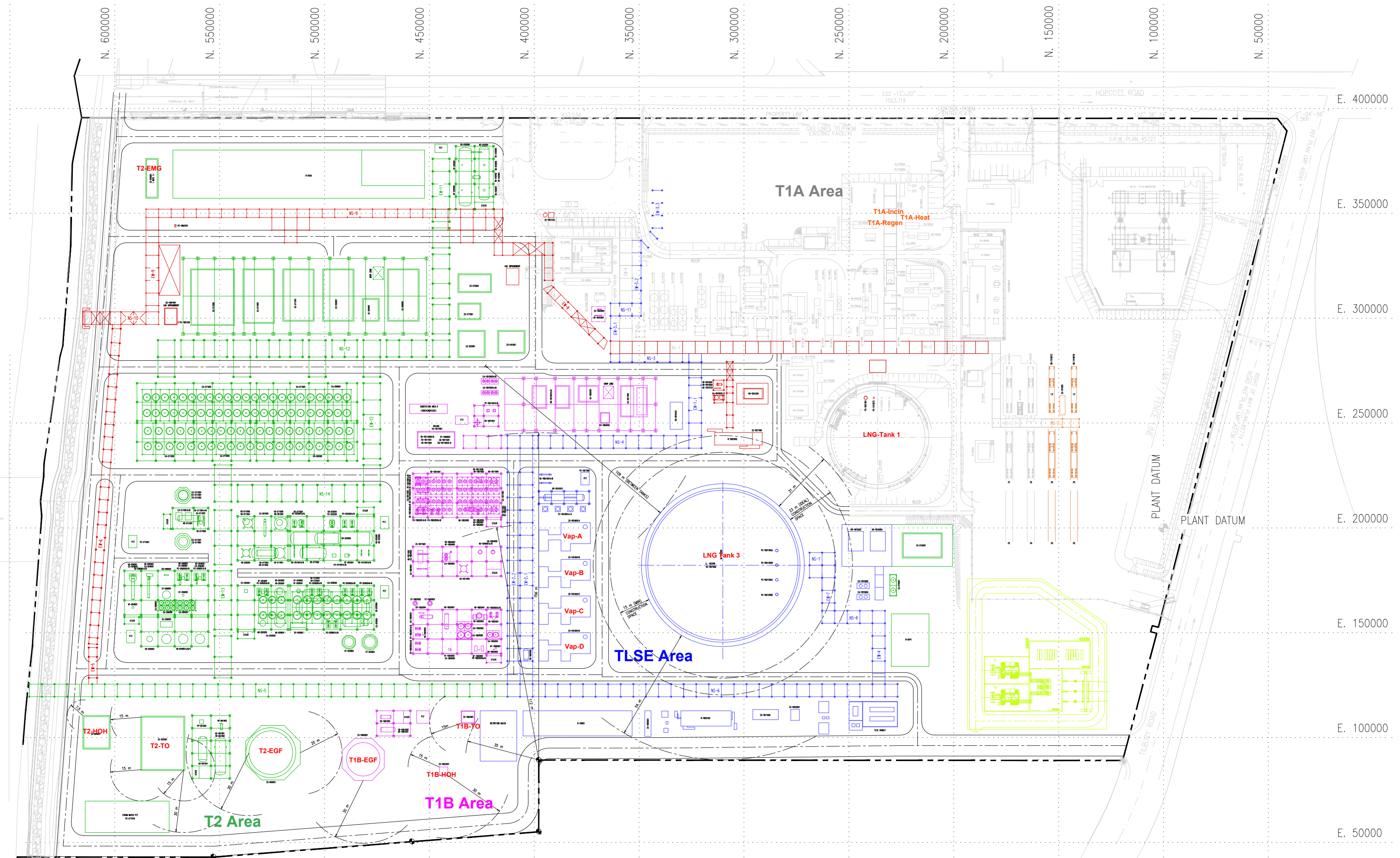
Figure Facility Layout, Modelled Buildings (blue) and Source Locations



TILBURY 1 LNG PLANT

TILBURY LNG FACILITY AND JETTY
PLOT PLAN

DRAWING NUMBER 43116-M-SPL-1U90-45003-R0-A



Metro Vancouver Dispersion Modelling Plan Template

Template Version 3.1
(released January 2025)

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PART 1: INFORMATION FOR ALL LEVELS OF ASSESSMENT

1.1. Revision History

Revision Number	Date	Description of Changes
1	June 17, 2022	Initial Modeling Plan to support draft Application
2	June 12, 2025	Modeling plan to support mitigated scenario for the Revised Application
3		

1.2. General Information

Facility Name	Fortis BC Energy Inc - Tilbury LNG Facility
Company Name	Fortis BC Energy Inc
MVRD Air Quality Permit Number	N/A
Facility Address	7555 Hopcott Road, Delta, BC V46 1B7

1.3. Primary Contact Information

Information	Company	Air Quality Consultant
Name	James Humble	
Title	FortiBC Environment Manager, Major Projects	
Telephone	604-328-4226	
E-mail	James.Humble@fortisbc.com	

Please submit a completed *Qualified Professional Declaration of Competency* and *Qualified Professional Conflict of Interest Disclosure Statement* as part of the completed dispersion modelling plan. These forms can be found in the Metro Vancouver Permit Application Form package:

<https://metrovancover.org/services/air-quality-climate-action/Documents/forms-package-for-air-permit-applications.docx>

1.4. Purpose of Dispersion Modelling

Describe the purpose of the dispersion modelling study (e.g., in support of an application for a new permit or a permit amendment; in support of registration under Bylaw 1087; to fulfill a permit reporting requirement):

The purpose of this dispersion modelling study is to support the air quality assessment component of the Environmental Assessment Certificate (EAC) application for the Tilbury Phase 2 LNG Expansion Project. Specifically, this study evaluates a conceptual mitigated scenario focused on reducing emissions of NO_x and SO₂, as these have been identified as priority pollutants. The results will inform the EAC process and help address the concerns of Technical Advisory Committee (TAC) members.

If the dispersion modelling study is in support of an application for a new permit or permit amendment, a draft application should be submitted with the draft model plan. Has a draft application been submitted? (Yes or No):

N

What level of assessment is proposed – 1, 2 or 3? (*Section 1.5*¹):

Level 3

Provide the rationale for the proposed level of assessment (e.g., exceedances predicted for a Level 1 assessment):

Unchanged from original modeling plan submitted in June 2022

¹ Numbers in italics refer to applicable sections or tables of the British Columbia Air Quality Dispersion Modelling Guideline, 2022.

1.5. Geographic Setting

Will complex flow (i.e., meteorology) need to be considered? Justify your response based on the terrain and land use characteristics within at least 5 km of facility location (e.g., flat, rolling, river valley, mountainous).

Unchanged from [original modeling plan submitted in June 2022](#).

What is the dominant land cover within 5 km of the facility location (e.g., urban, rural, forest, agricultural, industrial, water)?

Unchanged from [original modeling plan submitted in June 2022](#).

To provide context, provide the minimum distance to the nearest (note that for Level 2 and 3 assessments, several receptors for each category that span a range of potential wind directions should be modelled to ensure the maximum for each category is captured):

Business	71 m (Seaspan Ferries Corporation)
Residence	440 m (7180 68 St, Delta, BC)
School	4.05 km (Fawkes Academy)
Child care facility	2.63 km (Mustard Seed Children's Centre)
Seniors facility	4.44 km (Diversicare Canada Management Services)
Hospital	6.55 km (Delta Hospital)
Recreation (parks, playgrounds, playing fields, etc.)	

Are there any near-field sensitive receptors with elevated windows, balconies or ventilation intakes or other possible human exposure points? (Yes or No)

No

If yes, please provide the proposed vertical and horizontal receptor spacing as well as figures indicating the elevated receptors that will be modelled.

Elevated receptors will not be included consistent with the [original modelling plan submitted in June 2022](#). Modelled receptors (sensitive and grid) will remain unchanged from the previous modelling plan submitted in June 2022.

Are there any other nearby receptors of concern? (e.g., sensitive natural areas)

Unchanged from [original modeling plan submitted in June 2022](#).

1.6. Air Contaminants and Averaging Periods to be Modelled

Table 1.6 (add/delete rows as needed)

Air Contaminant	Averaging Period	Metro Vancouver Objective	Other Criteria ¹	Jurisdiction of Other Criteria
NO ₂	1- hour ^a Annual ^b	79 µg/m ³ 22.6 µg/m ³	79 µg/m ³ 22.6 µg/m ³	CAAQS-2025
SO ₂	1- hour Annual	183 µg/m ³ 10.5 µg/m ³	170 µg/m ³ 10 µg/m ³	CAAQS-2025

¹ If there are no Metro Vancouver objectives for the air contaminant to be modelled, then criteria from other jurisdictions (e.g., Alberta, Ontario, California or Texas) should be used to put predicted ambient contaminant concentrations in perspective. For odorous air contaminants, the Yoshio Nagata “Measurement of Odor Threshold by Triangle Odor Bag Method” reference should be used.

^a Achievement based on annual 98th percentile of the daily maximum 1-hour concentration averaged over three consecutive years

^b Achievement based on annual average of 1-hour concentrations over one year.

1.7. Baseline Air Quality

What metric will be used to determine existing baseline air quality for air contaminants other than NO₂, for short-term averaging periods (98th, 99th or 100th percentile²)?

98th, 90th and 75th percentiles for NO₂

99th percentile for SO₂

Baselines values will be calculated using the hourly values, not the daily maximum 1hr values (DH1M)

² Metro Vancouver’s ambient air quality objectives for SO₂ are “not to be exceeded” values and therefore the percentiles used to calculate the baseline values should be based on the hourly data set and not the daily maximum one-hour values indicated in *Section 8.1.4*. Baseline values for 24-hour averages should be calculated as rolling averages and not daily averages indicated in *Section 8.1.4*.

If NO₂ monitoring data is used, provide a description of how NO₂ chemistry, location and proximity of urban regions relative to the modelled source, and proximity of nearby large industrial or transportation sources of NO_x are considered when selecting the baseline dataset.

Selection of monitoring stations is unchanged from the original modelling plan submitted in June 2022.

Metro Vancouver requests¹ that annual NO₂ baseline be calculated based on the median of the hourly concentration dataset, and 1-hour NO₂ baseline be calculated following the sequential steps below:

- use the 98th percentile of the hourly dataset to calculate and report cumulative dispersion modelling results,

- if the cumulative results are predicted to exceed the 1-hour Metro Vancouver objective for NO₂, also report the cumulative results based on the 90th percentile of the hourly dataset,
- if the cumulative results are still predicted to exceed the 1-hour Metro Vancouver objective for NO₂, also report the cumulative results based on the 75th percentile of the hourly dataset, and
- (optional) perform additional analysis using the methods (e.g., Monte Carlo method) outlined in Section 3.3.2 of the *Guidance on NO₂ Dispersion Modelling in British Columbia*.

If this is not followed, please provide rationale for any proposed deviation.

This method will be followed for the purpose of the remodeling work in support of the conceptual mitigated scenario.

Will there be any additional analysis performed using the methods outlined in Section 3.3.2 of the *Guidance on NO₂ Dispersion Modelling in British Columbia*? If yes, provide details on the methodology. If Monte Carlo method is proposed, submit the computer code used to generate results.

No.

¹ Based on Metro Vancouver's Technical Memorandum on NO₂ Background Calculation Considerations for Dispersion Modelling Purposes:

<https://metrovancover.org/services/air-quality-climate-action/Documents/no2-baseline-calculation.pdf>

Table 1.7 Monitoring Data that will be used to Develop Existing Baseline Concentrations
(add/delete rows as needed)

Air Quality Stations	Source of Data ¹	Air Contaminants	Years ²	Will any wind directions be excluded? (If yes, provide wind directions and justification) ³	Will any exceptional events be excluded? (If yes, provide time periods and justification) ⁴
T17 - Richmond South	Metro Vancouver	NO ₂ , SO ₂ ,	2022-2024*	No	
T13 – North Delta	Metro Vancouver	NO ₂ ,	2022-2024*	No	

T18 – Burnaby South	Metro Vancouver	NO ₂ , SO ₂ ,	2022-2024*	No	
T31 – Richmond Airport	Metro Vancouver	NO ₂ , SO ₂ ,	2022-2024*	No	

¹ It is recommended that data are obtain directly from Metro Vancouver to ensure that data are verified.

² A minimum of 3 years is requested.

³ For excluding air quality data during certain wind directions, see *Section 8.1.4*.

⁴ Exceptional events such as wildfire smoke influenced days may be removed for PM_{2.5} and PM₁₀ on a daily basis.

Are there reasonably foreseeable projects that would overlap in time with the requested permit term? (Yes or No)	Yes
---	-----

If yes, please list the projects that will be included in a future baseline and explain how the future baseline will be developed.

Unchanged from original modeling plan submitted in June 2022.

1.8. NO to NO₂ Conversion (see Guidance for NO₂ Dispersion Modelling in British Columbia)

Please provide the NO₂ conversion method and rationale.

Note: Results for the Total Conversion Method must always be provided regardless of the conversion method selected for the project.

Unchanged from original modeling plan submitted in June 2022.

For Tier 2 ARM, describe the proposed dataset for the ARM2 curve and rationale. If a site-specific dataset is proposed, provide the dataset and completeness statistics (e.g., number of years, percentage complete per quarter).

Note: If CALPOST is used, provide the 24 values used for the step function

N/A

For Tier 3 OLM and PVMRM:

Indicate which O₃ dataset is proposed and provide the rationale.

Unchanged from original modeling plan submitted in June 2022.

If non-default equilibrium ratios are proposed, provide specifics and rationale.

N/A

Specify and provide rationale for in-stack ratio(s) used. If multiple NO_x sources are modelled, provide justification for the ISR selection for each source.

Source specific ISR values will be used, as per Appendix B of the *GUIDANCE FOR NO₂ DISPERSION MODELLING IN BRITISH COLUMBIA*.

1.9. Building Downwash

Table 1.9 (add/delete rows as needed)

The following sources will be updated for the mitigated scenario.

Emission Source ID	Source Height (m)	Is Emission Source on a Building? If no, provide distance to nearest building (m)	Height of Building (m)	Width of Building (m)
Phase 2- Flue Gas Desulphurization (T2-FGD)-Combined Stack	50	No		
Hot Oil Heater (T2-HOH)*	61.5	No		
Thermal Oxidizer (T2-TO)*	22.3	No		
* The FGD will serve as the combined point source, meaning that HOH and TO will not be individually modeled in the mitigated scenario. Remaining sources unchanged from <u>original modeling plan submitted in June 2022</u>.				

Will building downwash be modelled? (Yes or No)

Figure 4.b shows the locations of the facility buildings, LNG tanks, Enclosed Flares, the Project T2 stack locations for the mitigated case, and the T1A and T1B stack locations.

Yes,
unchanged
from
[original modeling plan submitted in June 2022](#).

If no, provide rationale.

1.10. Emission Sources and Characteristics

Are there any liquid storage tanks? (Yes or No)

Yes

If yes, indicate whether they are fixed or floating roof tanks. Follow the guidance provided in *Section 10.5*.

Unchanged from original modeling plan submitted in June 2022.

Table 1.10 Emission Sources and Characteristics (add/delete rows as needed)

Emission Number ¹	Description	Type: Point (P), Area (A), Line (L), Volume (V)	Contaminants (SO ₂ , NO _x , PM _{2.5} ² , . . .)	Basis of Emissions ³ (<i>Section 3.3</i>)	Stack Orientation (Vertical, Horizontal, Angled)	Raincap (<i>Section 10.4</i>) (Yes or No)
T2-FGD	Flue Gas Desulphurization	point	SO ₂ , NO _x ,	___current emission limits _x__proposed emission limits ___other (specify & justify)	Vertical	N
T2-HOH	Source not present in the mitigated scenario					
T2-TO	Source not present in the mitigated scenario					
Remaining sources unchanged from <u>original modeling plan submitted in June 2022</u> .						

¹ Emission numbers should be the same as in existing permit or permit application.

² For PM emissions indicate whether it is filterable, or filterable + condensables, or if unknown (see *Section 3.6*)

³ If dispersion modelling is being conducted in support of an application for an air quality permit or permit amendment then current or proposed emission limits should be modelled. If it is being conducted for a registration under Bylaw 1087, the emission concentrations listed in Appendix 1 or 2 of the Bylaw should be modelled.

Source Emission Rate Variability (Section 3.4)

Are there any batch processes?	No
If yes, provide plots of emission rate vs. time for each batch process.	
unchanged from original modeling plan submitted in June 2022.	
Are emissions expected to vary with load?	No
If yes, describe how this will be modelled.	
unchanged from original modeling plan submitted in June 2022.	
Will actual emissions or flow rates be less than 75% of permitted levels?	No
If yes, describe how this will be modelled (e.g., additional scenarios)	
unchanged from original modeling plan submitted in June 2022.	
Describe anticipated abnormal emission scenarios (e.g., start-up, shut-down, maintenance of control works) and their anticipated frequency:	
unchanged from original modeling plan submitted in June 2022.	
Will emission rates change with different averaging periods? (e.g., 1-hour, 24-hour, annual)	
If yes, describe how this will be modelled (e.g., emission rates generated for each averaging period).	
unchanged from original modeling plan submitted in June 2022.	
Does the proposed permit emission limit scenario represent the worst case scenario, in terms of ambient air quality concentrations, that can be anticipated (Section 3.4.2 and 10.1.2)?	
unchanged from original modeling plan submitted in June 2022.	

1.11. Dispersion Model

List model(s) and version(s) to be used (Section 2):
unchanged from original modeling plan submitted in June 2022.
If modifications to any of the models are planned, provide a description and the rationale (Section 2.3.2):
unchanged from original modeling plan submitted in June 2022.

If AERSCREEN is proposed, will it be run using:

- 1) The stand-alone MAKEMET program to generate the matrix of meteorological conditions and running AERMOD directly with the SCREEN option (preferred) or
- 2) The AERSCREEN command prompt interface?

Please justify your response.

N/A - AERSCREEN will not be used.

If a Level 1 assessment is proposed, indicate whether a standard screening dataset will be used or whether a project-specific dataset will be developed:

N/A

If a project-specific dataset will be developed for a Level 1 assessment, describe the proposed inputs (source and period of meteorological data, range of wind speeds and stability classes, range of wind directions, seasonal values of surface characteristics etc.):

N/A

If any of the emission sources have ambient exit temperatures, please explain how this will be modelled (e.g., buoyancy will be turned off, variable emission file with actual ambient temperature, exit temperature set to temperature below normal ambient temperature (e.g., -20°C) so that CALPUFF defaults to ambient temperature).

unchanged from [original modeling plan submitted in June 2022](#).v

1.12. Planned Model Output

Model results for all levels of assessment should include a table comparing overall maximum predicted concentrations as well as maximum concentrations predicted for each sensitive receptor type (e.g., school, hospital, daycare) to Metro Vancouver ambient air quality objectives or other relevant criteria. Please confirm the planned model output (*Section 8.3*).

Model results for Project- alone and the cumulative case will be presented in table(s) comparing overall maximum predicted concentrations as well as maximum concentrations predicted for each sensitive receptor type (e.g., school, hospital, daycare) to Metro Vancouver ambient air quality objectives and the CAAQS 2025.

PART 2: INFORMATION FOR LEVEL 2 AND 3 ASSESSMENTS ONLY

2.1. Planned Model Domain and Receptor Grid

Dimensions of proposed model domain (Section 7.1):
unchanged from original modeling plan submitted in June 2022.
Proposed receptor spacing (Section 7.2)¹:
unchanged from original modeling plan submitted in June 2022.
Provide a full page map of the proposed model domain and receptor grid that also shows the locations of all schools, hospitals, daycares and senior facilities within the study domain.
unchanged from original modeling plan submitted in June 2022.
Provide a full page, large-scale map (i.e. close up) with dimensions of ~750 m by 750 m of the proposed fence-line, model emission sources (point, line, area, volume) and all receptors (gridded and sensitive).
See figure 4.c
Please use a flagpole receptor height of 1.5 m. If a different height is proposed, please provide the height and rationale.
unchanged from original modeling plan submitted in June 2022. ^v

¹ Note that populated areas and businesses (including Burrard Inlet where ships are at anchor) and complex terrain should include higher resolution receptors (e.g., 250 m spacing) even though the concentration/deposition gradients may be low.

2.2. Default Switch Settings

For AERMOD identify any switch settings that could be different than the recommended defaults (see *Section 7.7*). Provide rationale.

N/A. AERMOD will not be used.

For CALPUFF/CALMET identify any switch settings in CALMET Input Groups 4 & 5 and CALPUFF Input Groups 2 & 12 that could be subject to deviation from the “black (do not touch)” defaults as per *Tables 6.2 and 7.1*. Provide rationale.

unchanged from [original modeling plan submitted in June 2022](#).

2.3. CALMET Parameters

If CALMET is planned to be used, provide (*Section 6.4.2*):

Unchanged from original modelling plan submitted in June 2022

- a domain map Figure 1
- anticipated grid resolution: 200 (m)
- number of grids in X and Y direction (NX = 150 , NY = 150)
- vertical levels (m): 10, 30, 50, 80, 125, 175, 250, 400, 750, 1250, 1750, 2500_

2.4. Planned Geophysical Data Input (*Section 4*)

Source of terrain data:

unchanged from [original modeling plan submitted in June 2022](#).

Source of land use data:

unchanged from [original modeling plan submitted in June 2022](#).

Is modification of the land use data necessary? If so, please describe the proposed modification and provide the rationale¹.

unchanged from [original modeling plan submitted in June 2022](#).

Provide a land use map plotted from the dispersion model input data (e.g., GEO.DAT).

unchanged from [original modeling plan submitted in June 2022](#).

If AERMOD is proposed, will land use surrounding the meteorological station or the location of emissions be used? Provide rationale.

N/A

If surface characteristics are required, use *Tables 4.8, 4.9, 4.10 and 4.12* for summer, autumn, winter and spring, respectively. If these Tables are not used, indicate source of data.

unchanged from [original modeling plan submitted in June 2022](#).

If CALMET is proposed, it is recommended that four GEO.DAT files be used to represent different seasons (*Section 4.4*) as outlined below²:

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3	3	3	5	5	1	1	1	2	2	3	3

If this is not followed, please indicate an alternative approach and rationale.

unchanged from [original modeling plan submitted in June 2022.](#)

If building downwash is applicable, use BPIP-PRIME. If not BPIP-PRIME, indicate method used to specify downwash parameters.

unchanged from [original modeling plan submitted in June 2022.](#)

¹ Modification of land use may be necessary to appropriately represent features such as a continuous Fraser River or large forested parks that may be absent from the land use data.

² This differs from guidance in the British Columbia Air Quality Dispersion Modelling Guideline (2022) since the climate in Metro Vancouver is different than the rest of BC.

2.5. Planned Meteorological Data Input and Processing

Table 2.5a Surface Meteorological Data (add/delete rows as needed)

Station ID	Location (lat/long or indicate on map)	Data Source MOE, MV, MSC, Site Specific, other (specify) ¹	Parameter(s) used in modelling ²	Years	% of Wind Speeds = calm ³	Anemometer Height (m) ⁴
unchanged from original modeling plan submitted in June 2022.						

¹ Data for MV stations should be obtained directly from MV by emailing Ken.Reid@metrovancover.org with the station IDs and period of data you are requesting. If data from a non - MOECCS, MV or MSC station is proposed, follow guidance in *Section 5.8 or 5.9*

² List all meteorological parameters that will be used from each station (e.g., wind speed, wind direction, air temperature, relative humidity, cloud cover). Wind speed and wind direction should be based on a true 60-min average, and not just top-of-the-hour observations.

³ For light wind/calm treatment of Metro Vancouver data consult with Metro Vancouver. For other data sources, follow guidance in *Section 5.8.2*.

⁴ Not all meteorological stations measure winds at the standard 10 m height (e.g., some MV observations are different heights). <https://metrovancover.org/services/air-quality-climate-action/Documents/lower-fraser-valley-air-quality-monitoring-network-station-information-2012.pdf>

Table 2.5b Upper-Air Meteorological Data (add/delete rows as needed)

Station Name	Years	Distance between the Upper Air Station and Project (km)
unchanged from original modeling plan submitted in June 2022.		

Table 2.5c Mesoscale Meteorological Model Output (attach map of domain)

Model (name, version, configuration)	Model Output Provider	Horizontal Grid Resolution (km)	Height of Vertical Levels (m)	Years	Planned Model Output Use ¹
unchanged from original modeling plan submitted in June 2022.					

¹ Sections 6.1 & 6.4.1.

If less than 3 years of meteorology are proposed, please provide justification.

unchanged from [original modeling plan submitted in June 2022.](#)

If CALMET Hybrid mode is proposed, describe in detail the choice of R1, RMAX1 and TERRAD.

unchanged from [original modeling plan submitted in June 2022.](#)

2.6. Special Topics

Indicate the conditions that are planned to be considered as part of the assessment.

Stagnation Conditions Provide an estimate of the frequency of stagnation based on local meteorological data. If AERMOD is proposed, provide methodology on how stagnation periods will be treated (see <i>Section 10.2</i>) unchanged from original modeling plan submitted in June 2022 .	
Shore/Coastal Effects	Y or N
If Yes, indicate whether sub-grid-scale Thermal Internal Boundary Layer option is selected along with the required input coastline coordinate data (see <i>Section 10.3</i>) unchanged from original modeling plan submitted in June 2022 .	
Plume Condensation (Fogging) and Icing	Y or N
If Yes, follow guidance in <i>Section 10.6</i> unchanged from original modeling plan submitted in June 2022	
Chemical Transformation	Y or N
If Yes, specify transformation method and provide details on inputs if Secondary PM _{2.5} , Acid Deposition or Visibility effects are to be estimated. Depending on the transformation method, this could include ammonia, ozone, hydrogen peroxide concentrations, nighttime loss and formation rates for nitrates and sulphates. unchanged from original modeling plan submitted in June 2022 .	
Particle Deposition	Y or N
If Yes, follow guidance in <i>Section 3.7</i> . If non-recommended particle size distributions are used, provide table of particle (including heavy metals) emission size/density distribution and indicate the basis for the table. Important: a separate model run should be conducted with deposition turned on. Maximum predicted concentration results should be presented with deposition turned off. unchanged from original modeling plan submitted in June 2022 .	

2.7. Quality Management Program

Geophysical and Meteorological Input Data

~~Strikeout~~ the tests that will not be undertaken to assure the quality of the inputs and provide rationale. Results of all tests must be provided in an appendix to the dispersion modelling report.

Unchanged from [original modelling plan submitted in June 2022](#). Geophysical input data:

- contour plot of topography
- plots of land use and land cover

Meteorological data:

- wind rose (annual and/or seasonal)
- frequency distribution of surface wind speeds
- average hourly temperature plot (annual and/or seasonal)

NWP output (*Section 6.1*)

- wind rose at selected locations and heights (annual and/or seasonal)
- average hourly temperature plot at selected locations and heights (annual and/or seasonal)
- wind field plots for selected periods that indicate topographic influences such as channeling and thermally generated flows

AERMOD QA/QC

List the tests that will be conducted to confirm the quality of the model input and output

N/A

CALMET/CALPUFF QA/QC

~~Strikeout~~ the tests that will not be conducted and provide justification (*Section 9.1*). All plots or other proof that the tests have been conducted should be provided in an appendix to the dispersion modelling report. We recommend that you provide a draft of this appendix to Metro Vancouver for review prior to commencing CALPUFF modelling to limit the need to remodel; however, this review should not be considered final approval of the CALMET. Metro Vancouver may have additional comments on the CALMET methodology once it reviews CALPUFF model results

CALMET is unchanged from the original modelling.

CALMET/CALPUFF QA Files:

- Plot the locations of the grid, NWP grid points, and source locations and compare to Google Earth or aerial photographs
- Check for blanks, comma instead of period, wrong UTM zone etc.

CALMET Input data:

- Plot of terrain and land use from the GEO.DAT input files to ensure they match with other maps of the area.
- Plot the locations of the meteorological observation stations to check whether they are located properly in the horizontal and vertical.
- Compare all the CALMET-ready input files with the raw data to ensure no errors in data conversion to CALMET-ready files (reformatting, unit conversions, etc.).
- Compare each month of CALMET input meteorological files with each other to ensure all parameters are consistent from month to month.
- Review all source information (values, formats, units) associated with Input Group 13-16 of the CALPUFF.INP file to ensure emission information is correct.
- Plot the source locations to ensure that they are located properly and ensure that their vertical location (stack base relative to terrain height for that location) is correct.
- Review locations (horizontally and vertically) of all specified receptors.

CALMET Output data:

- For a few representative periods where thermally driven flows would be expected, plot the wind vector fields at various levels to confirm that the wind fields are reasonable given the terrain and the meteorological conditions.
- For a few representative periods, when thermally driven flows would be expected, plot wind speed isopleths, derived from all grid cells in CALMET.
- Plot the frequency distribution of surface wind speeds for different locations in the domain and at the surface station locations and check for reasonableness.
- Plot annual and seasonal surface wind roses for different locations including the facility location as well as the surface station locations and check for realism (compare with observations, consider the location, and what might be expected based on topography).
- For different 24-h periods within a summer and winter season, plot a surface, mid-level and upper-level wind field every hour for a 24-h period with light winds and stable conditions. Check for

reasonableness of the wind fields in the domain (extent of terrain effects and the appropriateness of the settings that require expert judgment).

- Plot time series of average surface temperature by month for the source location as well as surface station locations. Compare with observations/climate normals. Check for reasonable monthly variation for the given locations.
- Plot time series of average surface temperature by hour-of-day for the source location as well as surface station locations. Compare with observations/climate normals. Check for reasonable diurnal variation for the given locations.
- Plot time series of average precipitation by month (if precipitation is an input) for one location as well as surface station locations. Compare with observations. Check for reasonable monthly variation for the given locations.
- Plot the frequency distribution of mixing heights for different locations. Check for reasonableness.
- Plot a time series of mixing heights for a 24-h summer and winter period during a light wind, and a clear sky period. Examine the diurnal behaviour for reasonableness.
- Plot the frequency distribution of P-G stability class for the source location as well as surface station location. Compare to the airport observation P-G class frequency distribution (if available). Check for reasonableness for the given locations.
- If NWP model output is used, examine CALMET-generated wind fields for a 24-h period of light winds, and clear skies at surface, mid and upper levels with and without NWP output and check for reasonableness.

2.8. Additional Model Output for Level 2 and 3 Assessments

All model input files (including surf.dat and geo.dat) must be submitted to Metro Vancouver with the dispersion modelling report. Please contact AssistantOfficers@metrovancover.org for a secure location to upload large files. Metro Vancouver may request the submission of all computer files (including the output files) associated with the modelling.

~~Strikeout~~ model output that will not be included in the report and provide justification:

- ~~documentation (text and plots) of tests conducted as part of the QA/QC program,~~
- ~~spatial distribution maps of air quality parameters including baseline values (maximums, exceedance frequencies, annual averages) for Project only (no background) and cumulative cases (with background),~~
- ~~tables of maximum short- and long-term average air quality parameters, for project only and cumulative cases with and without background values (locations and associated meteorological conditions),~~
- ~~tables of maximum predicted concentrations at any (not just the closest) residence, business, hospital, school, daycare, senior facility, recreation (parks, playgrounds, playing fields, etc.) or other type of sensitive receptor within the study dom with and without baseline background values, Note: for the cumulative case, maximum predicted concentration for each sensitive receptor category will be provided, similar to tables J.15 (OLM only) and J.16 of the original TDR.~~
- ~~if exceedances are predicted, tables and spatial distributions of the frequency of exceedance both with and without baseline values, for cumulative case.~~
- ~~tables of air quality parameters under certain emission situations (upsets, start up),~~
- ~~bar charts of the relative contribution of modelled sources to the maximum predicted concentrations at sensitive receptors,~~
- ~~elevation plots of flagpole receptors to represent balconies or windows on nearby sensitive receptors,~~
- ~~special output required for vegetation or health risk assessments,~~
- ~~other (specify):~~

Metro Vancouver Acceptance of Model Plan: _____

(Name, title): _____

Date: _____

Map Document: C:\GIS\2000436_Tilbury\2000436_Tilbury_LNG.aprx



Proposed Project Location, RAA and LAA

The AQ modelling domain is the same as the RAA

Map Projection: NAD 1983 UTM Zone 10N
Tilbury LNG - Delta, BC



Project #: 2000436

Drawn by: RCL	Figure: 1-1
Approx. Scale:	1:195,000
Date Revised:	Feb 15, 2022



Map Document: E:\GIS Work\2000436\2000436_Tilbury_LNG.aprx



Facility Layout, Modelled Buildings and Source Locations for the Mitigated Scenario

¹ Area sources representing emissions from security vessels and shipping emissions along the Fraser River are not shown here.

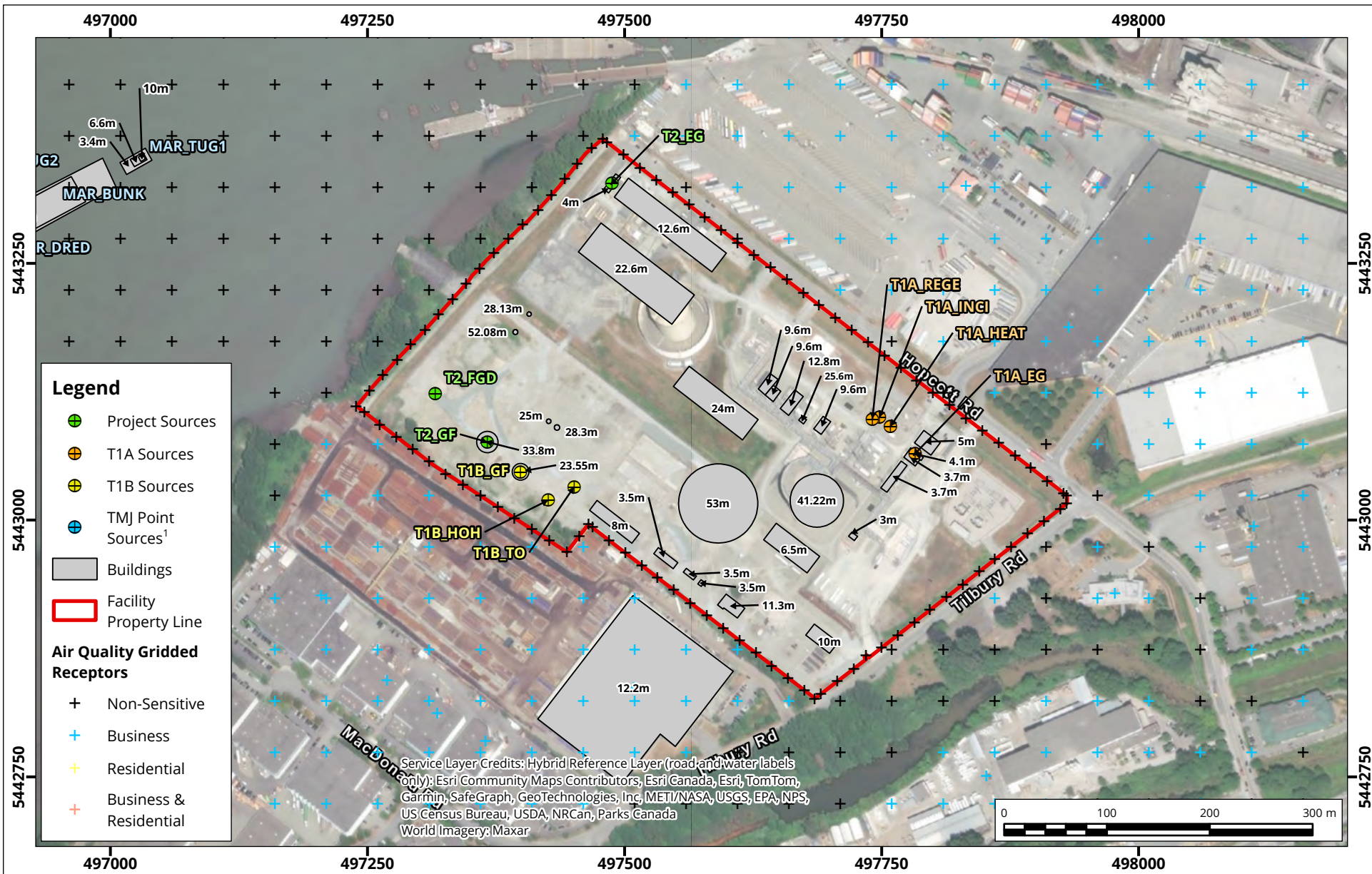
Map Projection: NAD 1983 UTM Zone 10N
Tilbury LNG - Delta, B.C.



Drawn by: DJH	Figure: 4.b
Approx. Scale:	1:5,500
Date Revised:	Jun 11, 2025

Project #: 2000436





Close-up map of the proposed fenceline, model sources, and receptors

Map Projection: NAD 1983 UTM Zone 10N
Tilbury LNG - Delta, B.C.

True North
↑
Project #: 2000436

Drawn by: DJH	Figure: 4.c
Approx. Scale: 1:5,250	
Date Revised: Jun 12, 2025	



AQ-APPENDIX B REVIEW OF FUTURE PROJECTS AND ACTIVITIES IN THE REGIONAL ASSESSMENT AREA



Table B.1: Reasonably Foreseeable Projects and Activities (RFP) Identified for the Cumulative Effects Assessment (CEA)

RFP Name	Description	Incl. in CEA?	Rationale
Tilbury Phase 1 LNG Expansion Project	Construction and operations of facilities for additional LNG production, storage and distribution capacity of LNG on Tilbury facility on Tilbury Island. Includes expansion to T1B (0.65 MT). Distance from PHASE 2: <1 km.	Yes	Located within Project LAA, on the Tilbury island with potential effects on AQ. Effects are likely to interact with PHASE 2 Project effects.
Tilbury Marine Jetty Project	Construction and operations of the Marine Jetty at Tilbury Island on the Fraser River in Delta, B.C. Includes the berthing and transferring of LNG to marine barges and carriers for delivery to local fuel markets and offshore export markets. Distance from PHASE 2: <1 km.	Yes	Located within Project LAA, right to the north of the PHASE 2 Project with potential effects on AQ. Effects are likely to interact with PHASE 2 Project effects.
Delta Grinding Facility Project	Construction, operation and decommission of a grinding facility with a marine terminal adjacent to the existing cement plant located on Tilbury Island in Delta, B.C. The facility will manufacture supplementary cementitious material. Distance from PHASE 2: <1 km	Qualitative	Located within Project LAA, with potential overlapping effects on AQ. However, this project is at pre-application stage and sufficient detailed information on air emission sources are not available yet. Therefore, discussed but not modelled.
Roberts Bank Terminal 2	A new container terminal proposed by Port Metro Vancouver at Roberts Bank in Delta, B.C. Distance from PHASE 2: 16 km.	Qualitative	Located in the southwest corner of the RAA. Effects on AQ are potentially occurring but localized. AQ Effects are not likely to interact with effects of the PHASE 2 Project Based on initial results released in 2014. Therefore, discussed but not modelled.
Vancouver Airport Fuel Facilities Corporation marine terminal	Marine Terminal, adjacent fuel storage facility, and 15km pipeline to YVR being built on the south arm of the Fraser River. Distance from PHASE 2: ~2 km	Qualitative	Located within Project LAA but with only occasional short-term effects due to low frequency of fuel delivery, and overall NO ₂ emission reductions. Discussed but not modelled.
Deltaport Expansion Berth 4	Proposed expansion of existing marine shipping facility on Roberts Bank in Delta, B.C., to increase the international shipping capacity of the facility. Includes the expansion of the existing terminals container storage and handling area, addition of a fourth berth on the southeast side of the Roberts Bank Causeway, and expansion of the existing intermodal rail yard. Distance from PHASE 2: 35 km	No	Located in the southwest corner of the RAA. Effects on AQ are potentially occurring but localized. AQ Effects are not likely to interact with effects of the PHASE 2 Project.
George Massey Tunnel Replacement	Replacement of the existing George Massey Tunnel across the South Arm of the Fraser River with a new bridge, replacement of the Westminster Highway, Steveston Highway and Highway 17A interchanges and widening of Highway 99 to accommodate dedicated transit/high-occupancy vehicle lanes between Bridgeport Road in Richmond and Highway 91 in Delta, B.C. Distance from PHASE 2: 5 km	No	Adverse AQ effects are limited to the construction phase and therefore intermittent. Once in operation, this RFP will likely improve AQ due to improved traffic.
Pattullo Gas Line Replacement	Replacement of approximately 6 km of new gas line, in Burnaby, B.C. Construction and operation of a new underground pressure regulating station.	No	Adverse AQ effects are limited to the construction phase and therefore intermittent.



RFP Name	Description	Incl. in CEA?	Rationale
Parkland Burnaby Refinery	Proposed expansion with construction of eight storage tanks at the Parkland Burnaby Refinery in Burnaby B.C. <i>Distance from T2: 16 km</i>	No	RFP is located outside of the RAA. RFP effects on AQ are not likely to interact with the T2 Project effects.
Annacis Island (Delta) Wastewater Treatment Plant	Includes building a new outfall pipe to carry treated wastewater from the plant to the Fraser River, increasing the size and treatment capacity of the plant, maintenance and improvement activities for the existing plant, and improving existing odour controls. <i>Distance from PHASE 2: 6 km</i>	No	RFP is located within the LAA but is not likely to have effects on AQ.
North Shore Wastewater Treatment Plant	A new tertiary treatment facility that will replace the existing Lions Gate Wastewater Treatment Plant, in the district of North Vancouver, B.C. <i>Distance from PHASE 2: 21 km</i>	No	RFP is outside of the RAA and is not likely to have effects on AQ.
Second Narrows Water Supply Tunnel	Construction of a new water supply tunnel deep under Burrard Inlet, between the District of North Vancouver and the City of Burnaby. B.C. <i>Distance from PHASE 2: 16 km</i>	No	RFP is outside of the RAA and is not likely to have effects on AQ.
Northwest Langley Wastewater Treatment Plant	Includes upgrading Northwest Langley Wastewater Treatment Plant (located in Langley, B.C. to improve effluent quality, provide enhanced environmental protection for the Fraser River and accommodate projected population growth. <i>Distance to PHASE 2: 27 km</i>	No	RFP is outside of the RAA and is not likely to have effects on AQ.
Annacis Water Supply Tunnel	Construction of a new water supply tunnel deep under the Fraser River, between the City of New Westminster and the City of Surrey	No	Adverse AQ effects are limited to the construction phase and therefore intermittent.
Annacis Water Main South	Construction of a new water main in the City of Surrey and City of Delta, approximately 3 km long.	No	Adverse AQ effects are limited to the construction phase and therefore intermittent.
Coquitlam Water Main Project	Installation of a new water main in the City of Coquitlam.	No	Adverse AQ effects are limited to the construction phase and therefore intermittent.
Douglas Road Water Main - Still Creek	Construction of a new water main that will replace the existing Douglas Road Water Main which spans 15 km between North Burnaby and the City of New Westminster.	No	Adverse AQ effects are limited to the construction phase and therefore intermittent.
Fleetwood Reservoir and Water Main	Construction of a new underground reservoir and water main in the City of Surrey that will provide drinking water to communities south of the Fraser River.	No	Adverse AQ effects are limited to the construction phase and therefore intermittent.
Hellings Reservoir	Expansion of existing Hellings Reservoir located at 8554- 116 Street in the City of Delta	No	Adverse AQ effects are limited to the construction phase and therefore intermittent.
Jericho Reservoir	Construction a new aboveground reservoir at 20400 – 73A Avenue in the Township of Langley.	No	Adverse AQ effects are limited to the construction phase and therefore intermittent.



RFP Name	Description	Incl. in CEA?	Rationale
Stanley Park Water Supply Tunnel	Construction a new water supply tunnel deep underground in Stanley Park.	No	Adverse AQ effects are limited to the construction phase and therefore intermittent.
Delta Fresh	Cold Storage Warehouse/Food Processing Facility: Construction of a cold storage warehouse and food processing facility with administrative offices located at 10555 64 Avenue in City of Delta. <i>Distance from PHASE 2: 8 km</i>	No	RFP's AQ effects are likely insignificant, localized, and not likely to interact with PHASE 2 Project effects.
Rezoning and Design Review at 5519 Admiral Way	The proposal is for a one-floor neighbourhood commercial building with a one-level parkade under the building, in the City of Delta	No	Adverse AQ effects are limited to the construction phase and therefore intermittent.
The Southlands development	Property development in Delta B.C. including agricultural, natural habitat, public open space and greenways on 80 percent of the land and residential, commercial and institutional uses on 20 percent of the land.	No	Adverse AQ effects are limited to the construction phase and therefore intermittent.
Pattullo Bridge Replacement	Construction of a new four-lane bridge and demolition of the existing bridge that spans the Fraser River between New Westminster and Surrey, B.C.	No	Adverse AQ effects are limited to the construction phase and therefore intermittent.

AQ-APPENDIX C EXISTING CONDITIONS

C.1 INTRODUCTION

RWDI was retained by FortisBC Energy Inc. (FortisBC) to conduct an air quality assessment for the proposed expansion of storage and production capacity at its existing Tilbury liquefied natural gas (LNG) facility on Tilbury Island, in Delta, BC (the Project).

An air quality Technical Data Report (TDR) is required as part of the Environmental Assessment (EA) submitted to the British Columbia (BC) Environmental Assessment Office (BC EAO) and the Impact Assessment Agency of Canada (IAAC).

This appendix presents the existing conditions with respect to air quality and the local climate in order to provide background concentrations for the modelling assessment and the context within which results are presented in the TDR.

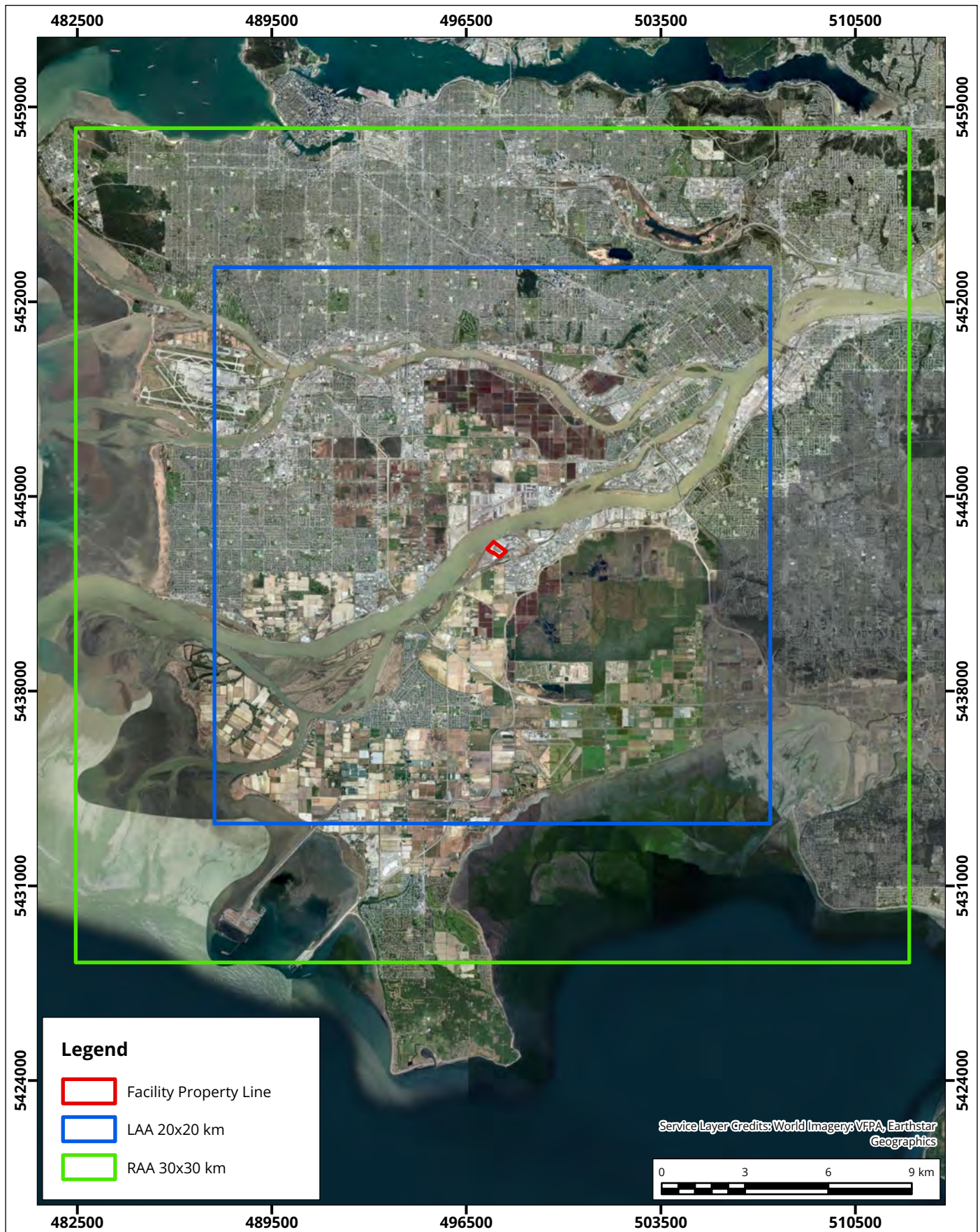
C.1.1 Temporal and Spatial Boundaries

The proposed Project is located on Tilbury Island, within the Tilbury Industrial Park, adjacent to the Fraser River in Delta. Neighbouring properties are mainly used for industrial purposes with the nearest resident being approximately 450 meters (m) to the southwest of the proposed Project, although the closest residential area is approximately 3 km away.

The Regional Assessment Area (RAA) was defined to comprise of the area where the predicted residual effects from the proposed Project may act in combination with residual effects of existing (including past) and reasonably foreseeable projects and activities (RFP) and activities to cause cumulative effects. The RAA for AQ covers a 30 km by 30 km area centered on the proposed Project Footprint and extends to the coast on the west, the United States (U.S.) border to the south, Vancouver and Burnaby to the north, and Surrey to the east. Project location, the LAA and the RAA are shown in Figure C.1.

The proposed Project includes three to six years of construction, 40 to 60 years of operational life span, and two years of decommissioning. Potential effects of the proposed Project during construction and operation on ambient air quality are studied.

Map Document: D:\GIS\desktop\2000436_Tilbury\AQ work\2000436_Tilbury_LNG.aprx



Project Location, RAA and LAA

The AQ modelling domain is the same as the RAA

Map Projection: NAD 1983 UTM Zone 10N
Tilbury LNG - Delta, BC



Project #: 2000436

Drawn by: RCL	Figure: C.1
Approx. Scale: 1:190,000	
Date Revised: Sep 13, 2022	



C.2 AIR QUALITY

This section aims to describe the ambient air quality conditions at the Project site prior to construction and to provide context for the background concentrations that were calculated and used in the modelling evaluation.

According to the Caring for the Air 2021 (Metro Vancouver (MV), 2022) the overall air quality in the MV area has been improving over the past decade. Most of the gaseous pollutants concentrations generally continued to decrease while particulate matter concentrations increased due to out-of-region wildfires. The following snapshot from this report shows the trend for gaseous pollutants over the past decade.



10-Year Averaged Air Quality Trends from Horseshoe Bay to Hope. Source: MV, 2022.

For the purpose of this assessment, four air quality stations representative of the Project location were selected and analyzed in detail.

The air quality monitoring station datasets used in this report are described in Table C.1 and in Figure C.2: they are located in North Delta (T13), Richmond South (T17), Richmond Airport (T31) and Burnaby South (T18). All stations measure nitrogen dioxide (NO₂), oxides of nitrogen (NO_x), particulate matter of a diameter less than 2.5 µm (PM_{2.5}) and ozone (O₃). Sulphur dioxide (SO₂) and carbon monoxide (CO) are measured at T17, T18 and T31 and particulate matter of a diameter less than 10 µm (PM₁₀) is measured at T18 and T31 only. All four stations were operational for the period of 2019-2021, inclusively. These stations are operated, and the data are collected and quality controlled by MV to the highest standard (MV, 2012).



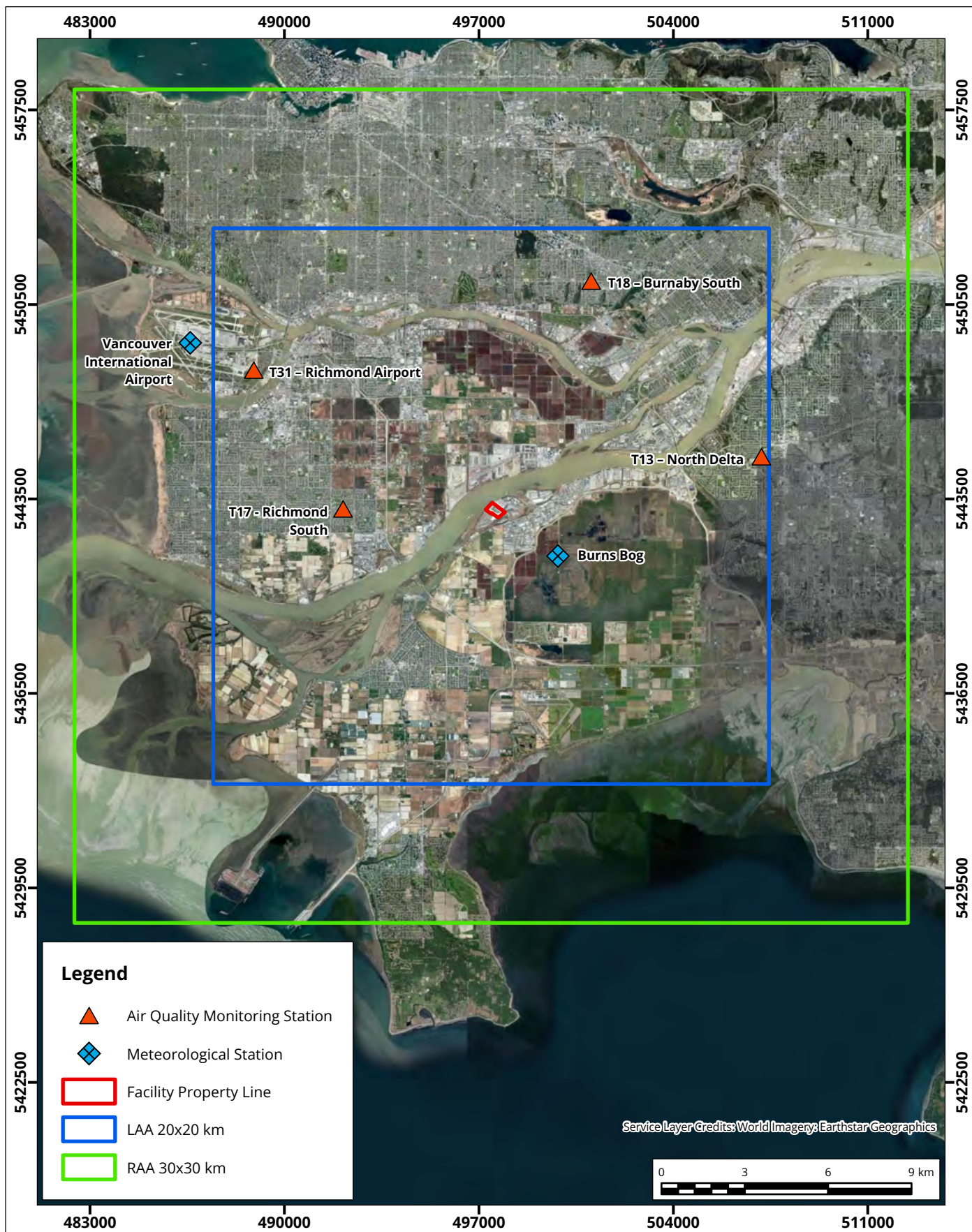
Data capture rates of each of the criteria air contaminants (CAC) of interest at each of the above-mentioned stations are presented in Table C.2. Data completeness was below 75% for: PM_{2.5} at T17 during the fourth quarter of 2022, PM₁₀ at T18 during the third quarter of 2019 and 2021, and O₃ at T13 during the first quarter of 2020 and fourth quarter 2021; all other parameters met the minimum completeness criterion of 75% to calculate background concentrations as laid out by BC ENV (2022). The PM_{2.5}, PM₁₀ and O₃ datasets from T17, T18 and T13 respectively were still used to calculate background because the aggregate data capture rate over the 3 years at multiple stations was greater than 75%.

Background concentrations for each of the CAC's examined in this study are presented in Table C.3. For comparison to local objectives (MV Ambient Air Quality Objectives - MV AAQO), provincial objectives (British Columbia Ambient Air Quality Objectives – BC AAQO) and federal standards (Canadian Ambient Air Quality Standards - CAAQS), background calculations were performed using their respective metrics (MV, 2022; MV, 2025; British Columbia Government, 2022; Canadian Council of Ministers of the Environment, 2025).

Table C.1. Air Quality Monitoring Station Data

Air Quality Stations	Station Location (Latitude, Longitude)	Air Contaminants	Period Considered
T13 – North Delta	49.1583° N, 122.9017° W	NO ₂ , NO _x , PM _{2.5} , O ₃	2019-2021
T17 - Richmond South	49.1414° N, 123.1082° W	NO ₂ , NO _x , SO ₂ , CO, PM _{2.5} , O ₃	2019-2021
T18 – Burnaby South	49.2152° N, 122.9857° W	NO ₂ , NO _x , SO ₂ , CO, PM ₁₀ , PM _{2.5} , O ₃	2019-2021
T31 – Richmond Airport	49.1863° N, 123.1524° W	NO ₂ , NO _x , SO ₂ , CO, PM ₁₀ , PM _{2.5} , O ₃	2019-2021

Map Document: D:\GIS\desktop\2000436_Tilbury\AQ work\2000436_Tilbury_LNG.aprx



Air Quality Monitoring and Meteorological Stations for Existing Conditions



Project #: 2000436

Drawn by: RCL	Figure: C.2
Approx. Scale: 1:190,000	
Date Revised: Sep 13, 2022	





Table C.2: Monitoring Data Completeness Criteria at the Four Stations from 2019-2021.

Year	Quarter	T13			T17					T18						T31					
		Percent Completeness (%)																			
		PM _{2.5}	NO _x	O ₃	PM _{2.5}	SO ₂	NO _x	CO	O ₃	PM _{2.5}	PM10	SO ₂	NO _x	CO	O ₃	PM _{2.5}	PM10	SO ₂	NO _x	CO	O ₃
2019	Q1	97	98	99	98	99	99	99	99	99	99	95	98	95	99	99	85	94	99	95	99
	Q2	76	96	94	100	100	100	100	100	100	93	96	99	96	99	99	99	95	97	95	99
	Q3	92	100	100	98	100	100	100	100	91	27	91	95	9	95	99	99	95	100	96	100
	Q4	95	100	100	99	96	100	100	100	97	96	95	99	95	99	99	93	95	98	94	99
2020	Q1	99	99	62	100	95	98	100	100	100	100	96	99	96	100	97	98	97	98	97	98
	Q2	82	98	98	100	95	96	99	99	100	100	96	99	96	100	100	99	99	99	99	100
	Q3	83	95	99	86	98	98	86	99	86	85	99	98	85	99	86	85	100	100	87	100
	Q4	99	97	99	100	100	100	100	100	100	99	100	99	100	99	100	99	100	100	100	100
2021	Q1	99	100	99	99	99	100	95	96	99	100	100	99	100	100	98	99	99	99	99	99
	Q2	99	99	100	99	99	99	99	99	98	99	100	99	96	100	99	98	100	100	100	100
	Q3	96	95	76	94	100	99	94	100	96	70	100	98	95	100	95	95	100	99	96	100
	Q4	22	100	20	100	100	100	100	99	97	100	100	100	99	100	100	99	100	100	100	98

Note: values below 75% are shown in **bold** font.

Table C.3: Calculated Background Concentrations at the Four Air Monitoring Stations from 2019-2021.

Air Contaminant	Averaging Period	Objective or Standard	Metric Used to Calculate Background	Criteria		Background	
				µg/m ³	ppb	µg/m ³	ppb
Carbon Monoxide (CO) ^[2]	1-hour	MV AAQO	98 th perc. of hourly values	14,900	13,000	557	489
	8-hour	MV AAQO	98 th perc. of 8-HRA.	5,700	5,000	505	443
Nitrogen Dioxide (NO₂)	1-hour	BC AAQO / CAAQS 2020	98 th perc. of D1HM	113	60	73.4	39.0
		Previous MV AAQO	98 th perc. of hourly avg.	113	60	58.1	30.9
		Current MV AAQO / CAAQS 2025	98 th perc. of D1HM	79	42	73.4	39.0
	Annual	BC AAQO / CAAQS 2020 / Previous MV AAQO	Annual avg. of hourly avg.	32	17	21.1	11.2
		Current MV AAQO / CAAQS 2025	Annual avg. of hourly avg.	22.6	12	21.1	11.2
Nitrogen Oxides (NO_x)	1-hour	BC AAQO / CAAQS 2020	Same as NO ₂	-	-	256	136
		Previous MV AAQO		-	-	150	79.8
		Current MV AAQO / CAAQS 2025		-	-	256	136
	Annual	BC AAQO / CAAQS 2020 / Previous MV AAQO		-	-	32.6	17.3
		Current MV AAQO / CAAQS 2025		-	-	32.6	17.3
Sulphur Dioxide (SO₂)	1-hour	BC AAQO / CAAQS 2020	99 th perc. of D1HM	183	70	8.43	3.2
		MV AAQO	99 th perc. of hourly values	183	70	3.64	1.4
		CAAQS 2025	99 th perc. of D1HM	170	65	8.43	3.2
	Annual	BC AAQO / CAAQS 2020 / Previous MV AAQO	Annual avg. of hourly avg.	13	5	0.63	0.2
		Current MV AAQO / CAAQS 2025	Annual avg. of hourly avg.	10.5	4	0.63	0.2
Ozone (O₃)	1-hour	MV AAQO	3-year average of annual maximum 1-hour average	161	82	119.4	60.8
		BC AAQO	3-year average of annual maximum 1-hour average	160	82	119.4	60.8
	8-hour	BC AAQO / CAAQS 2020/ Previous MV AAQO	3-year average of annual 4 th highest of daily maximum 8-hour average concentrations	123	62	83.4	42.5
		Current MV AAQO / CAAQS 2025	3-year average of annual 4 th highest of daily maximum 8-hour average concentrations	118	60	83.4	42.5



Air Contaminant	Averaging Period	Objective or Standard	Metric Used to Calculate Background	Criteria		Background	
				µg/m ³	ppb	µg/m ³	ppb
PM _{2.5} ^[2]	24-hour	BC AAQO	98 th perc. of 24-hour avg.	25	-	11.9	-
		CAAQS 2020 / CAAQS 2025	98 th perc. of 24-hour avg.	27	-	11.9	-
		MV AAQO	98 th perc. of 24-HRA	25	-	12.0	-
	Annual	BC AAQO / MV AAQO	Annual avg. of hourly avg.	8	-	4.91	-
		CAAQS 2020 / CAAQS 2025	Annual avg. of hourly avg.	8.8	-	4.91	-
PM ₁₀ ^[2]	24-hour	BC AAQO / MV AAQO	98 th perc. of 24-HRA	50	-	18.4	-
	Annual	Previous MV AAQO	Annual avg. of hourly avg.	20	-	9.19	-
		Current MV AAQO	Annual avg. of hourly avg.	8 (6) ^[3]	-	9.19	-

Notes: D1HM = Daily 1-hour maximum; ppb = parts per billion; ppm = parts per million

[1] All contaminants were calculated using 2019-2021 data, based on stations T13, T17, T18 and T31.

[2] PM_{2.5}, PM₁₀, and CO outliers caused by wildfires were removed for the following dates as per MV Air Quality Advisories.

2020 removed days: Sep 08-19

2021 removed days: Aug 12-14

[3] Metro Vancouver's annual PM_{2.5} planning goal of 6 mg/m³ is a longer-term aspirational target to support continuous improvement.
Abbreviations: perc.: Percentile, avg.: Average, 8-HRA: 8-hour rolling average, 24-HRA: 24-hour rolling average.

C.2.1 Nitrogen Dioxide

Nitric oxide (NO) and nitrogen dioxide (NO₂) are produced by high temperature combustion reactions. They are collectively referred to as oxides of nitrogen (NO_x). Nitric oxide typically predominates near the source of the combustion emissions, but it rapidly undergoes chemical reactions in the atmosphere to produce NO₂. Nitrogen dioxide has been tied to acute and chronic respiratory illness, creation of acid rain, acidification and eutrophication of soil and water, impact on vegetation, ozone formation, and is a precursor to secondary particulate formation.

In the Lower Fraser Valley, transportation sources account for approximately 77% of NO_x emissions, with stationary and area sources contributing the remainder (MV, 2018).

C.2.1.1 Long-term trends

Long-term trends of annual average and short-term peak concentrations of nitrogen dioxide concentrations for MV are presented in Figure C.3 and Figure C.4. Both graphs show a general downward trend over time. The improvements are largely due to improved transportation emission standards and the AirCare program in the MV Airshed. The calculated annual and 1-hour background concentrations of 11.2 ppb and 30.9 ppb, respectively, calculated for the 2019-2021 period in Table C.3 are in line with the observed trends.

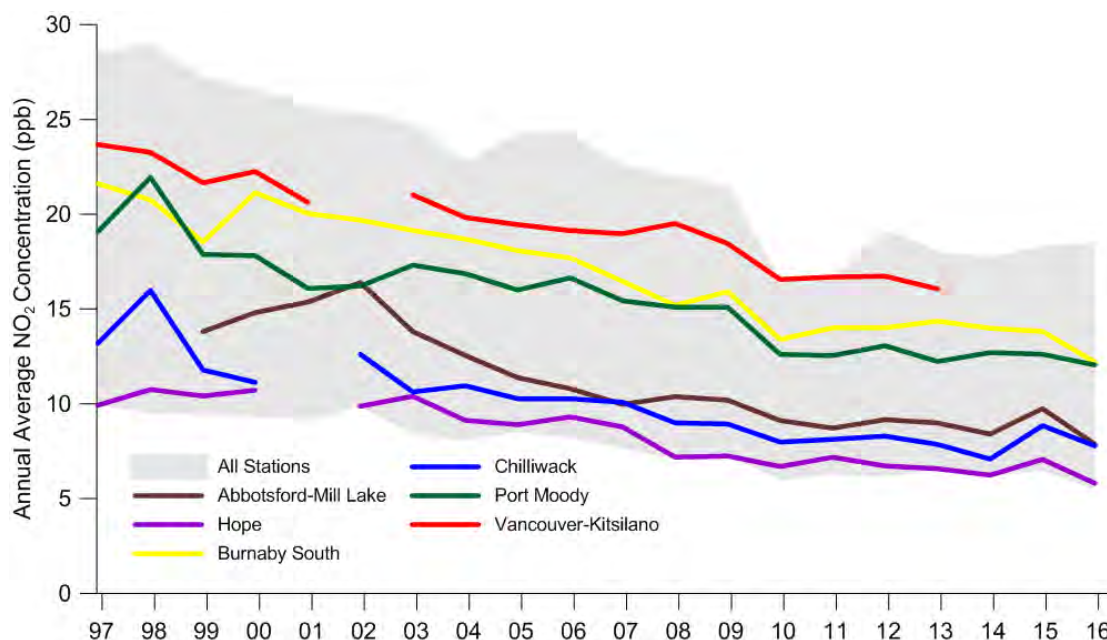


Figure C.3: Annual Average Nitrogen Dioxide Trend from 1997 to 2016 (MV, 2018)

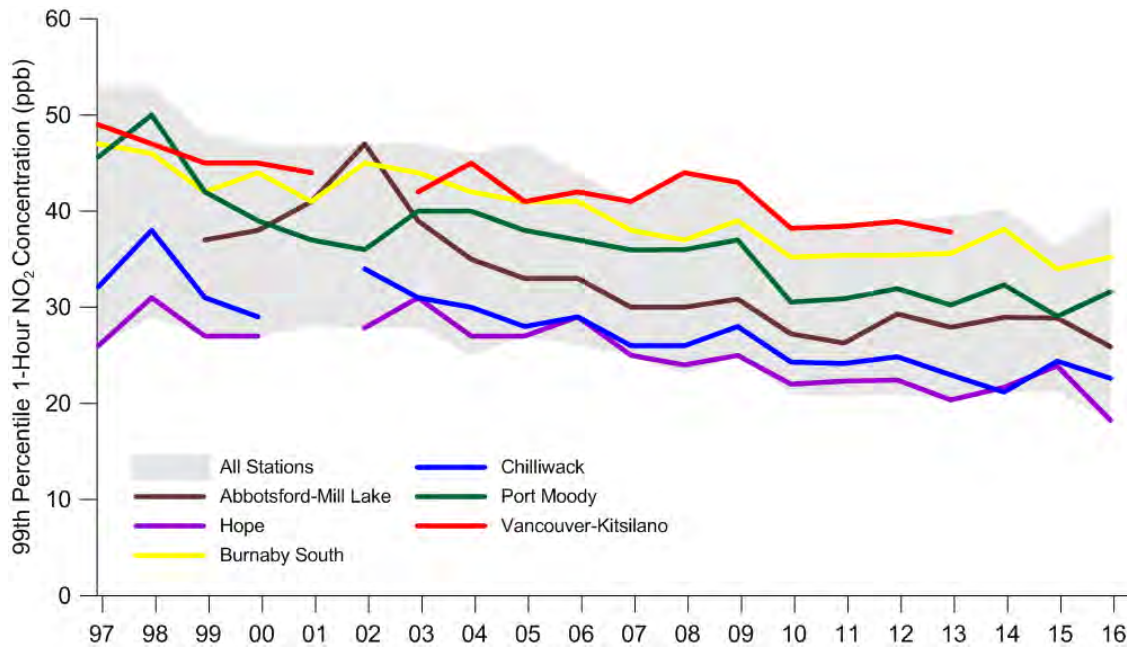


Figure C.4: Short-Term Peak Nitrogen Dioxide Trend from 1997 to 2016 (MV, 2018)

Figure C.5 and Figure C.6 show annual average and short-term peak concentrations of nitrogen dioxide concentrations from 2011 to 2021 at the four monitoring stations. Despite limited interannual variations at the four stations, annual average NO_2 concentrations exhibit an overall slight downward trend. Short-term peak concentrations show greater fluctuations, and an overall trend is less evident. The dashed lilac-coloured line in Figure C.5 shows a linear fit of the average between stations and illustrates a discernable decrease over the 10-year period above the black dashed CAAQS 2025 target.

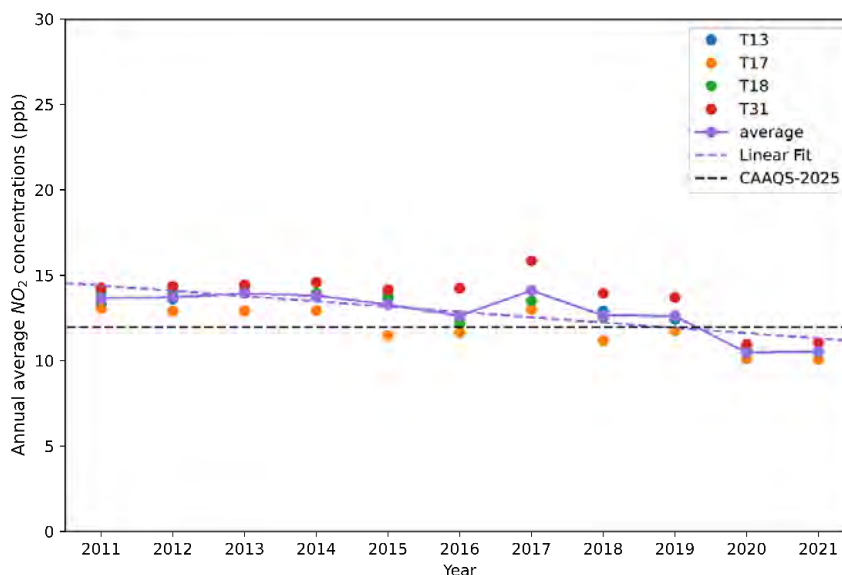


Figure C.5: Annual Average Nitrogen Dioxide Trend from 2011 to 2021

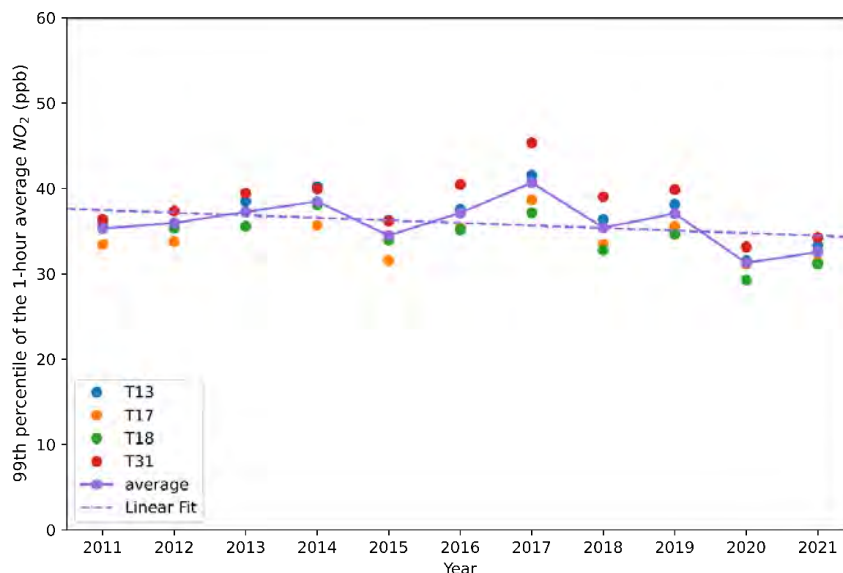


Figure C.6: Short-Term Peak Nitrogen Dioxide Trend from 2011 to 2021

C.2.1.2 Recent trends (2019-2021)

Figure C.7 through Figure C.10 present the NO₂ data summary in box and whisker plots from 2019 to 2021. These values were used to calculate background concentrations for the air dispersion modelling study and have been presented by month of the year. The lower and upper whiskers show the minimum and maximum hourly averages, the lower and upper edges of the boxes show the first and third quartiles, the middle line shows the median and the red dot shows the average concentration. Overall, there is a seasonal variation with greater NO₂ concentrations being observed in the winter months (November to March). This is attributed to space heating and to more stable atmospheric conditions and lower atmospheric inversion heights during winter. This trend is observed across all four stations.

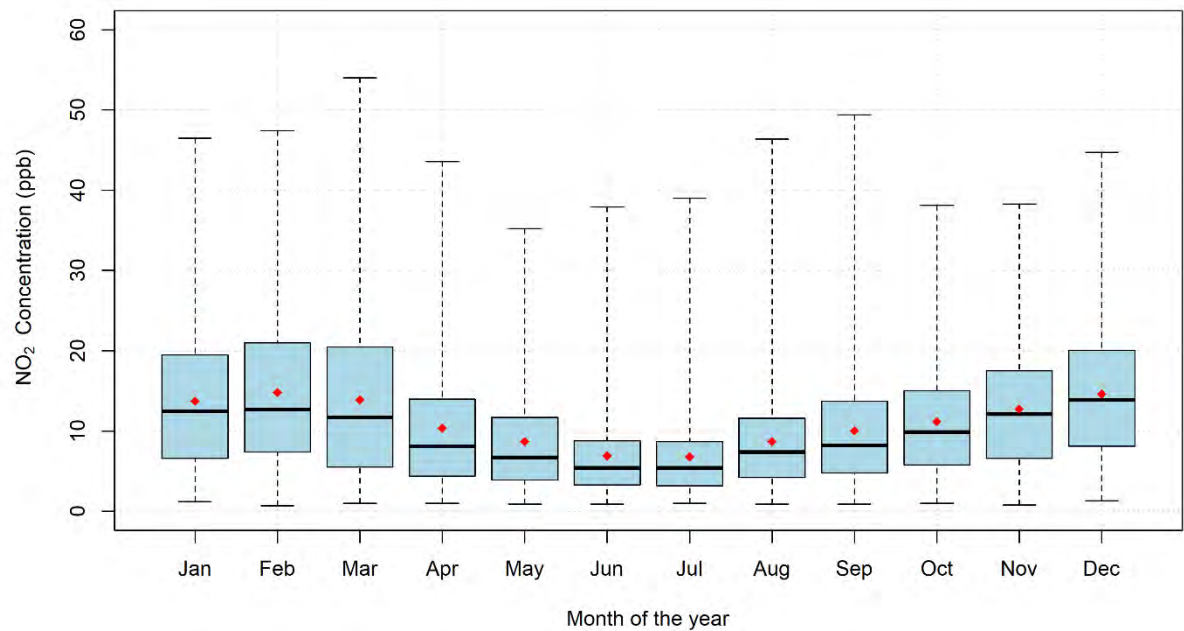


Figure C.7: NO₂ Concentrations at T13 Station by Month of the Year (2019-2021)

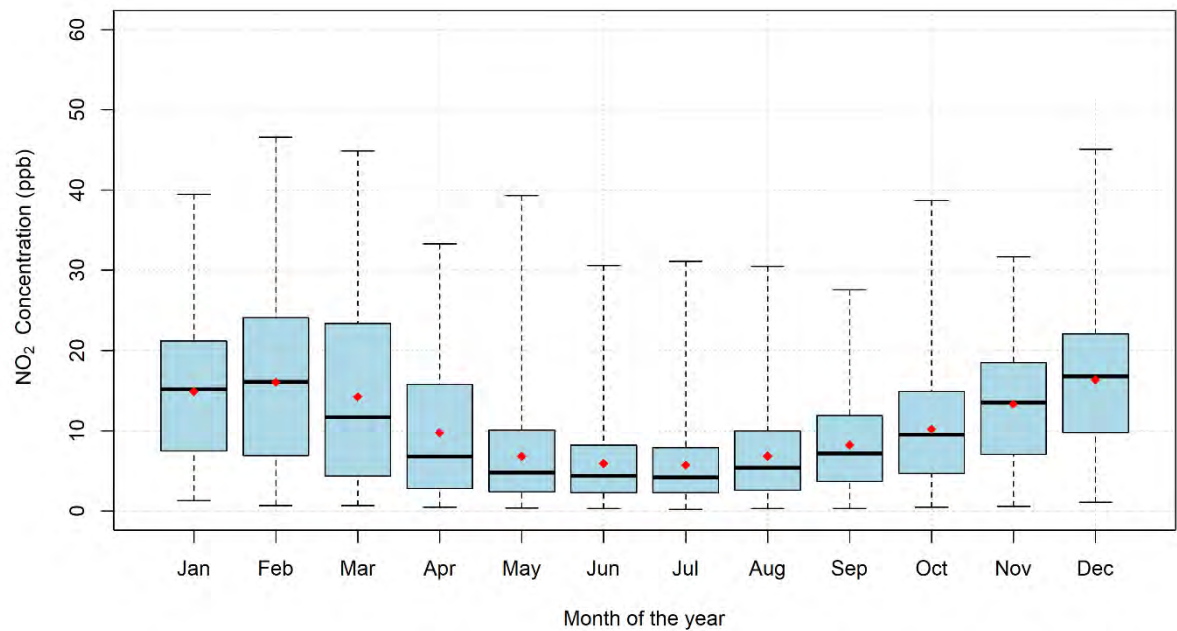


Figure C.8: NO₂ Concentrations at T17 Station by Month of the Year (2019-2021)

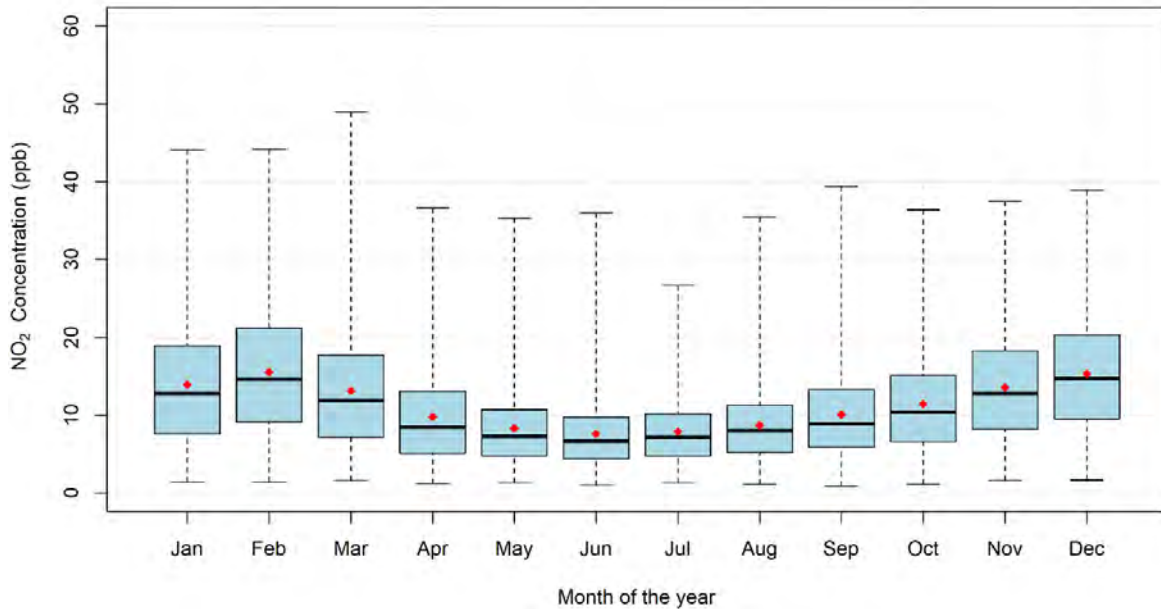


Figure C.9: NO₂ Concentrations at T18 Station by Month of the Year (2019-2021)

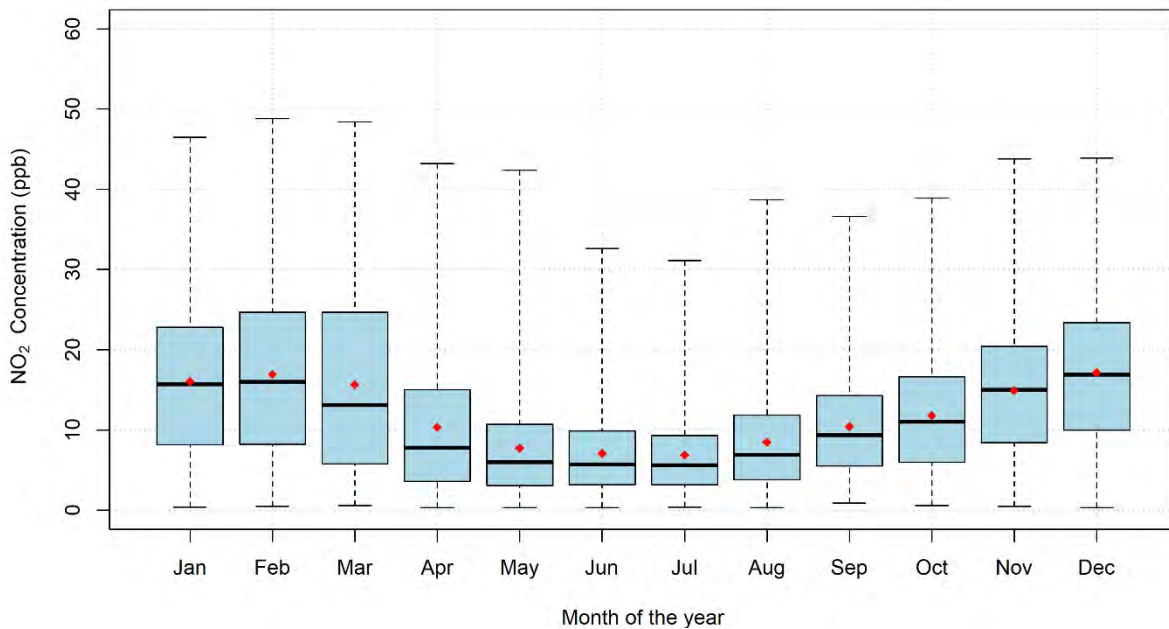


Figure C.10: NO₂ Concentrations at T31 Station by Month of the Year (2019-2021)

Table C.4 compares existing ambient concentrations to the previous MV AAQO, current MV AAQO, BC AAQO, CAAQS 2020 and CAAQS 2025. Previous MV AAQO, the BC AAQO and the CAAQS 2020 were not exceeded in the 2019-2021 period for any of the specified averaging periods; however, the annual average NO₂ concentrations were observed to exceed the current MV AAQO and CAAQS 2025 in 2019 at the T13, T18 and T31 stations.



Table C.4: Existing Nitrogen Dioxide (NO₂) Concentrations in 2019-2021.

						T13		T17		T18		T31	
Objective period	Objective	Metric	Value		Year	Concentration (ppb)	Exceedance	Concentration (ppb)	Exceedance	Concentration (ppb)	Exceedance	Concentration (ppb)	Exceedance
1-hour	Previous MV AAQO (1) / BC AAQO / CAAQS 2020	3-year average of annual 98 th percentile of daily maximum 1-hour average concentrations ⁽¹⁾	60	ppb	2019-2021	40.1	No	37.1	No	37.9	No	41.0	No
	Current MV AAQO / CAAQS 2025		42	ppb	2019-2021								
Annual	Previous MV AAQO / BC AAQO / CAAQS 2020	Annual average over one year	17	ppb	2019	12.4	No	11.8	No	12.6	No	13.7	No
					2020	10.1	No	10.2	No	10.6	No	11.0	No
					2021	10.5	No	10.1	No	10.6	No	11.1	No
	Current MV AAQO / CAAQS 2025		12	ppb	2019	12.4	Yes	11.8	No	12.6	Yes	13.7	Yes
					2020	10.1	No	10.2	No	10.6	No	11.0	No
					2021	10.5	No	10.1	No	10.6	No	11.1	No

⁽¹⁾ The metric for background calculation for modelling purposes is the 3-year average of annual 98th percentile of hourly concentrations as per MV Model Plan. The metric for comparison with the MV AAQO is the 3-year average of annual 98th percentile of daily maximum 1-hour average concentrations.

C.2.1.3 Special considerations for CAAQS 2025

Given the observed exceedances of the annual current MV AAQO and CAAQS 2025, additional attention was given to current trends in NO₂ concentrations and its significance at the proposed Project site when the current MV AAQO and CAAQS 2025 come into effect. Figure C.11 shows a timeseries of the rolling 3-year average of the 98th percentile of the daily 1-hour maximum NO₂ concentrations from 2011 to 2021 which corresponds to the metric used to compare to the current MV AAQO and CAAQS 2025. The solid lilac-coloured line and points represent the average of the four stations and the dashed lilac-coloured line is a linear fit of the average. There is no discernable trend over the 10-year period; however, the decrease from 2018-2020 and 2019-2021 may be indicative of a recent trend. The notable decrease in annual average NO₂ from above current MV AAQO and CAAQS 2025 to just below is also shown in Figure C.5.

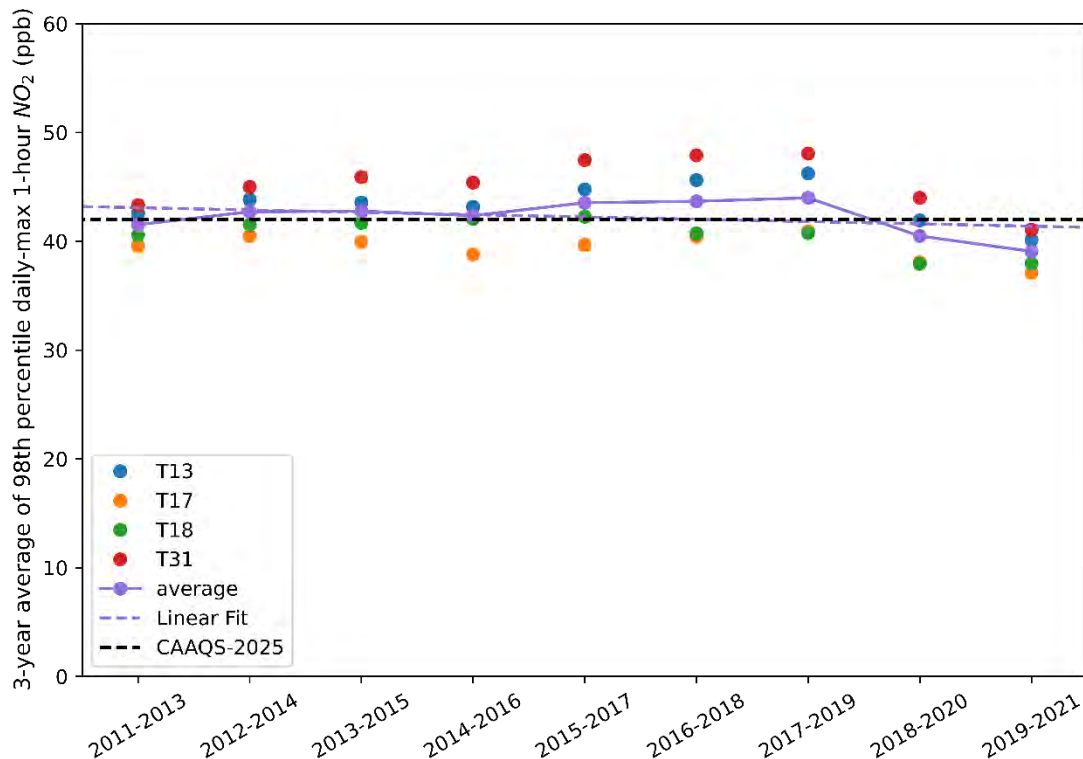


Figure C.11: 98th Percentile of Daily 1-Hour Maximum NO₂ Concentrations from 2011 to 2021 (3-year rolling average).

C.2.2 Sulphur dioxide

Sulphur dioxide (SO₂) is emitted when fossil fuels containing sulphur are burned. It reacts in the air to form acidic substances such as sulphuric acid (acid rain) and sulphate particulate.

The largest source of SO₂ emissions include the oil and gas sector, the pulp and paper sector, and metal smelters in BC. Marine vessels and petroleum refining are the largest sources of SO₂ in Metro Vancouver. Off-road diesel engines, industry, heating and transportation are additional sources of SO₂. Local SO₂ emissions in MV are low relative to cities of similar size due to the use of natural gas for space heating rather than coal or oil (MV, 2018).

C.2.2.1 Long-term trends

Long-term trends of annual average and short-term peak concentrations of sulphur dioxide concentrations are presented in Figure C.12 and Figure C.13. Both figures show a steady decline over time, particularly Burnaby-Capitol Hill, Vancouver-Kitsilano and Port Moody. The other stations also show similar improvement, but are less drastic as concentrations were already very low in comparison.

The largest contributing factor to this rapid decline in SO₂ concentrations in recent years is the imposition of stricter requirements for lower sulphur content marine fuels (MV, 2018).

The annual and 1-hour background concentrations are 0.2 ppb and 1.4 ppb, respectively are presented in Table C.3 and are in line with the observed long-term trends.

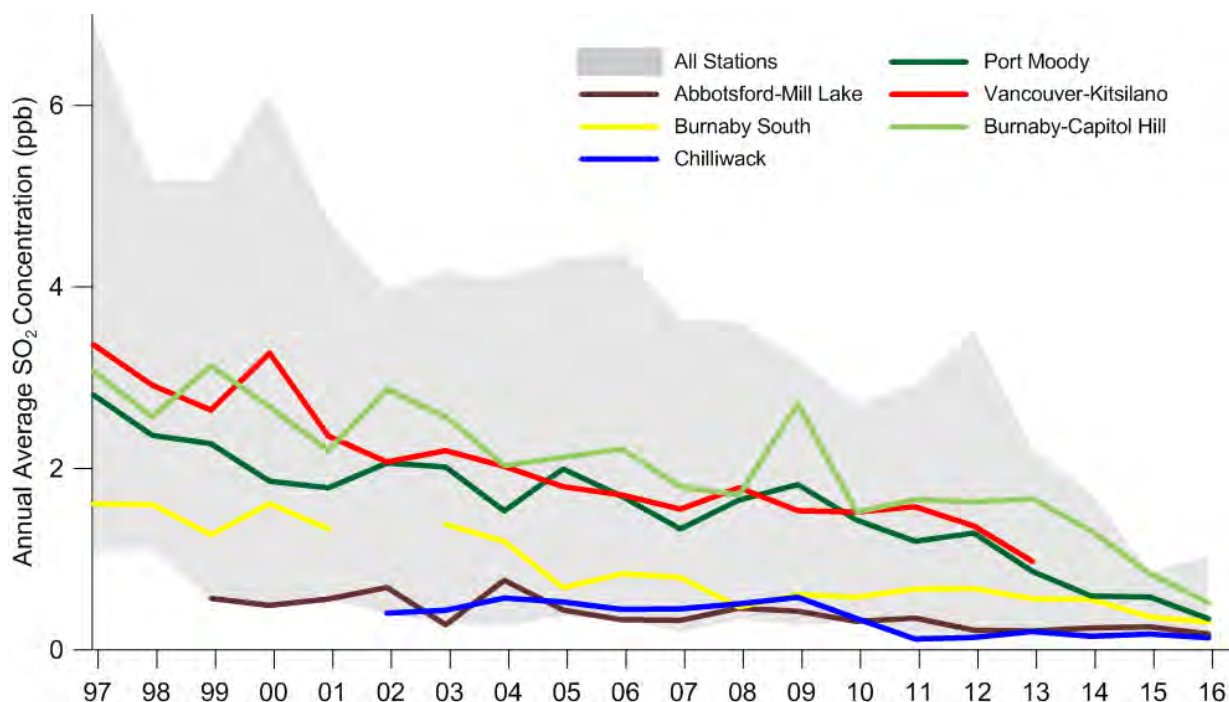


Figure C.12: Annual Average Sulphur Dioxide Trend from 1997 to 2016 (MV, 2018)

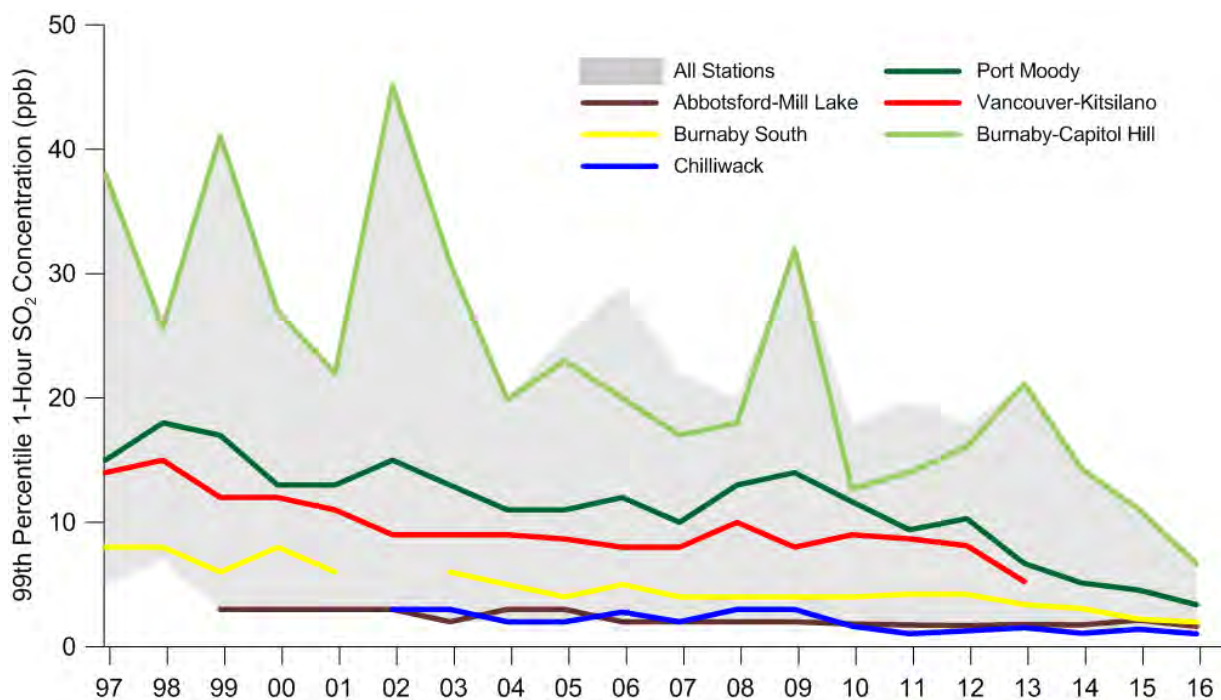


Figure C.13: Short-Term Peak Sulphur Dioxide Trend from 1997 to 2016 (MV, 2018)

C.2.2.2 Recent trends (2019-2021)

Figure C.14 through Figure C.16 examine the data from 2019 to 2021 that was used to calculate background values for the air dispersion modelling study. There are no discernable seasonal variations in SO₂ concentrations; SO₂ concentrations are very low on average, with very few outliers.

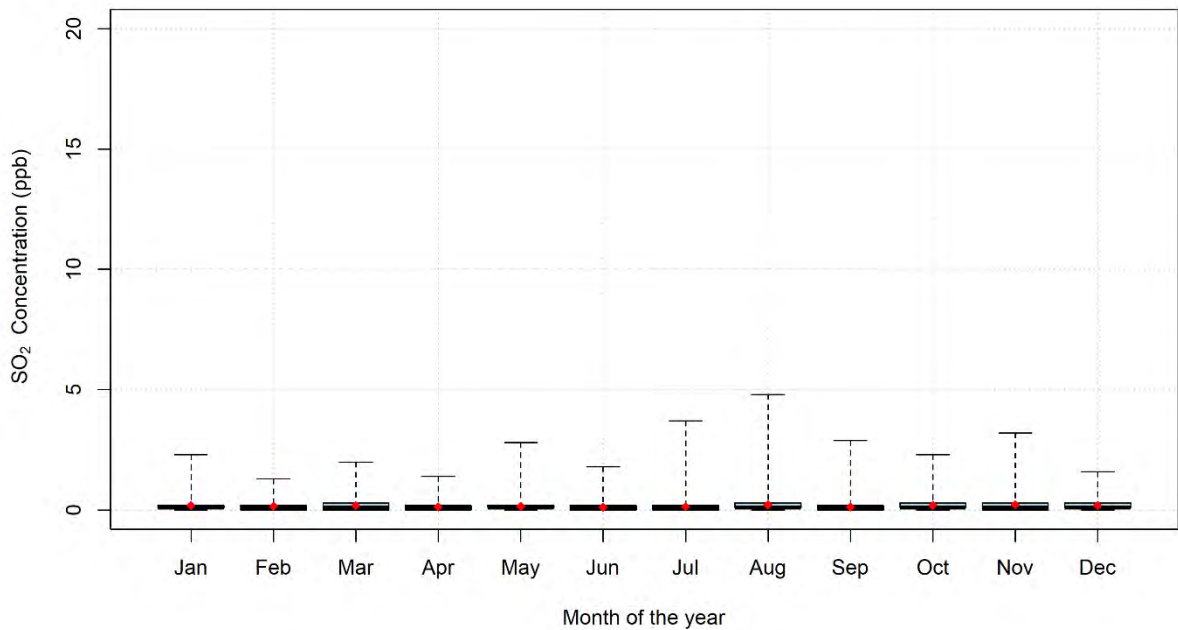


Figure C.14: SO₂ Concentrations at T17 Station by Month of the Year (2019-2021)

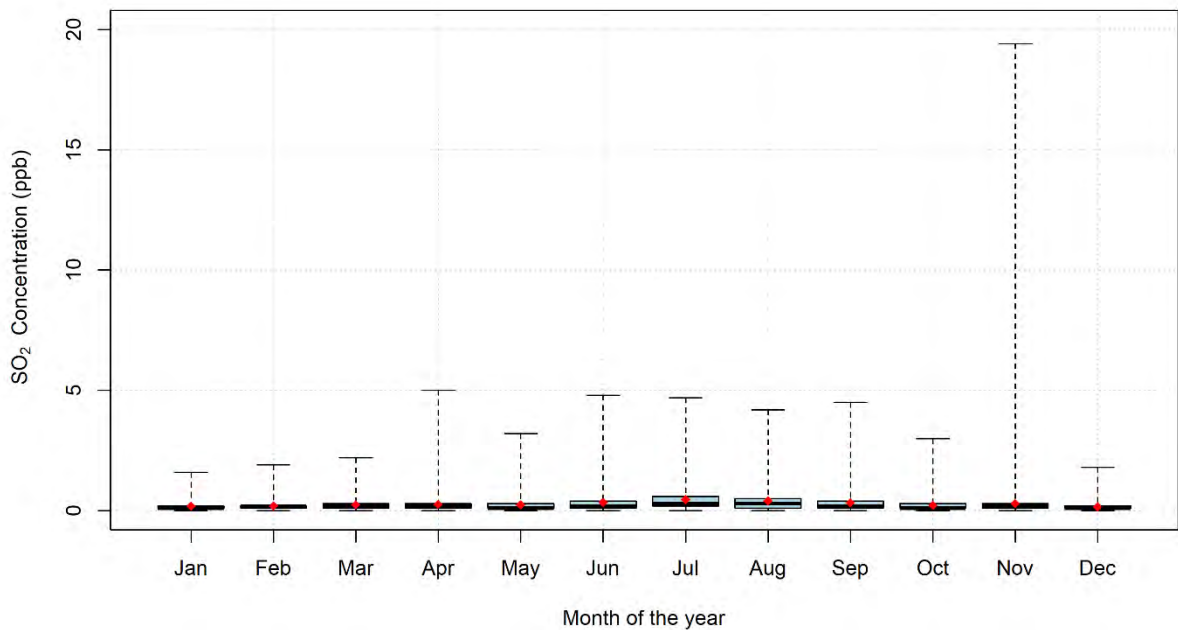


Figure C.15: SO₂ Concentrations at T18 Station by Month of the Year (2019-2021)

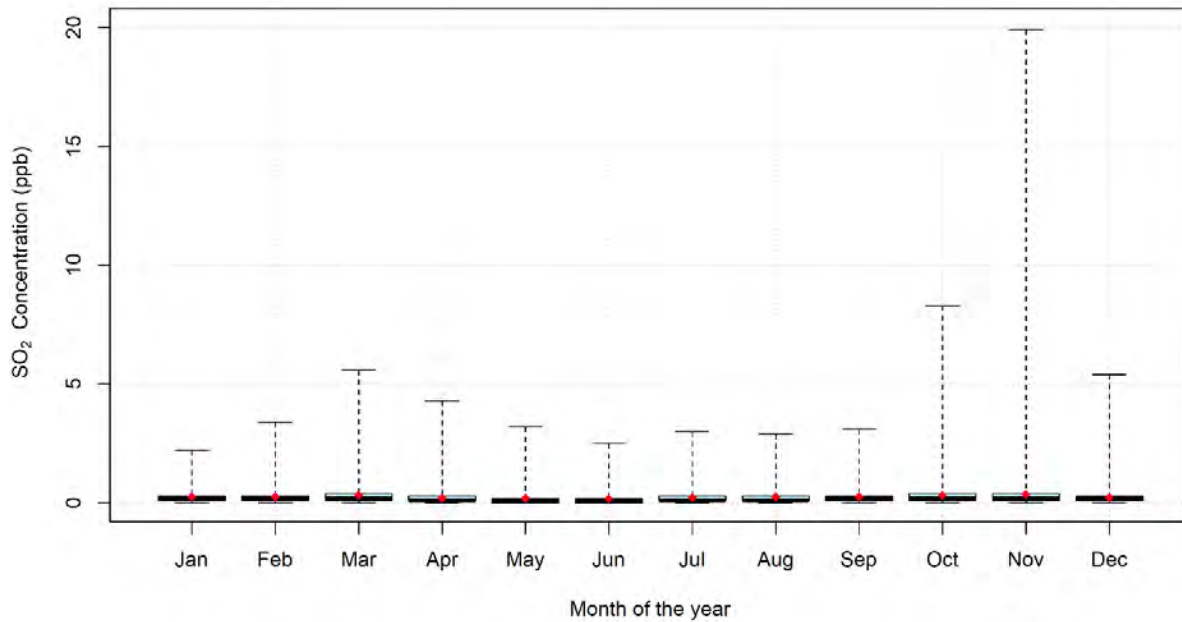


Figure C.16: SO₂ Concentrations at T31 Station by Month of the Year (2019-2021)

Table C.5 compares existing ambient concentrations to the previous MV AAQO, current MV AAQO, BC AAQO, CAAQS 2020 and CAAQS 2025. There were no exceedances of the previous MV AAQO, current MV AAQO, BC AAQO, CAAQS 2020 or CAAQS 2025 for SO₂ in the 2019-2021 period for the T17, T18 and T31 stations for any of the specified averaging periods. Note that T13 does not measure concentrations of SO₂.



Table C.5: Existing Sulphur Dioxide (SO₂) Concentrations in 2019-2021.

						T17		T18		T31	
Objective period	Objective	Metric	Value		Year	Concentration (ppb)	Exceedance ⁽¹⁾	Concentration (ppb)	Exceedance ⁽¹⁾	Concentration (ppb)	Exceedance ⁽¹⁾
1-hour	BC AAQO / CAAQS 2020	3-year average of annual 99 th percentile of daily maximum 1-hour average concentrations	70	ppb	2019-2021	2.0	No	3.6	No	4.1	No
	CAAQS 2025		65	ppb	2019-2021		No		No		No
	MV AAQO	Maximum 1-hour average ⁽²⁾	70	ppb	2019	4.8	0	19.4	0	6.9	0
					2020	2.8	0	5.7	0	19.9	0
					2021	1.7	0	4.4	0	9.6	0
	Annual	Previous MV AAQO / BC AAQO / CAAQS 2020	Annual average over one year	5	ppb	2019	0.3	No	0.3	No	0.4
2020						0.2	No	0.3	No	0.2	No
2021						0.1	No	0.2	No	0.2	No
Current MV AAQO / CAAQS 2025		4		ppb	2019	0.3	No	0.3	No	0.4	No
					2020	0.2	No	0.3	No	0.2	No
					2021	0.1	No	0.2	No	0.2	No

Note:⁽¹⁾ Yes/No is used where the objective is expressed in the form of a pass/fail metric. A value represents multiple exceedances in one year.
⁽²⁾ The MV metric for background calculation for modelling purposes as per MV Model Plan is the annual 99th percentile of hourly concentrations. The metric for comparison with the MV AAQO is the maximum 1-hour average.

C.2.3 Carbon Monoxide

Carbon Monoxide (CO) is emitted during incomplete combustion of fuels containing carbon. In the human body, it binds to hemoglobin, thereby reducing the ability of blood to transport oxygen. Chronic exposure may cause adverse effects in people suffering from cardiovascular disease.

The principal sources of CO are non-road engines and motor vehicles, 91% of CO in the lower Fraser valley are from these sources (MV, 2018). Building heating, commercial and industrial operations, and smoke from wildfires, contribute the remaining CO observed in MV (MV, 2018).

C.2.3.1 Long-term trends

Long-term trends of annual average and short-term peak concentrations dating from 1997 to 2016 (99th percentile 1-hour concentrations) are shown in Figure C.17 and Figure C.18. A steady decline was observed up until 2008 and have considered to plateaued to their present-day levels. This dramatic improvement has been attributed to improved transportation emission standards and the AirCare program (MV 2018).

The 1-hour background concentration of 0.49 ppm (490 ppb) shown in Table C.3 is in line with the trend of short-term peak values (Figure C.18).

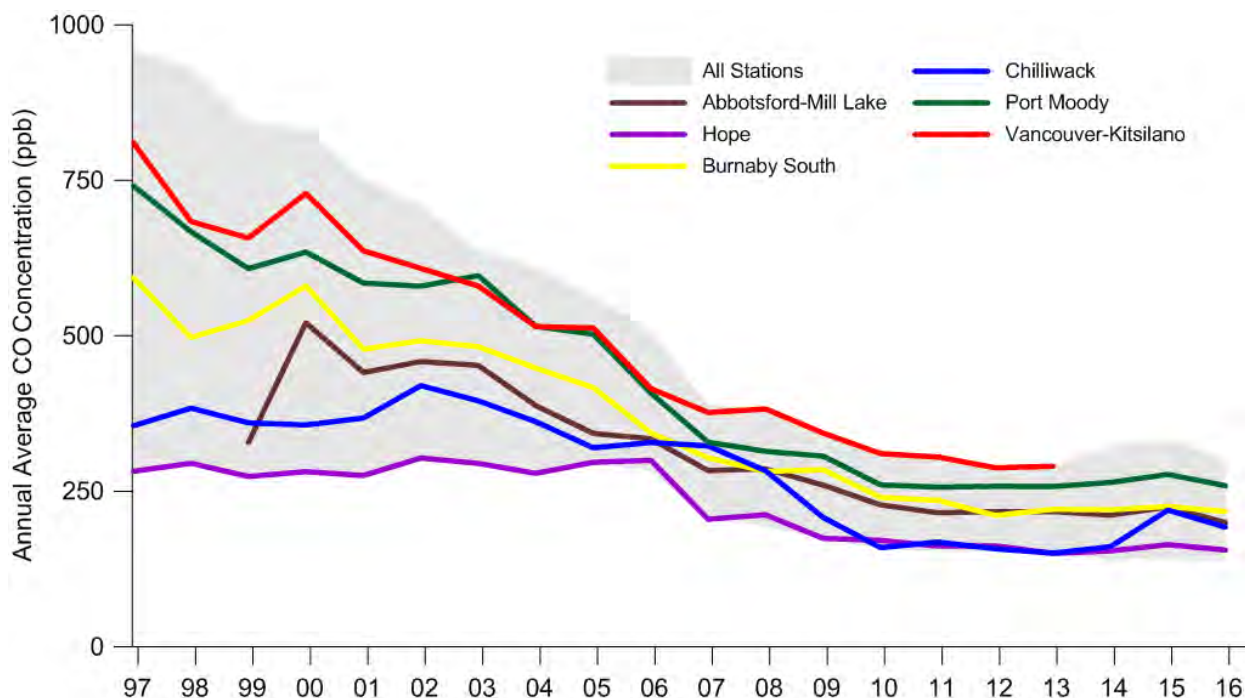


Figure C.17: Annual Average Carbon Monoxide Trend from 1997 to 2016 (MV, 2018)

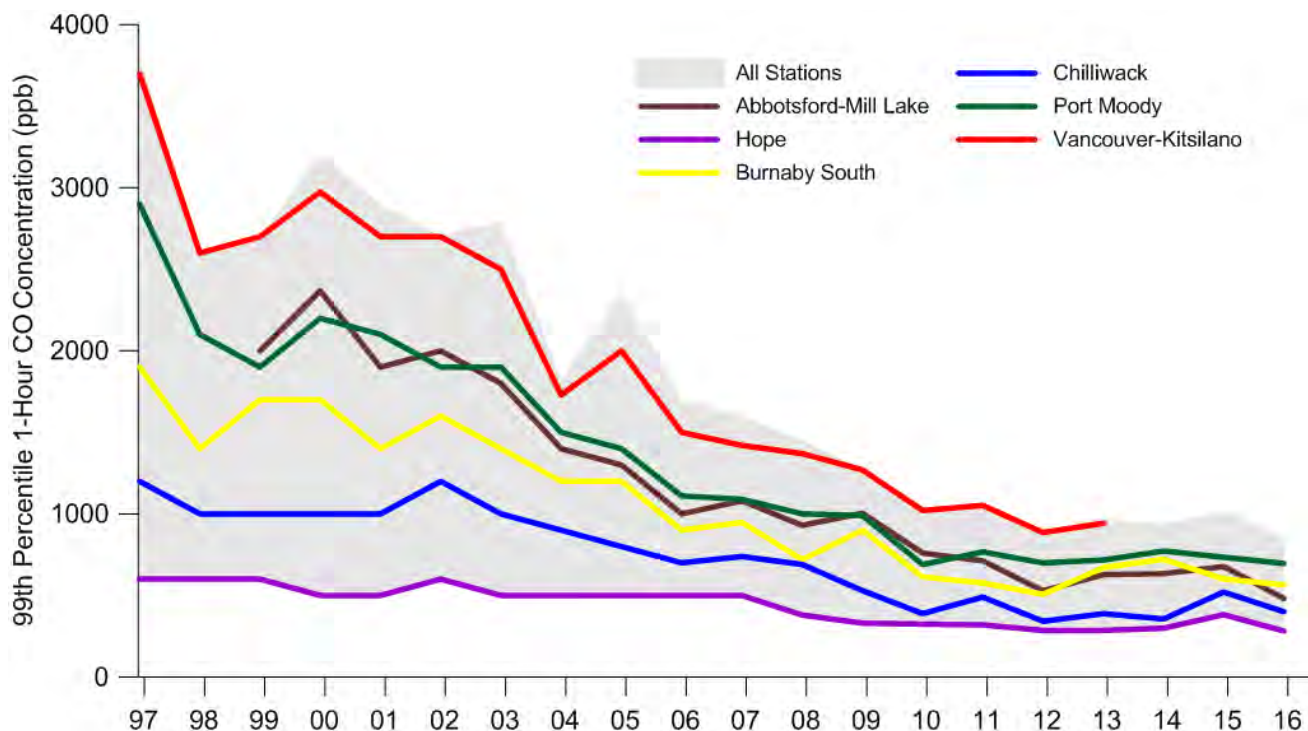


Figure C.18: Short-term Peak Carbon Monoxide Trend from 1997 to 2016 (MV, 2018)

C.2.3.2 Recent trends (2019-2021)

Figure C.19 through Figure C.21 examine the data from 2019 to 2021 that was used to calculate background values in the form of box and whisker plots, the data have been aggregated by month of the year. A seasonal trend is discernable: overall CO concentrations are higher from October to March and lower from April to September. Higher emissions in the winter are linked to space heating and lower atmospheric mixing heights. Smoke from forest fires can create brief outliers during the summer and early fall. Wildfires events occurred during 2020 on September 8th to 19th and in 2021 on August 12th to 14th. Data from these periods were removed as outliers.

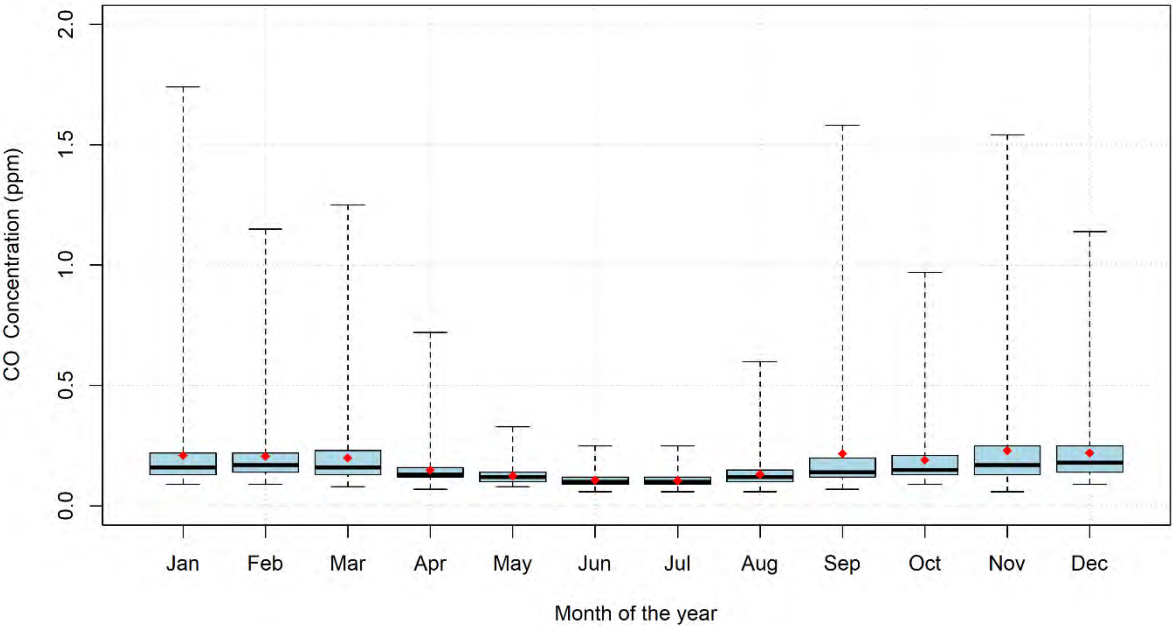


Figure C.19: CO Concentrations at T17 Station by Month of the Year (2019-2021)

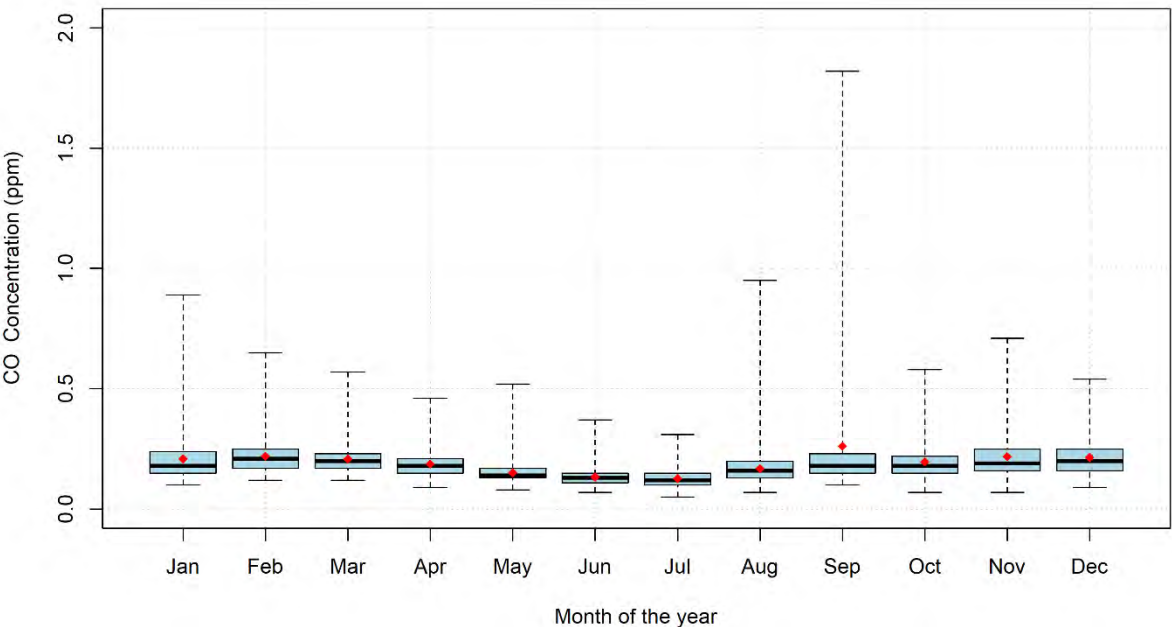


Figure C.20: CO Concentrations at T18 Station by Month of the Year (2019-2021)

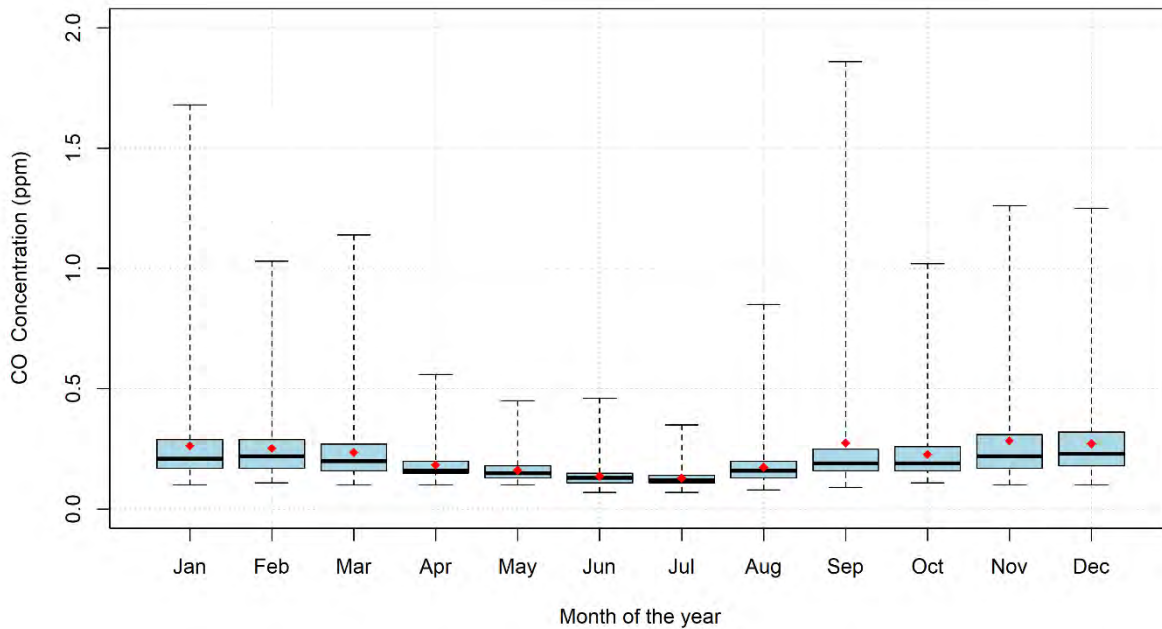


Figure C.21: CO Concentrations at T31 Station by Month of the Year (2019-2021)

Table C.6 presents the ambient air quality objectives of different jurisdictions (MV AAQO and the BC Pollution Control Objective) for CO alongside the metric calculated for evaluating MV AAQO or the BC pollution Control Objective during 2019-2021 at T17, T18 and T31 stations for any of the prescribed averaging periods. Note that station T13 does not measure concentrations of CO.

Table C.6: Existing Carbon Monoxide (CO) Concentrations in 2019-2021.

Objective period	Objective	Metric	Value		year	T17		T18		T31	
						Concentration	Exceedance	Concentration	Exceedance	Concentration	Exceedance
1-hour	MV AAQO	Annual maximum 1-hour averages ^(1,2)	13	ppm	2019	1.740	0	0.890	0	1.680	0
					2020	1.540	0	0.580	0	1.250	0
					2021	1.160	0	0.510	0	0.930	0
8-hour	MV AAQO	Annual maximum 8-hour rolling averages ^(1,2)	5	ppm	2019	1.080	0	0.670	0	1.229	0
					2020	0.883	0	0.463	0	0.846	0
					2021	0.654	0	0.403	0	0.650	0

Notes: ⁽¹⁾ CO concentrations on days affected by wildfires were removed from the dataset prior to calculating the concentrations. Wildfires events occurred during 2020 on September 08-19 and in 2021 on August 12-14.

⁽²⁾ The MV metric for background calculation for modelling purposes as per MV Model Plan is the annual 98th percentile of the 1hr/8hra concentrations. The metric for comparison of concentrations with the MV AAQO is the maximum 1-hour/8hra average.

C.2.4 Fine Particulate matter (PM_{2.5})

Particulate matter of a diameter less than 2.5 µm (PM_{2.5}) is considered to be an air pollutant of serious concern by health experts because it can cause both chronic and acute human health impacts when it penetrates into the finer structure of the lungs.

Local sources of PM_{2.5} are associated with heating, transportation, industrial activity and non-road engines. PM_{2.5} is capable of being transported long distances from large forest fires in other parts of Western Canada or the United States.

C.2.4.1 Long-term trends

Long-term trends of annual average and short-term peak concentrations (99th percentile 24-hour concentrations) are shown in Figure C.22 and Figure C.23. Overall, concentrations are quite stable over time. There is a significant sudden increase in 2013 at the stations when monitoring technology was upgraded from tapered element oscillating microbalances (TEOM) to federal equivalent method (FEM), however stations still equipped with TEOM monitors did not show any appreciable increase in concentrations.

The annual and 24-hour background concentrations of 4.9 µg/m³ and 12.0 µg/m³ respectively that are shown in Table C.3 are in line with the trends based on FEM measurements.

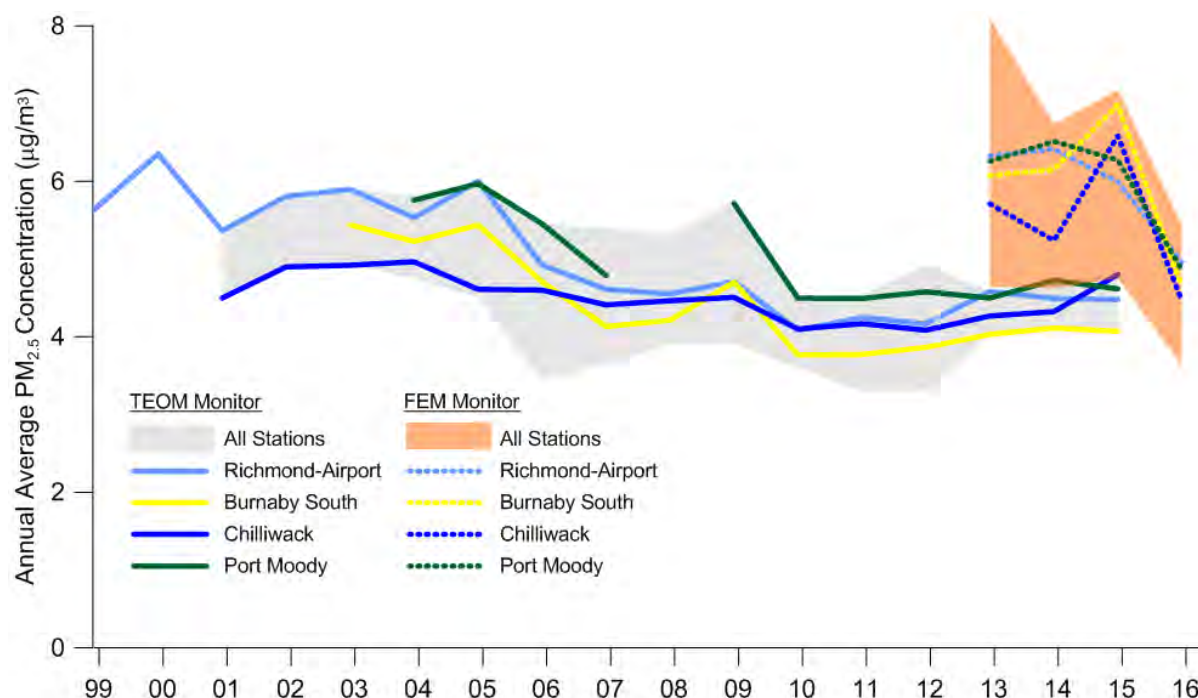


Figure C.22: Annual Average PM_{2.5} Trend from 1997 to 2016 (MV, 2018)

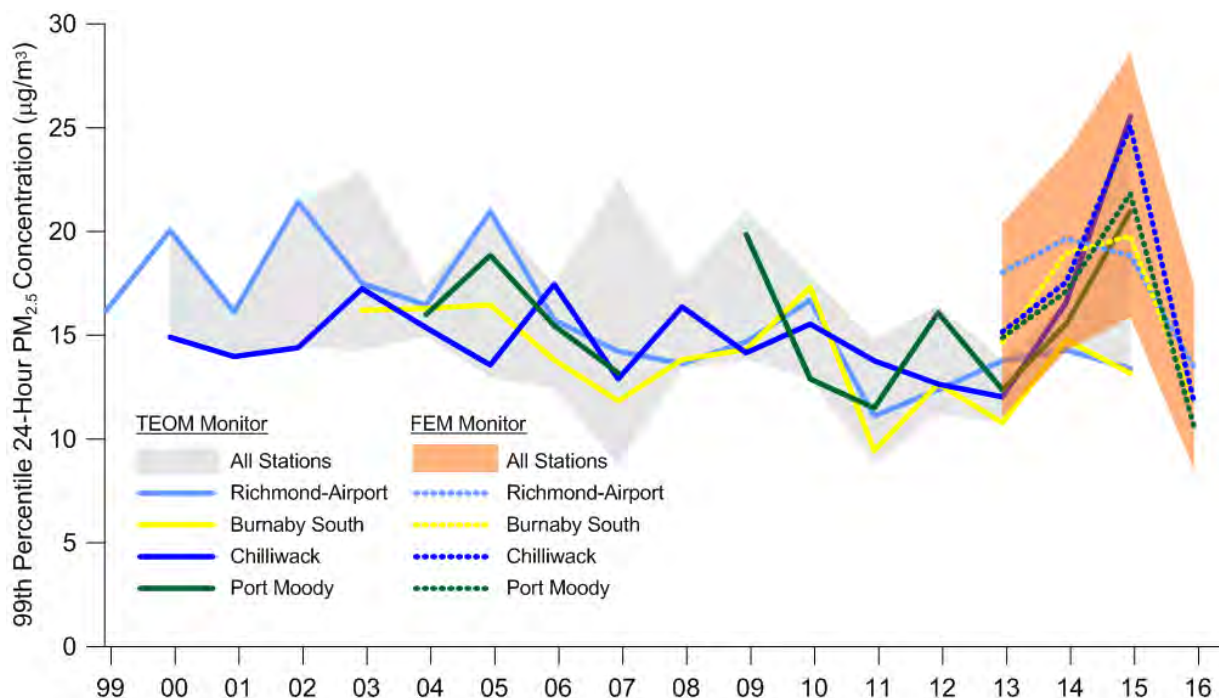


Figure C.23: Short-Term Peak PM_{2.5} Trend from 1997 to 2016 (MV, 2018)

C.2.4.2 Recent trends (2019-2021)

Figure C.24 through Figure C.27 show the PM_{2.5} concentrations from 2019-2021 that were used to calculate background values in the form of box and whisker plots. Little or no seasonal variation is apparent in the aggregate values. The lower and upper whiskers show the minimum and maximum hourly averages, the lower and upper edges of the boxes show the first and third quartiles. Extreme outliers show up during the dry summer months due to secondary particulate formation and smoke from wildfires, particularly in August and September at all four stations.

Table C.7 presents the ambient air quality objectives of different jurisdictions (MV AAQO, the BC AAQO, the CAAQS 2020 and the CAAQS 2025) for PM_{2.5}. There were no exceedances of the annual MV AAQO, BC AAQO, CAAQS 2020 or CAAQS 2025 at any of the stations. There were also no exceedances of the 24-hour BC AAQO, CAAQS 2020 and the CAAQS 2025 at any of the stations. Exceedances of the 24-hour MV PM_{2.5} objective were observed at T17 and T31 in 2019 and at T17 in 2020. Periods affected by forest fire smoke were removed based on MV air quality advisories.

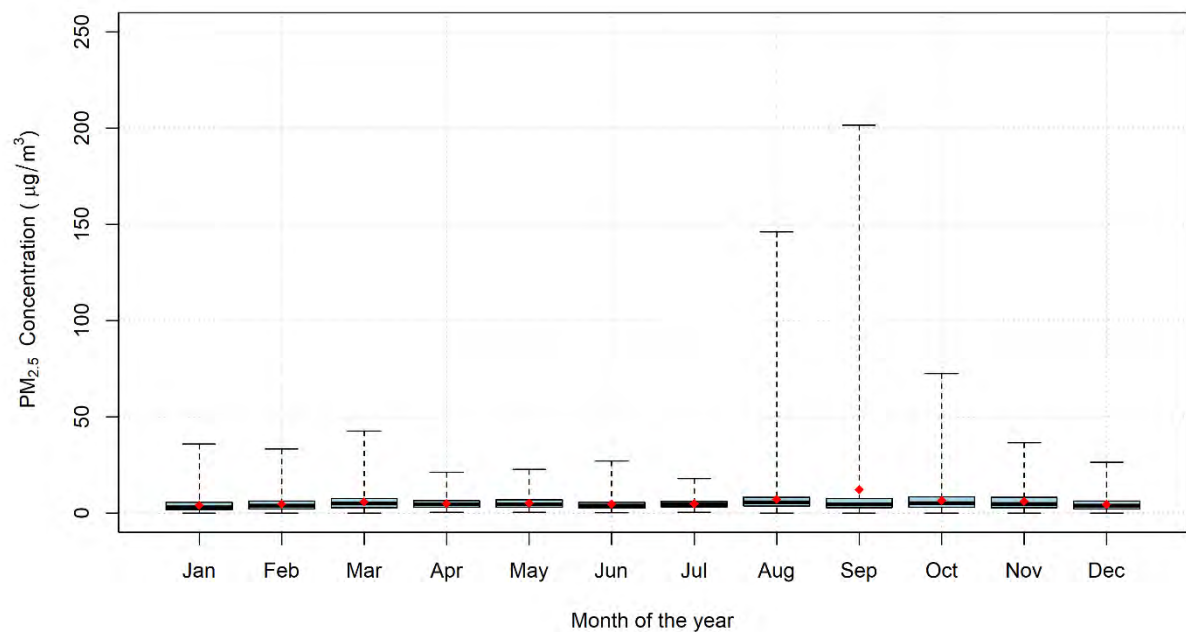


Figure C.24: PM_{2.5} Concentrations at T13 Station by Month of the Year (2019-2021)

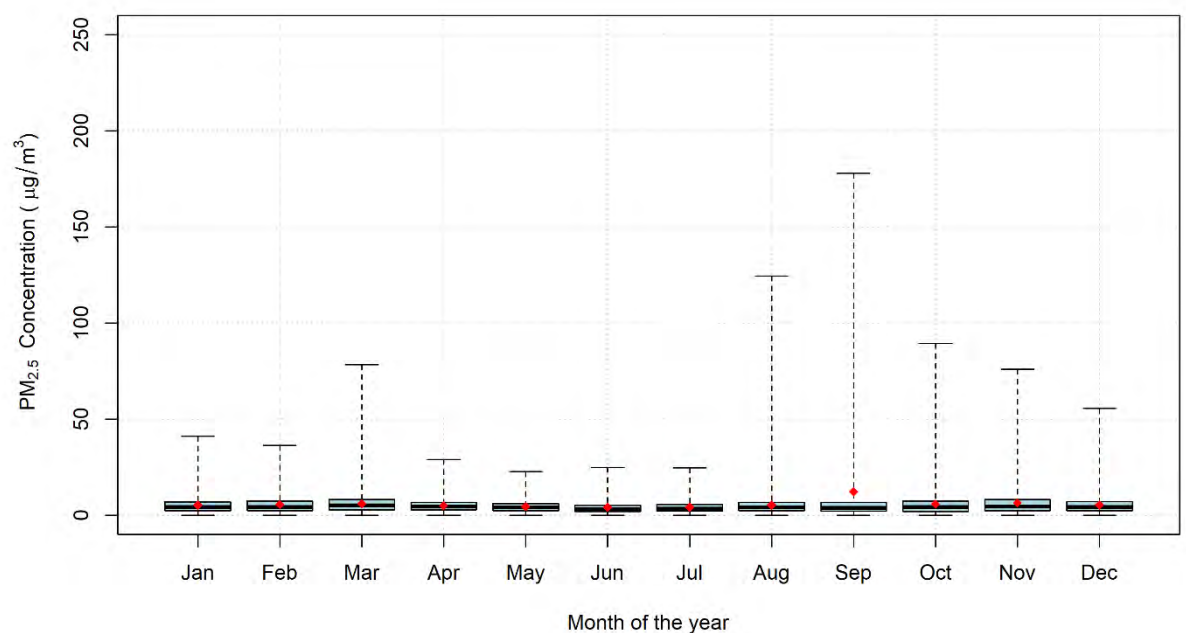


Figure C.25: PM_{2.5} Concentrations at T17 Station by Month of the Year (2019-2021)

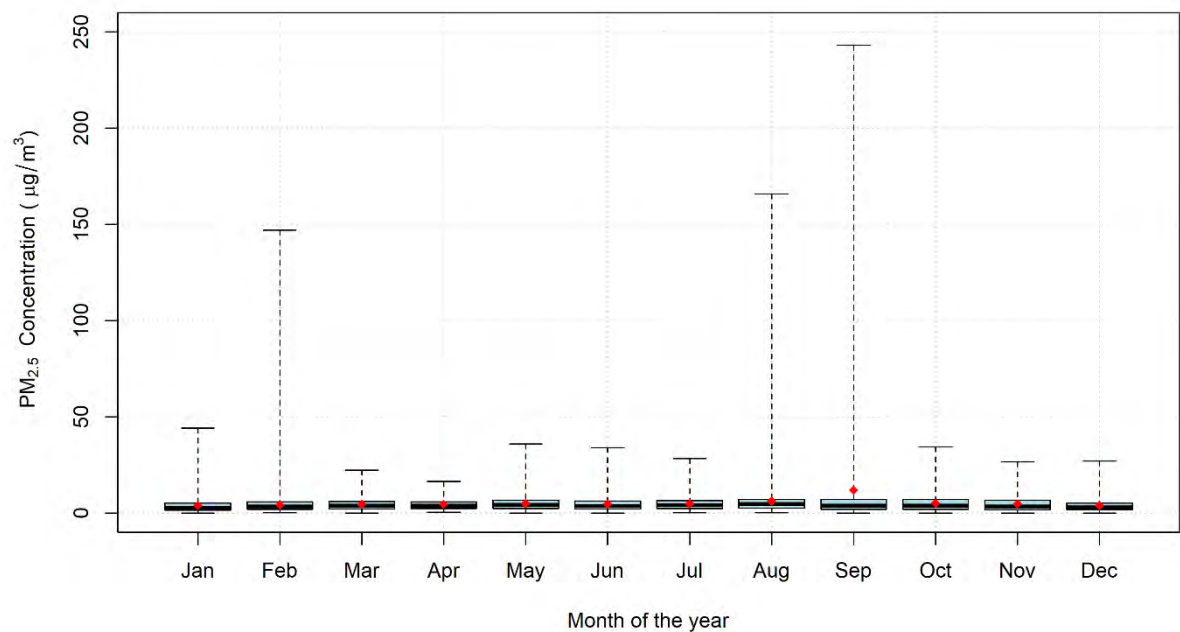


Figure C.26: PM_{2.5} Concentrations at T18 Station by Month of the Year (2019-2021)

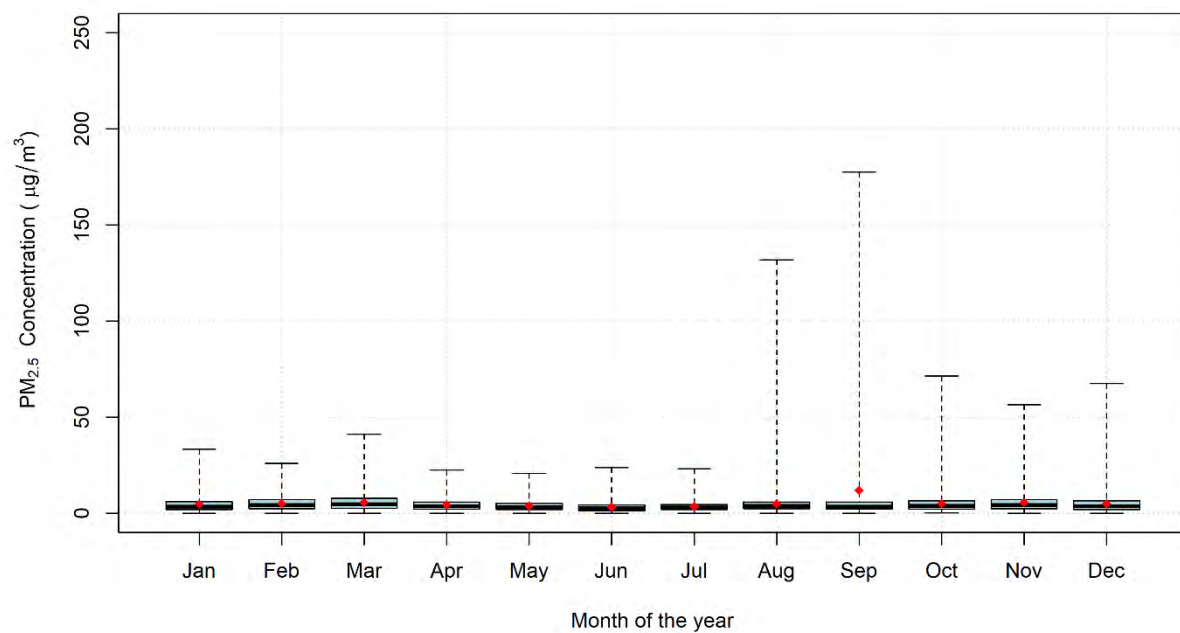


Figure C.27: PM_{2.5} Concentrations at T31 Station by Month of the Year (2019-2021)



Table C.7: Existing PM_{2.5} Concentrations in 2019-2021.

Objective period	Objective	Metric	Value		Year	T13		T17		T18		T31	
						Concentration (µg/m³)	Exceedance ⁽¹⁾	Concentration (µg/m3)	Exceedance ⁽¹⁾	Concentration (µg/m³)	Exceedance ⁽¹⁾	Concentration (µg/m³)	Exceedance ⁽¹⁾
24-hour	BC AAQO	98 th percentile of daily average over one year	25	µg/m³	2019	12.7	No	15.2	No	11.7	No	13.7	No
					2020	12.7	No	12.1	No	10.6	No	11.0	No
					2021	10	No	11.1	No	11.9	No	10.1	No
	CAAQS 2020 / CAAQS 2025	3-year average of annual 98 th percentile of daily average concentrations	27	µg/m³	2019-2021	11.8	No	12.8	No	11.4	No	11.6	No
	MV AAQO	Maximum 24-hour rolling average	25	µg/m³	2019	22.7	No	45.4	29	19.7	0	29.2	13
					2020	24.2	0	36.6	22	19.3	0	21.6	0
					2021	12.8	0	17.4	No	15.4	0	14.8	0
Annual	MV AAQO / BC AAQO	Annual average over one year	8	µg/m³	2019	5.7	No	5.9	No	5.1	No	5.2	No
					2020	4.9	No	5.0	No	4.4	No	4.1	No
					2020	4.6	No	4.1	No	4.2	No	4.1	No
	CAAQS 2020 / CAAQS 2025	Annual average, averaged over 3 consecutive years	8.8	µg/m³	2019-2021	5.1	No	5.0	No	4.6	No	4.5	No

Note: - PM_{2.5} concentrations on days affected by wildfires were removed from the dataset prior to calculating the concentrations included in this table based on MV air quality advisories.
⁽¹⁾ Yes/No is used where the objective is expressed in the form of a pass/fail metric. A value represents multiple exceedances in one year.

C.2.5 Inhalable particulate matter (PM₁₀)

Particulate matter of a diameter less than 10 µm (PM₁₀) can aggravate existing pulmonary and cardiovascular disease, increase symptoms in asthmatics and long-term exposure can increase respiratory mortality. High PM₁₀ concentrations can also increase corrosion and soiling of materials, damage vegetation and degrade visual air quality (MV 2018).

The main source of PM₁₀ is road dust. Other major contributors are vehicle exhaust, construction and demolition, residential wood heating, agriculture and industry.

C.2.5.1 Long-term trends

Long-term trends of annual average and short-term peak concentrations (99th percentile 24-hour concentrations) are in Figure C.28 and Figure C.29. Annual averages exhibit a steady downward trend over the 20-year period amidst large interannual variability. Sudden increases in the short-term peaks for some years have been attributed to a number of significant events: a dust storm originating in Asia causing long-range transport impacts to southwestern BC, in late April in 1998, a fire in Delta's Burns Bog in 2005 and wildfire smoke in 2015 (MV, 2018).

The annual and 24-hour background concentrations of 9.2 µg/m³ and 18.4 µg/m³ respectively that are presented in Table C.3. are in line with the trends shown in Figure C.28 and Figure C.29.

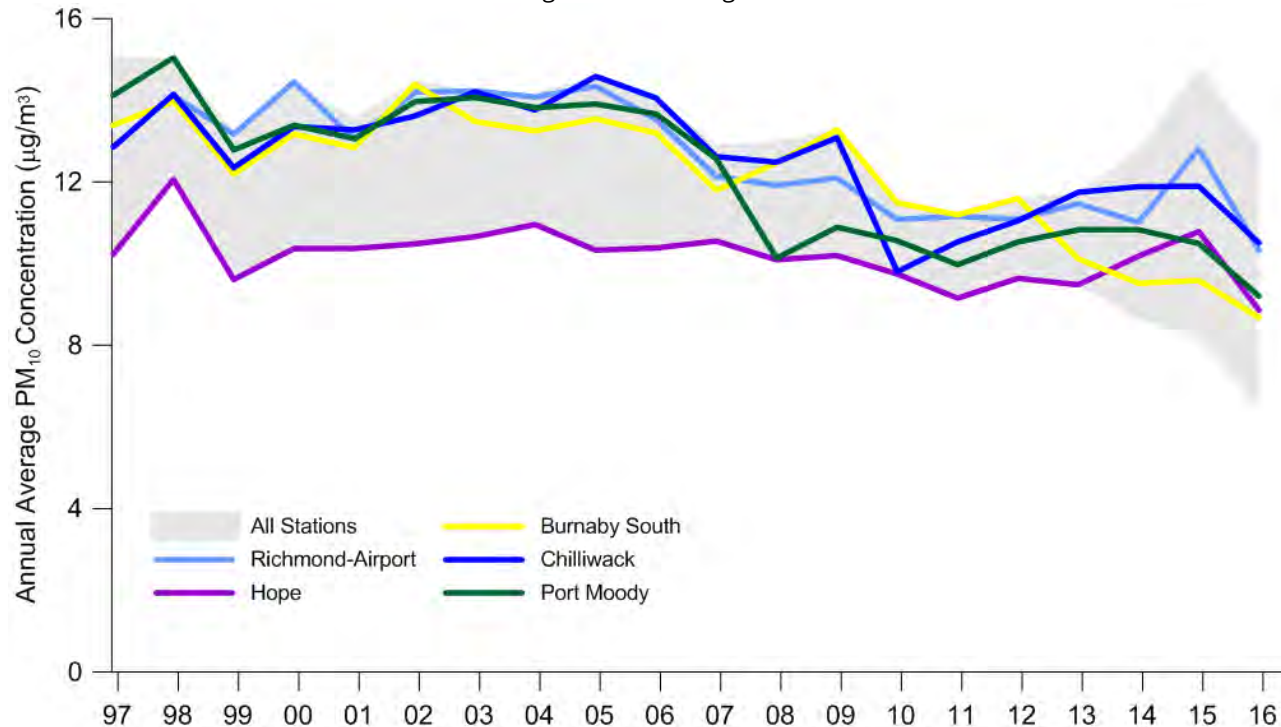


Figure C.28: Annual average PM₁₀ trend from 1997 to 2016 (MV, 2018)

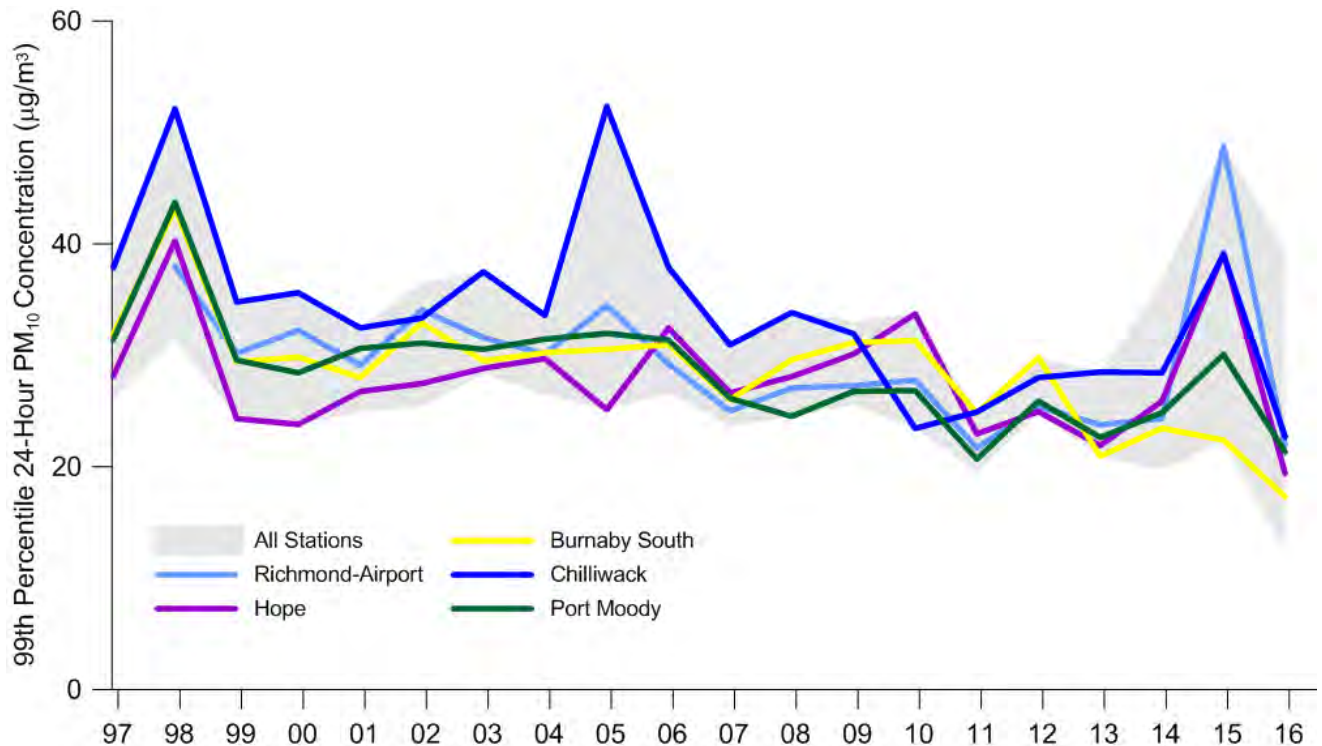


Figure C.29: Short-Term Peak PM₁₀ Trend from 1997 to 2016 (MV, 2018)

C.2.5.2 Recent trends (2019-2021)

Figure C.30 and Figure C.31 show the PM₁₀ concentrations from 2019-2021 that were used to calculate background values in the form of box and whisker plots. Mean concentrations were generally elevated in August and September at both T18 and T31. This is likely related to smoke from forest fires given that they coincide with MV smoke advisories.

Table C.8 presents the ambient air quality objectives of different jurisdictions (MV AAQO and BC AAQO) for PM₁₀ alongside the metric calculated for evaluating them and whether the objectives had any exceedances in the 2018-2020 period. There were no exceedances of 24-hour BC AAQO and MV AAQO, and previous annual MV AAQOs. Exceedances of the current annual MV AAQO were observed at T17 in 2019 and T31 in 2019-2021.

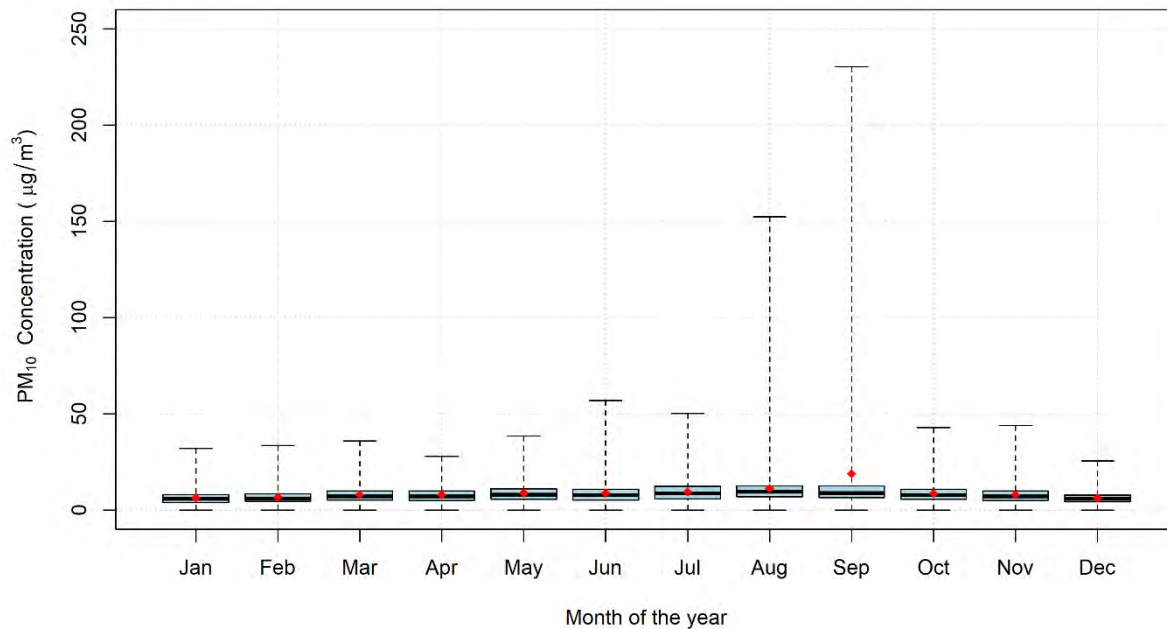


Figure C.30: PM₁₀ Concentrations at T18 Station by Month of the Year (2019-2021)

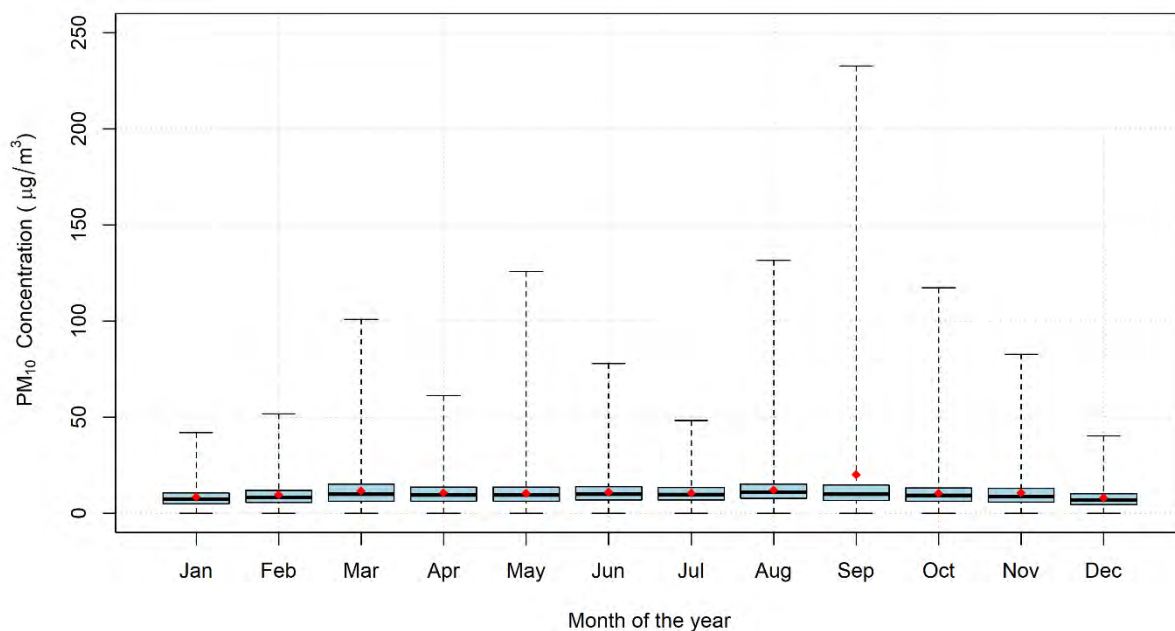


Figure C.31: PM₁₀ Concentrations at T31 Station by Month of the Year (2019-2021)

Table C.8: Existing PM₁₀ Concentrations in 2019-2021.

Objective period	Objective	Metric	Value		year	T18		T31	
						Concentration (µg/m ³)	Exceedance ⁽¹⁾	Concentration (µg/m ³)	Exceedance ⁽¹⁾
24-hour	BC AAQO	Maximum 24-hour daily average	50	µg/m ³	2019	20.2	0	28.4	0
					2020	21.5	0	27.3	0
					2021	30.1	0	34.3	0
	MV AAQO	Maximum 24-hour rolling average	50	µg/m ³	2019	20.6	0	37.6	0
					2020	23.5	0	28.8	0
					2021	32	0	34.4	0
Annual	Previous MV AAQO	Annual average over one year	20	µg/m ³	2019	8.5	No	11.7	No
					2020	7.7	No	9.5	No
					2021	8.0	No	9.8	No
	Current MV AAQO	Annual average over one year	8	µg/m ³	2019	8.5	Yes	11.7	Yes
					2020	7.7	No	9.5	Yes
					2021	8.0	No	9.8	Yes

Notes: - PM₁₀ concentrations on days affected by wildfires were removed from the dataset prior to calculating the concentrations included in this table based on MV air quality advisories.

⁽¹⁾ Yes/No is used where the objective is expressed in the form of a pass/fail metric. A value represents multiple exceedances in one year.

C.2.6 Ozone

Ozone (O_3) is a secondary pollutant formed when oxides of Nitrogen (NO_x) and volatile organic compounds (VOCs) react in the presence of heat and sunlight. The role of sunlight in the reaction means that annual maximum O_3 concentrations are expected to occur during late spring and the summer months. Ozone is a significant oxidant and can irritate the eyes, nose and throat as well as reduce lung function. High concentrations can also increase the susceptibility to respiratory illness and reduce crop yields (MV, 2018).

The highest levels of ozone formation occur downwind of major precursors. Precursors include NO_x and VOCs. For NO_x , the dominant sources are vehicle exhaust, non-road engines, boilers and building heating systems. For VOCs, the main sources are chemical product use (paints, varnishes, solvents), natural sources (trees and vegetation) and internal combustion engines.

C.2.6.1 Long-Term Trends

Long-term trends of annual average and short-term peak concentrations dating back from 1997 to 2016 (99th percentile 1-hour concentrations) are shown in Figure C.32 and Figure C.33. Annual average ozone concentrations have been generally increasing in the MV Airshed whereas short-term peak concentrations have been stable. This is despite significant reductions in ozone precursor pollutants over the last 15 to 20 years. Research indicates that global background ozone concentrations are rising (MV, 2018).

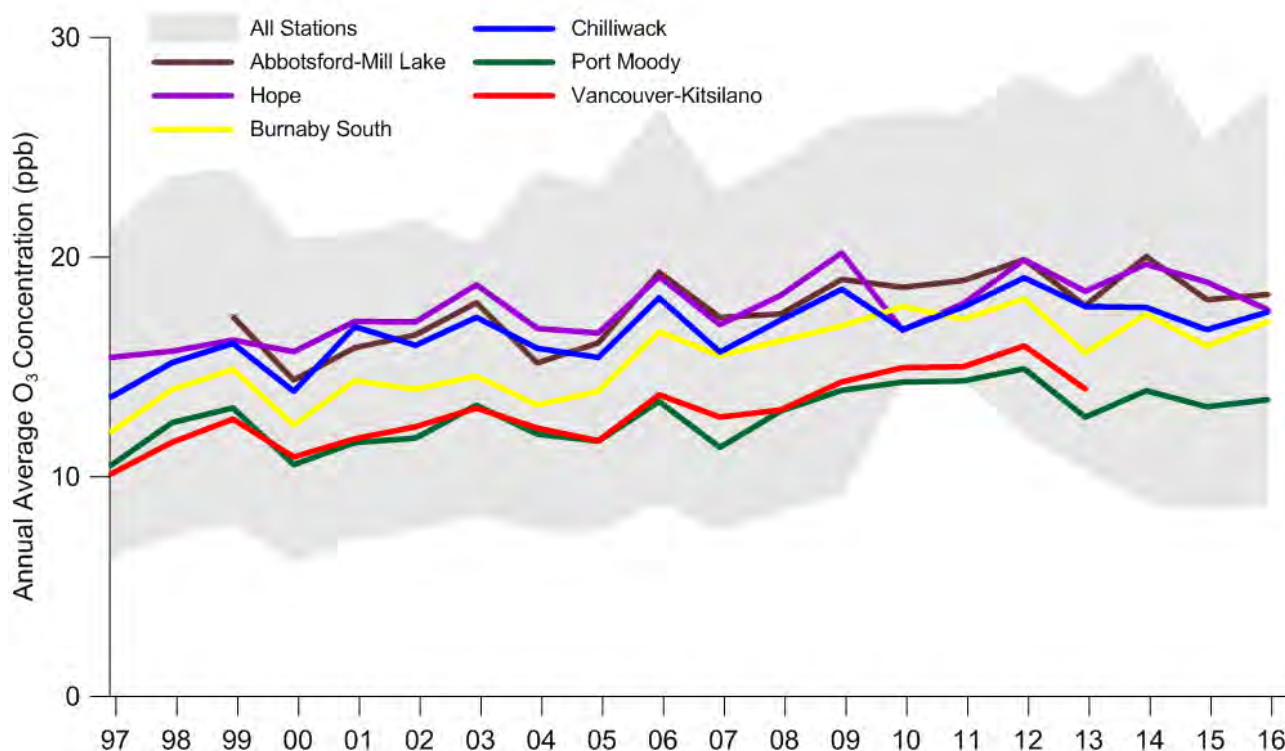


Figure C.32: Annual Average Ozone Trend (MV, 2018)

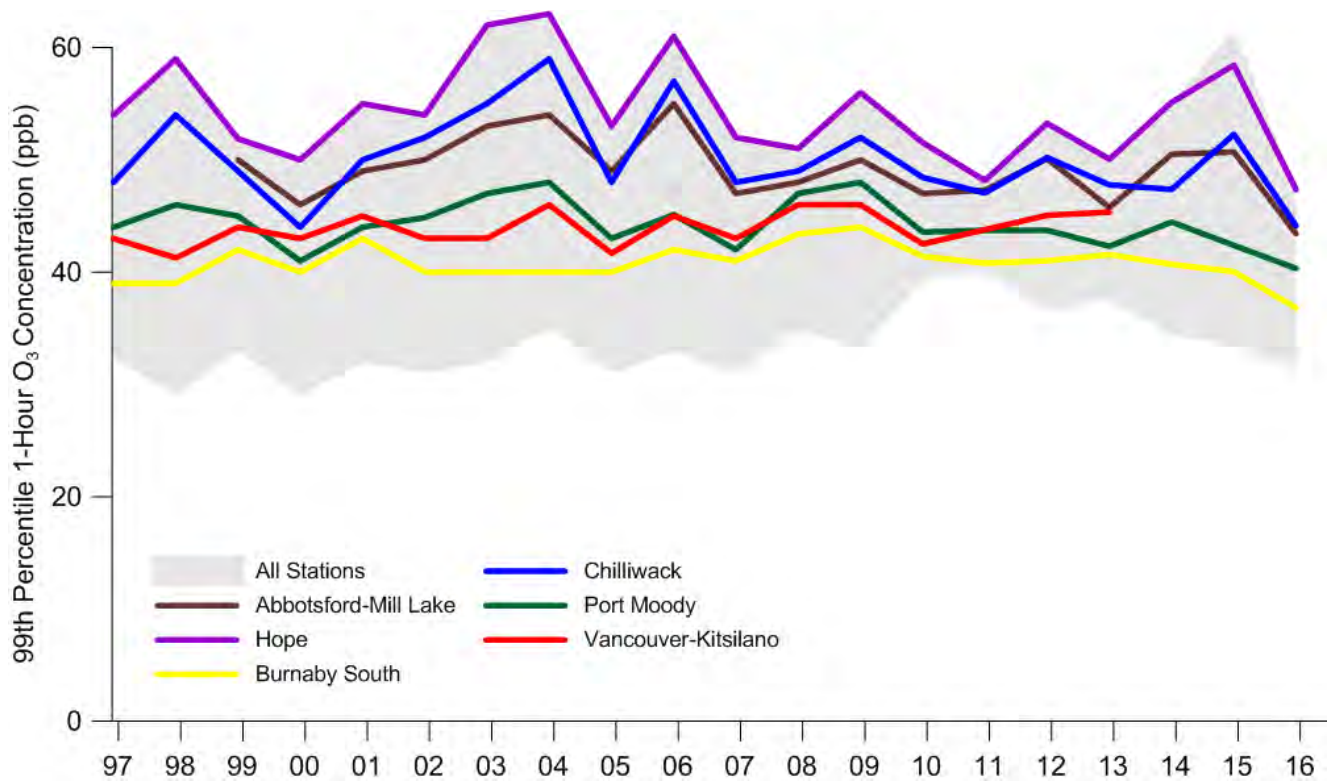


Figure C.33: Short-Term Peak Ozone Trend (MV, 2018)

C.2.6.2 Recent trends (2019-2021)

Figure C.34 through Figure C.41 present the distribution of ozone concentrations by month of year and by hour of the day at T13, T17 and T18. As expected, there is a strong seasonal variation with O₃ concentrations peaking in April and declining gradually throughout the summer months. Over the day, ozone concentrations typically peak in the afternoon when it is the warmest with the highest incoming solar radiation.

Table C.9 presents the ambient air quality objectives of different jurisdictions (previous MV AAQO, current MV AAQO, the BC AAQO and the CAAQS 2020 and CAAQS 2025) for O₃ alongside the metric calculated for evaluating them and whether the objectives had any exceedances in the 2019-2021 period. There were no exceedances of the 1-hour or 8-hour previous MV AAQO, current MV AAQO, BC AAQO, CAAQS 2020 or CAAQS 2025.

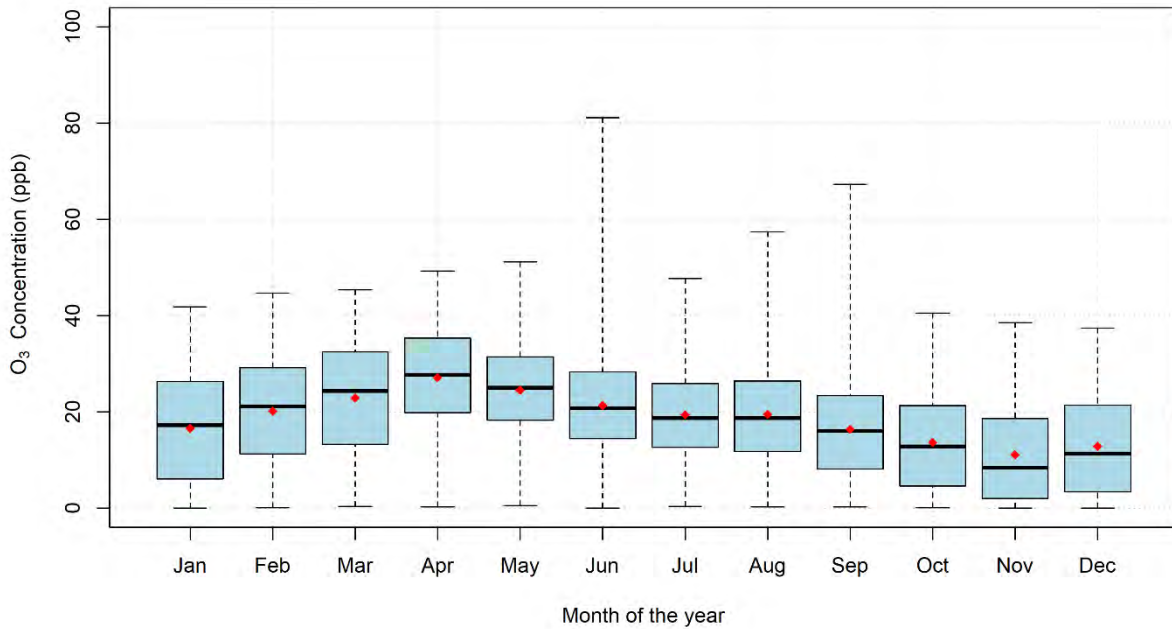


Figure C.34: O₃ Concentrations at T13 Station by Month of the Year (2019-2021)

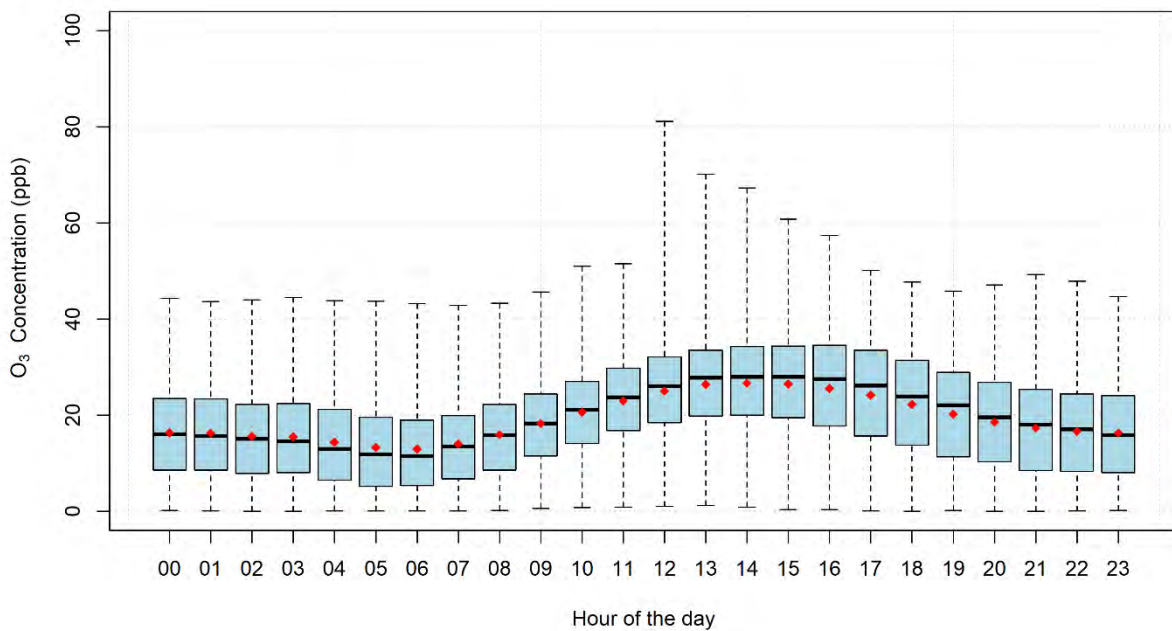


Figure C.35: O₃ Concentrations at T13 Station by Hour of the Day (2019-2021)

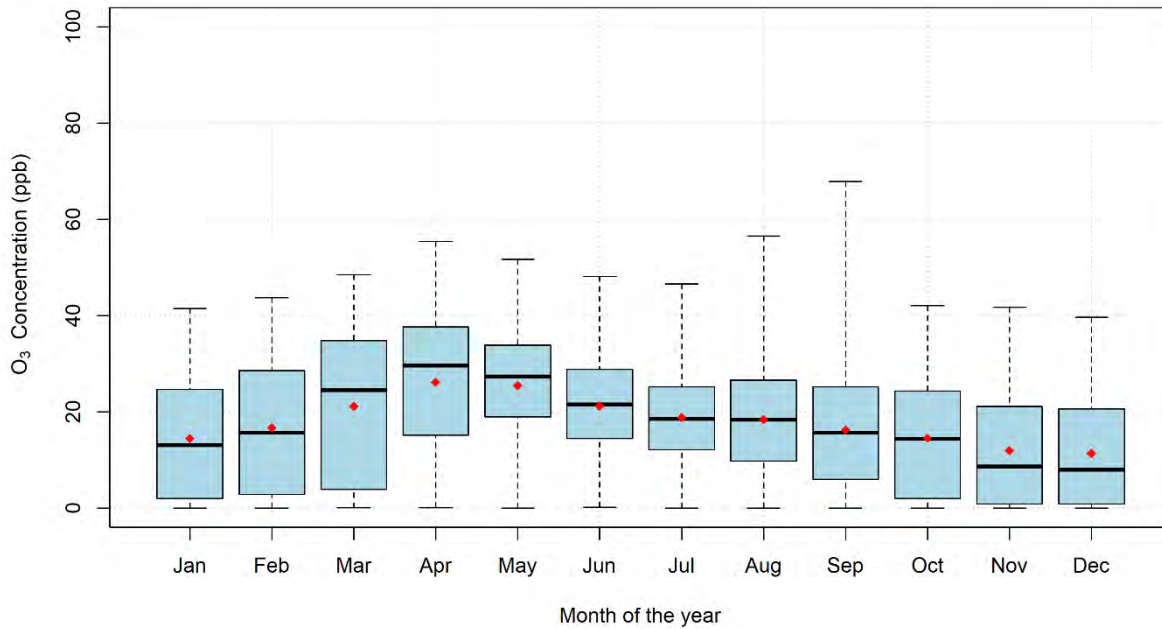


Figure C.36: O₃ Concentrations at T17 Station by Month of the year (2019-2021)

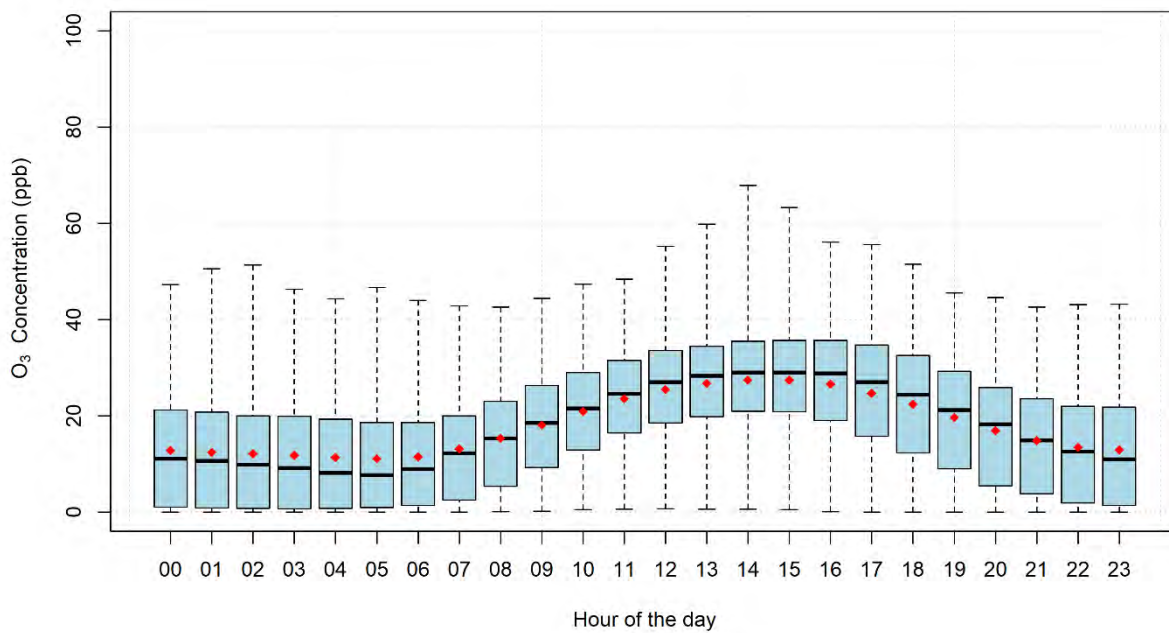


Figure C.37: O₃ Concentrations at T17 Station by Hour of the Day (2019-2021)

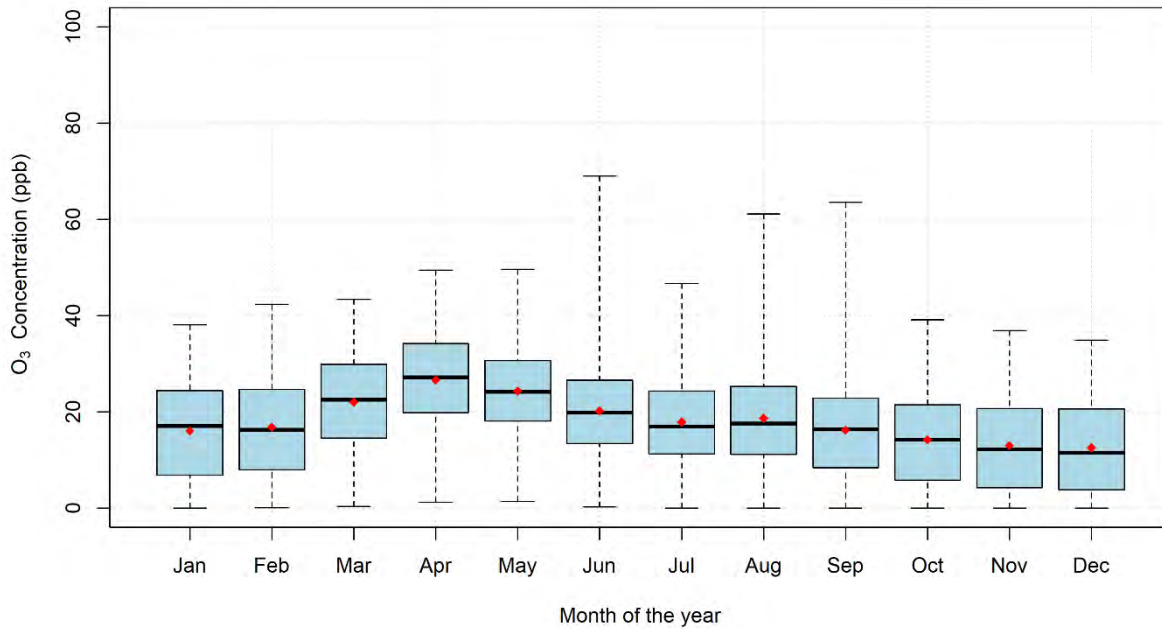


Figure C.38: O₃ Concentrations at T18 Station by Month of the Year (2019-2021)

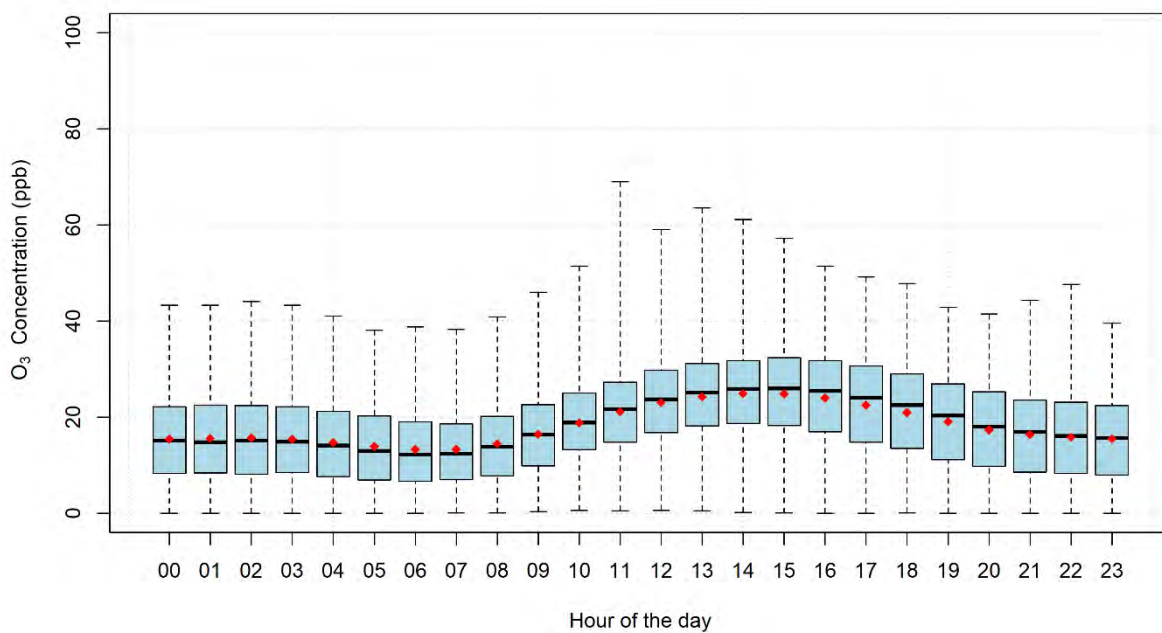


Figure C.39: O₃ Concentrations at T18 Station by Hour of the Day (2019-2021)

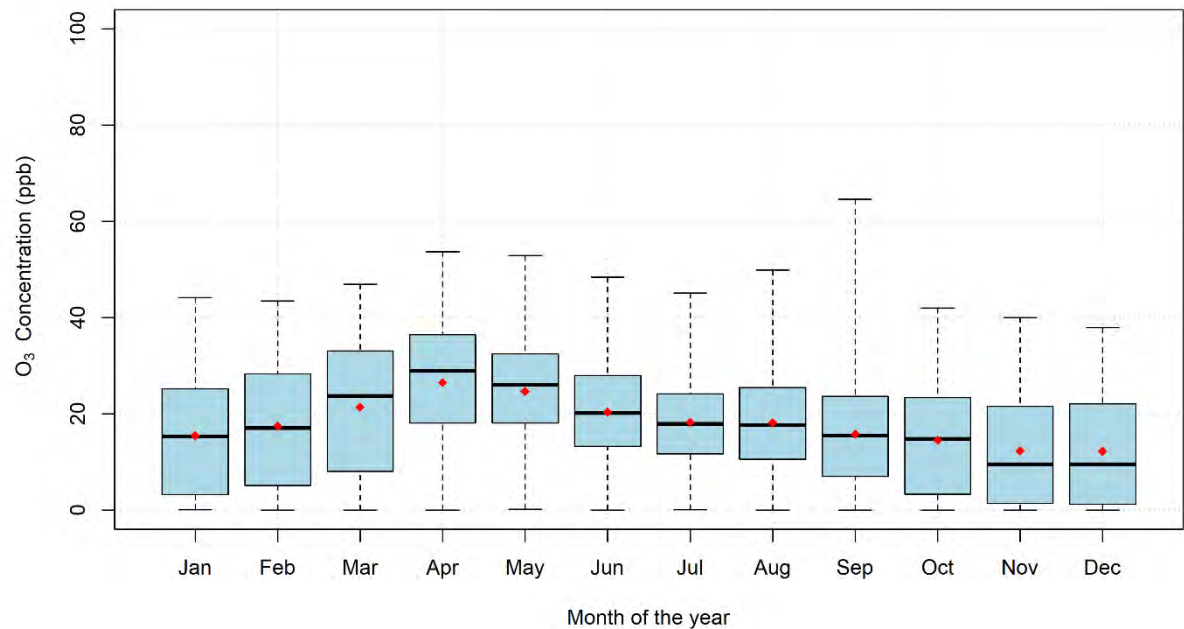


Figure C.40: O₃ Concentrations at T31 Station by Month of the Year (2019-2021)

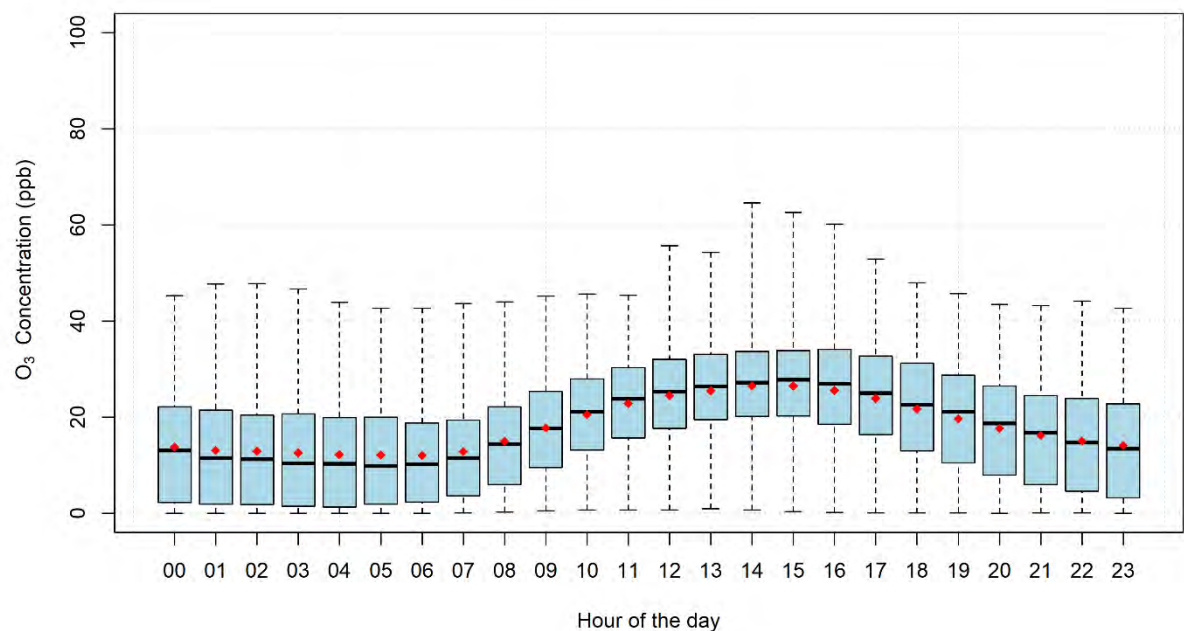


Figure C.41: O₃ Concentrations at T31 Station by Hour of the Day (2019-2021)



Table C.9: Existing Ozone (O₃) Concentrations in 2019-2021.

Objective period	Objective	Metric	Value		Year	T13		T17		T18		T31	
						Concentration (ppb)	Exceedance ⁽¹⁾	Concentration (ppb)	Exceedance ⁽¹⁾	Concentration (ppb)	Exceedance ⁽¹⁾	Concentration (ppb)	Exceedance ⁽¹⁾
1-hour	MV AAQO / BC AAQO	Maximum 1-hour average	82	ppb	2019	51.2	0	55.2	0	47.1	0	52.9	0
					2020	67.3	0	67.9	0	63.5	0	64.6	0
					2021	81.1	0	56.5	0	69.0	0	53.7	0
8-hour	Previous MV AAQO / BC AAQO / CAAQS 2020	3-year average of annual 4 th highest of daily maximum 8-hour average concentrations	62	ppb	2019-2021	44.6	No	45.0	No	43.6	No	44.0	No
	Current MV AAQO / CAAQS 2025		60	ppb	2019-2021		No		No		No		No

Note: (1): Yes/No is used where the objective is expressed in the form of a pass/fail metric. A Yes value may represent multiple exceedances in one year.

C.2.7 Non-CAC contaminants

Volatile Organic Compounds are measured at the T18 and T31 stations. Samples are taken on the NAPS 6-day (T18) and 12-day (T31) schedules, and the data are available through NAPS (National Air Pollutant Surveillance Program). Background concentrations for each available compound from the most recent period of 2017-2019 were calculated and are presented in Table C.10.

Hydrogen Sulfide (H₂S) is monitored in Burnaby North and Port Moody, at the northern edge of the RAA near the refinery and oil terminal; monitored TRS values there are not representative of the concentrations within the RAA and are thus not presented here.

Table C.10: 1-hour, 24-hour and Annual Background Concentrations of VOCs Measured at Burnaby South (T18) and Richmond Airport (T31) Stations Using 2017-2019.

Contaminant	1-hour (µg/m ³) ^[1]	24-hour (µg/m ³) ^{[2], [3]}	Annual (µg/m ³) ^[3]
Total VOCs	150	90.2	32.8
1,1,1-Trichloroethane	0.04	0.02	0.01
1,1,2,2-Tetrachloroethane	0.006	0.003	0.0006
1,1,2-Trichloroethane	0.01	0.007	0.004
1,1-Dichloroethane	0.02	0.009	0.005
1,1-Dichloroethylene	0.003	0.002	0.0003
1,2,3-Trimethylbenzene	0.3	0.2	0.04
1,2,4-Trichlorobenzene	0.03	0.02	0.006
1,2,4-Trimethylbenzene	1.2	0.7	0.2
1,2-Dichlorobenzene	0.01	0.008	0.003
1,2-Dichloroethane	0.4	0.2	0.08
1,2-Dichloropropane	0.1	0.08	0.02
1,3,5-Trimethylbenzene	0.4	0.2	0.05
1,3-Butadiene	0.4	0.3	0.06
1,3-Dichlorobenzene	0.02	0.01	0.003
1,3-Diethylbenzene	0.06	0.03	0.009
1,4-Dichlorobenzene	0.1	0.08	0.03
1,4-Diethylbenzene	0.1	0.08	0.02
1-Butene/Isobutene	1.3	0.8	0.2
1-Heptene	0.06	0.03	0.004
1-Hexene/2-Methyl-1-Pentene	0.2	0.1	0.04
1-Pentene	0.3	0.2	0.05
2,2,4-Trimethylpentane	3.5	2.1	0.6
2,2-Dimethylbutane	0.3	0.2	0.07
2,3,4-Trimethylpentane	0.5	0.3	0.08
2,3-Dimethylbutane	0.5	0.3	0.1

Contaminant	1-hour ($\mu\text{g}/\text{m}^3$) ^[1]	24-hour ($\mu\text{g}/\text{m}^3$) ^{[2], [3]}	Annual ($\mu\text{g}/\text{m}^3$) ^[3]
2,3-Dimethylpentane	1.6	1.0	0.3
2,4-Dimethylhexane	0.2	0.1	0.04
2,4-Dimethylpentane	0.7	0.4	0.1
2,5-Dimethylhexane	0.2	0.1	0.03
2-Ethyltoluene	0.3	0.2	0.04
2-Methyl-1-butene	0.4	0.2	0.06
2-Methyl-2-butene	0.5	0.3	0.06
2-Methylheptane	0.4	0.2	0.07
2-Methylhexane	1.7	1.0	0.3
2-Methylpentane	1.6	1.0	0.3
3-Ethyltoluene	0.8	0.5	0.1
3-Methyl-1-Butene	0.09	0.05	0.02
3-Methylheptane	0.3	0.2	0.06
3-Methylhexane	2.1	1.3	0.4
3-Methylpentane	1.3	0.8	0.2
4-Ethyltoluene	0.4	0.2	0.05
4-Methylheptane	0.1	0.08	0.02
Acetylene	4.4	2.6	0.7
A-Pinene	3.4	2.0	0.4
Benzene	2.7	1.6	0.5
Benzylchloride	0.03	0.02	0.004
B-Pinene	0.7	0.4	0.1
Bromoform	0.09	0.05	0.02
Bromomethane	0.08	0.05	0.03
Butane	16.7	10.0	2.7
Camphene	0.2	0.1	0.03
Carbontetrachloride	1.1	0.6	0.5
Chlorobenzene	0.08	0.05	0.009
Chloroethane	0.04	0.03	0.01
Chloroform	0.4	0.2	0.1
Chloromethane	1.9	1.2	1.0
cis-1,2-Dimethylcyclohexane	0.07	0.04	0.01
cis-2-Butene	0.3	0.2	0.04
cis-2-Hexene	0.04	0.02	0.006
cis-2-Pentene	0.2	0.1	0.03
cis-3-Methyl-2-Pentene	0.06	0.04	0.007
Cyclohexane	0.9	0.6	0.1
Cyclopentane	2.7	1.6	0.1

Contaminant	1-hour ($\mu\text{g}/\text{m}^3$) ^[1]	24-hour ($\mu\text{g}/\text{m}^3$) ^{[2], [3]}	Annual ($\mu\text{g}/\text{m}^3$) ^[3]
Decane	0.8	0.5	0.1
Dichloromethane	6.6	4.0	0.6
D-Limonene	0.8	0.5	0.1
Dodecane	0.4	0.2	0.07
Ethane	19.9	11.9	4.6
Ethylbenzene	1.6	1.0	0.3
Ethylene	8.3	5.0	1.4
Freon 11	3.4	2.0	1.6
Freon 114	0.2	0.1	0.1
Freon 12	4.5	2.7	2.4
Freon 22	2.3	1.4	1.0
Heptane	1.8	1.1	0.3
Hexachlorobutadiene	0.02	0.009	0.004
Hexane	2.1	1.3	0.3
Indane	0.1	0.08	0.02
Isobutane	6.5	3.9	1.0
Isopentane	9.5	5.7	1.4
Isoprene	1.1	0.6	0.1
Iso-Propylbenzene	0.09	0.06	0.01
m and p-Xylene	5.2	3.1	0.8
Methylcyclohexane	0.9	0.5	0.1
Methylcyclopentane	1.1	0.7	0.2
MTBE	0.04	0.02	0.003
Naphthalene	0.7	0.4	0.09
Nonane	0.7	0.4	0.1
n-Propylbenzene	0.2	0.1	0.04
Octane	0.6	0.3	0.09
o-Xylene	1.7	1.0	0.3
p-Cymene	0.3	0.2	0.05
Pentane	19.1	11.5	1.0
Propane	15.0	9.0	3.0
Propylene	2.2	1.3	0.3
Styrene	2.3	1.4	0.1
Tetrachloroethylene	0.7	0.4	0.1
Toluene	19.4	11.7	1.8
trans-2-Butene	0.4	0.3	0.06
trans-2-Hexene	0.07	0.04	0.01

Contaminant	1-hour ($\mu\text{g}/\text{m}^3$) ^[1]	24-hour ($\mu\text{g}/\text{m}^3$) ^{[2], [3]}	Annual ($\mu\text{g}/\text{m}^3$) ^[3]
trans-2-Octene	0.04	0.02	0.002
trans-2-Pentene	0.4	0.2	0.06
trans-3-Methyl-2-Pentene	0.07	0.04	0.009
trans-4-Methyl-2-Pentene	0.05	0.03	0.006
Trichloroethylene	0.4	0.3	0.05
Undecane	0.6	0.3	0.1
Vinylchloride	0.03	0.02	0.002

Note: [1]: Calculated from the 24-hour background concentrations using scaling factor from the US EPA AERSCREEN model.
[2]: Maximum of measured values is used for 24-hour averaging period.
[3]: Results based on average over three years.

C.2.8 Odour

Odour is another air quality issue of growing concern. Given the wide array of odour causing compounds that are emitted from very large number of different sources, it cannot be measured by continuous observation equipment and relies on trained personnel to quantify the intensity. To adequately document and follow-up on odour problems, MV relies on complaints from the public.

Access to MV list of complaints for the purpose of this report was not available. However, the Smell Vancouver project (Smell Vancouver, 2021) collects similar data (location, severity, strength, odour descriptions) which are publicly available. In the area surrounding Tilbury Island, all complaints in 2021 appear to be related to the Annacis Island wastewater treatment plant, the Vancouver landfill, and the Delta composting facility.

C.2.9 Climate change considerations

Current climate change scenarios predict that global mean temperatures will continue to rise over the 21st century as greenhouse gas (GHG) emissions continue. The already moist Lower Fraser Valley (LFV) is expecting to see an increase in the precipitation it receives with more intense extreme precipitation events.

Regarding air quality parameters, ozone concentrations are expected to increase if precursor emissions remain constant (Reuten et al., 2011). Changes in temperature and precipitation patterns are projected to both lengthen the ozone season and intensify high ozone episodes in some areas (Peel et al., 2013). Changes to circulation patterns are expected to bring increased periods of stagnation which favours ozone formation. Warmer temperatures may lead to greater concentrations of precursor contaminants such as NO_x and VOCs.



Effects of climate change on concentrations of $PM_{2.5}$ in the RAA are unclear (Orru, 2017). While more severe stagnation events can lead to increased pollutant levels, areas where rainfall is expected to increase and/or become more extended (in part due to increased cloudiness), secondary pollutant formation is expected to decrease. Rain will further reduce levels by removing PM and soluble gases. Higher temperatures will also shift the thermodynamic equilibrium of the reaction of nitric acid with ammonia to form ammonium nitrate aerosols, leading to lower levels of that aerosol product. Thus, the impact that climate change will have on $PM_{2.5}$, will vary, with the potential for some areas to experience increases and others decreases.

More forest fires are expected in the BC interior where conditions are predicted to be drier and hotter during the forest fire season and these would lead to increases in PM. Given the far-reaching effects of forest fires, they need not have to occur in the LFV for that effect to be felt within the RAA.

Oxides of Nitrogen and CO would also see an increase due to increased forest fire activity. According to Peel et. Al (2013), NO_x concentrations could also be affected by other climate-related changes that may increase the atmospheric release of nitrogen compounds through impacts on soil emissions and biogenic emissions from terrestrial ecosystems. Greater temperatures also increase production of biogenic VOCs.

Many of the steps taken to reduce GHG emissions and fight climate change, such as electrification, fuel switching, reduced emissions from transportation, and societal behavioral changes, have the co-benefit of reducing emissions of CACs, thereby improving overall air quality.

C.3 METEOROLOGY

Metro Vancouver experiences a moderate oceanic climate that borders on a warm-summer Mediterranean climate (Beck, 2018). The summer months of July and August are typically very dry with little to no precipitation while the rest of the year is rainy, especially between October and March. While Vancouver's coastal location serves to moderate its temperatures, sea breezes and adjoining mountainous terrain contribute to making Greater Vancouver a region of microclimates, much like the rest of coastal British Columbia.

Despite normally mild winters from onshore air flow over the North Pacific Current, occasional cold Arctic outflow in winter lasting a week or more, leading to below freezing temperatures and temporary snow accumulation. MV is also subject to significant spatial variations in summer temperatures between inland areas of the Fraser Valley and the ocean-tempered coastal regions when localized on-shore breezes are in effect.

The west coast of North America is also well located for receiving large amounts of precipitation in the form of atmospheric rivers and there are typically 10 to 20 of them in a year. A subset of those land in the MV area. An atmospheric river is a long, narrow stream of water vapour traveling through the sky. They originate in tropical ocean regions near the equator and when they cross land and are subjected to orographic uplift, the vapour condenses and can result in a month's worth of precipitation in a few days. Climate change is expected to lead to warmer air temperatures. Consequently, we can expect atmospheric rivers that reach the B.C. coast to become up to 25% wider, 25% longer and overall 50% more intense than before. The resulting rainfall events will likely also become longer in duration (Espinoza, 2018).

C.3.1 Climate Normal

Environment and Climate Change Canada (ECCC) has operated the Delta Burns Bog meteorological station located 3 km to the southeast of the existing facility since November 2010. This station is too recent to have been included in the calculation of the 30-year climate normal which currently span from 1981-2010. The nearest ECCC station for which climate normal are available is the Vancouver International Airport, 12 km to the west-northwest. This station is expected to be more tempered by its proximity to the Salish sea but the availability of climate normal for this location provides a more reliable set of metrics by which to discuss the climate at the site.

Observations from both stations were compared using the ten full years of data for which they have been operating concurrently: 2011-2020 (see Section 4 for detailed comparison). Adequate agreement was found between the stations, and it was deemed acceptable to use climate normal from the Vancouver International Airport station to describe the climate at the facility in this report.

Figure C.42 shows the daily minimum, average and maximum temperature and the average monthly precipitation total by month of the year. July and August are the warmest months of the year whereas January and December are the coldest. On average, there are 76.5 days during which the maximum temperature exceeds 20°C, only 0.29 that exceed 30°C and there are no days in the climate normal that exceed 35°C. Regarding cold temperatures, the climate normal count 20.5 days during which the minimum temperature was below -2°C, 1.6 days that were below -10°C and no days for which the minimum temperature was below -20°C.

The most precipitation is observed in November and January and the least precipitation is recorded in July and August. The climate normal for total annual precipitation is 1189 mm, 1152.8 mm of which is recorded as rainfall and the remaining precipitation is recorded as 38.1 cm of snowfall. Just less than half the year (168.9 days) records more than 0.2 mm of precipitation on average. Forty-two (42) of those days record more than 10mm and 6.8 of those record more than 25 mm. At least trace amounts of snow are present for 9.3 days of the year on average.

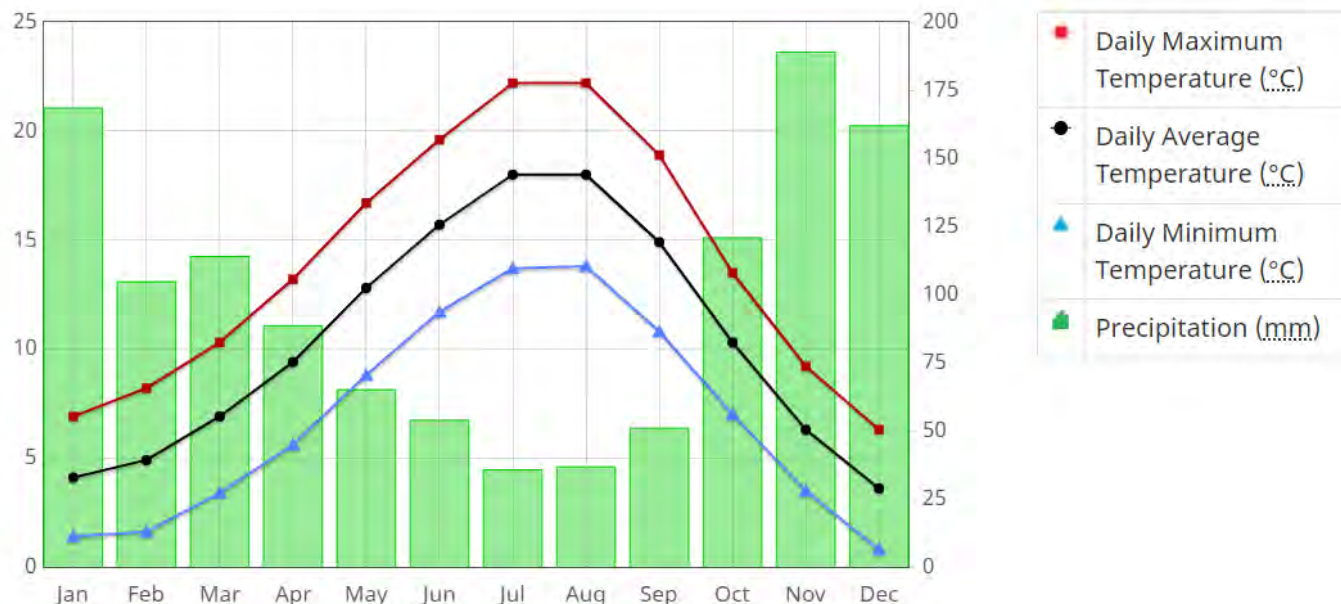


Figure 42: Temperature (Left Axis, in °C) and Precipitation (Right Axis, In mm) Graph for 1981 to 2010 Canadian Climate Normals at YVR (ECCC. 2021)

C.3.2 Wind speed and direction

Wind roses expressing the wind speed and direction at the stations used in this study for the 2018-2020 period are presented in Figure C.43 through Figure C.54. Given the greater spatial variability of the wind field and its sensitivity to terrain features and ground cover, full period and seasonal wind roses from the MV stations T13, T17 and T18 are presented in addition to those from Vancouver International Airport and Delta Burns Bog stations. These three MV stations were also used as surface wind inputs to the dispersion modelling work. The locations of all the stations used in this section are listed in Table C.11.

Table C.11: Meteorological Stations

Meteorological Stations	Station Location (Latitude, Longitude)	Parameters used in this report
ECCC Vancouver International Airport	49.1947° N, 123.1839° W	Air Temperature, Relative Humidity, Precipitation, wind speed and direction.
ECCC Delta Burns Bog	49.1258°N, 123.0022°W	Air Temperature, Relative Humidity, Precipitation, wind speed and direction.
T13 – North Delta	49.1583° N, 122.9017° W	Wind speed and direction.
T17 – Richmond South	49.1414° N, 123.1082° W	Wind speed and direction.
T18 – Burnaby South	49.2152° N, 122.9857° W	Wind speed and direction.
T31 – Richmond Airport	49.1863° N, 123.1524° W	Wind speed and direction.

Winds at T13 (North Delta) were predominantly blowing from the east at speeds up to 4 m/s. Occasional higher wind speeds up to 6 m/s were observed from the west, south and southeast. The autumn and winter months saw the greatest predominance of easterly winds. Summer months were more evenly distributed from the east through to the west.

Winds at T17 (Richmond South) were mostly from the east, east-northeast, southeast and west-northwest. Wind speeds were most frequently under 4 m/s. A greater preponderance of higher wind speeds (up to 8 m/s) was seen from the west-northwest. Spring and summer months were associated with greater frequencies of wind from the southeast and west-northwest. Winter months were associated with more wind from the east and east-northeast.

Winds at T18 (Burnaby South) were evenly distributed in frequency as blowing from the north through to the east and from the south. The former was observed more often in winter with higher frequencies of greater wind speeds (4 to 6 m/s) and the latter were observed more commonly in the summer.

Winds at T31 (Richmond Airport) were predominantly from the east with wind speeds from the west and west-northwest occasionally up to 6 m/s and over 10 m/s. In the autumn and winter, easterly winds are even more dominant whereas in spring and summer, the wind directions are more evenly distributed yet still mostly either from the east, east-southeast, west or the west-northwest.

Winds at the Vancouver international airport (YVR) are similar to T31 Richmond Airport where they were predominantly from the east with wind speeds more frequently up to 6 m/s and occasionally over 10 m/s. In winter, easterly winds are even more dominant whereas in summer, the wind directions are more evenly distributed yet still mostly either from the east, east-southeast or the west-northwest.

Winds at Delta Burns Bog are predominantly from the east with low wind speeds all below 4 m/s and the rate of calms is also very high at 43.9%. Winter months see a majority of winds blowing from the east whereas the summer months see mostly winds from the south and lower wind speeds: up to 2 m/s.

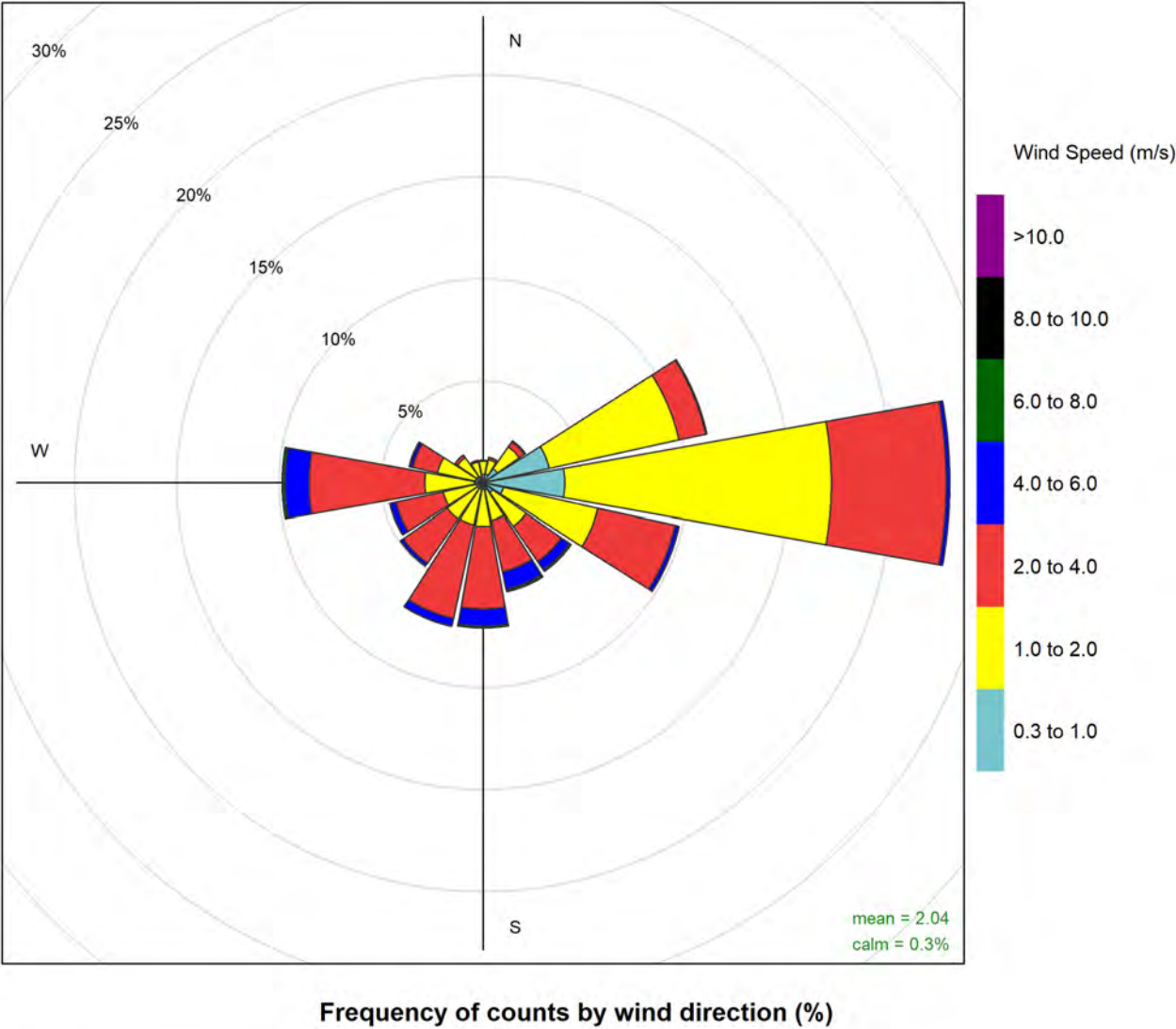


Figure C.43: Wind Rose at T13 (North Delta) for the Whole Period of 2018-2020

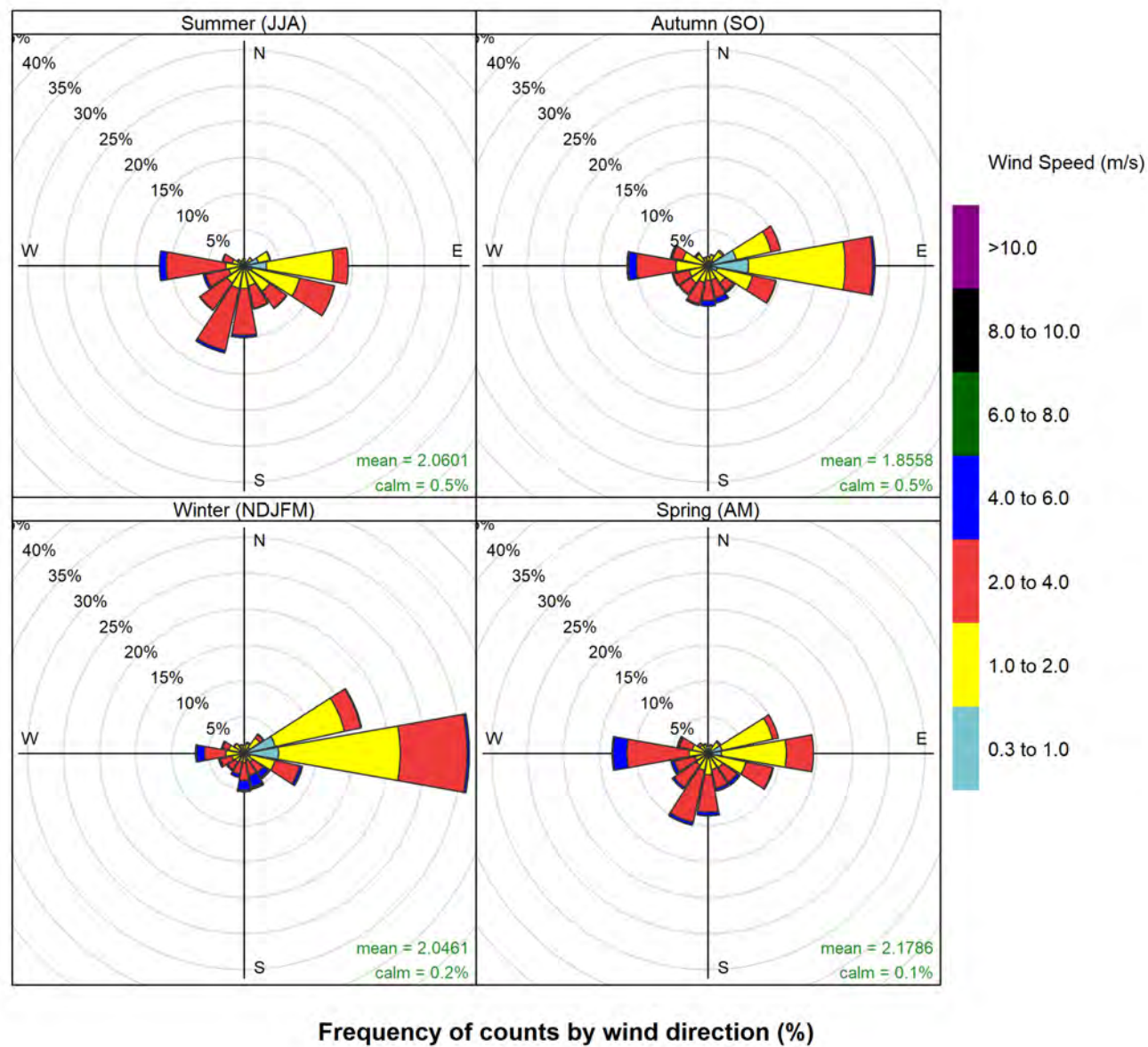
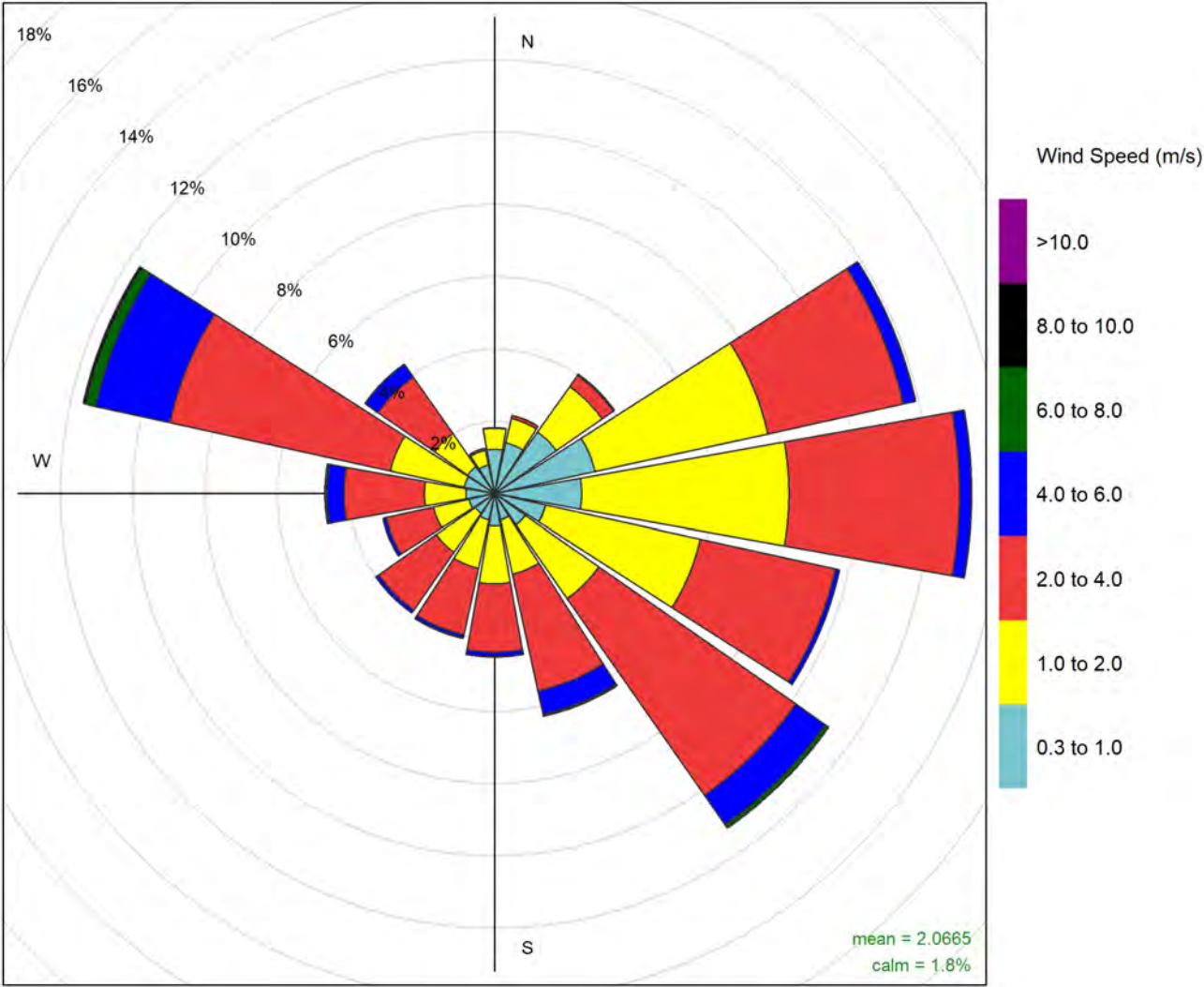


Figure C.44: Wind Roses by Season for Station T13 (North Delta) for 2018-2020



Frequency of counts by wind direction (%)

Figure C.45: Wind Rose at T17 (Richmond South) for the Whole Period of 2018-2020

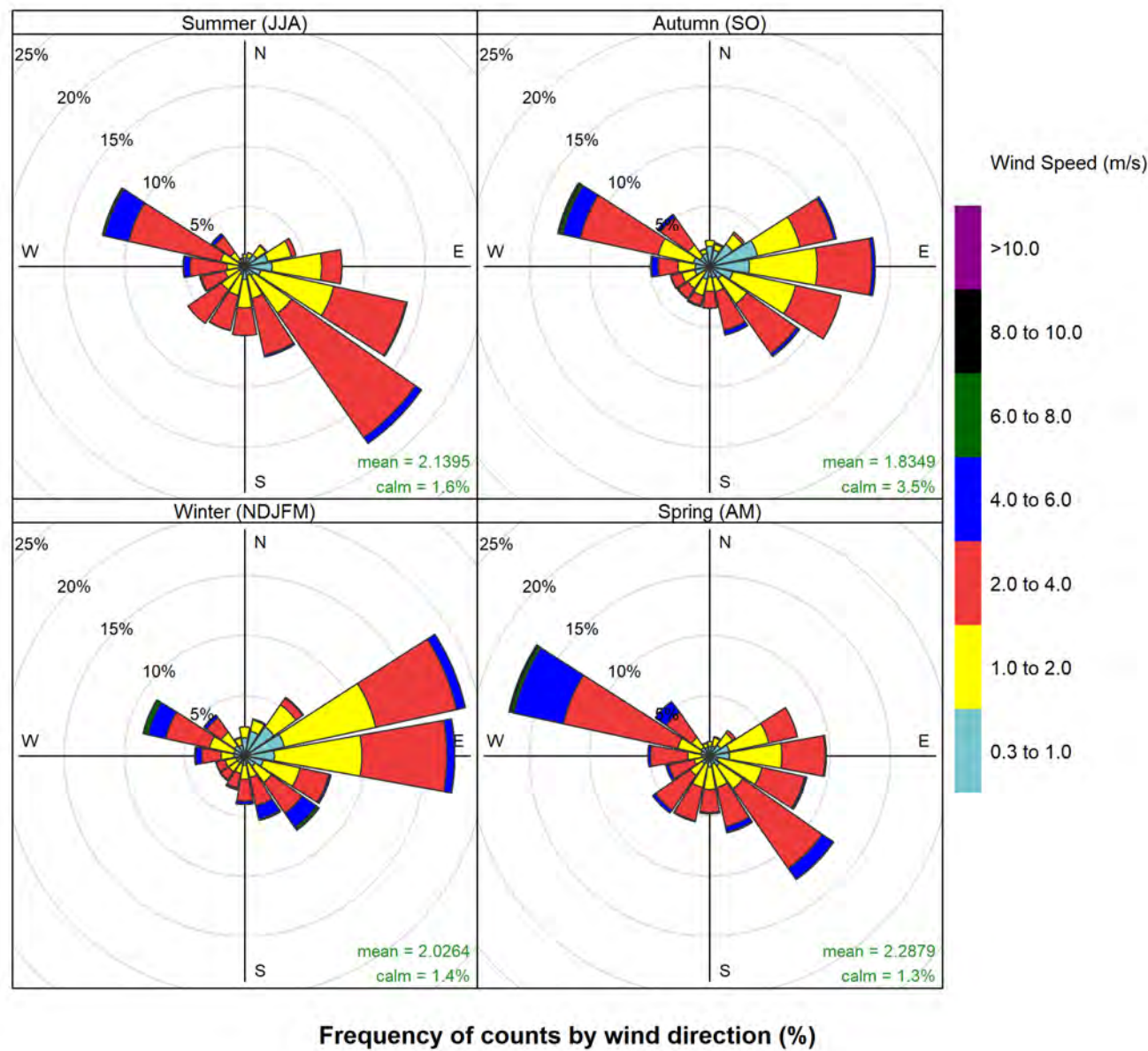
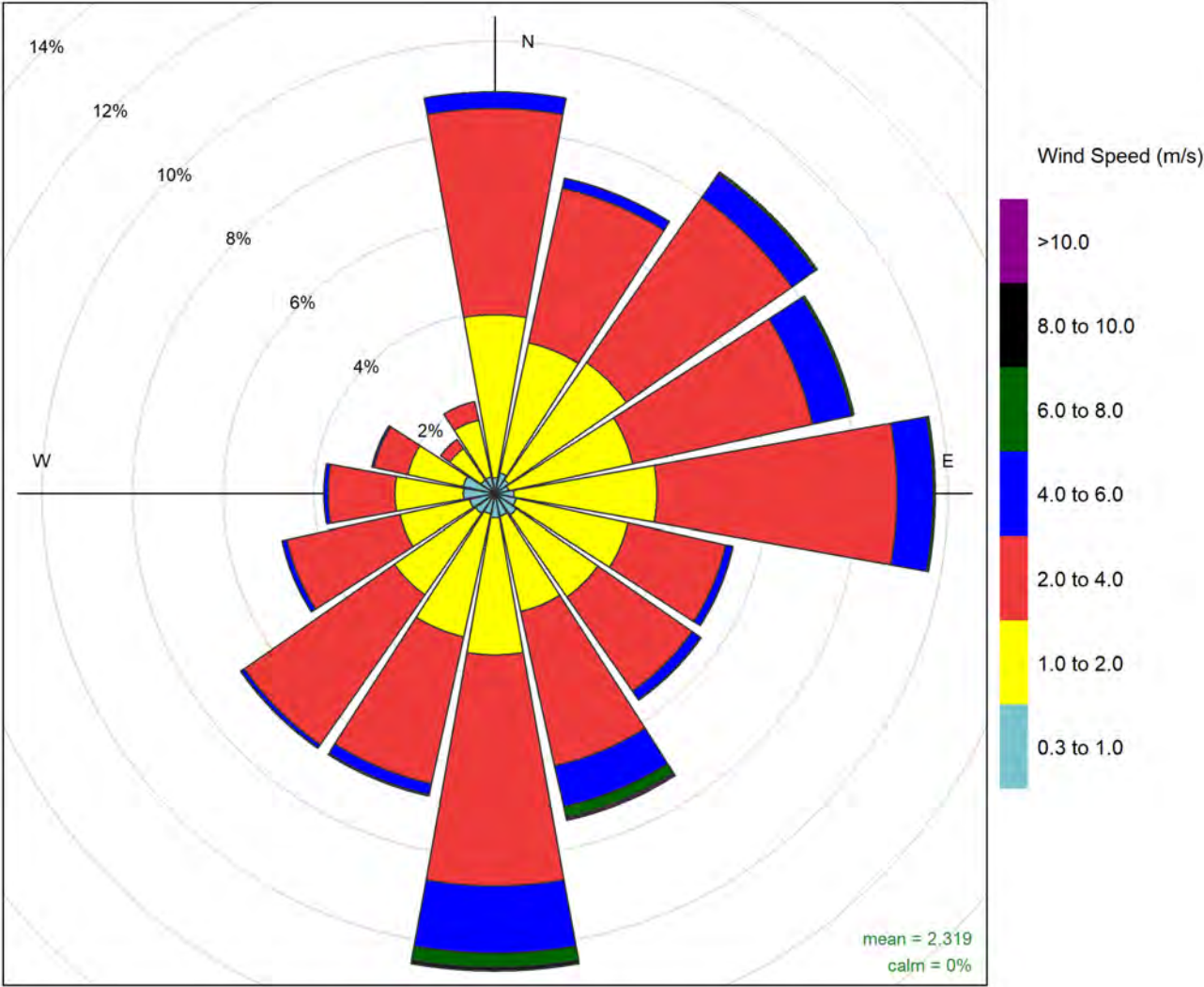
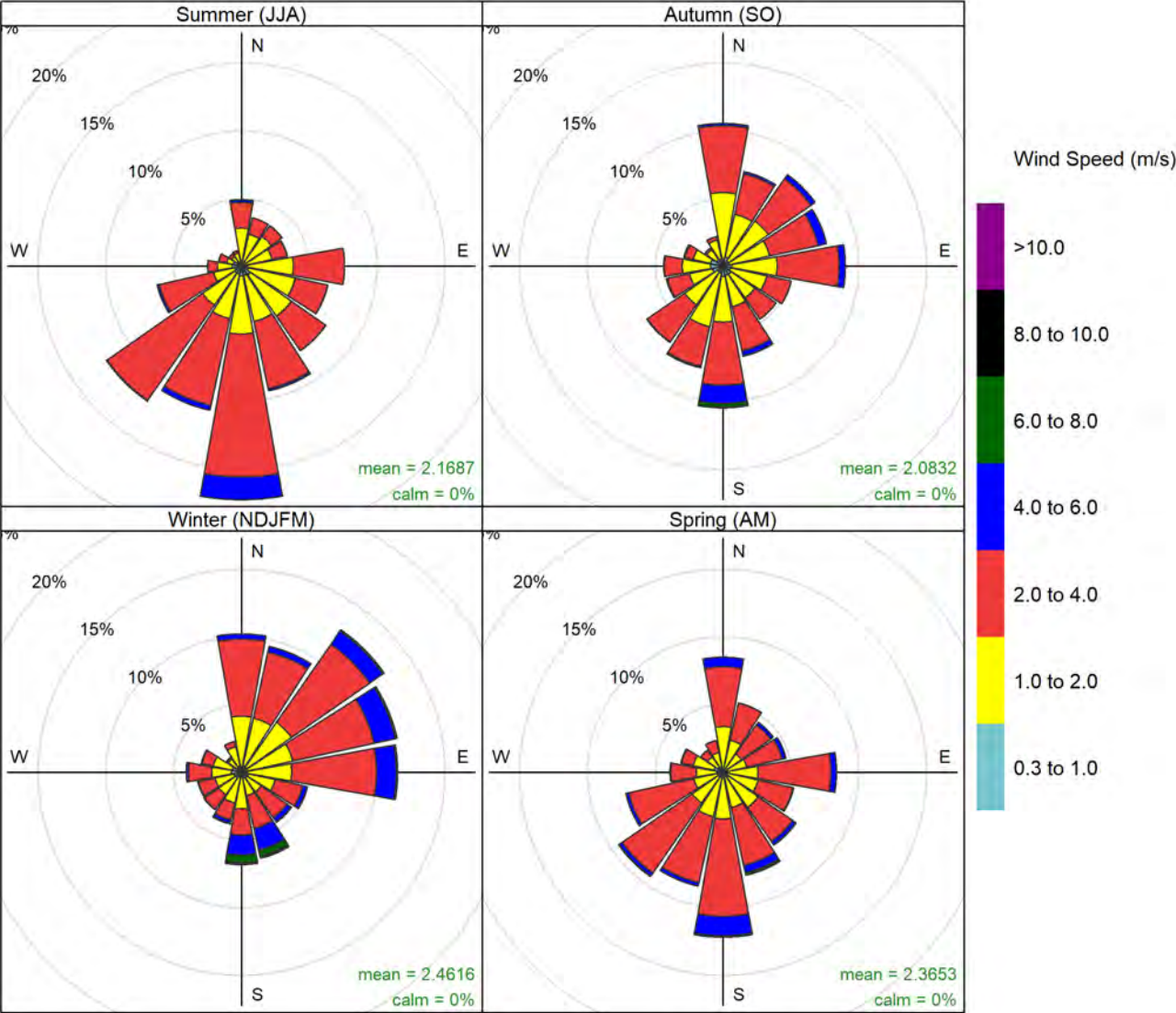


Figure C.46: Wind Roses by Season for Station T17 (Richmond South) for 2018-2020



Frequency of counts by wind direction (%)

Figure C.47: Wind Rose at T18 (Burnaby South) for the Whole Period of 2018-2020



Frequency of counts by wind direction (%)

Figure C.48: Wind Roses by Season for Station T18 (Burnaby South) for 2018-2020

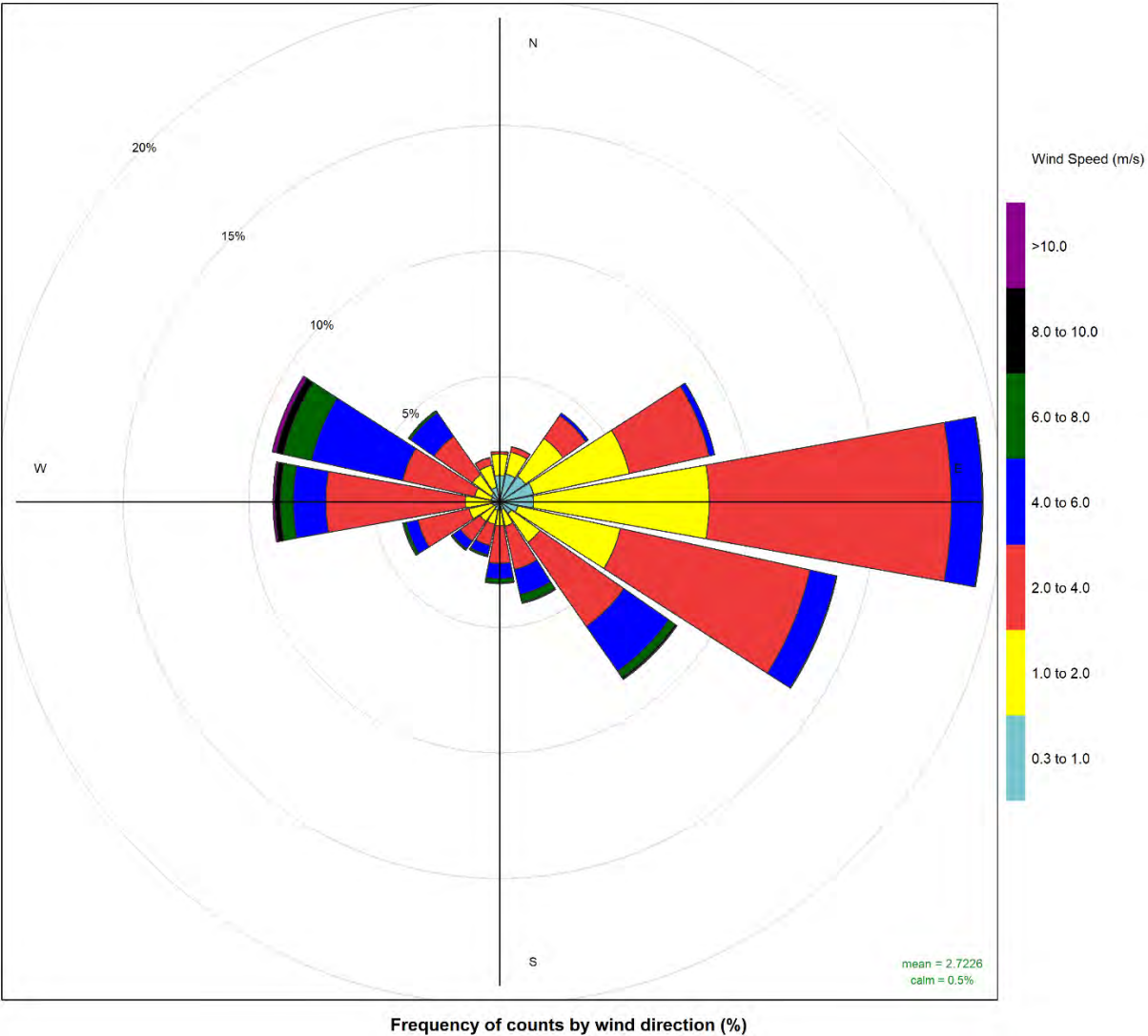


Figure C.49: Wind Rose at T31 (Richmond Airport) for the Whole Period of 2018-2020

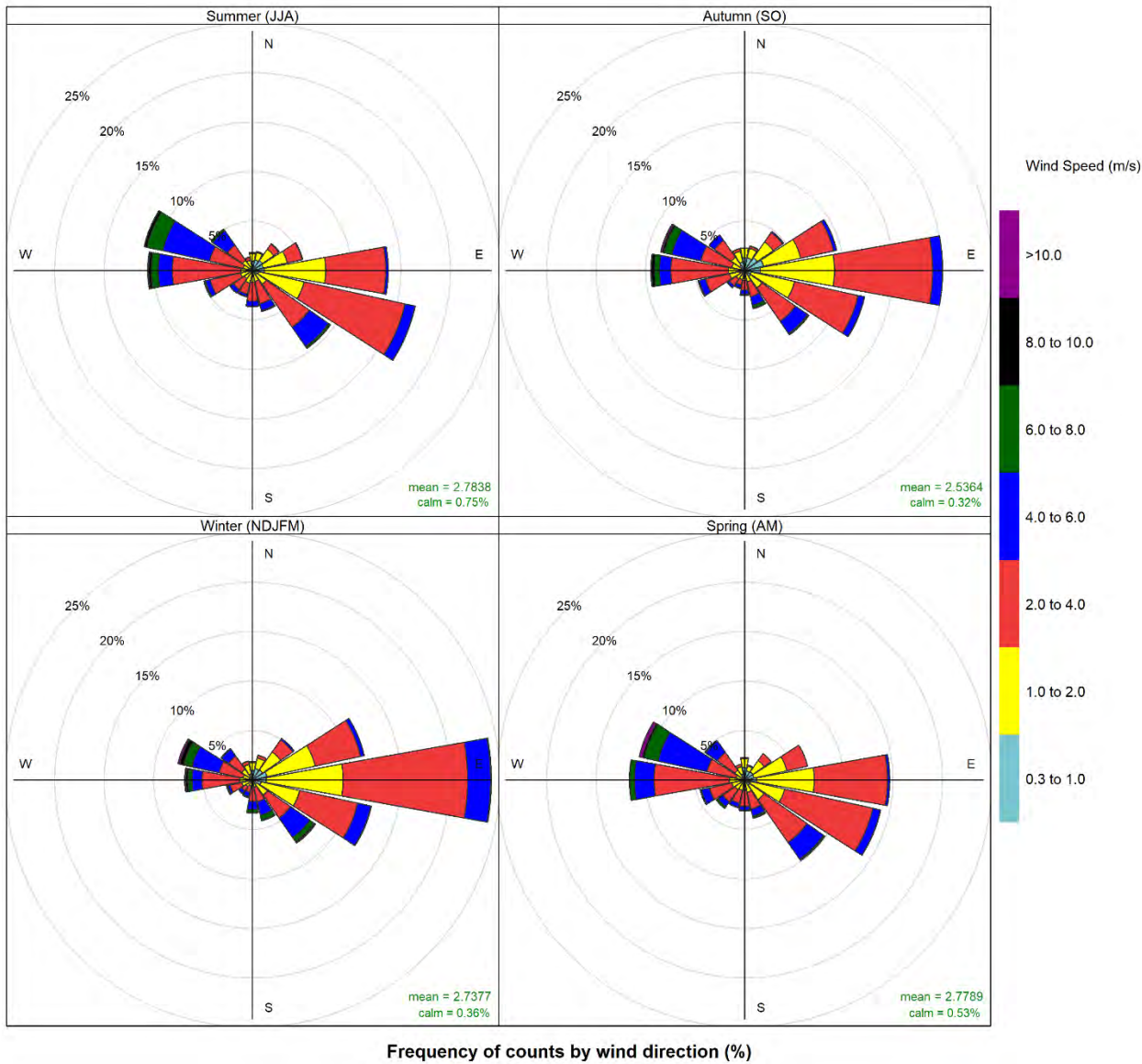


Figure C.50: Wind Roses by Season for Station T31 (Richmond Airport) for 2018-2020

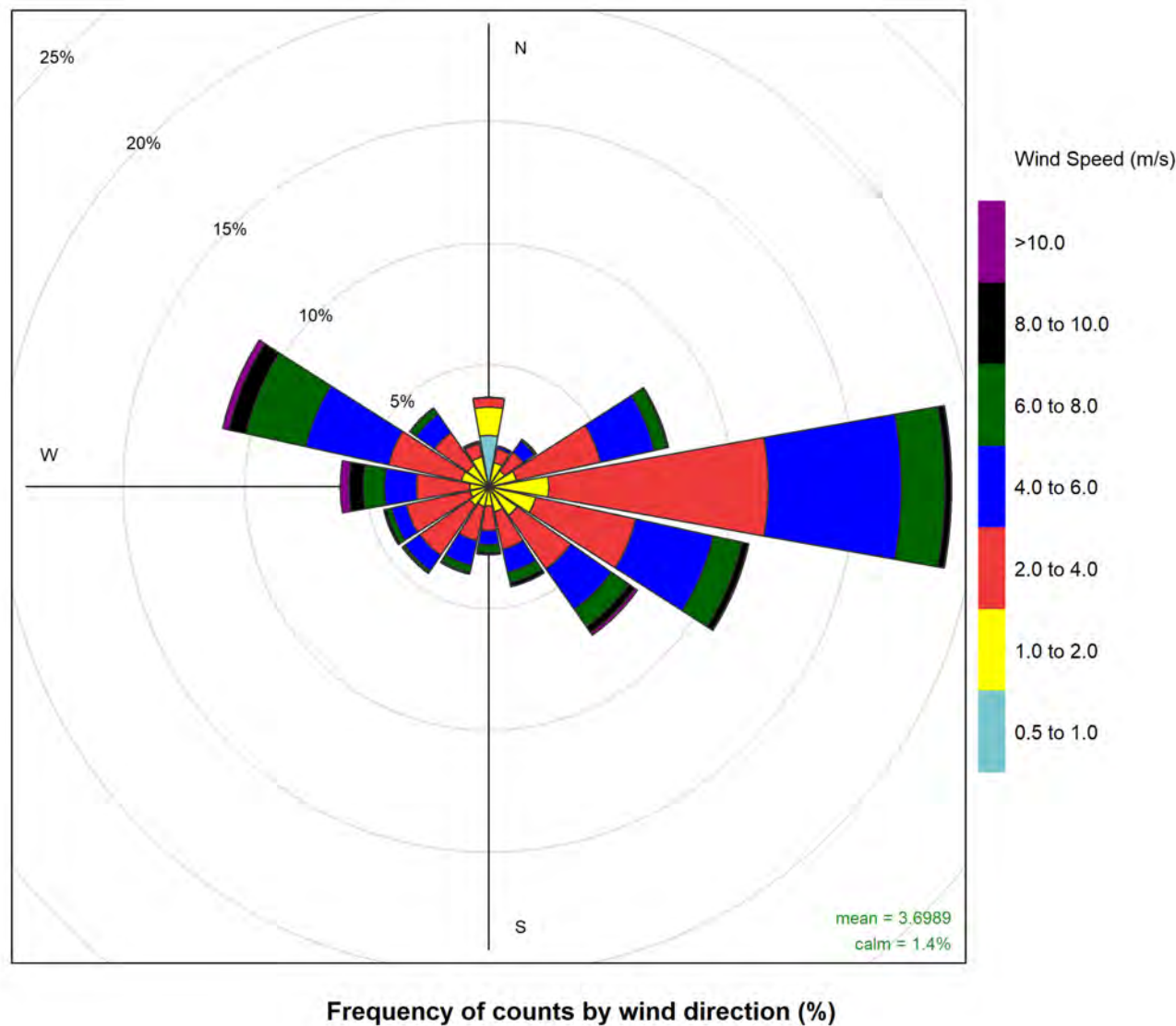


Figure C.51: Wind Rose for Vancouver International Airport for the Whole Period of 2018-2020

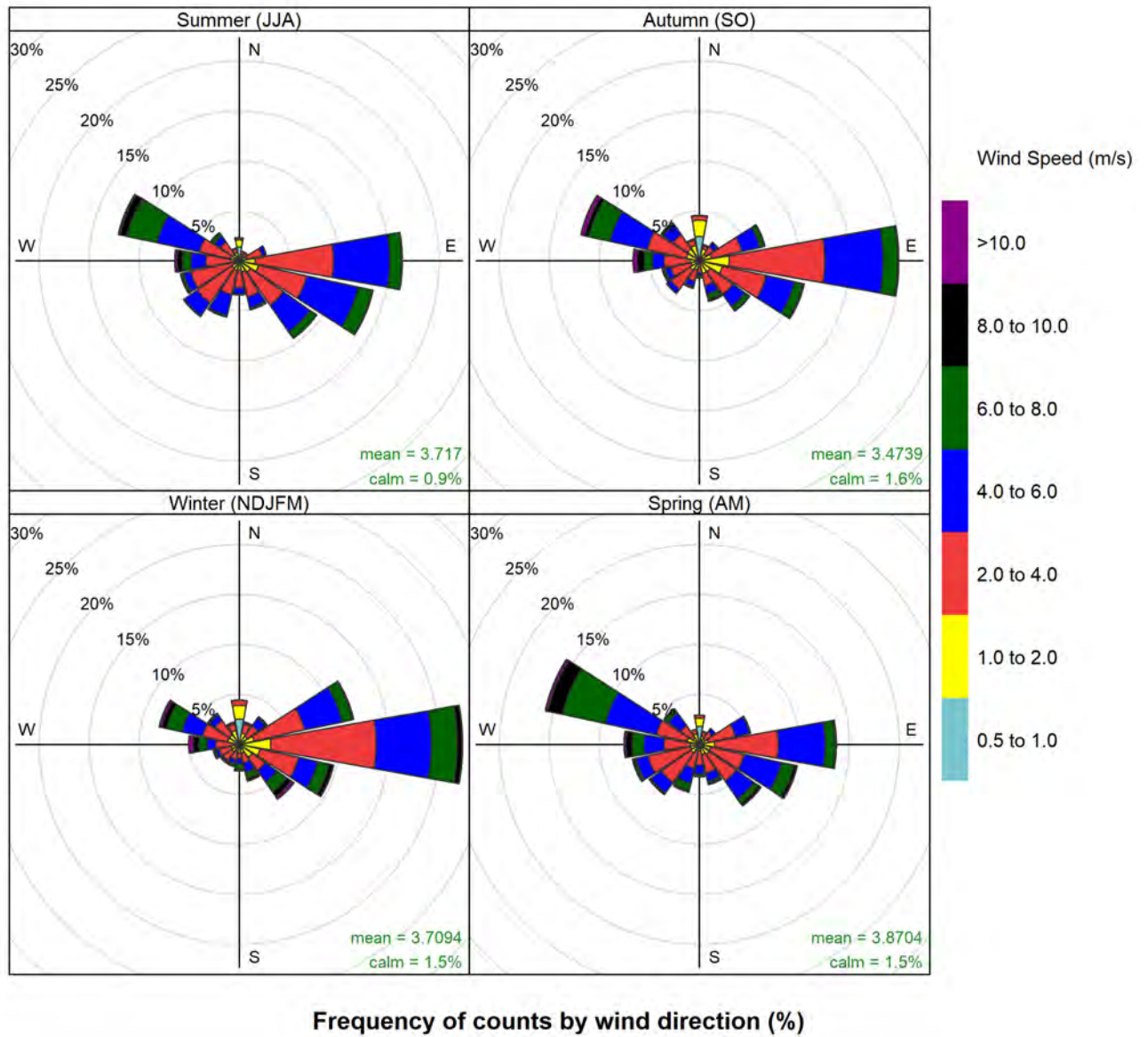


Figure C.52: Wind Roses by Season for Vancouver International Airport for 2018-2020

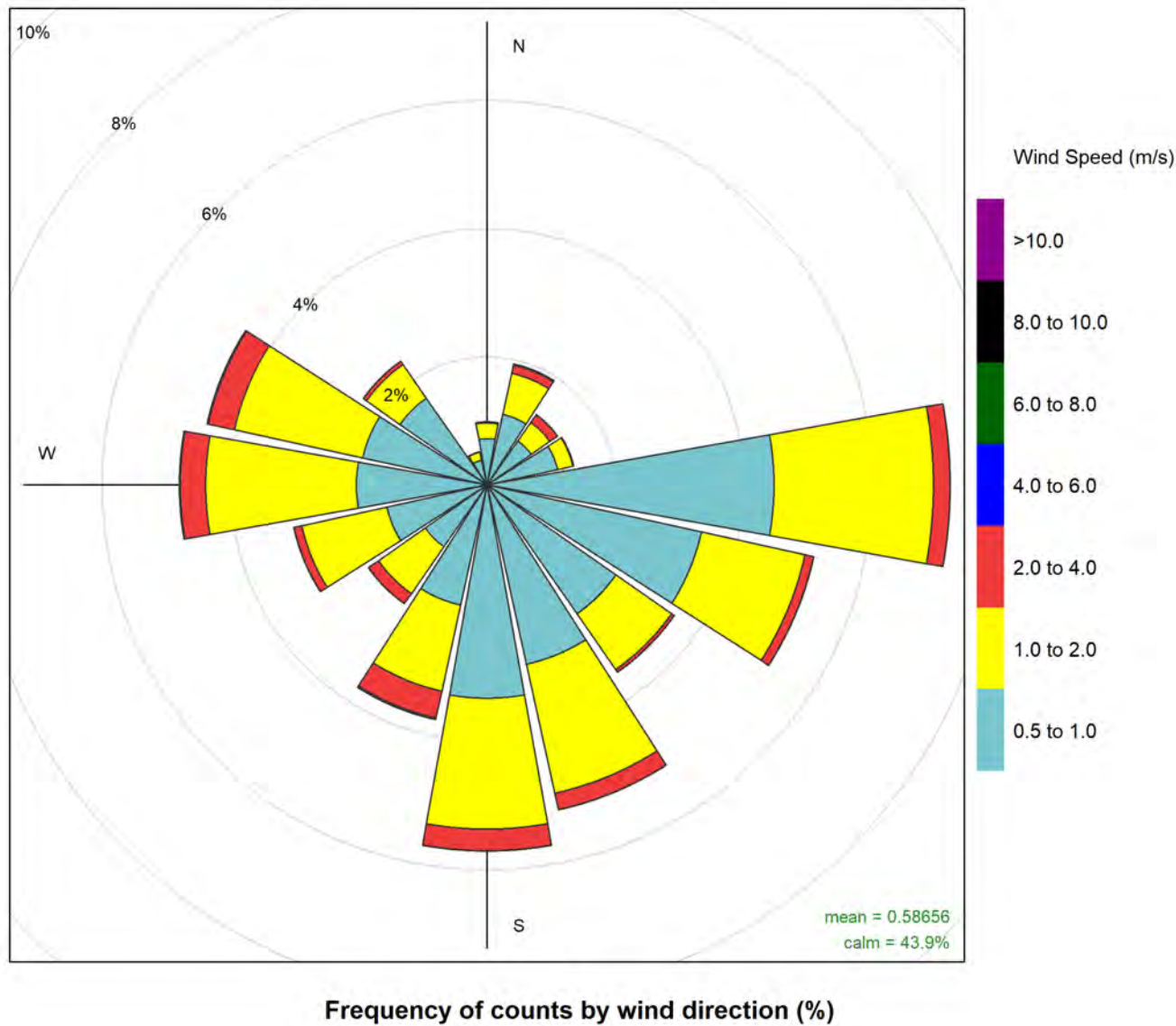


Figure C.53: Wind Rose at Delta Burns Bog for the Whole Period of 2018-2020

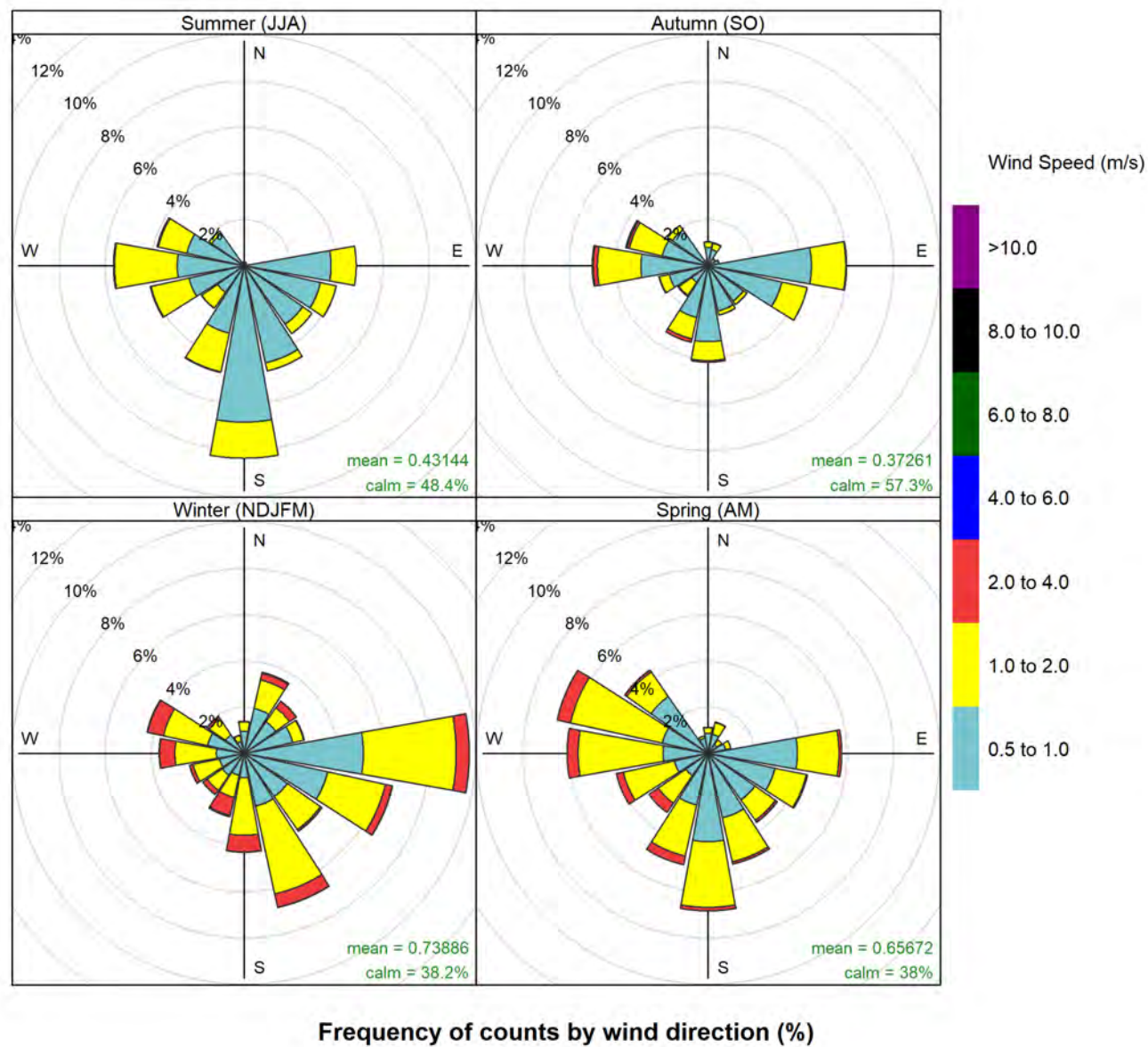


Figure C.54: Wind Roses by Season at Delta Burns Bog for 2018-2020

C.4 STATION COMPARISON BETWEEN VANCOUVER INTERNATIONAL AIRPORT AND DELTA BURNS BOG

The comparison performed in this section serves to verify the adequacy of using the 30-year climate normal developed for the ECCC station at Vancouver International Airport to describe the climate on Tilbury Island. The ECCC station at Delta Burns Bog is nearer to the Project however it has not operated long enough for there to be climate normal calculated for this location. In this section, 10 full years of available data during which Delta Burns Bog and Vancouver International Airport Stations were both operating were used to compare temperature, precipitation, relative humidity, and wind speed and direction.

Figure C.53 are scatterplots of the daily minimum, mean and maximum temperatures at both stations. There is generally good agreement between the stations but with a larger offset for minima and a flatter slope for the maxima. This can be attributed to the greater proximity of the airport to the Salish Sea where temperatures are less subject to warming, by incoming solar radiation later in the day and radiative cooling at night, than further inland.

Daily and monthly precipitation totals are presented in Figure C.56. Monthly precipitation totals show very good agreement with a slope of 1 and an offset of 1.9 mm. Daily precipitation totals have a flatter slope of 0.93 which is likely caused by a large number of smaller precipitation events (less than 10 mm) that register more precipitation at Vancouver International Airport than at Delta Burns Bog.

Relative humidity observations are compared in Figure C.57. Due to the range over which relative humidity fluctuates daily and its strong dependence on temperature, instead of averaging it, values are typically selected from early morning and late afternoon. In the early morning, relative humidity is predominantly greater at the Delta Burns Bog station as would be expected due to the site being more inland and more prone to overnight radiative cooling. In the afternoon, points are more evenly split on either side of the 1:1 line, due mainly to seasonal variations. In winter, the relationship is more similar to the early morning when temperatures are expected to be colder at Delta Burns Bog than at Vancouver International Airport whereas the reverse is observed in summer where the effect of the proximity to the Salish sea is to lower temperatures.

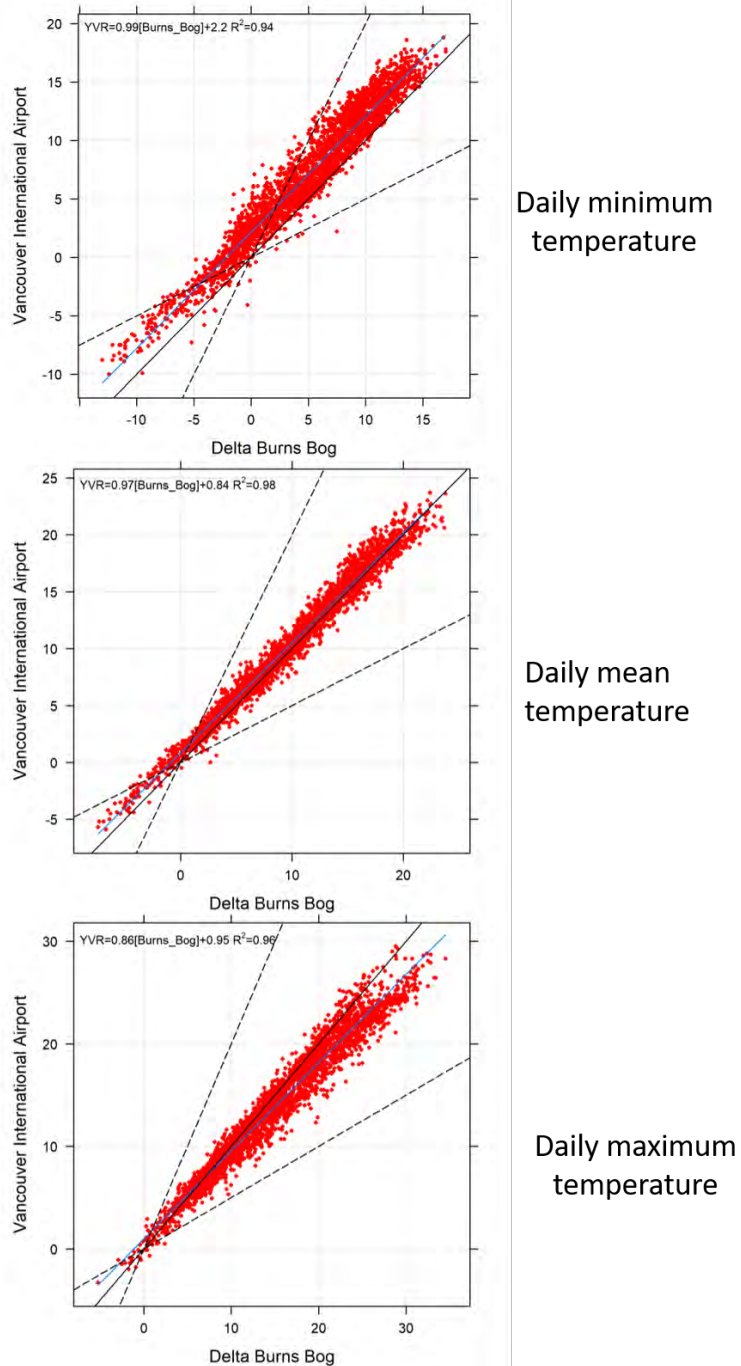


Figure C.1: Comparison of Daily Aggregated Temperatures (°C) Observed at Vancouver International Airport and Delta Burns Bog ECCC Stations from 2011 to 2020.

The solid black line is 1:1 and the dashed lines are 1:2 and 2:1. The blue line is a linear fit.

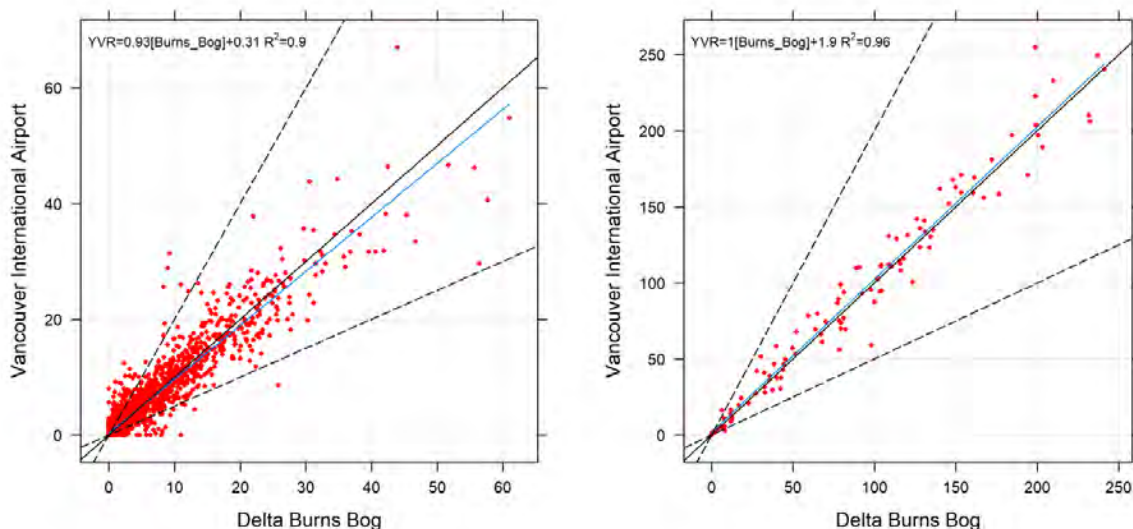


Figure C.2: Comparison of Daily (Left) and Monthly (Right) Precipitation Totals (mm) Observed at Vancouver International Airport and Delta Burns Bog ECCC Stations from 2011 to 2020.

The solid black line is 1:1 and the dashed lines are 1:2 and 2:1. The blue line is a linear fit.

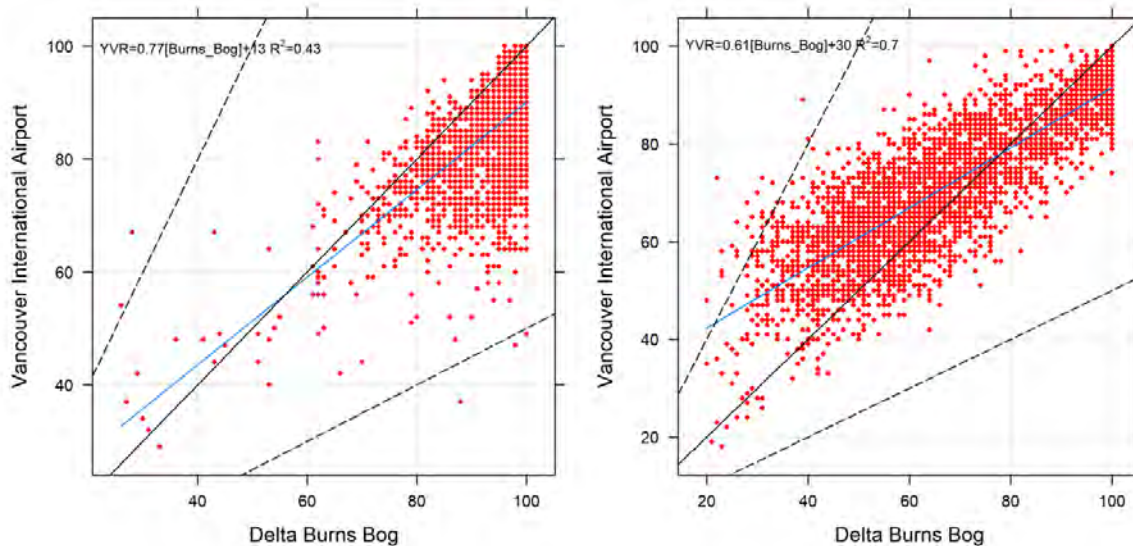


Figure C.3: Comparison of 0600 LST (Left) and 1500 LST (Right) Average Relative Humidity (%) Observed at Vancouver International Airport and Delta Burns Bog ECCC Stations from 2011 to 2020.

The solid black line is 1:1 and the dashed lines are 1:2 and 2:1. The blue line is a linear fit.

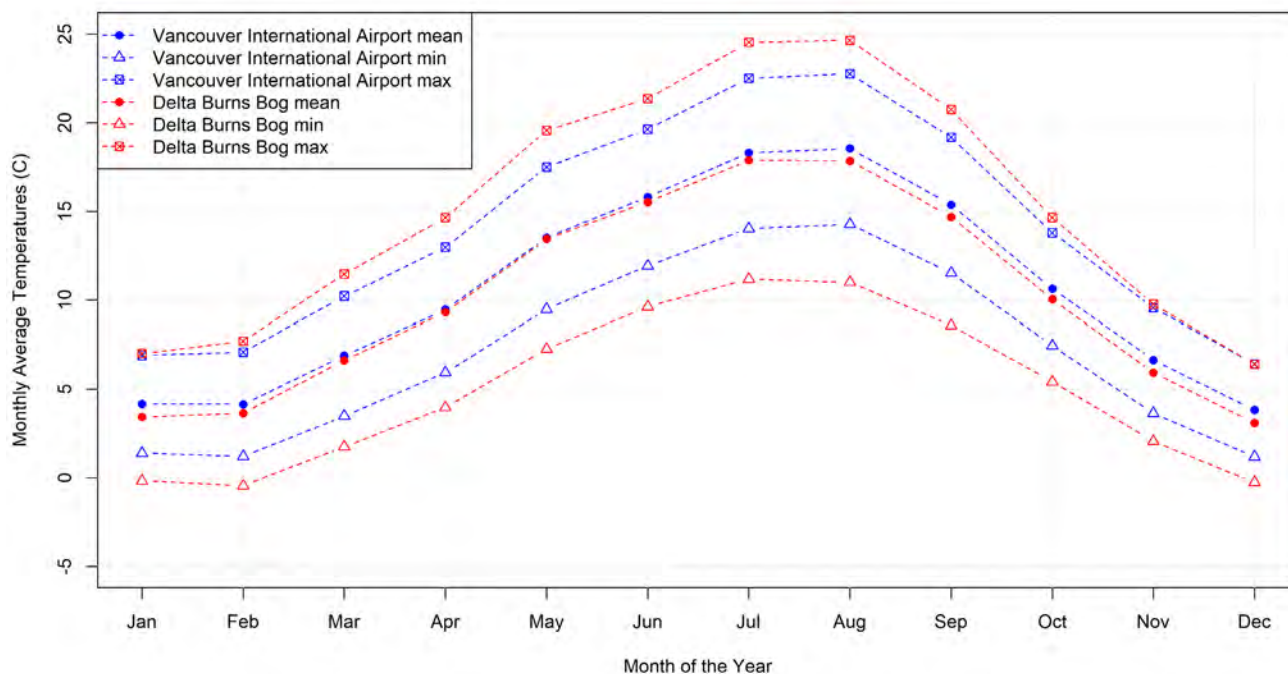


Figure C.4: Monthly Mean, Minimum and Maximum Temperatures Calculated for Vancouver International Airport and Delta Burns Bog Station Datasets from the 2011-2020 Period.

Figure C.58 shows the monthly temperatures at both stations calculated analogously to the 30-year climate normal but with 10 years of data. The mean temperatures agree closely but the minima and maxima exhibit a greater range at the Delta Burns Bog station than at the Vancouver International Airport Station (likely due to the buffering influence of the sea).

Figure C.59 shows the average monthly total precipitation at both stations. Both agree at each month to within 6mm of each other. The greatest differences are in December and February.

Figure C.60 compares the wind roses from both stations. Wind speeds are much weaker at the Delta Burns Bog station and they are more evenly distributed in direction than at Vancouver International Airport where they are strongly aligned in the east-west direction. This is not unexpected to find a large difference in the winds between these stations as they are subject to different ground cover and surrounding terrain.

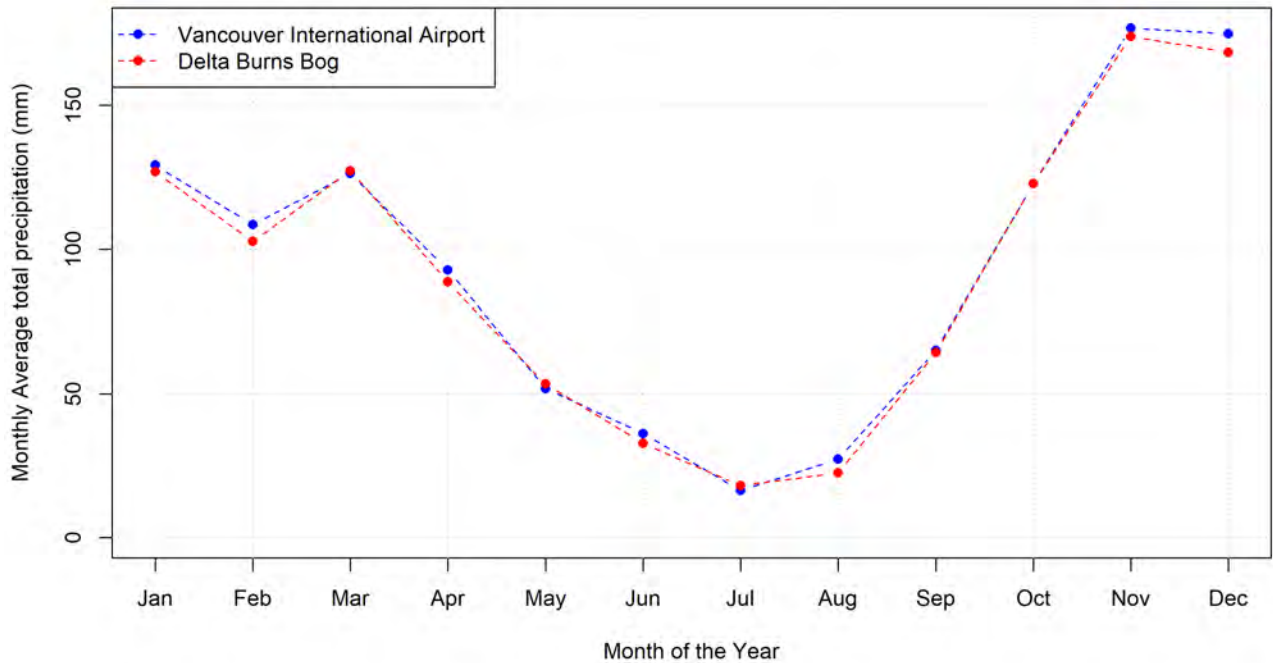


Figure C.5: Average Monthly Total Precipitation (mm) Calculated for Vancouver international Airport and Delta Burns Bog Station Datasets from the 2011-2020 Period.

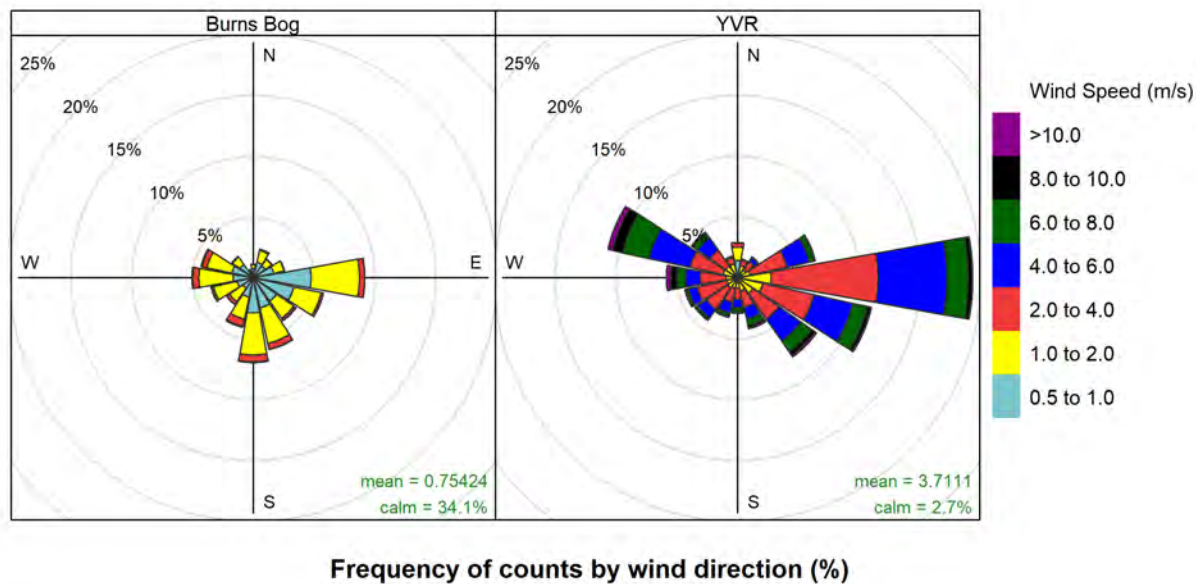


Figure C.6: Comparison Between the Wind Rose for the Delta Burns Bog and the Vancouver International Airport Stations for the 2011-2020 Period.

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AQ-APPENDIX D CONSTRUCTION EMISSIONS

D.1 CONTAMINANTS

The emissions from construction activities including site preparation, onsite module assembly and tank construction were estimated and focused on the primary contaminants generated by the activities taking place. The primary contaminants include criteria air contaminants (CACs) from fuel combustion and particulate matter generated during earthworks and material handling. The CACs expected to be emitted from operations during the construction phase of the Project include:

- Nitrogen oxides (NO_x)
- Sulphur dioxide (SO₂)
- Carbon monoxide (CO)
- Total suspended particulate (TSP $\leq$ 30 μ m)
- Particulate matter less than 10 micrometers in diameter (PM₁₀)
- Particulate matter less than 2.5 micrometers in diameter (PM_{2.5})
- Volatile organic compounds (VOCs)

The assessment of construction impacts included the emissions of all contaminants listed above.

D.2 EMISSION SOURCE ACTIVITIES

Direct emissions from the construction phase of the Project have been quantified. Activities resulting in emissions during construction include:

- Non-road and on-road engines (vehicle exhaust) - Various diesel-powered on-site construction equipment will be used during the construction phase and will result in emissions of CACs and additional contaminants from diesel combustion.
- Material handling - Material such as soil, gravel, and overburden will be processed during the construction phase. Material handling will result in fugitive particulate emissions.
- Excavating - Excavating and bulldozing operations during the construction phase will result in fugitive particulate emissions.
- Grading - Surface grading operations during the construction phase will result in fugitive particulate emissions.

It is acknowledged that additional indirect emissions may be associated with the construction phase, including embodied emissions from the production of concrete and other raw materials. However, these upstream emissions are beyond the defined scope of the air quality assessment and have therefore not been quantified or included in the analysis.

D.3 EMISSION SCENARIOS

Two emission scenarios were presented for material delivery under the alternative means in the original Application: (i) Primarily trucks and (ii) Barges and trucks. These scenarios considered how construction materials will be transported to the site. Scenario (i) “primarily trucks” moves material on-roads and avoids the waterway; Scenario (ii) “barges and trucks”, includes a greater number of movements via water with a reduction in on-road movements. Based on the feedback received, the proposed Project has removed all marine vessel deliveries from its scope. As a result, the revised Application considers only a single scenario—delivery primarily by trucks—and excludes any marine transportation to the site entirely.

D.4 EMISSIONS ESTIMATION

Emission rates for the various construction activities listed above were calculated using methodology and emission factors from the following sources:

- United States Environmental Protection Agency (US EPA) Motor Vehicle Emission Simulator (MOVES)
- Western Regional Air Partnership (WRAP) Fugitive Dust Handbook
- US EPA AP-42 Chapter 13.2.4 Aggregate Handling and Storage Piles
- US EPA AP-42 Chapter 11.9 Western Surface Coal Mining
- Environment and Climate Change Canada (ECCC) Marine Emission Inventory Tool (MEIT) obtained from data within the EAC Application (Marine Shipping Assessment) for the Tilbury Marine Jetty project.

The calculation of total emissions was based on the assumption that the construction phase could extend up to a maximum duration of six years. This assumption accounts for potential variations in the construction schedule, such as delays or changes in the pace of work, which could result in the same total work hours being completed over a longer timeframe. The total emissions calculation is based on a maximum construction duration of six years, which provides the highest possible emission estimate under the given conditions.

The following sections describe the approaches used to calculate emissions from the identified construction activities.

D.4.1 Non-road and On-road Engines

Construction equipment will include equipment such as excavators, pickup trucks, dump trucks, loaders, compactors, cranes, compressors, power generators, and pumps. Delivery trucks transporting construction materials from various locations and disposal of waste are also included. Most of the equipment use diesel fuel engines which will emit CACs from combustion. A summary of the construction equipment to be used as well as their emissions during site preparation, onsite module unloading and assembly and tank construction is provided in Table D.1. While the specific details about equipment and emission tiers are not available at this planning stage, fuel-efficient equipment will be used to meet the applicable emission standards. On-road truck deliveries are presented in Tables D.2.

Table D.1: Construction Equipment Summary and the Associated Emissions throughout Construction Phase

Equipment Type ^[1]	Horse-power ^[2]	Load Factor ^[3]	Total Equipment Hours	Total Emissions (tonnes) ^[5]					
				NO _x	SO ₂	CO	PM _{2.5}	PM ₁₀	VOC
Site Preparation									
Cat 330 Excavator	273	0.59	2,358	0.108	0.001	0.035	0.007	0.008	0.008
Pickup truck (1/2 or 3/4 ton) ^[4]	450	0.59	7,765	0.005	0.001	0.052	0.0003	0.0004	0.004
Tandem Dump Truck ^[4]	600	0.59	9,558	0.242	0.001	0.147	0.019	0.021	0.051
Loader Cat 966 or similar	280	0.59	2,394	0.840	0.002	0.408	0.076	0.078	0.128
Cat D6 Dozer	215	0.59	3,060	0.170	0.001	0.035	0.008	0.008	0.008
Cat CS533 10T Compactor	130	0.43	3,096	0.146	0.001	0.046	0.011	0.011	0.008
Crawler Crane terex 275	325	0.43	5,768	0.980	0.003	0.250	0.038	0.039	0.052
Air compressor 450-800 cfm	264	0.43	6,180	0.642	0.003	0.153	0.029	0.030	0.043
Generator 300-330 KVA	350	0.43	8,910	3.269	0.006	0.986	0.145	0.150	0.213
Loader (2-3m3) (cat 938 or similar)	188	0.59	6,180	1.456	0.003	0.707	0.131	0.135	0.222
Light Plant	10	0.59	2,060	0.051	0.0001	0.031	0.003	0.003	0.010
135 ft telescopic boom lift	74	0.21	2,472	0.162	0.0002	0.008	0.001	0.001	0.002
Bauer RG 27/BCM10	755	0.21	1,162	0.357	0.001	0.188	0.020	0.021	0.019
185 CFM Compressor	60	0.43	1,494	0.115	0.0002	0.027	0.004	0.004	0.005
4" Trash Pump	11	0.43	830	0.017	0.00002	0.011	0.001	0.001	0.003
20T Excavator (cat 315 or similar)	146	0.59	830	0.031	0.0003	0.011	0.003	0.003	0.002
10T Telehandler	130	0.21	830	0.005	0.0001	0.034	0.006	0.007	0.010
Asphalt Paver	173	0.59	90	0.007	0.00003	0.002	0.001	0.001	0.0003
Asphalt Rollers	131	0.59	90	0.006	0.00003	0.002	0.0004	0.0005	0.0003
Bobcat (t650 or similar)	75	0.59	75	0.013	0.00002	0.009	0.001	0.001	0.002
Cat 938 loader	188	0.59	25	0.006	0.00001	0.003	0.001	0.001	0.001

Equipment Type ^[1]	Horse-power ^[2]	Load Factor ^[3]	Total Equipment Hours	Total Emissions (tonnes) ^[5]					
				NO _x	SO ₂	CO	PM _{2.5}	PM ₁₀	VOC
Sheet Pile Hammer ICE 216D with power pack	175	0.43	45	0.004	0.00001	0.001	0.0003	0.0003	0.0002
80T Kobelco Crawler Crane	213	0.43	45	0.003	0.00002	0.001	0.0001	0.0001	0.0002
Onsite Module Unloading and Assembly and Tank Construction									
Aerial Work Platforms	50	0.21	10,665	0.024	0.001	0.168	0.032	0.033	0.049
Forklifts	73	0.59	8,700	1.565	0.001	0.078	0.007	0.007	0.020
Major Equipment (Generators, Air compressors, etc.)	350	0.59	38,850	23.906	0.035	5.550	0.754	0.777	1.091
Minor Equipment (portable weld machines, concrete vibrators, small generators, light towers, etc.)	175	0.59	18,000	7.844	0.010	4.735	0.464	0.479	1.534
Mobile Cranes	325	0.43	18,240	1.593	0.010	0.375	0.071	0.073	0.105
Site Vehicles (Trucks, Vans, ATVs) ^[4]	450	0.59	18,360	0.012	0.001	0.122	0.001	0.001	0.010

Notes:

[1] Equipment types and hours provided by Golder Associates.

[2] Power rating assumed by equipment description.

[3] Load Factor assumed equal to EPA defaults, taken from Appendix A of MOVES Nonroad Technical Reports (US EPA, 2010)

[4] Equipment was considered on-road.

[5] Total emissions calculated based on the total required equipment hours for liquefaction and storage. It was assumed that the construction phase could last for a minimum of three years and extend up to six years. It accounted for potential variations in the construction schedule, such as delays or changes in the pace of work, which would result in the same total work hours being completed over a longer timeframe (i.e. total emissions remain the same).

Table D.2: On-Road Truck Deliveries

Construction Phase	Total Trucks ^[1]	Average Speed (km/hr) ^[2]	Roundtrip Distance Travelled (km) ^[3]	Total Travel Time (Hours) ^[4]	Total Idling (Hours) ^{[3][5]}	Total Distance Travelled (km) ^[4]
Phase 2 Liquification	13,000	40	40	13,000	13,000	520,000
LNG Storage Tank	14,000	40	40	14,000	14,000	560,000
Total	27,000			27,000	27,000	1,080,000

Notes:

[1] Information provided in Transportation Desktop Analysis (prepared by Solaris Management Consultants for Fortis BC, 03- Feb, 2023).

[2] Assumed average speed of 40km/hr and confirmed by Fortis BC.

[3] Provided by Fortis BC.

[4] Calculated by RWDI.

[5] Idling associated with onsite security clearance and position for product unloading.

The Motor Vehicle Emission Simulator (MOVES) model, version 2014, developed by the US EPA (US EPA, 2018), is a state-of-the-science emission modeling system that estimates emissions for mobile sources at the national, county, and project level for criteria air pollutants. For this reason, this model was used for the assessment.

Vehicle exhaust emissions are sensitive to outside temperature and humidity conditions and MOVES allows the user to input temperature and humidity information and calculate emission factors month by month. For this assessment, a more practical approach was sought in which a single, reasonably worst-case set of emission factors was applied to all months of the year. The emission factors used were based on typical temperature and humidity data obtained from Environment Canada's climate normals website (Government of Canada, 2017) for the month of January, when vehicle operating conditions are relatively cold. MOVES also allows the user to generate emission factors by time of day, which accounts for diurnal fluctuations in temperature and relative humidity. In the present analysis, four sets of emission factors were generated: morning (AM, 6:00am to 9:00am), mid-day (MD, 9:00am-4:00pm), evening (PM, 4:00pm-7:00pm), and overnight (ON, 7:00pm-6:00am).

Estimation of exhaust emissions from construction equipment were based on emission factors derived from MOVES for the year 2022. While the specific details about equipment and emission tiers are not available at this planning stage, default vehicle population and age distribution from MOVES2014b were adopted for deriving the emissions rates. However, it is anticipated that by the time the proposed Project enters construction, vehicles and equipment have improved fuel-efficiency due to ongoing advancements in technology and stricter emissions standards. FortisBC intends to encourage fuel-efficient equipment use to ensure compliance with applicable regulations. Additional modelling assumptions included the use of a single-unit short-haul truck operating at an average speed of 40 km/hr during travel and idling at 0 km/hr for short-term onsite activities.

Non-road Engines

Tailpipe emissions for construction equipment were calculated based on emission factors developed using MOVES-2014b with the non-roads option. This option is designed specifically for calculating emissions of non-road sources and produces emission factors in terms of grams per horsepower-hour. Emission rates of CACs from diesel combustion were calculated using the following equation:

$$ER = EF \times HP \times LF \times Total\ Equipment\ Hours \div 10^6$$

Where:

- ER = emission rate (tonnes/day)
- EF = MOVES emission factor (g/hp-hr)
- HP = Engine Rating (hp)
- LF = load factor (dimensionless)

The emission factors used to calculate the emission rates are shown in Table D.3. A summary of total emissions from the non-road equipment during the entire construction phase is provided in Table D.4.

Table D.3: Non-Road Equipment Emission Factors

Equipment Type	Emission Factor ^[1]					
	NO _x	SO ₂	CO	PM _{2.5}	PM ₁₀	VOC
Site Preparation – g/hp-hr						
Cat 330 Excavator	2.86E-01	3.61E-03	9.10E-02	1.96E-02	2.02E-02	2.01E-02
Loader Cat 966 or similar	2.12E+00	4.74E-03	1.03E+00	1.91E-01	1.97E-01	3.24E-01
Cat D6 Dozer	4.37E-01	3.63E-03	9.10E-02	1.96E-02	2.02E-02	2.01E-02
Cat CS533 10T Compactor	8.42E-01	3.74E-03	2.68E-01	6.39E-02	6.58E-02	4.46E-02
Crawler Crane terex 275	1.22E+00	3.69E-03	3.10E-01	4.73E-02	4.87E-02	6.42E-02
Air compressor 450-800 cfm	9.15E-01	3.80E-03	2.18E-01	4.20E-02	4.33E-02	6.13E-02
Generator 300-330 KVA	2.44E+00	4.18E-03	7.35E-01	1.08E-01	1.12E-01	1.58E-01
Loader (2-3m3) (cat 938 or similar)	2.12E+00	4.74E-03	1.03E+00	1.91E-01	1.97E-01	3.24E-01
Light Plant	4.22E+00	5.41E-03	2.55E+00	2.50E-01	2.58E-01	8.25E-01
135 ft telescopic boom lift	4.21E+00	3.93E-03	2.11E-01	1.92E-02	1.98E-02	5.25E-02
Bauer RG 27/BCM10	1.94E+00	4.09E-03	1.02E+00	1.10E-01	1.14E-01	1.05E-01

Equipment Type	Emission Factor ^[1]					
	NO _x	SO ₂	CO	PM _{2.5}	PM ₁₀	VOC
185 CFM Compressor	2.98E+00	4.36E-03	6.92E-01	9.40E-02	9.69E-02	1.36E-01
4" Trash Pump	4.34E+00	5.41E-03	2.68E+00	2.82E-01	2.91E-01	8.18E-01
20T Excavator (cat 315 or similar)	4.37E-01	3.63E-03	1.51E-01	3.7W5E-02	3.87E-02	2.24E-02
10T Telehandler	2.17E-01	4.88E-03	1.50E+00	2.84E-01	2.93E-01	4.40E-01
Asphalt Paver	7.51E-01	3.71E-03	2.34E-01	5.66E-02	5.83E-02	3.72E-02
Asphalt Rollers	8.42E-01	3.74E-03	2.68E-01	6.39E-02	6.58E-02	4.46E-02
Bobcat (t650 or similar)	3.87E+00	5.32E-03	2.80E+00	3.96E-01	4.09E-01	5.30E-01
Cat 938 loader	2.12E+00	4.74E-03	1.03E+00	1.91E-01	1.97E-01	3.24E-01
Sheet Pile Hammer ICE 216D with power pack	1.05E+00	3.82E-03	3.42E-01	7.96E-02	8.21E-02	6.56E-02
80T Kobelco Crawler Crane	6.25E-01	3.85E-03	1.47E-01	2.78E-02	2.86E-02	4.11E-02
Pickup Truck, Tandem Dump Trucks and Assembly Site Vehicles – g/h						
Pickup truck (1/2 or 3/4 ton)	6.64E-01	6.67E-02	6.66E+00	4.43E-02	4.94E-02	5.55E-01
Tandem Dump Truck	2.53E+01	8.55E-02	1.54E+01	2.01E+00	2.18E+00	5.29E+00
Assembly Site Vehicles	6.64E-01	6.67E-02	6.66E+00	4.43E-02	4.94E-02	5.55E-01
Onsite Module unloading and Assembly and Tank Construction – g/hp-hr						
Aerial Work Platforms ^[2]	2.17E-01	4.88E-03	1.50E+00	2.84E-01	2.93E-01	4.40E-02
Forklifts	4.21E+00	3.93E-03	2.11E-01	1.92E-02	1.98E-02	5.25E-02
Major Equipment (Generators, Air compressors, etc.) ^[3]	2.98E+00	4.36E-03	6.92E-01	9.40E-02	9.69E-02	1.36E-01
Minor Equipment (portable weld machines, concrete vibrators, small generators, light towers, etc.) ^[4]	4.22E+00	5.41E-03	2.55E+00	2.50E-01	2.58E-01	8.25E-01
Mobile Cranes ^[5]	6.25E-01	3.85E-03	1.47E-01	2.78E-02	2.86E-02	4.11E-02

Notes:

[1] Emission factors developed using MOVES-2014b.

[2] Emission factor assumed to be same as 10T telehandler.

[3] Most conservative emission factors for air compressor used.

[4] Most conservative emission factors for light towers used.

[5] Emission factors assumed to be same as 80T Kobelco Crawler Crane.

Table D.4: Total Emissions from the Non-Road Equipment

Activity	Total Emissions (tonnes) ^[1]					
	NO _x	SO ₂	CO	PM _{2.5}	PM ₁₀	VOC
Non-road Engines	43.3	7.83E-02	13.9	1.81	1.87	3.53

Notes:

[1] Total emissions calculated based on the total required equipment hours for liquefaction and storage. It was assumed that the construction phase could last for a minimum of three years and extend up to six years. It accounted for potential variations in the construction schedule, such as delays or changes in the pace of work, which would result in the same total work hours being completed over a longer timeframe (i.e. total emissions remain the same).

On-road Engines

Tailpipe emissions for on-road vehicles were calculated based on emission factors using MOVES2014b. Emission rates for CACs from diesel combustion during the construction phase, used the following equation:

$$ER = ((Travel\ EF \times Total\ Travel\ Hours) \div 10^6) + ((Idling\ EF \times Total\ Idle\ Hours) \div 10^6)$$

Where:

- ER = emission rate (tonnes/day)
- EF = MOVES emission factor (g/hr)

The emission factors used to calculate the emission rates are shown in Tables D.4.1 and D.4.2.

Table D.5.1: On Road Delivery Emission Factors

Construction Phase	Emission Factor (g/km distance travelled) ^[1]					
	NO _x	SO ₂	CO	PM _{2.5}	PM ₁₀	VOC
Phase 2 Liquefaction	5.6	0.01	1.5	0.3	0.5	0.3
LNG Storage Tank	5.6	0.01	1.5	0.3	0.5	0.3

Notes:

[1] Emission factors based on 40 km/h for single-unit short haul truck.

Table D.4.2: Idling Emission Factors

Construction Phase	Emission Factor (g/hour) ^[1]					
	NO _x	SO ₂	CO	PM _{2.5}	PM ₁₀	VOC
Phase 2 Liquefaction	45.06	0.06	13.78	3.06	3.32	5.55
LNG Storage Tank	45.06	0.06	13.78	3.06	3.32	5.55

Notes:

[1] Emission factors based on 0 km/h for single-unit short haul truck.

A summary of total emissions over the construction phase from the on-road equipment during the Phase 2 Liquefaction and LNG Storage Tank construction phases is provided in the Table D.6.

Table D.6: Total Emissions from the On-Road Equipment

Construction Phase	Total Emissions (tonnes) ^[1]					
	NO _x	SO ₂	CO	PM _{2.5}	PM ₁₀	VOC
Phase 2 Liquefaction	3.48	0.006	0.96	0.20	0.32	0.22
LNG Storage Tank	3.75	0.007	1.03	0.22	0.34	0.23
Total	7.23	0.013	1.99	0.42	0.66	0.45

Notes:

[1] Total emissions calculated based on the total required equipment hours for liquefaction and storage. It was assumed that the construction phase could last for a minimum of three years and extend up to six years. It accounted for potential variations in the construction schedule, such as delays or changes in the pace of work, which would result in the same total work hours being completed over a longer timeframe (i.e. total emissions remain the same).

D.4.2 Onsite Material Handling

Soil, gravel, and overburden material will be handled and transferred by two dump trucks and three loaders as part of construction operations. The handling and transfer of materials will result in fugitive particulate emissions. Emissions from material handling were estimated using information provided in Chapter 4 of the WRAP Fugitive Dust Handbook and AP-42 Chapter 13.2.4 Aggregate Handling and Storage Piles. Emissions calculations have not considered control methods for fugitive dust.

Emissions factors for TSP ≤ 30 µm, PM₁₀, and PM_{2.5} were calculated using the following equation from AP-42 Chapter 13.2.4.

$$EF = k(0.0016) \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$

Where:

- EF = emission factor (kg/Mg)
- k = particle size multiplier (dimensionless)
- U = mean wind speed (m/s)
- M = material moisture content

The particle size multipliers provided in AP-42 Chapter 13.2.4 are presented in Table D.7.

Table D.7: Particle Size Multipliers

Description	Value (unitless)
TSP ≤ 30 µm	0.74
PM ₁₀	0.35
PM _{2.5}	0.053

The average wind speed for the site from CALMET was used. The moisture content for the material was assumed based on values provided in AP-42 Table 13.2.4-1 for Western surface coal mining, exposed ground.

Emission rates of TSP ≤ 30 µm, PM₁₀, and PM_{2.5} were calculated using the following equation:

$$ER = EF \left(\frac{kg}{Mg} \right) \times Processing\ Rate \left(\frac{Mg}{hr} \right) \times Total\ Equipment\ Hours \times \frac{1\ tonne}{1000\ kg}$$

The hourly processing rate was estimated assuming the two dump trucks carry material at a capacity of 6 megagrams per hour and all material is moved by the three loaders.

A summary of total emissions of TSP ≤ 30 µm, PM₁₀, and PM_{2.5} from material handling based on the total hours of operation for the construction phase are provided in Table D.8.

Table D.8: Total Emissions from Material Handling

Activity	Total Emissions (tonnes) ^[1]		
	TSP ≤ 30 µm	PM _{2.5}	PM ₁₀
Material Handling	3.96E-02	2.84E-03	1.87E-02

Notes:

[1] Total emissions calculated based on the total required equipment hours for liquefaction and storage. It was assumed that the construction phase could last for a minimum of three years and extend up to six years. It accounted for potential variations in the construction schedule, such as delays or changes in the pace of work, which would result in the same total work hours being completed over a longer timeframe (i.e. total emissions remain the same).

D.4.3 Excavating

Excavating activities will occur as part of construction operations by three excavating machines including two excavators and one dozer. This activity will result in fugitive particulate emissions. Emissions from excavating were estimated using information provided in AP-42 Chapter 11.9 Western Surface Coal Mining. Emissions calculations have not considered control methods for fugitive dust.

Emissions factors for $TSP \leq 30 \mu m$ and particulate matter less than 15 micrometers in diameter (PM_{15}) were calculated using the following equation provided in AP-42 Table 11.9-2 for Bulldozing, Overburden.

$$TSP \leq 30 \mu m EF = \frac{2.6 (s)^{1.2}}{(M)^{1.3}}$$

$$PM_{15} EF = \frac{0.45 (s)^{1.5}}{(M)^{1.4}}$$

Where:

- EF = emission factor (kg/hr)
- s = material silt content (%)
- M = material moisture content (%)

The silt and moisture content for the material was assumed based on values provided in AP-42 Table 13.2.4-1 for Western surface coal mining, exposed ground.

Scaling factors provided in AP-42 Table 11.9-2 were used to calculate emissions factors for PM_{10} from $TSP \leq 30 \mu m$ and $PM_{2.5}$ from PM_{15} . The scaling factors are presented in Table D.9.

Table D.9: Scaling Factors

	PM_{10} from $TSP \leq 30 \mu m$	$PM_{2.5}$ from PM_{15}
Scaling Factor	0.75	0.105

Emission rates of $TSP \leq 30 \mu m$, PM_{10} , and $PM_{2.5}$ were calculated using the following equation.

$$ER = EF \left(\frac{kg}{hr} \right) \times Total Equipment Hours \times \frac{1 tonne}{1000 kg}$$

A summary of total emissions of $TSP \leq 30 \mu m$, PM_{10} , and $PM_{2.5}$ from excavating during the entire construction phase are provided in Table D.10.

Table D.10: Total Emissions from Excavating

Activity	Total Emissions (tonnes) ^[1]		
	TSP ≤ 30 µm	PM _{2.5}	PM ₁₀
Excavating	85.3	8.96	22.1

Notes:

[1] Total emissions calculated based on the total required equipment hours for liquefaction and storage. It was assumed that the construction phase could last for a minimum of three years and extend up to six years. It accounted for potential variations in the construction schedule, such as delays or changes in the pace of work, which would result in the same total work hours being completed over a longer timeframe (i.e. total emissions remain the same).

D.4.4 Grading

Grading activities will occur as part of construction through the use of a compactor. This activity will result in fugitive particulate emissions. Emissions from grading were estimated using information provided in AP-42 Chapter 11.9 Western Surface Coal Mining. Emissions calculations have not considered control methods for fugitive dust.

Emissions factors for TSP ≤ 30 µm and PM₁₅ were calculated using the following equation provided in AP-42 Table 11.9-2 for Grading.

$$TSP \leq 30 \mu m EF = 0.0034(S)^{2.5}$$

$$PM_{15} EF = 0.0056(S)^{2.0}$$

Where:

- EF = emission factor (kg/VKT)
- S = mean vehicle speed (km/hr)

The mean vehicle speed for the compactor was assumed to be 5 kilometres per hour.

Scaling factors provided in AP-42 Table 11.9-2 were used to calculate emissions factors for PM₁₀ from TSP ≤ 30 µm and PM_{2.5} from PM₁₅. The scaling factors are presented in Table D.11.

Table D.11: Scaling Factors

	PM ₁₀ from TSP ≤ 30 µm	PM _{2.5} from PM ₁₅
Scaling Factor	0.60	0.031

Emission rates of TSP ≤ 30 µm, PM₁₀, and PM_{2.5} were calculated using the following equation.

$$ER = EF \left(\frac{kg}{VKT} \right) \times \frac{5 km}{hr} \times Total Equipment Hours \times \frac{1 tonne}{1000 kg}$$

A summary of the total emissions of TSP ≤ 30 µm, PM₁₀, and PM_{2.5} from grading, during the entire construction phase, are provided in Table D.12.

Table D.12: Total Emissions from Grading

Activity	Total Emission (tonnes) ^[1]		
	TSP ≤ 30 µm	PM _{2.5}	PM ₁₀
Grading	2.94	9.12E-02	1.30

Notes:

[1] Total emissions calculated based on the total required equipment hours for liquefaction and storage. It was assumed that the construction phase could last for a minimum of three years and extend up to six years. It accounted for potential variations in the construction schedule, such as delays or changes in the pace of work, which would result in the same total work hours being completed over a longer timeframe (i.e. total emissions remain the same).

D.4.5 Total Construction Emissions

Activities resulting in emissions during construction include non-road engines, on-road engines, material handling, excavating and grading. The proposed Project has removed all marine vessel deliveries from its scope. As a result, the revised Application considers excludes any marine transportation to the site entirely.

Table D.13 presents the emission summary of the activities during the entire construction phase.

Table D.13: Summary of Estimated Total Construction Emissions (in Tonnes) ^[1,2]

Activity	NO _x	SO ₂	CO	PM _{2.5}	PM ₁₀	VOC
Non-road Engines	43.3	0.08	13.90	1.81	1.87	3.53
On-road Engines	7.23	0.013	1.99	0.42	0.66	0.45
Material Handling	-	-	-	0.003	0.02	-
Excavating	-	-	-	8.96	22.10	-
Grading	-	-	-	0.09	1.30	-
Total	50.53	0.09	15.89	11.28	25.95	3.98

Notes:

[1] Total emissions calculated based on the total required equipment hours for liquefaction and storage. It was assumed that the construction phase could last for a minimum of three years and extend up to six years. It accounted for potential variations in the construction schedule, such as delays or changes in the pace of work, which would result in the same total work hours being completed over a longer timeframe (i.e. total emissions remain the same).

[2] Based on the feedback received, the proposed Project has removed all marine vessel deliveries from its scope. As a result, the revised Application excludes any marine transportation to the site entirely.

D.5 REFERENCES

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AQ-APPENDIX E

ABNORMAL CONDITIONS

E.1 INTRODUCTION

The following abnormal conditions are considered:

- Commissioning
- Startup and shutdown (SS)
- Upset condition
- Grid power outage

Non-routine flaring of LNG and other gases through the fully enclosed ground flare (T2_GF) is expected to occur during commissioning, start-up and shutdown (SS) and upset conditions. Only the emissions of NO₂ and SO₂ were considered for these cases, and emissions of other contaminants were considered insignificant.

As these events are intermittent and short-term, modelled concentrations are only compared to the 1-hour air quality standards and objectives. Emission characteristics are developed using the AERFlare spreadsheet recommended by Alberta Energy Regulator (AER) for routine and non-routine flaring operations (<https://www.aer.ca/regulating-development/rules-and-directives/directives/directive-060>), and information provided by Fortis. AERFlare spreadsheet (V3.02.220404) was obtained from the developer website (<https://www.zeltpsi.com/aertools.html>) and was used as directed by AER. Impacts were modelled with CALPUFF for the 3-year modelling years 2013 – 2015.

In case of a grid power outage, the T1A and Phase 2 emergency diesel generators (T1A_EG and T2_EG) will supply power to the facility. These conditions were modelled in CALPUFF for NO₂ only. Only short-term averaging period was considered.

E.2 MODELLING APPROACH

Non-routine flaring:

For non-routine flaring, exit flow parameters and emission rates from the T2-GF were estimated for the following non-routine operations:

- Commissioning of LNG trains
- Start-up and shut down
- Upset: thermal oxidizer stream rerouted to flare

As the flare is enclosed, the incinerator calculation process in the AERflare (v302.220404) spreadsheet was used to estimate the exit parameters at the flare outlet. The gas stream compositions and flow rate used as input to the AERflare spreadsheet are provided in Table E.1. A typical value of 100% Excess Air was assumed in the calculations.

Table E.1: Flowrate and Flow Composition^[1] at the Flare Inlet

Parameter	LNG Train Commissioning	SS	Upset
Flowrate (kg/h)	137,200	137,200	37,900
Volumetric Flowrate (10 ³ m ³ /d) ^[2]	4,562.9	4,562.9	785.2
H ₂ O (mol. fraction)	0.00009	0.00009	0.0215
N ₂ (mol. fraction)	0.01	0.01	0.0056
CO ₂ (mol. fraction)	0.02	0.02	0.39338
H ₂ S (mol. fraction) ^[3]	0.00001	0.00001	0.00020
CH ₄ (mol. fraction)	0.9536	0.9536	0.56891
C ₂ H ₆ (mol. fraction)	0.0101	0.0101	0.006
C ₃ H ₈ (mol. fraction)	0.0045	0.0045	0.0027
C ₄ H ₁₀ (mol. fraction)	0.0016	0.0016	0.0013
C ₅ H ₁₂ (mol. fraction) ^[4]	0.0001	0.0001	0.0004

Notes:

- [1] Flow compositions were normalized for input to the AERflare spreadsheet.
- [2] Estimated for input to AERflare spreadsheet and from ideal gas assumption at 1 atm and 15 °C.
- [3] All sulphides and Mercaptans were assumed to be H₂S.
- [4] C₅₊/BTX were assumed to be C₅H₁₂.

All CALPUFF settings and CALMET files were the same as for normal operations. For SS, the flare was modelled as a single source, and it was assumed all other sources at the facility will not be emitting. For the upset condition, the thermal oxidizer will be shut down, but the hot oil heater will be operating normally, therefore, both the flare and hot oil heater were modelled together.

The flare was modelled as a continuous point source in CALPUFF: note that it is not modelled as a flare source in CALPUFF because it is a ground flare, the flame is at the bottom of a tall enclosure, and the exhaust goes up the enclosure as if exiting a normal stack. It was conservatively assumed that the exit temperature at the top of the flare enclosure tower would be the same as that of normal flare operations (30C; provided by the flare manufacturer). The latter assumption is quite conservative as during more intense flaring the exhaust temperature could be higher, enhance buoyancy and initial plume rise. The exit diameter was set to the diameter of the flare tower. The exit velocity at the top of the tower was estimated at this exit temperature and diameter and from the calculated pseudo flow parameters at the flare outlet. And In-Stack-Ratio of NO₂ to NO_x of 0.4 was assumed for the ground flare similar to normal operations (process gas combustion as per the BC AQDMG). The estimated emission rates and exit velocities are presented in Table E.2.

Table E.2: Parameters Used for the Modelling of Phase 2 Non-Routine Flaring

Parameter	LNG Train Commissioning	SS	Upset
Exit Height (m) ^[1]	33.8		
Exit Diameter (m) ^[1]	20.7		
Exit Temperature (K) ^[2]	304		
Exit Velocity (m/s) ^[3]	3.03	3.03	0.97
SO ₂ Emission Rate (g/s) ^[4]	1.43	1.43	4.92
NO _x Emission Rate (g/s) ^[5]	58.7	58.7	10.1

Notes:

- [1] Based on information received on flare tower design
- [2] Assumed same as normal operating conditions
- [3] From estimated pseudo flowrate, corrected for actual exit diameter and temperature
- [4] Conservatively assuming 100% conversion of H₂S to SO₂
- [5] Based on US EPA emission factors (US EPA, 2018, AP-42, Chapter 13.5, Table 13.5-1 Emission Factors for Flare Operations)

Power Outage

For a facility-wide grid power outage the following was considered:

- Power outage: The emergency generators T2_EG and T1A EG running to provide power to the facility; T2_GF in pilot mode and Phase 2 thermal oxidiser running at critical load (T2_TO_CL).

The emergency diesel generators were modelled as single sources both with and without rain cap and the more conservative case (with rain cap) was chosen for modelling of power outage condition. Emission rates and stack parameters for the emergency generators, T2_GF and T2_TO_CL were provided by FortisBC and summarized in Table E.3 and Table E.4 below. Note that for the power outage condition only NO_x was modelled as the emission rates for other contaminants were minimal.

Table E.3: Emission Rates for the Power Outage Condition (in $\mu\text{g}/\text{m}^3$) ¹

Event	Source	ID	NO _x	CO	PM _{2.5} ²	PM ₁₀ ²	VOC
Power Outage	Phase 2 Emergency Generator	T2_EG	3.106	1.782	0.102	0.102	0.204
	T1A Emergency Generator	T1A_EG	8.914	0.466	0.085	0.085	0.296
	Phase 2 Flare (pilot mode ³)	T2_GF (pilot)	0.031	0.012	0.010	0.010	0.001
	Phase 2 Thermal Oxidizer (critical load ⁴)	T2_TO_CL (critical)	0.836	0.105	0.034	0.034	0.0001

Notes:

1. Only NO_x emissions were modelled.
2. It was assumed all particulate matter is PM_{2.5}.
3. Same as normal operation.
4. Only pilot burner is active. Fuel demand for critical load is 361.4 kg/hr.

Table E.4: Modelled Sources Parameters for the Power Outage Condition

Source	ID	Height (m)	Stack Diameter (m)	Exit Velocity (m/s)	Exit Temperature (K)	ISR ²	Release Orientation
Phase 2 Emergency Generator	T2_EG	5.944	0.457	33.84	758	0.083	Note ³
T1A Emergency Generator	T1A_EG	5.944	0.457	44.48	750	0.083	Note ³
Phase 2 Flare (pilot mode ⁴)	T2_GF (pilot)	33.8	20.73	0.82	304	0.4	Vertical, no cap
Phase 2 Thermal Oxidizer (critical load ⁵)	T2_TO (critical)	22.31	2.57	2.61	1089	0.4	Vertical, no cap

Notes:

1. Flow rate at normal conditions.
2. In-stack-ratio of NO₂/NO_x. Based on Table B-1 of BC Guidance on NO₂ Dispersion Modelling (2021) - Reciprocating IC Engine with Diesel.
3. This source was modelled with and without rain cap and maximum result of both was used for reporting.
4. Same as normal operation.
5. Only pilot burner is active. Fuel demand for critical load is 361.4 kg/hr.

E.3 MODELLING RESULTS

For non-routine flaring (i.e. commissioning, SS, and upset conditions), as well as the power outage conditions, the NO₂ concentrations (using OLM) were predicted to be above the ambient air quality objectives and standards. Note that these events are expected to be infrequent, and last for a few hours only. Predicted SO₂ concentrations for commissioning and SS flaring were well below the ambient air quality objectives and standards. For the upset flaring conditions, the predicted SO₂ concentrations exceed both the MV objective and the CAAQS. Modelling results are summarized in Table E.5 below. Isoleths are provided in Figures E.1 through E.7.

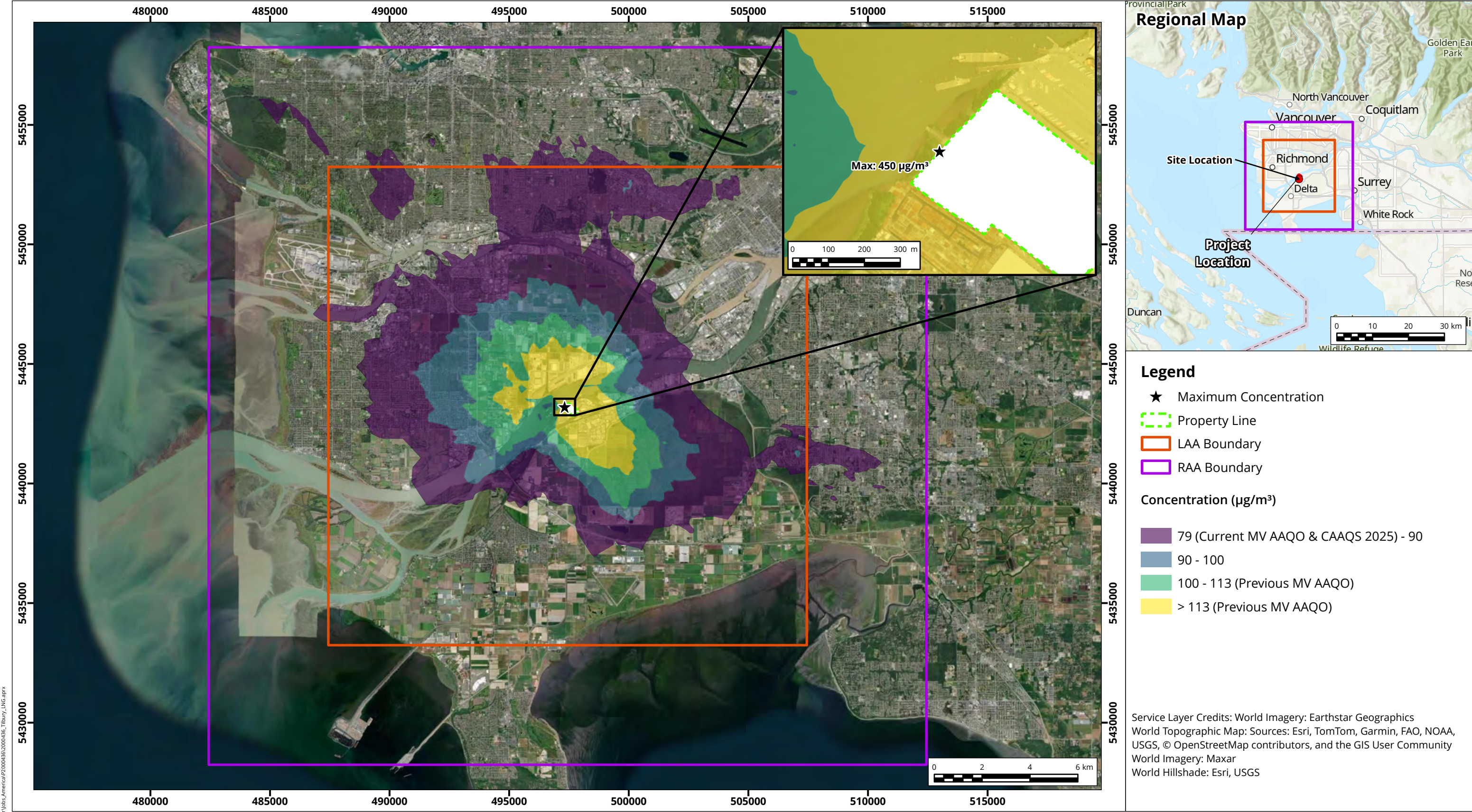
Table E.5: Predicted hourly Concentrations (annual 98th percentile of hourly values) averaged over 2013-2015 for Abnormal Conditions (in µg/m³)

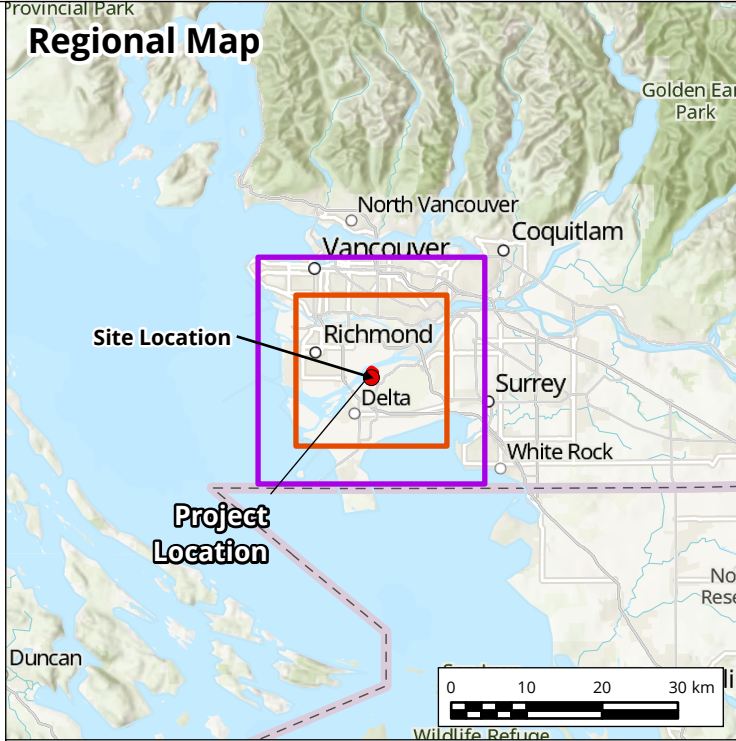
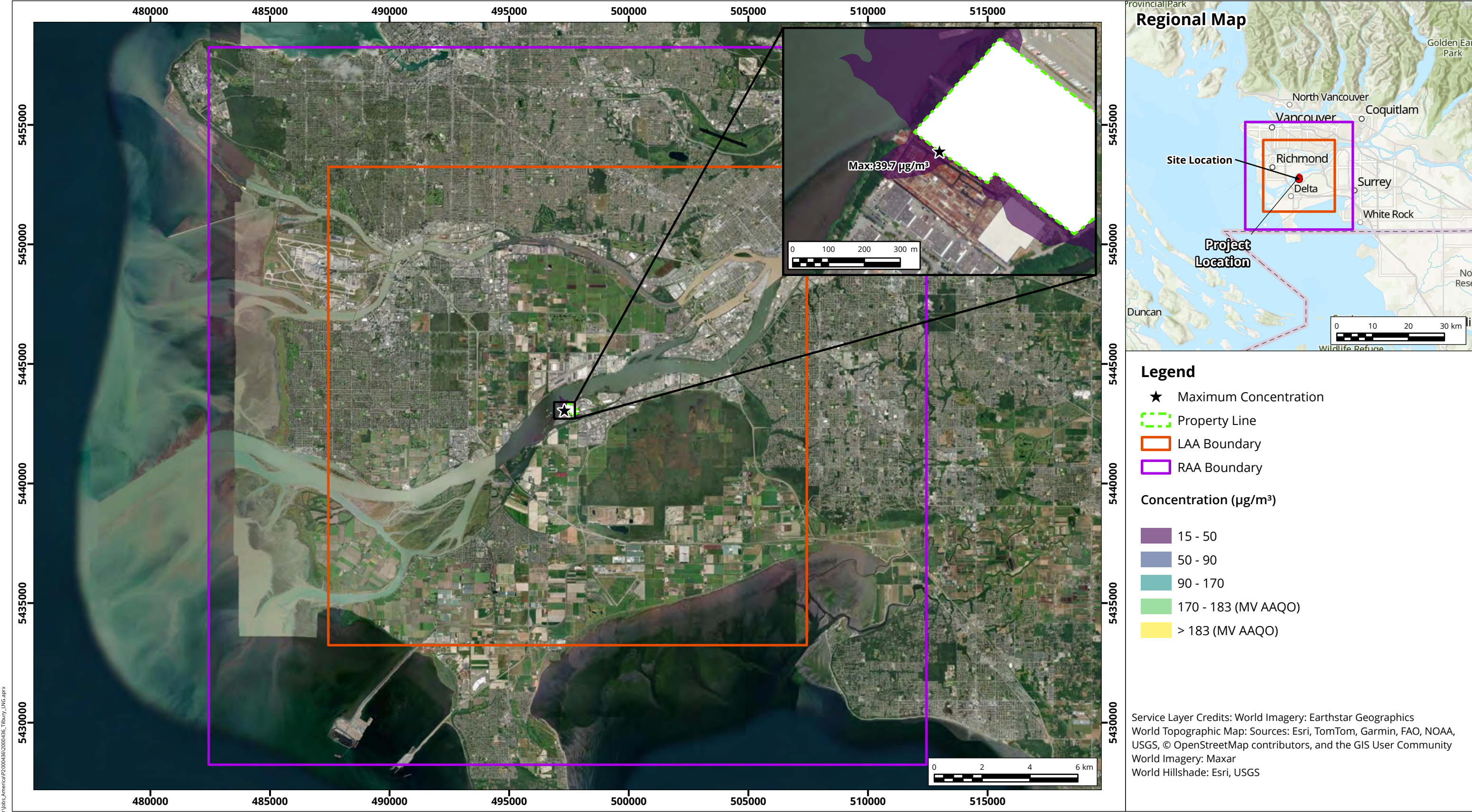
Conditions	Contaminant	Averaging Period	Predicted Concentration		Objective/Standard
			Project	Project + Background	
Commissionin g of LNG Train	NO ₂ (Total Conversion)	1-hour	835	894	Previous MV: 113 Current MV and CAAQS: 79
	NO ₂ (OLM)		392	450	Previous MV: 113 Current MV and CAAQS: 79
	SO ₂		36.1	39.7	MV: 183
			27.3	30.9	CAAQS: 170.3
Startup/shutd own	NO ₂ (Total Conversion)		835	894	Previous MV: 113 Current MV and CAAQS: 79
	NO ₂ (OLM)		392	450	Previous MV: 113 Current MV and CAAQS: 79
	SO ₂		36.1	39.7	MV: 183
			27.3	30.9	CAAQS: 170.3
Upset	NO ₂ (Total Conversion)		557	615	Previous MV: 113 Current MV and CAAQS: 79
	NO ₂ (OLM)		278	336	Previous MV: 113 Current MV and CAAQS: 79
	SO ₂		429	433	MV: 183
			304	307	CAAQS: 170.3
Power Outage	NO ₂ (Total Conversion)		1190	1248	Previous MV: 113 Current MV and CAAQS: 79
	NO ₂ (OLM)		171	229	Previous MV: 113 Current MV and CAAQS: 79



List of Contour Plots for Abnormal Conditions

E.1	Predicted Annual 98 th perc. of D1HM NO ₂ (OLM) Concentrations Averaged over 2013-2015 - Commissioning, Startup and Shutdown Conditions
E.2	Predicted Annual 100 th perc. of 1-Hour SO ₂ Concentrations Averaged over 2013-2015 - Commissioning, Startup and Shutdown Conditions
E.3	Predicted Annual 99 th perc. of D1HM SO ₂ Concentrations Averaged over 2013-2015 - Commissioning, Startup and Shutdown Conditions
E.4	Predicted Annual 98 th perc. of D1HM NO ₂ (OLM) Concentrations Averaged over 2013-2015 - Upset Conditions
E.5	Predicted Annual 100 th perc. of 1-Hour SO ₂ Concentrations Averaged over 2013-2015 - Upset Conditions
E.6	Predicted Annual 99 th perc. of D1HM SO ₂ Concentrations Averaged over 2013-2015 - Upset Conditions
E.7	Predicted Annual 98 th perc. of D1HM NO ₂ (OLM) Concentrations Averaged over 2013-2015 - Grid Power Outage Conditions





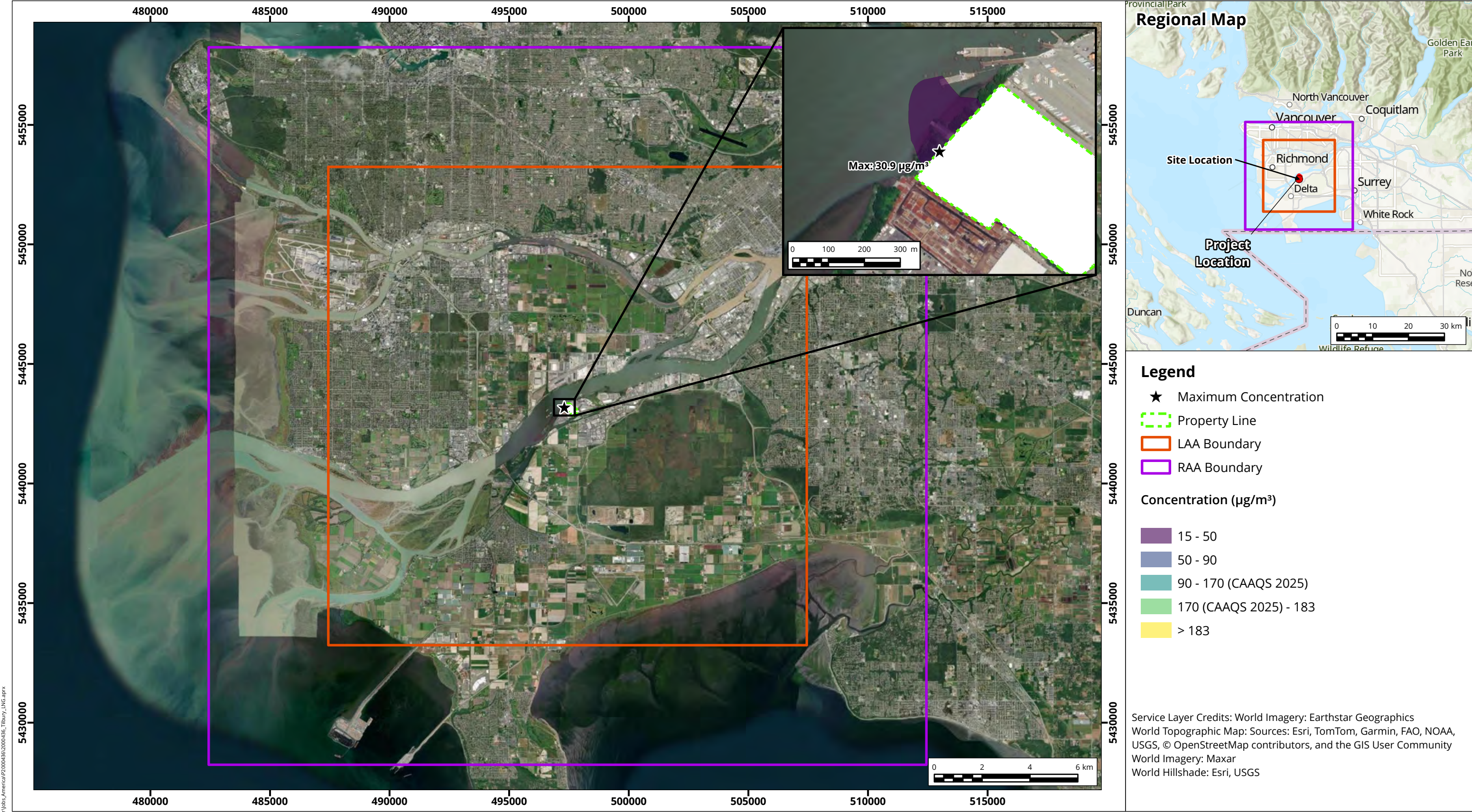
Legend

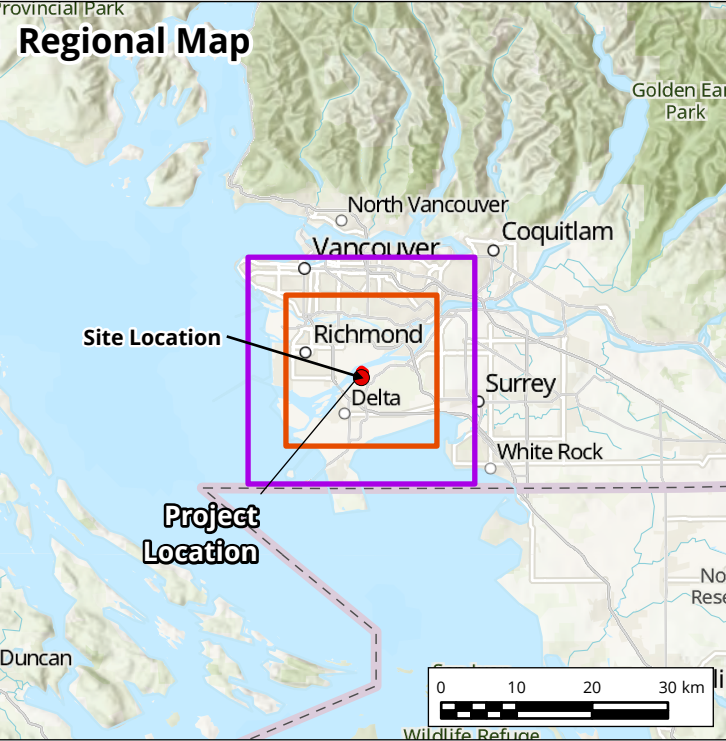
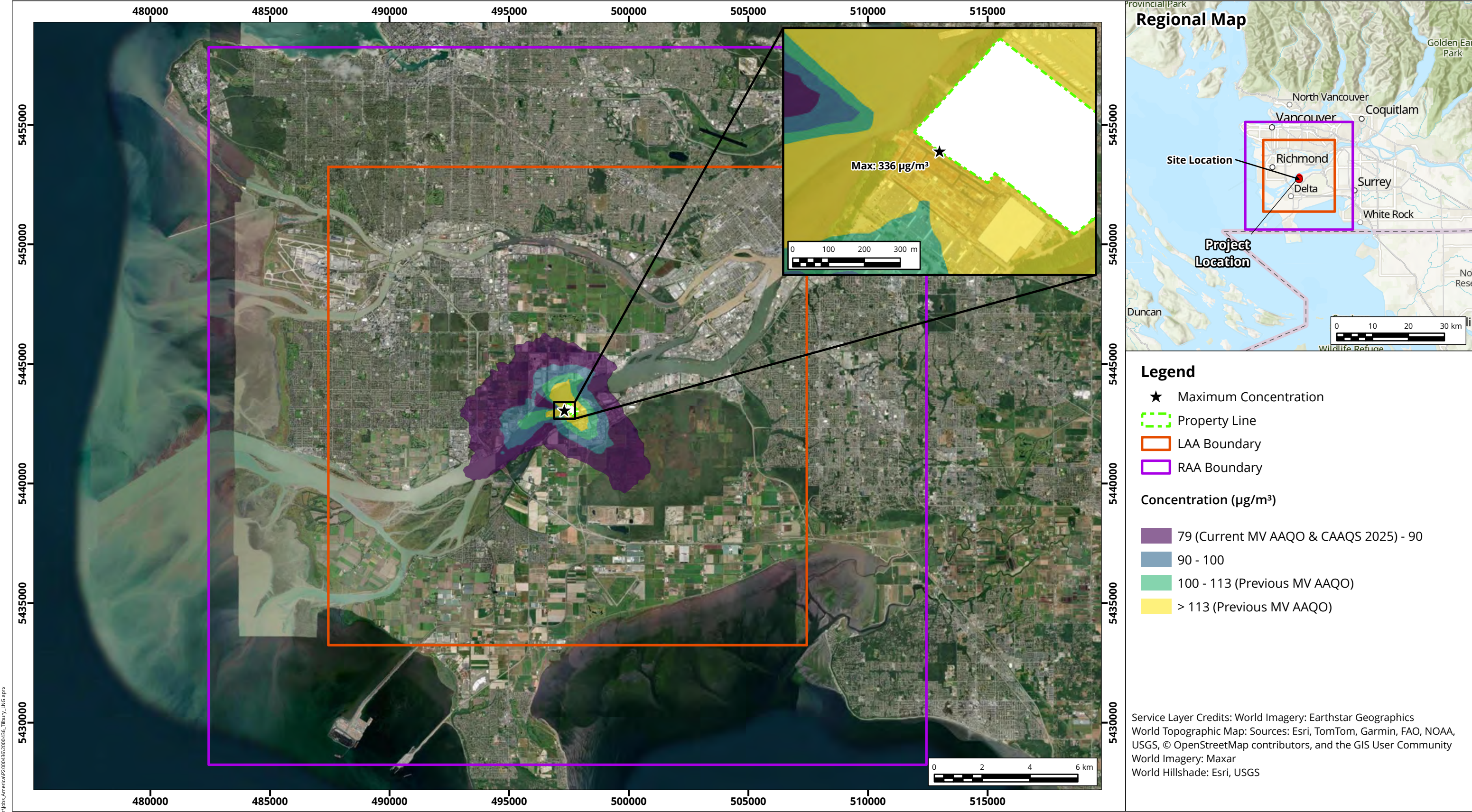
- ★ Maximum Concentration
- Property Line
- LAA Boundary
- RAA Boundary

Concentration ($\mu\text{g}/\text{m}^3$)

- 15 - 50
- 50 - 90
- 90 - 170
- 170 - 183 (MV AAQO)
- > 183 (MV AAQO)

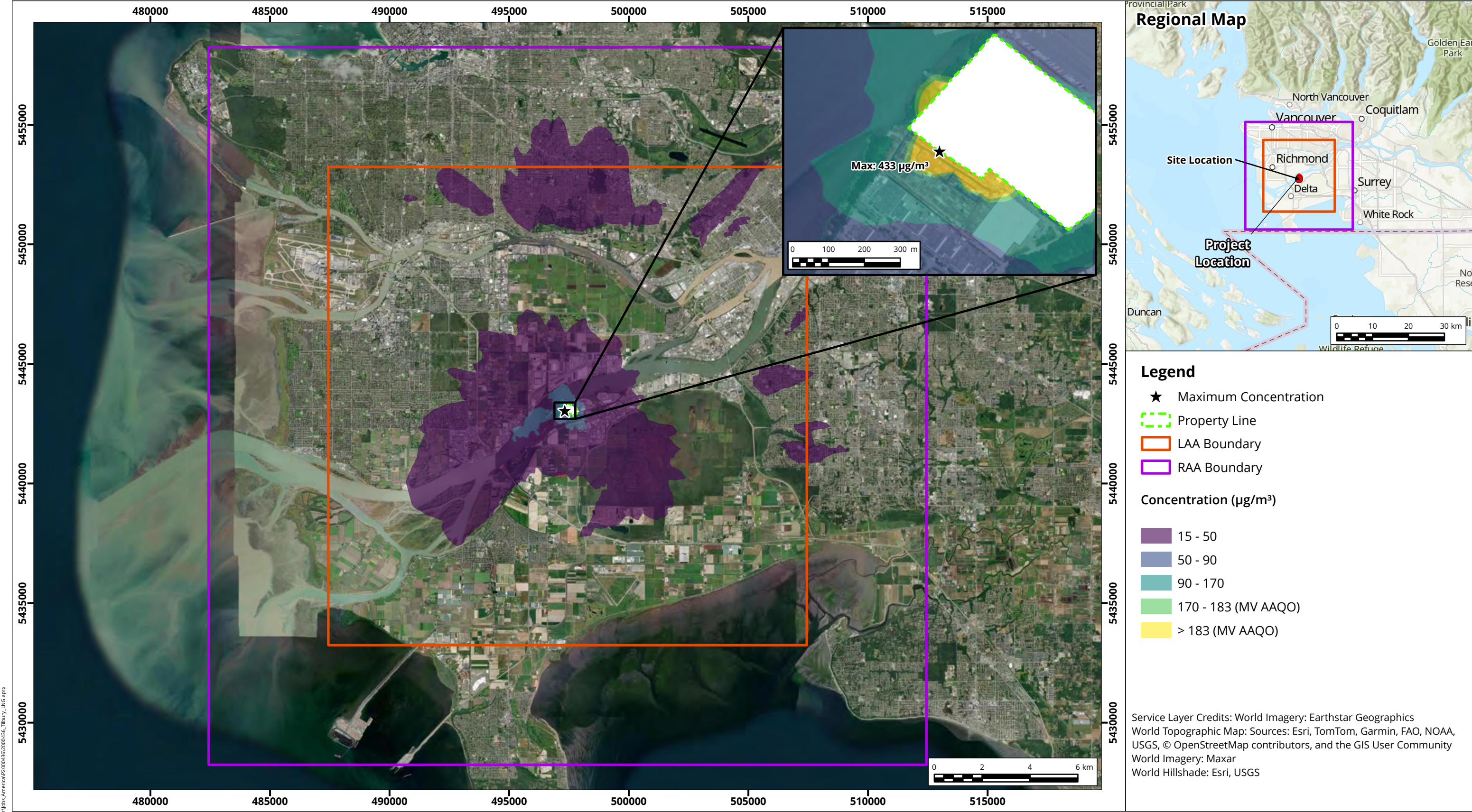
Service Layer Credits: World Imagery: Earthstar Geographics
World Topographic Map: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
World Imagery: Maxar
World Hillshade: Esri, USGS

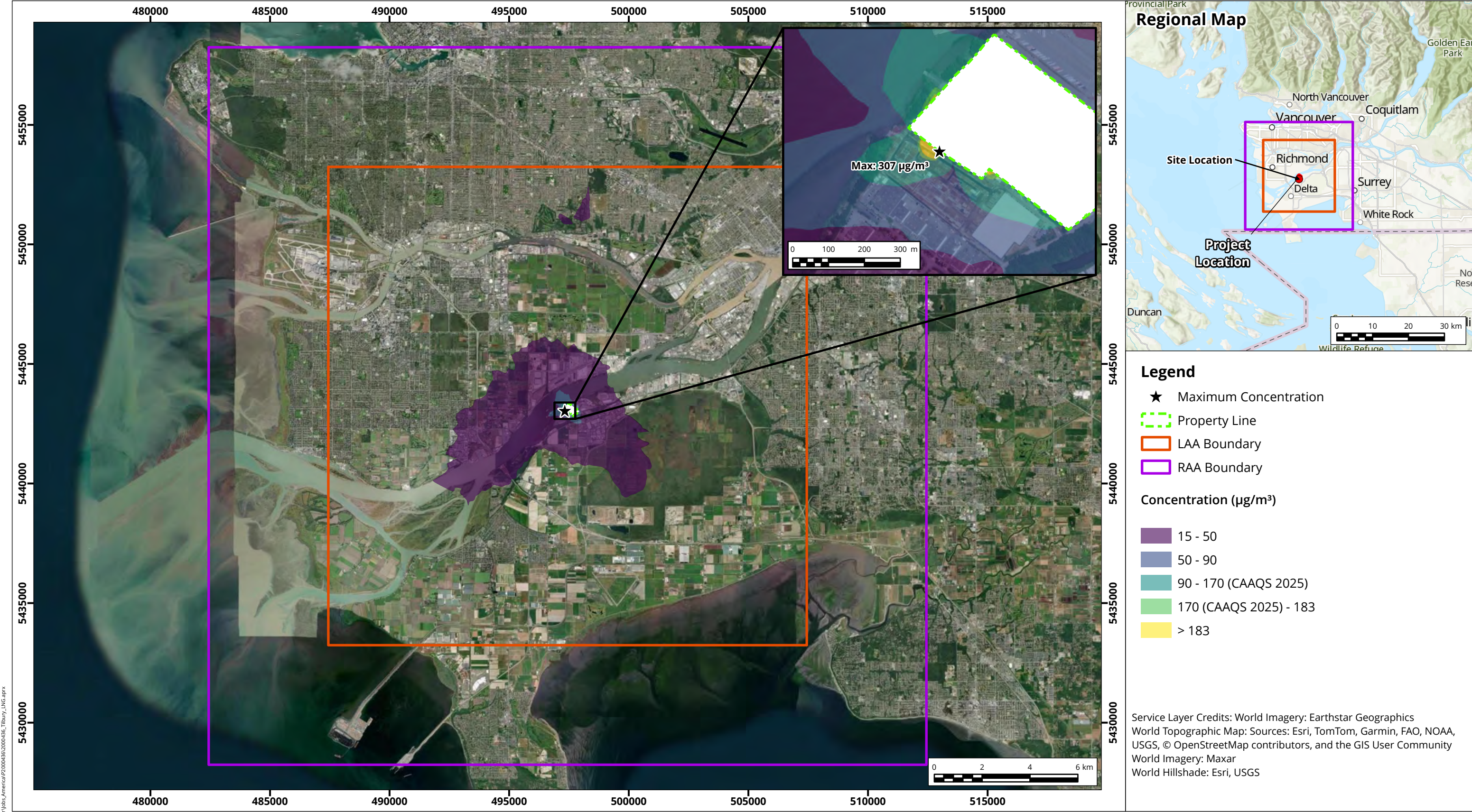


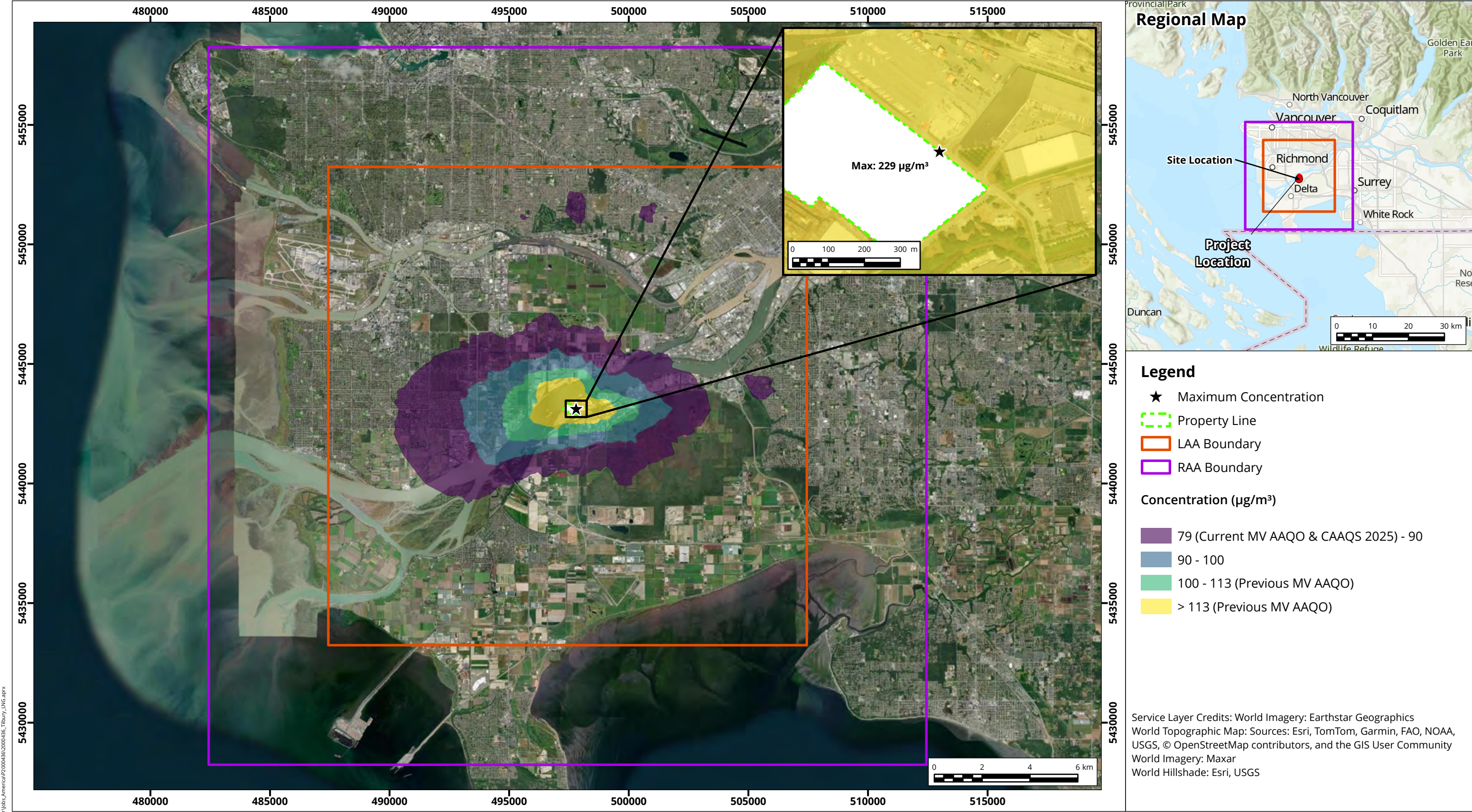


- Legend**
- ★ Maximum Concentration
 - Property Line
 - LAA Boundary
 - RAA Boundary
- Concentration ($\mu\text{g}/\text{m}^3$)**
- 79 (Current MV AAQO & CAAQS 2025) - 90
 - 90 - 100
 - 100 - 113 (Previous MV AAQO)
 - > 113 (Previous MV AAQO)

Service Layer Credits: World Imagery: Earthstar Geographics
World Topographic Map: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
World Imagery: Maxar
World Hillshade: Esri, USGS







AQ-APPENDIX F

TILBURY MARINE JETTY

F.1 MODELLING SCENARIOS

Emissions from the proposed Tilbury Marine Jetty Project (TMJ) were considered for the cumulative assessment. The proposed TMJ is undergoing an environmental assessment and the application is currently under review.

The normal operation modelling scenarios and emissions for TMJ were taken from reports submitted to date to the BC Environmental Assessment Office (EAO) as part of the assessment process, and downloaded from EPIC (<https://www.projects.eao.gov.bc.ca/>), namely:

- Appendix 4.4.1-6 Air Emission Estimation Methodology (Golder, 2018),
- Wespac Tilbury Marine Jetty Project Building Downwash Supplemental Memo (Golder, 2019) and,
- Bunker Vessel Scenario Assessment, Tilbury Marine Jetty Project (Golder, 2022).

Activities resulting in emissions include berthing and loading of LNG carriers (diesel-powered and LNG-powered) and diesel-powered ATB¹ bunkering vessels at the proposed TMJ, marine mobile emissions along the shipping route, patrolling with a security vessel and dredging. All emission sources are shown in Figure F.1, and emission details for the modelled scenarios are provided in Section 2 of this Appendix.

The most representative scenarios are considered for each short-term averaging period, while the full planned activities are assessed for the annual average scenario, as summarized in Table F.1:.

For the purpose of a cumulative assessment with the Project, the most representative hourly TMJ scenario was modelled. Since planned bunkering activity (nearly daily) is much more frequent than planned LNG tanker activity (about once a week), hourly emissions associated with bunkering were modelled for the hourly scenario.

¹ ATB = Articulated Tug Barge



Table F.1: Normal Operation Modelled Scenarios Summary

Equipment	Specifications	Assumption
1-hour Scenario		
Diesel-Powered ATB Bunker Vessels	4,000 m ³ LNG capacity	- Auxiliary engine operates for 0.4 hours during loading - The main and auxiliary engines of the diesel-powered ATB bunker vessel operate for 0.6 hours during berthing/departing
Security Vessel	N/A	Main engine operating for 1 hour
8-hour Scenario¹		
Diesel-Powered ATB Bunker Vessels	4,000 m ³ LNG capacity	- Auxiliary engine operates for 6.5 hours during loading - The main and auxiliary engines of the diesel-powered ATB bunker vessel operate for 0.6 hours during berthing/departing
Diesel-Powered LNG Carrier	100,000 m ³ LNG capacity	The main and auxiliary engine plus boiler operating for 0.9 hours during berthing/departing
Security Vessel	N/A	Main engine operating for 8 hours
24-hour Scenario¹		
Diesel-Powered ATB Bunker Vessels	4,000 m ³ LNG capacity	- Auxiliary engine operates for 6.5 hours during loading - The main and auxiliary engines of the diesel-powered ATB bunker vessel operate for 0.6 hours during berthing/departing
Diesel-Powered LNG Carrier	100,000 m ³ LNG capacity	The main and auxiliary engine plus boiler operating for 2 hours during berthing/departing and the auxiliary engine operating for 14.9 hours during loading
Security Vessel	N/A	Main engine operating for 24 hours in security zone (area source)
Annual Scenario		
Diesel-Powered ATB Bunker Vessels	4,000 m ³ LNG capacity	307 LNG bunker vessel calls per year, where 100% of the bunker vessels are assumed to be the 4,000 m³ Diesel-Powered ATBs without assistance of diesel-fueled tug vessels
Diesel-Powered LNG Carrier	100,000 m ³ LNG capacity	6 Diesel-Powered LNG carrier calls per year (10% of the carriers), with assistance of three diesel-fueled tug vessels per call
LNG-Powered Carrier	100,000 m ³ LNG capacity	52 LNG-powered carrier calls per year (90% of the carriers), with assistance of three diesel-fueled tug vessels per call
Three Tug Vessels	3,728 kWh Diesel-Powered Engine	174 tug vessels assisting 58 LNG carrier calls (three for each call),
Security Vessel	N/A	25 days per year of security vessel patrol
Dredger	Main & Auxiliary Engines, Thrusters and Pumps	14 days per year of 24-hour dredger work
Shipping emissions	N/A	Shipping emissions along shipping route based on average annual TMJ emissions scaled down to Fortis, BC, Tilbury LNG facility modelling domain.

Note: ¹ Tug vessels assisting diesel-powered LNG carrier during berthing/departing were not included for short -term averaging periods.

F.2 MARINE EMISSIONS AND SOURCE PARAMETERS

F.2.1 Source Parameters

Source parameters for all point and area sources are included in Table F.2 and F.3 respectively

Table F.2: Modelled Point Source Parameters

Modelled Emission Source	Emission Activities	UTM Zone 10		Stack Height (m)	Base Elevation (m asl)	Stack Diameter (m)	Exit Velocity (m/s)	Exit Temperature (K)	Include Building Downwash?
		Easting (km)	Northing (km)						
Diesel-Powered LNG Carrier ¹	Diesel Carrier Main & Auxiliary Engine Emissions, Boiler Emissions	496.799	5443.225	47	0	1.0	20	655	Y
Tug Vessel 1 ²	Tug Main Engine Emissions	497.031	5443.352	10	0	0.3	20	573	Y
Tug Vessel 2 ²	Tug Main Engine Emissions	496.867	5443.338	10	0	0.3	20	573	Y
Tug Vessel 3 ²	Tug Main Engine Emissions	496.767	5443.199	10	0	0.3	20	573	Y
Dredger	Dredger Main & Auxiliary Engine, Thrusters and Pumps Emissions	496.897	5443.276	17	0	0.3	20	655	N
LNG Powered Carrier (LNG powered)	LNG Powered LNG Carrier Main & Auxiliary Engine Emissions	496.799	5443.225	47	0	1.0	20	655	Y
Diesel-Powered ATB Bunker Vessel	Diesel-Powered ATB Bunker Vessel Main & Auxiliary Engine Emissions	496.947	5443.306	18	0	0.5	20	655	N

Notes: ¹ UTM's were updated and building downwash from the diesel-powered carrier was included as per Golder, 2019.
² Building downwash was included as per Golder, 2019.

Table F.3: Normal Operation Modelled Area Source Parameters

Modelled Emission Source	Emission Activities	Effective Height (m)	Base Elevation (m asl)	Sigma Z (m)	Area (m ²)
Security Vessel	Main Engine Emissions	1.5	0	1.40	164,848
Shipping Emissions ²	Mobile Emissions	10	0	4	3,067,214

Note: ¹ RWDI did not include VOC emissions from pipeline fugitive losses.

F.2.2 One hour averaging period

The normal operation scenario includes the main and auxiliary engine emissions and boiler emissions from one diesel-powered ATB bunker vessel with a maximum capacity of 4,000 m³ LNG and the main engine emissions from a security vessel. The main and auxiliary engines of the diesel-powered ATB bunker vessel operate for 0.6 hours during departing and berthing, and the auxiliary engine operate for 0.4 hours during loading.

Hourly emission rates for the diesel-powered ATB bunker vessel are summarized in Table F.4 and hourly emission rates for the security vessel are summarized in Table F.5.

Table F.4: Hourly Emission Rates

Modelled Emission Source	Emission Activities	Emission Rate (g/s)					
		NO _x	SO ₂	CO	PM _{2.5}	PM ₁₀	VOC
Diesel-Powered ATB Bunker Vessel ³	Diesel-Powered ATB Bunker Vessel Main & Auxiliary Engine Emissions	0.654	0.0050	0.118	0.020	0.021	0.053

Table F.5: Normal Operation Modelled Area Source Parameters - Hourly Emission Scenario

Modelled Emission Source	Emission Activities	Emission Rate (g/s)					
		NO _x	SO ₂	CO	PM _{2.5}	PM ₁₀	VOC ¹
Security Vessel	Main Engine Emissions	0.287	0.0001	0.023	0.005	0.005	0.008

Note: ¹ RWDI did not include VOC emissions from pipeline fugitive losses.

F.2.3 Eight-hour averaging period

The 8-hour averaging period is based on:

- 0.6 hours of operation of the main and auxiliary engine during departing/preparing, auxiliary engine operating for 6.5 hours during loading for one diesel-powered ATB bunker vessel, and
- One diesel-powered LNG carrier's main and auxiliary engine plus boiler operating for 0.9 hours during berthing/departing.
- Tug vessels assisting diesel-powered LNG carrier during berthing/departing were not included.
- Security vessel main engine operating for 8 hours.

This represents the normal operation 8-hour averaging period which applies to CO only. The modelled emission rates are provided in Table F.6

Table F.6: Emissions for Each Activity and Duration in the 8-hour Emission Scenario

Emission Source	Activity	CO (g/s)	Hours
Diesel-Powered LNG Carrier	Carrier Main and Auxiliary Engine Emissions and Boiler Emissions during berthing, departing and preparing	0.051	0.9
Diesel-Powered ATB Bunker	Bunker Vessel Main and Auxiliary Engine Emissions during departing and preparing	0.024	0.6
	Bunker Vessel Auxiliary Engine Emissions during loading		6.5
Security Vessels	Security Vessel Main Engine Emissions	0.023	8

F.2.4 24-hour averaging period

The 24-hour averaging period is based on:

- 0.6 hours of operation of the main and auxiliary engine during departing/preparing, auxiliary engine operating for 6.5 hours during loading for one diesel-powered ATB bunker vessel.
- One diesel-powered LNG carrier's main and auxiliary engine plus boiler operating for 2 hours during berthing/departing and the auxiliary engine operating for 14.9 hours during loading.
- Tug vessels assisting one diesel-powered LNG carrier during berthing, departing and preparing were not included.
- Security vessel main engine operating for 24 hours.

This represents the normal operation 24-hour averaging period which applies to PM_{2.5} and PM₁₀ only. The modelled emission rates are provided in Table F.7

Table F.7: Emissions for Each Activity and Duration in the 24-hour Emission Scenario

Emission Source	Activity	PM _{2.5} (g/s)	PM ₁₀ (g/s)	Hours/day
Diesel-Powered LNG Carrier	Carrier Main and Auxiliary Engine Emissions and Boiler Emissions during berthing, departing, preparing	0.029	0.031	2.0
	Auxiliary Engine Emissions during loading			14.9
Diesel-Powered ATB Bunker	Bunker Vessel Main and Auxiliary Engine Emissions during departing, preparing and loading	0.002	0.002	0.6
	Auxiliary Engine Emissions during loading			6.5
Security Vessels	Security Vessel Main Engine Emissions	0.005	0.005	24

F.2.5 Annual averaging period

The Bunker Vessel Assessment Report (Golder, 2022) indicated that shipping emissions along the South Fraser River from Sand Heads Lighthouse to the Project location and back to Sand Heads Lighthouse were included and provided the annual emissions in Section 4.2, Table C8 of that report. These emissions were included into the annual scenario but scaled down to the portion of the route included in the RAA modelling domain.

Marine vessels in transit along the shipping routes were modelled in CALPUFF as 10 area sources. A series of adjacent area sources were defined along the shipping routes with a maximum length-to-width ratio of 10. The width of the area sources was set to approximately 240 m within the Fraser River corridor. Area source parameters for modelling combustion emissions from marine engines were selected to represent a typical exhaust stack from a tug vessel as tug emissions are the primary contributor (approximately 86%) of total NO_x shipping emissions. The release height was set to 10 m with an initial sigma-z of 4 m.

All anticipated emissions over one year (as per Golder (2022)) were modelled, including:

- 58 LNG carrier calls per year, with assistance of three diesel-fueled tugs per call; where 90% of the carriers are expected to be LNG-fueled vessels while the remaining 10% are diesel-fueled vessels;
- 307 LNG bunker vessel calls per year, where 100% of the bunker vessels are assumed to be 4,000 m³ Diesel-Powered ATBs without assistance of diesel-fueled tug vessels;
- 25 days per year of security vessel patrol;
- 14 days per year of 24-hour dredger work; and,
- Shipping emissions based on average annual emissions scaled down to Fortis, BC, Tilbury LNG facility modelling domain.



Annual emissions are provided in Table F.8

Table F.8: Annual emission rates

Modelled Emission Source	Emission Rates (g/s)					
	NO _x	SO ₂	CO	PM _{2.5}	PM ₁₀	VOC
Diesel-Powered Carrier	0.032	0.001	0.003	0.001	0.001	0.001
Tug Vessel 1	0.054	2.7E-05	0.007	0.001	0.001	0.003
Tug Vessel 2	0.054	2.7E-05	0.007	0.001	0.001	0.003
Tug Vessel 3	0.054	2.7E-05	0.007	0.001	0.001	0.003
Dredger	0.336	1.7E-04	0.047	0.007	0.008	0.018
LNG Powered Carrier	0.008	0	0.008	5.2E-05	5.2E-05	0.002
Diesel-Powered Bunker Vessel	0.053	0.001	0.007	0.001	0.001	0.003
Security vessels	0.020	9.0E-06	0.002	3.2E-04	3.4E-04	0.001
Shipping Emissions	1.126	0.007	0.623	0.024	0.024	0.144



F.3 REFERENCES

Golder, 2018: Appendix 4.4.1-6 Air Emission Estimation Methodology. Accessed January, 2022: [Microsoft Word - 1314220049-169-A-Rev0-Appendix 4.4.1-6 Emissions Estimate 11OCT 18.docx \(gov.bc.ca\)](#)

Golder, 2019: Wespac Tilbury Marine Jenny Project Building Downwash Supplemental Memo. Accessed January, 2022: [20190808 MV AQwe Building Downwash.pdf \(gov.bc.ca\)](#)

Golder, 2022: Bunker Vessel Scenario Assessment, Tilbury Marine Jetty Project.

AQ-APPENDIX G

METEOROLOGICAL MODELLING



G.1 INTRODUCTION

In order to provide three-dimensional hourly meteorological input into CALPUFF, the BC regulatory model, CALMET (Scire et al, 2000), was run for a three-year period from January 1, 2013, to December 31, 2015, over the RAA (i.e. over a 30 km by 30 km modelling domain), with input from local hourly meteorological observations from the Metro Vancouver monitoring network and mesoscale meteorological modelling fields provided BC ENV.

CALMET horizontal domain resolution was set at 200 m. In the vertical direction, 12 layers were chosen, from the surface to 3000m, with the top of the layers set as 20, 40, 60, 100, 150, 200, 300, 500, 1000, 1500, 2000 and 3000 m above ground level.

CALMET was initialized for the three-year model period using the Weather Research and Forecasting (WRF) model. The WRF model is a mesoscale, numerical, weather prediction system designed to serve both atmospheric research and operational forecasting needs. It represents the latest numerical weather forecasting model to be adopted by the United States National Weather Service and by the United States military and private meteorological services. The BC MOE WRF dataset for 2013-2015, with a 4-km configuration covering a 100 km by 100 km area over Vancouver and southwestern B.C., was obtained from Exponent Inc (http://www.src.com/calpuff/data/bc_wrf.html)

In the absence of observed hourly upper air soundings in the vicinity of the Project, the WRF fields also provided upper meteorological information to the modelling.

The summary of CALMET model input datasets and setup is provided in Table G.1 and discussed in more details in Section G.2

The CALMET model performance was assessed by reviewing various model outputs and, where possible, comparing to observations, as per MV Modelling protocol. This analysis is presented in Section G.3.

Table G.1: Summary of CALMET Setup

Parameter	Period of Record (start/end date)
Meteorological Model	CALMET Version 6.5.0
Modeling Period	January 1, 2013 to December 31, 2015
Domain Size	RAA: 30 km x 30 km, centered on the Project
Grid Resolution	200 m
Prognostic Data	WRF at 4km resolution, provided by ENV
Surface Meteorology	Surface observations blended with WRF
Terrain Elevations	Canadian Digital Elevation Model (Natural Resources Canada)
Land Cover Data	Baseline Thematic Mapping present land use version 1 spatial layer (BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development)



G.2 CALMET SETTINGS

The terrain elevation characterization information used as input into the CALMET model was obtained from Canadian Digital Elevation Model (Natural Resources Canada). The land cover characterization information used as input into CALMET was obtained from Baseline Thematic Mapping present land use version 1 spatial layer (BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development). The terrain elevation and land use information for the study area used as input into the CALMET model are illustrated in Figure G.1 and Figure G.2.

Geophysical Parameters

The CALMET model requires gridded geophysical parameters including surface roughness length, albedo, Bowen ratio, soil heat flux, vegetation leaf area index, and anthropogenic heat flux. To represent the seasonally dependent geophysical parameters more accurately in the CALMET model, five seasons were specified as per the BC AQDMG (ENV, 2022):

- Season 1: Mid-summer with lush vegetation (June to August)
- Season 2: Autumn with cropland that has not yet been harvested (September and October)
- Season 3: Winter with freezing temperatures, no snow on ground (November to March)
- Season 4: Winter with sub-freezing temperatures, snow cover on ground (Not used as these conditions are infrequent in Project location)
- Season 5: Transitional spring with partially green short annuals (April and May)

All geophysical parameters were defined by land cover characterization type and seasonal category based on the BC modelling guideline. A 2D map of the gridded land use categories over the RAA is provided in Figure G.2.

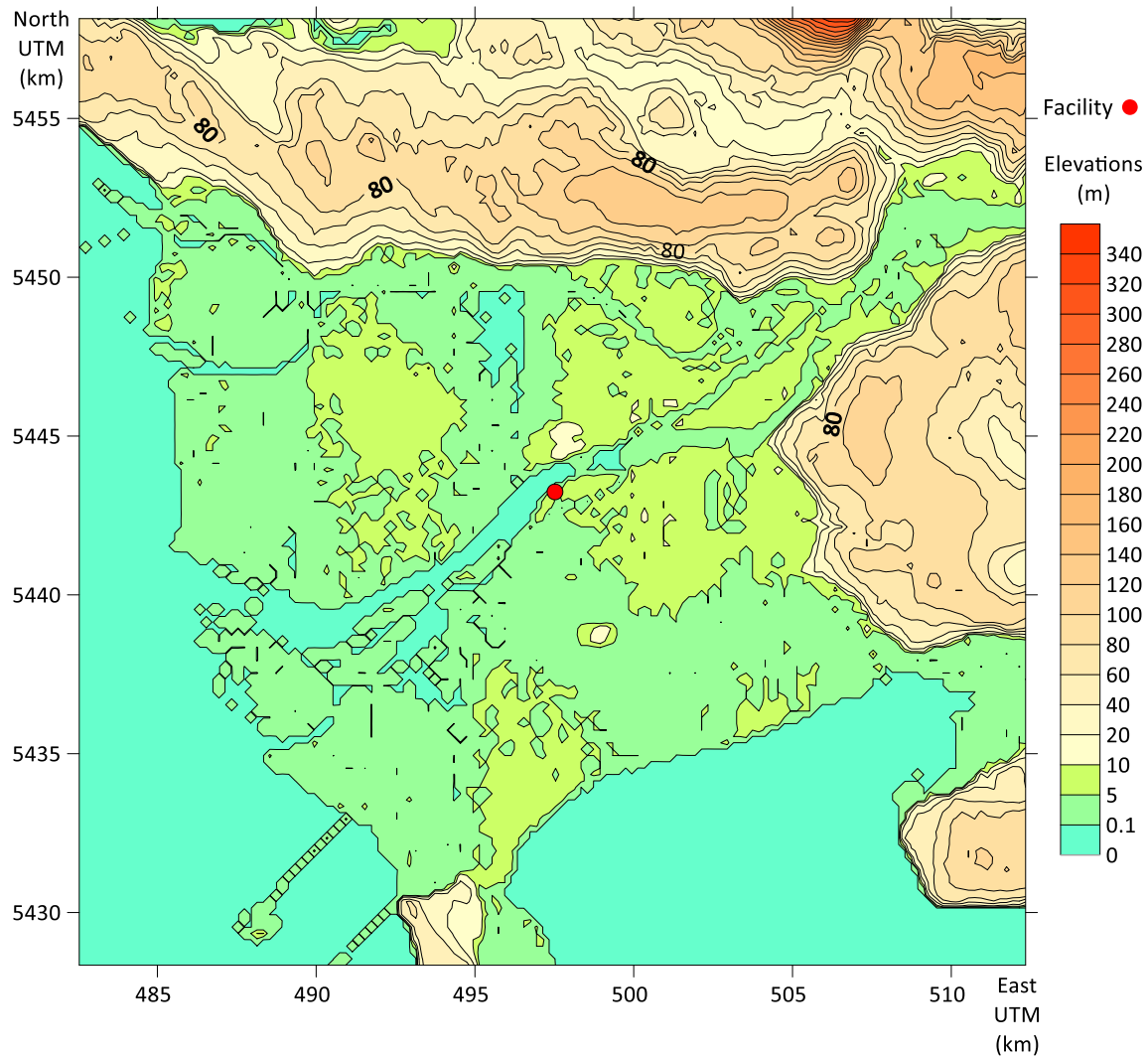


Figure G.1: Terrain Elevations in CALMET Domain

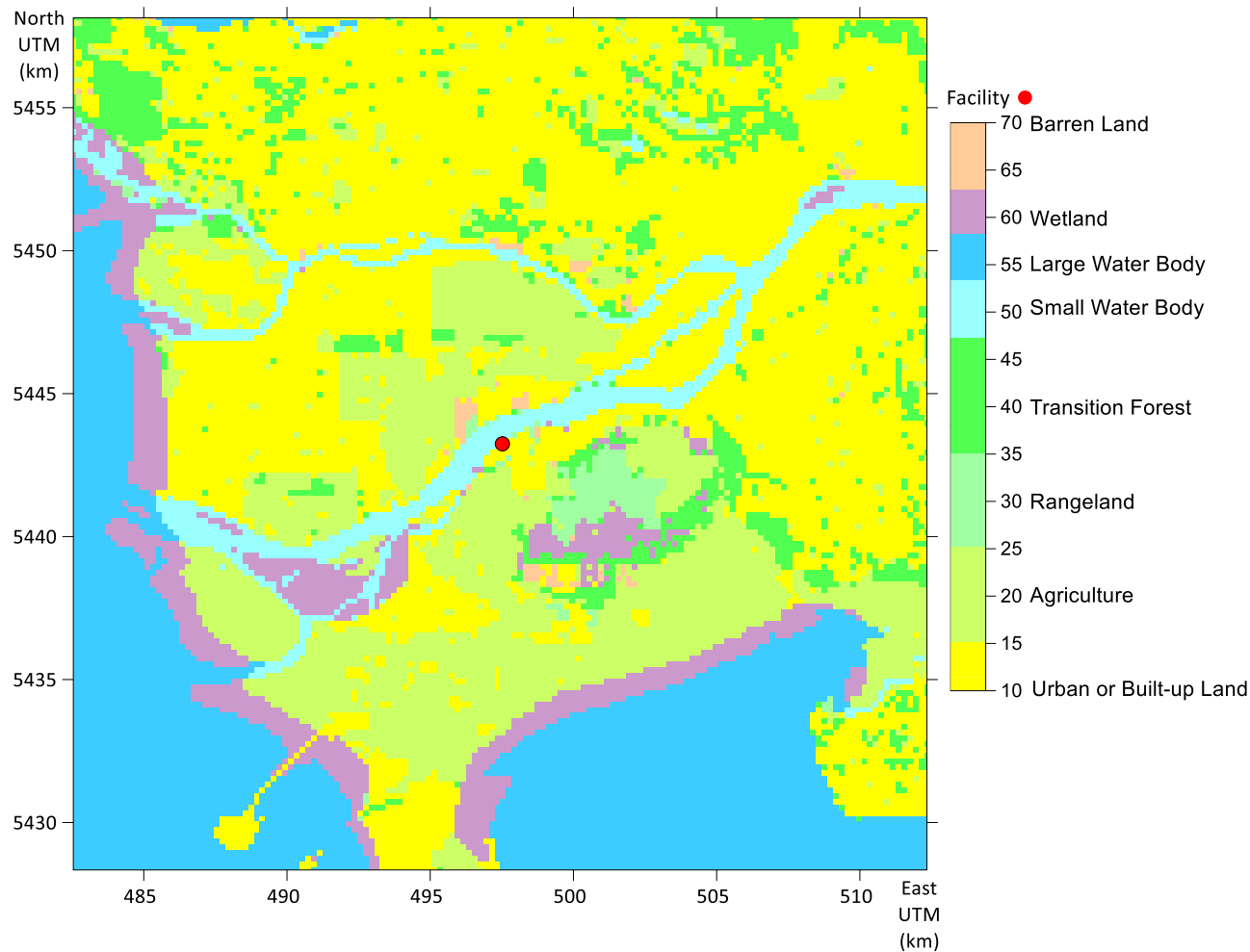


Figure G.2: Land Use in CALMET Domain



Surface Meteorology

Surface meteorological data from the MV network were obtained from Metro Vancouver, and used in the CALMET model, as well as data from the ECCC station at the Vancouver Airport (YVR). A total of nine surface stations were used in the CALMET model as presented in Table G.2. The locations of the surface meteorological stations are shown in Figure G.3.

As recommended by Metro Vancouver, for stations with Ultimate Logger, measured wind speeds less than 1.1 km/h at the MV stations were set as calms in the CALMET model to account for the anemometer stall speed. Also, wind speed and direction measurements taken by ECCC at the Vancouver International Airport were excluded from the CALMET model because they are not hourly averages.

Table G.2: Surface Meteorological Data Stations in CALMET

Surface Met Data Station	Data Source	Period of Record (start/end date)	% of Wind Speeds = 0.0 ¹
T2 - Vancouver Kitsilano	MV	January 1, 2013/December 31, 2015	2.2
T13 - North Delta	MV	January 1, 2013/December 31, 2015	0.1
T17 - Richmond South	MV	January 1, 2013/December 31, 2015	0.2
T18 - Burnaby South	MV	January 1, 2013/December 31, 2015	0.0
T22 - Burnaby Burmount	MV	January 1, 2013/December 31, 2015	0.5
T31 - Richmond Airport	MV	January 1, 2013/December 31, 2015	0.0
T38 - Annacis Island	MV	January 1, 2013/December 31, 2015	0.0
T39 - Tsawwassen	MV	January 1, 2013/December 31, 2015	0.64
Vancouver Airport	ECCC	January 1, 2013/December 31, 2015	Wind data excluded ²

Notes: ¹ Measured wind speeds less than 1.1 km/h at the MV stations with Ultimate Logger were set as calms in the CALMET model to account for the anemometer stall speed, as recommended by Metro Vancouver for previous projects.

² Wind speed and direction measurements taken by ECCC at YVR are not hourly averages and are therefore not appropriate to use in dispersion modelling, as recommended by Metro Vancouver for previous projects.



Figure G.3: Meteorological Stations used in CALMET

Model Options and User Switches

The diagnostic model options were chosen in accordance with the BC modelling guideline. Features of note include:

- The model was initialized using WRF prognostic meteorological model output at 4 km resolution.
- Surface observations were extrapolated upward within the boundary layer. This was done using the option to invoke Monin-Obukhov similarity theory and to represent winds more accurately at lower levels.
- Upper air temperature and winds, cloud cover, relative humidity, and overwater conditions were based on WRF modelling output.



A detailed list of the CALMET model options used is provided in Table G.3 and Table G.4.

Table G.3: CALMET model switch settings group 5 - Wind Field Options and Parameters

Parameter	Default	Project	Comments
IWFCOD	1	1	Diagnostic wind module used
IFRADJ	1	1	Froude number adjustment effects computed
IKINE	0	0	Kinematic effects not computed
IOBR	0	0	No adjustment to vertical velocity profile at top of model domain
ISLOPE	1	1	Slope flow effects computed
IEXTRP	-4	-4	Similarity theory to extrapolate surface observed winds (not upper air observations hence <0)
ICALM	0	0	Surface winds not extrapolated if calm
BIAS	NZ*0	NZ*0	irrelevant since no upper air station data
RMIN2	4	-1	Used to ensure extrapolation of all surface stations for IEXTRP = -4
IPROG	0	14	Used WRF prognostic model output for initial guess field (IGF)
ISTEPPGS	3600	3600	Hourly WRF fields
LVARY	F	F	Varying radius of influence not used
RMAX1	NA	8	Relatively flat terrain increases representativeness of surface observations away from station locations
RMAX2	NA	8	For extrapolated sfc obs (no upper air stations)
RMAX3	NA	20	Irrelevant (no overwater stations)
RMIN	0.1	0.1	
TERRAD	NA	4	Identified from main terrain feature of influence; no greater than WRF resolution (which captures terrain effects at coarser scale)
R1	NA	4	Favors IGF+terrain effects over observed winds away from met station locations
R2	NA	6	Favors IGF(WRF)effects over vertically extrapolated observed winds away from met station locations (complex terrain)
NBAR	0	0	Barriers not used
ISURFT	-1	-1	Diagnostic module surface temperatures based on 2-D spatially varying temperature field
IDIOPT2	0	0	Lapse rate computed internally
IUPT	-1	-1	Upper air stations not used
ZUPT	200	200	Lapse rate computed for default depth



Table G.4: CALMET model switch settings group 6 - Mixing Height, Temperature and Precipitation Parameters

Parameter	Default	Project	Comments
IAVEZI	1	1	Conduct spatial averaging of mixing height
MNMDAV	1	1	limited upwind averaging of mixing height
HAFANG	30	30	Half-angle of upwind looking cone for upwind averaging of mixing height and temperature
ILEVZI	1	1	Layer of winds used in upwind averaging of mixing height
IMIXH	1	1	Method to compute the convective mixing height (Maul Carson for land and water)
THRESHL	0	0	Threshold buoyancy flux required to sustain convective mixing height growth overland (W/m^3)
THRESHW	0.05	0.05	Threshold buoyancy flux required to sustain convective mixing height growth overwater (W/m^3)
IZICRLX	1	1	Flag to allow relaxation of convective mixing height to equilibrium value
TZICRLX	800	800	Relaxation time of convective mixing height to equilibrium value
ITWPROG	0	2	Use WRF ΔT and overwater lapse rates for overwater convective mixing height growth
ILUOC3D	16	16	Ocean land use category in WRF datasets
ZIMIN	50	50	Default minimum overland mixing height (m)
ZIMAX	3000	3000	Default maximum overland mixing height (m)
ZIMINW	50	50	Default minimum over-water mixing height (m)
ZIMAXW	3000	3000	Default maximum over-water mixing height (m)
ICOARE	10	10	COARE with no wave parameterization
IRHPROG	0	0	3D relative humidity from surface data
ITPROG	0	1	Surface temperature from surface stations; upper air temperatures from WRF
IRAD	1	1	temperature spatial interpolation based on $1/R$
TRADKM	500	500	Default radius of influence for temperature interpolation (km)
NUMTS	5	10	Allow all local surface stations to be included for temperature interpolation
IAVET	1	1	Conduct spatial averaging of temperatures
JWAT1	-	99	Disabled - Overwater temperatures from WRF.
JWAT2	-	99	Disabled - Overwater temperatures from WRF.
NPSTA	N/A	-1	Interpolate WRF precipitation (no observation)
NFLAGP	2	2	Precipitation interpolation method ($1/R^2$)
SIGMAP	100	100	Radius of Influence (km) – reset automatically by CALMET to $\sqrt{2} \times$ WRF resolution
CUTP	0.01	0.01	Default minimum precipitation rate cut-off (mm/hr)



G.3 RESULTS

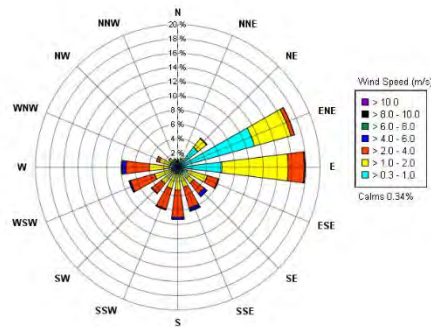
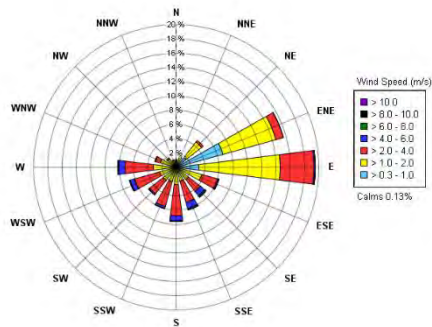
The CALMET model performance was assessed by reviewing various model outputs and, where possible, comparing to observations. These outputs include surface wind roses for various monitoring locations, CALMET-derived stabilities and mixing heights and domain wind vector plots under various stability and flow regimes.

G.3.1 Surface Winds

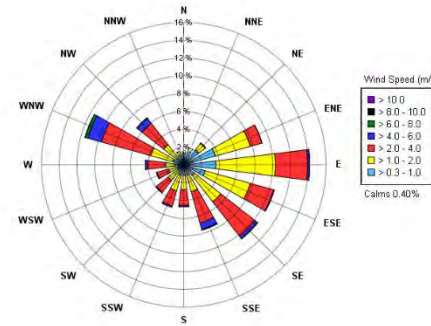
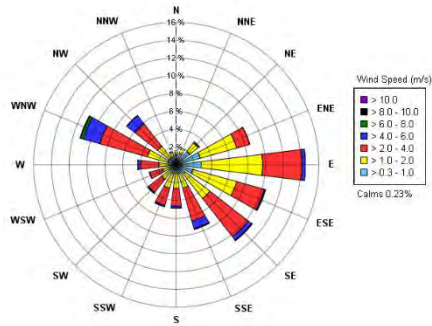
Annual windroses display the combined frequency distribution of wind speed and direction at a given location for the model period and over the course of a year each year. CALMET is designed to match the observations that have been assimilated in the modelling at the observation sites. Windroses based on modelled winds should therefore closely match windroses based on observations, as long as the modelled windroses are extracted at a model gridpoint nearly co-located to meteorological stations. In complex terrain situations, even a small location departure may cause additional terrain-driven winds and differences in the modelled windroses.

Observed and modelled windroses for 2013-2015 at T13 North Delta, T17 Richmond South and T18 Burnaby South stations are shown in Figure G.3 for the model period average, Figure G.4 for the 2013 annual average, Figure G.5 for the 2014 annual average, Figure G.6 for the 2015 annual average, Figure G.7 for the summer months (June to August), Figure G.8 for the autumn months (September and October), Figure G.9 for the winter months (January to March, November and December), and Figure G.10 for the spring months (April and May). Observed winds at T13, T17, and T18 stations are at the anemometer height of 18.3, 12.5, and 19.9 m, respectively. Modelled winds presented in the windroses are at the height of 10 m. Modelled period and seasonal wind roses for the facility are shown in Figure G.11, reflecting the East and East-Northeast dominant winds, in the direction of the Fraser River, which are also observed at the nearby North Delta station, as well as weaker winds from the West and West-Northwest. A histogram summarizing the wind speed frequency distributions at the monitoring stations (observed) and at the Facility (modelled) for the model period is also included in Figure G.12. The windspeeds at the facility are similar to those at the monitoring stations (whether observed or modelled).

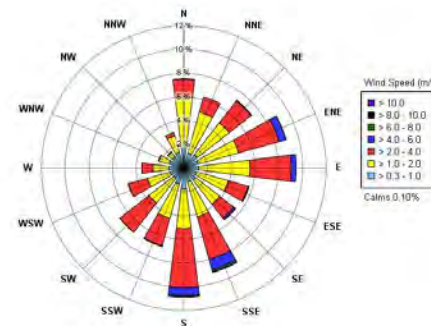
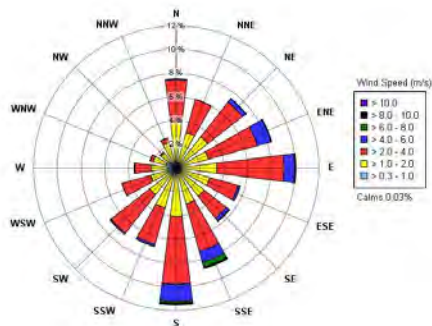
Observed and modelled surface wind roses match closely at North Delta, Richmond South and Burnaby South for the annual average, summer and winter months.



T13 North Delta



T17 Richmond
South

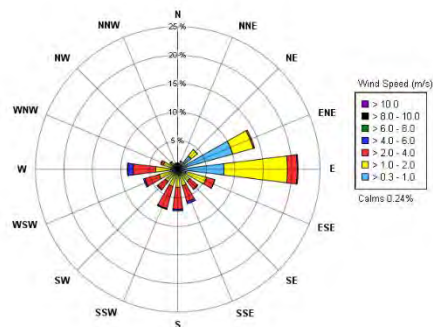
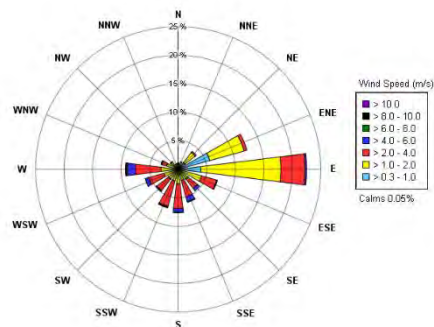


T18 Burnaby South

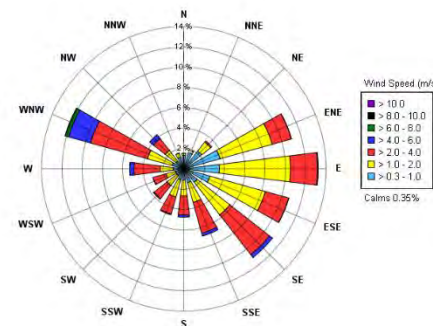
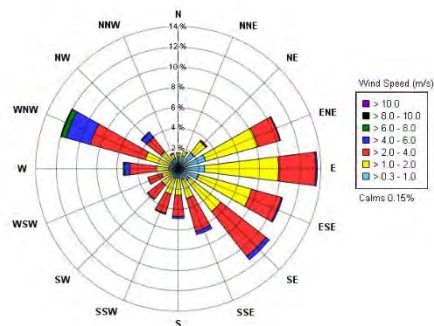
Observed

Modelled (CALMET)

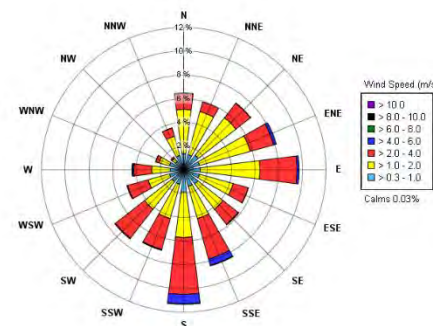
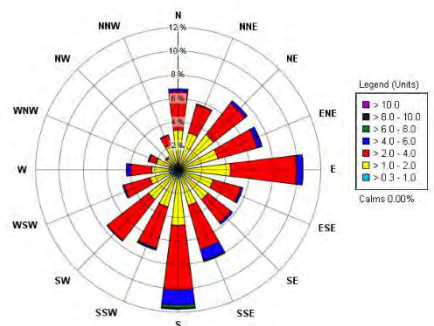
Figure G.3: Observed and modelled annual wind roses at North Delta, Richmond South, and Burnaby South (2013-2015).



T13 North Delta



T17 Richmond
South

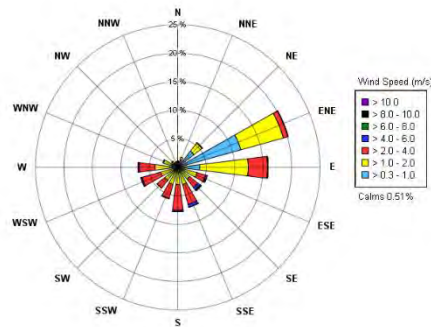
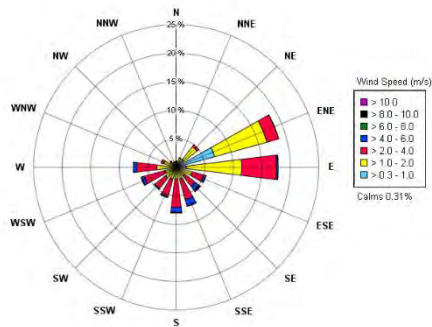


T18 Burnaby South

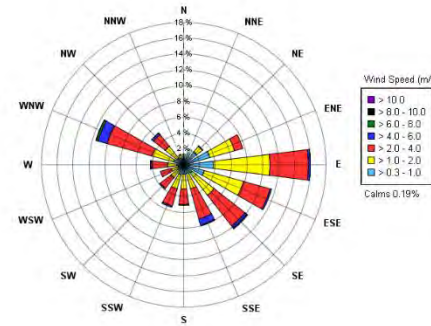
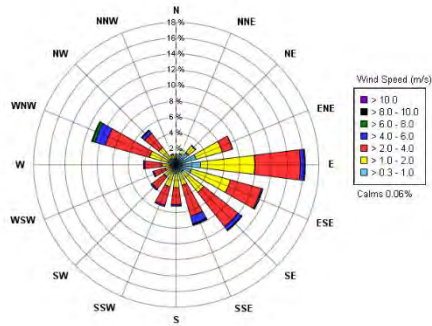
Observed

Modelled (CALMET)

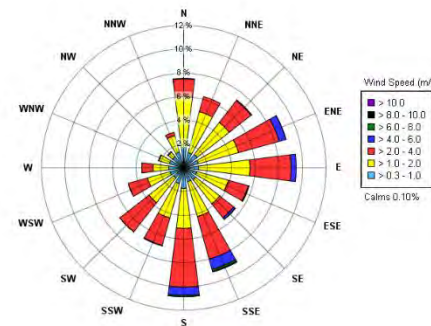
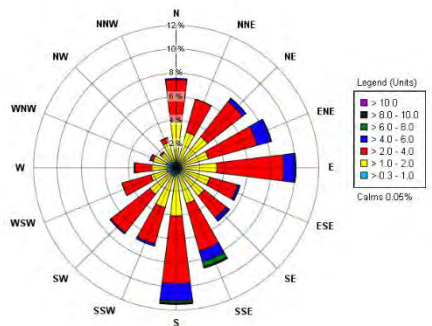
Figure G.4: Observed and modelled annual wind roses at North Delta, Richmond South, and Burnaby South (2013)



T13 North Delta



T17 Richmond
South

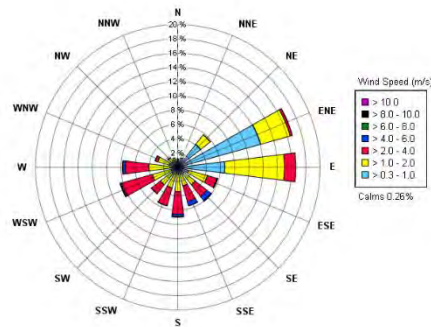
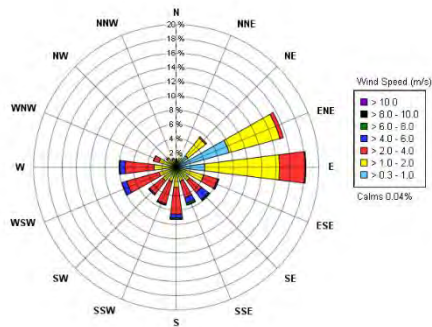


T18 Burnaby South

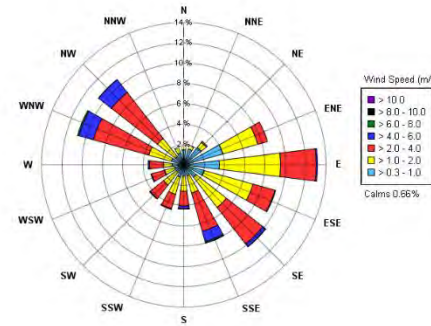
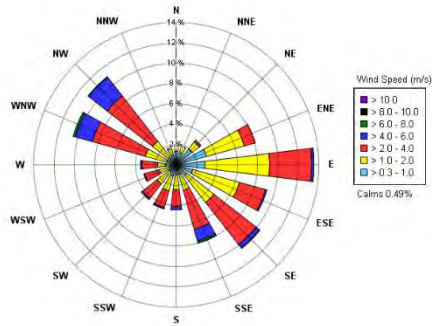
Observed

Modelled (CALMET)

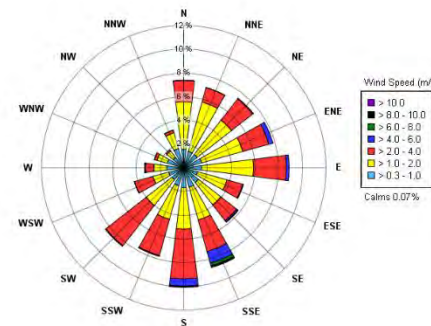
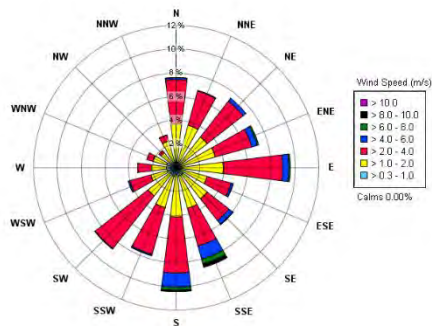
Figure G.5: Observed and modelled annual wind roses at North Delta, Richmond South, and Burnaby South (2014)



T13 North Delta



T17 Richmond
South

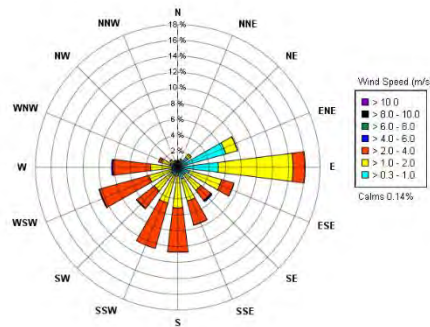
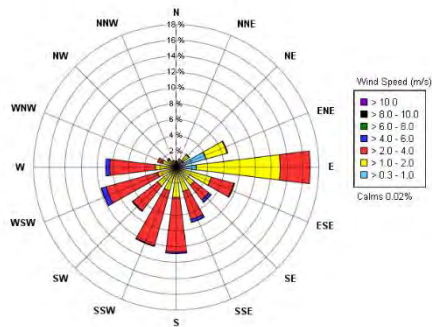


T18 Burnaby South

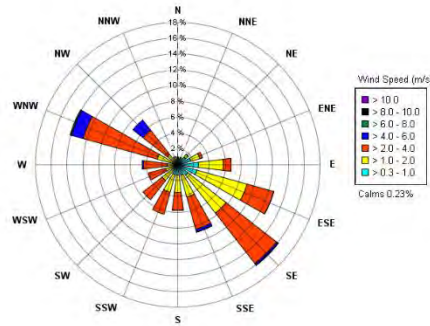
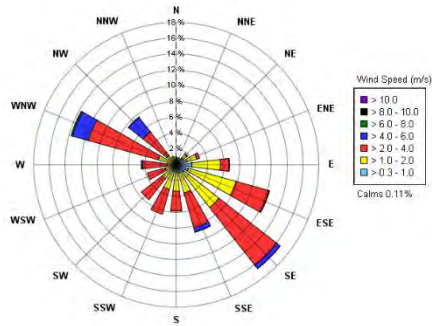
Observed

Modelled (CALMET)

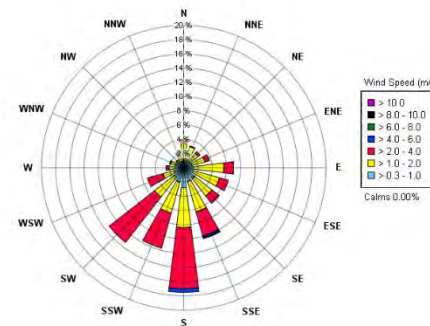
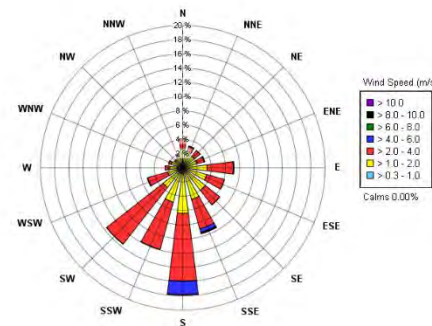
Figure G.6: Observed and modelled annual wind roses at North Delta, Richmond South, and Burnaby South (2015)



T13 North Delta



T17 Richmond
South

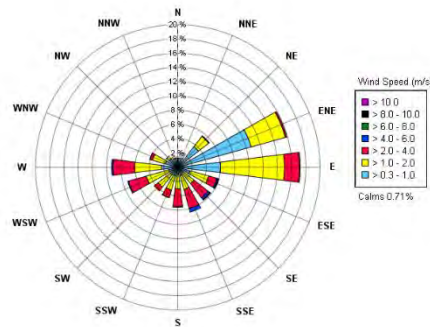
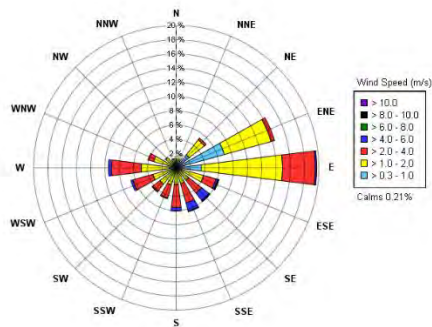


T18 Burnaby South

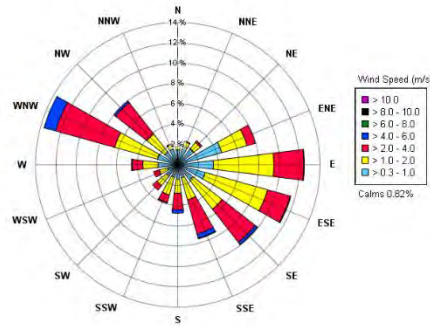
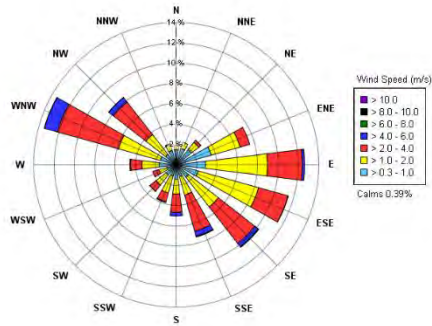
Observed

Modelled (CALMET)

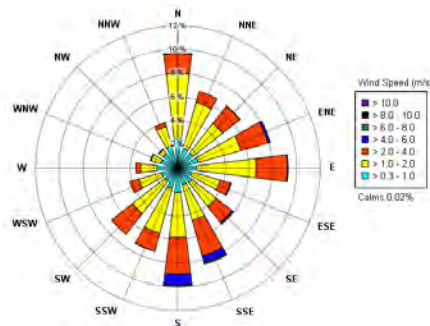
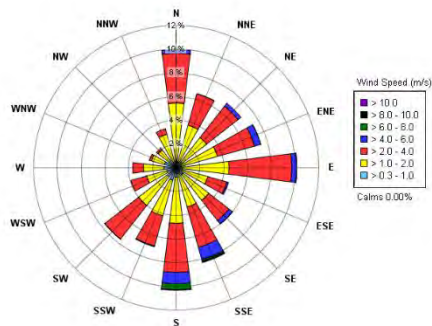
Figure G.7: Observed and modelled summer (June to August) wind roses at North Delta, Richmond South, and Burnaby South (2013-2015)



T13 North Delta



T17 Richmond
South

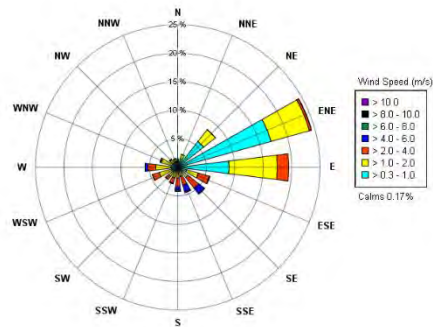
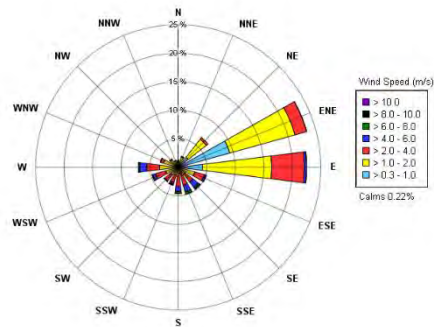


T18 Burnaby South

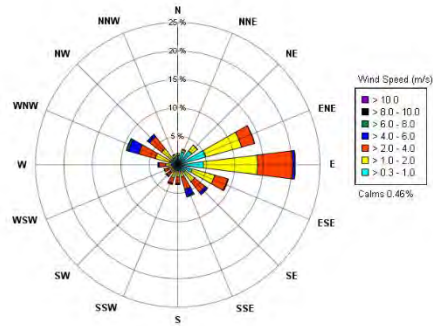
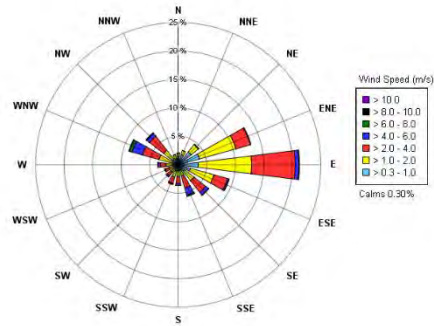
Observed

Modelled (CALMET)

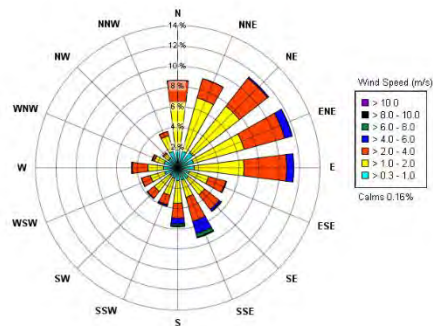
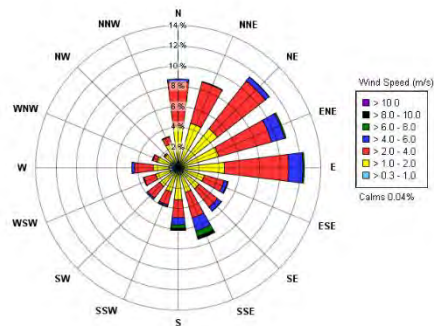
Figure G.8: Observed and modelled Autumn (September and October) wind roses at North Delta, Richmond South, and Burnaby South (2013-2015)



T13 North Delta



T17 Richmond
South

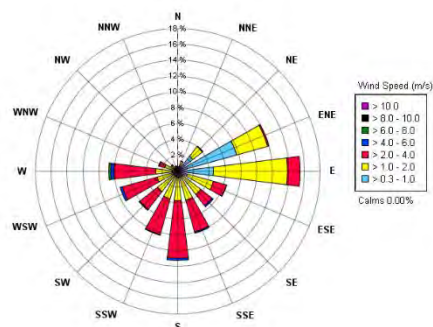
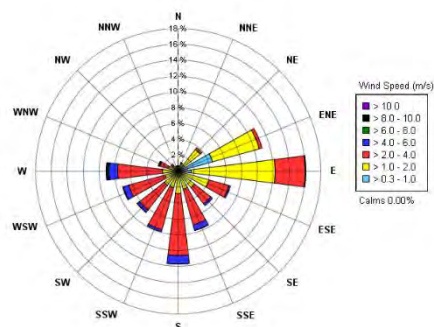


T18 Burnaby South

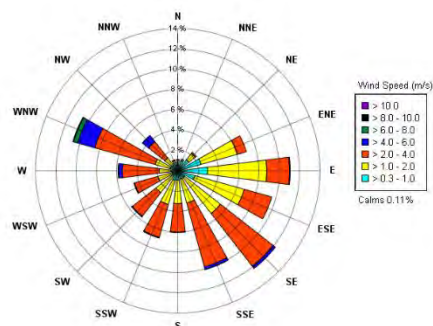
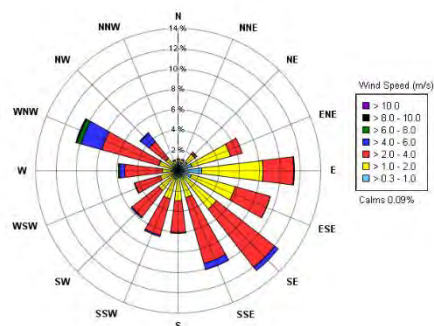
Observed

Modelled (CALMET)

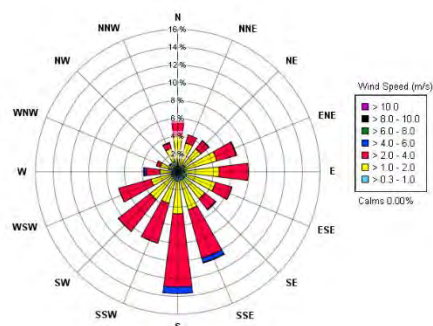
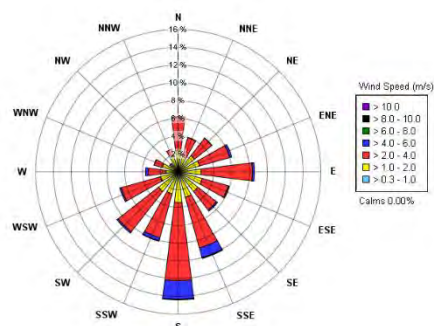
Figure G.9: Observed and modelled Winter (January-March and November-December) wind roses at North Delta, Richmond South, and Burnaby South (2013-2015)



T13 North Delta



T17 Richmond
South

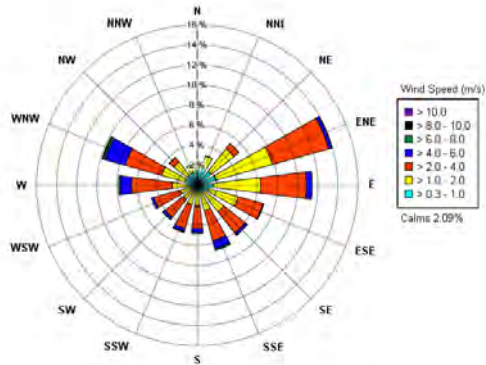


T18 Burnaby South

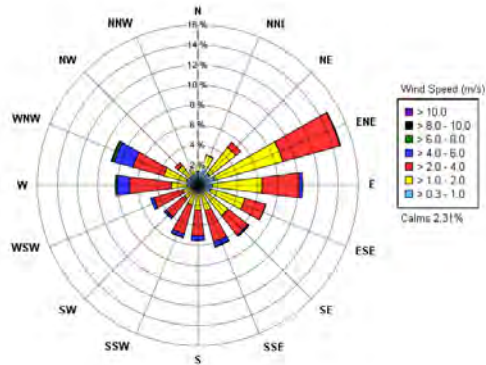
Observed

Modelled (CALMET)

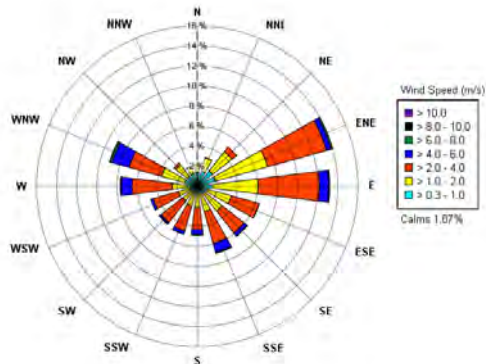
Figure G.10: Observed and modelled Spring (April-May) wind roses at North Delta, Richmond South, and Burnaby South (2013-2015)



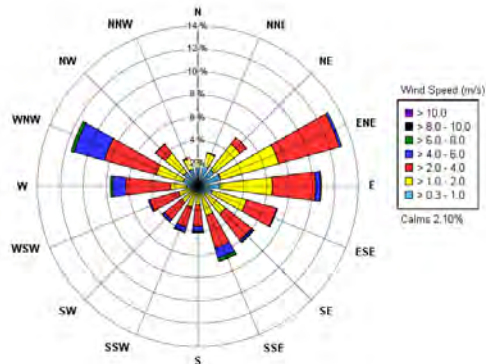
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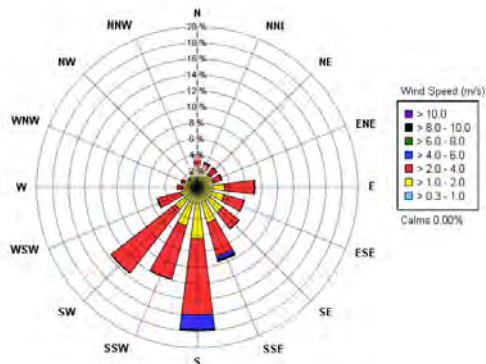
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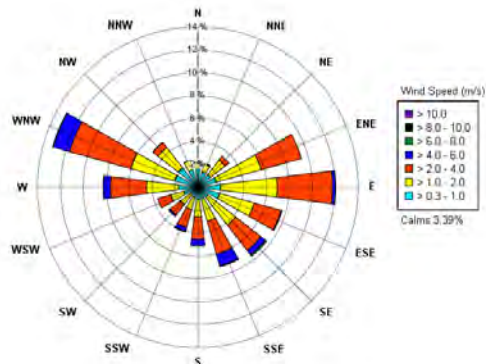
Annual - 2014



Annual - 2015



Summer



Autumn

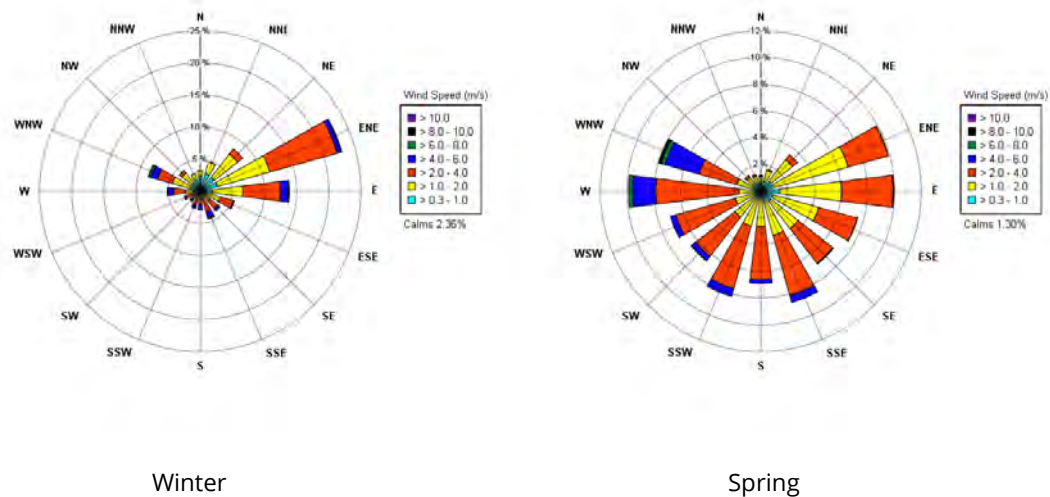


Figure G.11: Modelled period, annual and seasonal wind roses at the Facility (2013-2015)

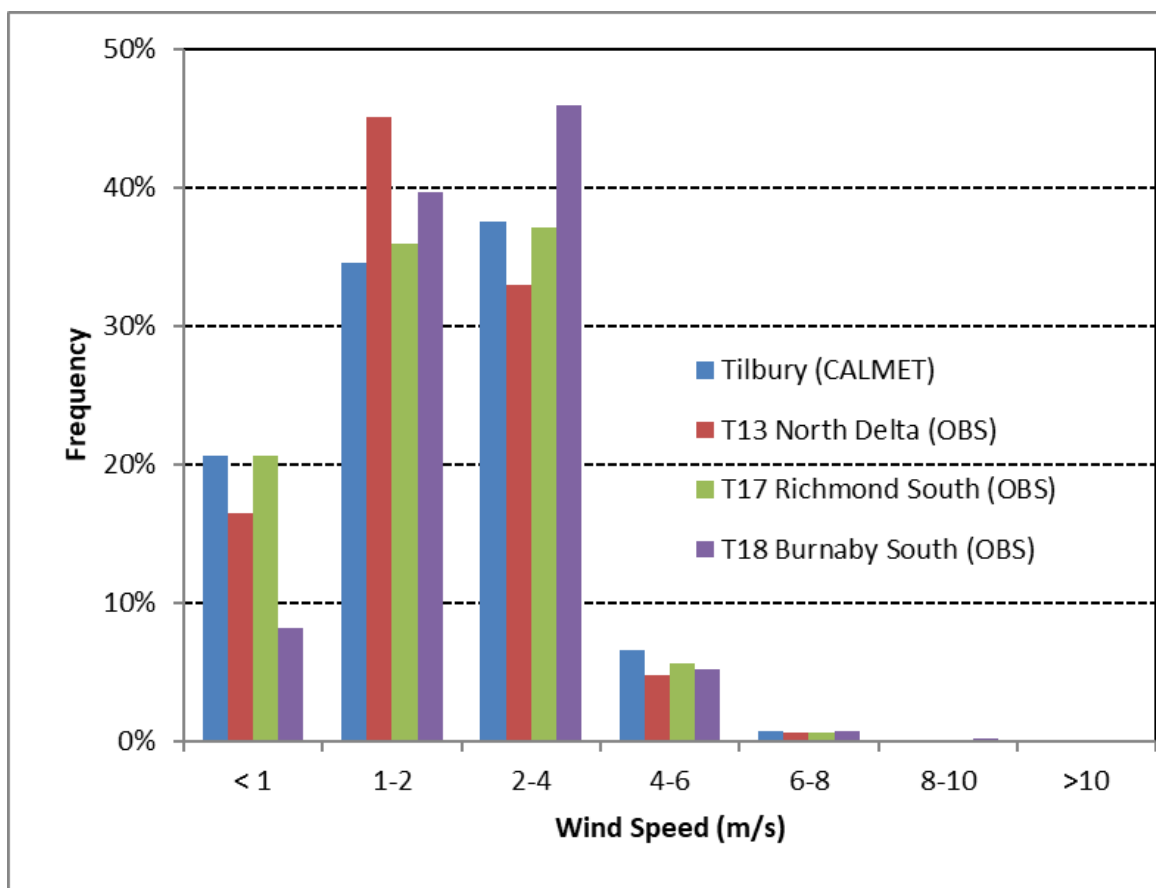


Figure G.12: Frequency of occurrence of surface wind speeds modelled at the Facility (CALMET), and observed at North Delta, Richmond South and Burnaby South Stations (2013-2015)

G.3.2 Pasquill-Gifford Stability Class

In CALMET, the Pasquill-Gifford stability scheme is used to classify atmospheric stratification in the boundary layer over land. These classes range from unstable (Classes A, B and C), through neutral (Class D) to stable (Classes E and F). Normally, unstable conditions are associated with daytime, ground-level heating, which results in thermal turbulence activity in the boundary layer. Stable conditions are primarily associated with night-time cooling, which results in the suppression of the turbulence levels and temperature inversion at lower levels. Neutral conditions are mostly associated with high wind speeds or overcast sky conditions.

The frequency distributions of CALMET-derived Pasquill-Gifford stability classes for North Delta, Richmond South and Burnaby South stations and the Facility for the model period are shown in Figure G.13. For all four locations, the most frequent stability class is Class D or neutral. This is a result of the frequency of overcast sky conditions. Very stable conditions (category F) are nearly as frequent as neutral conditions, while very unstable conditions (category A) are rare.

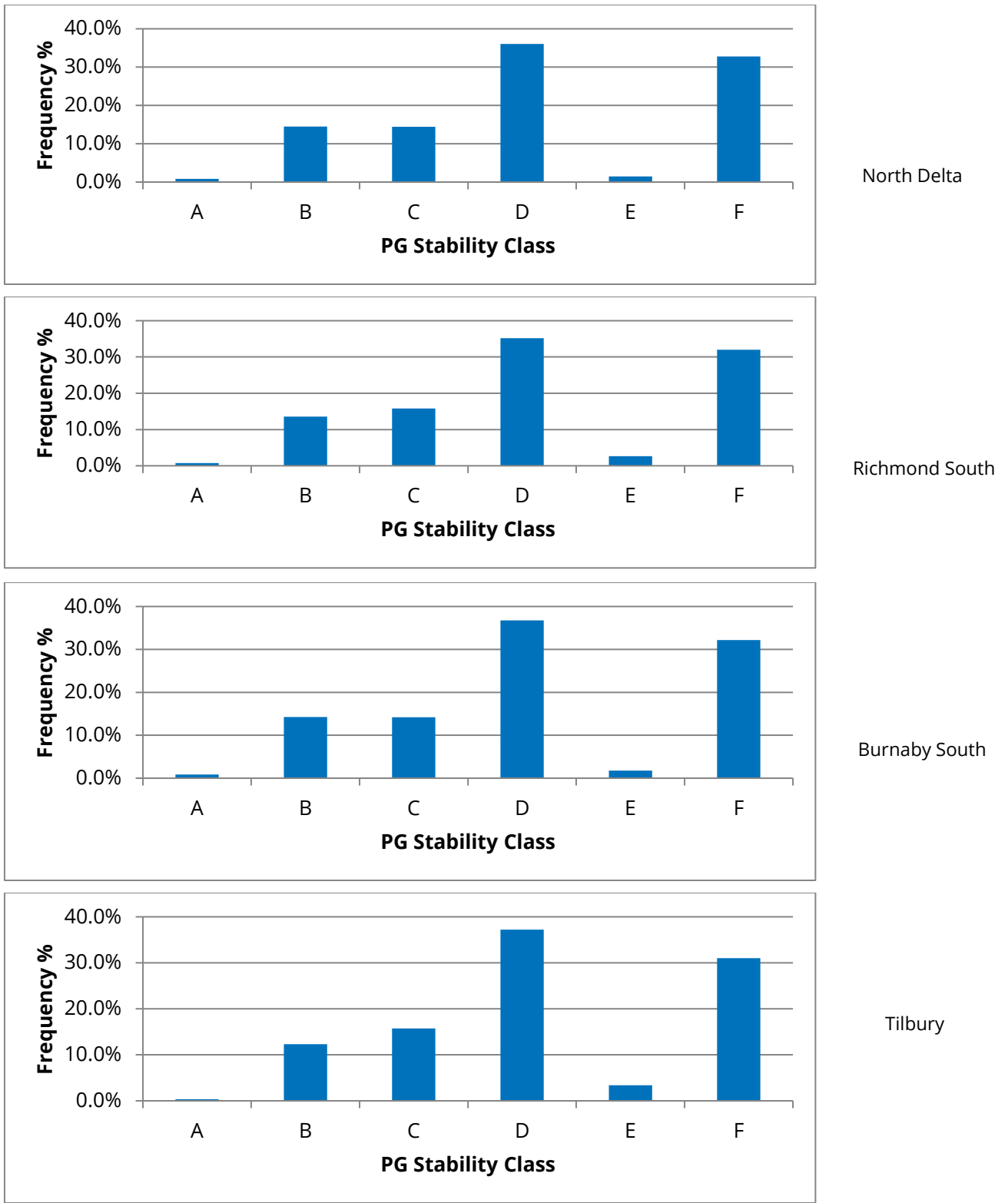


Figure G.13: Frequency of modelled Pasquill-Gifford stability classes at North Delta, Richmond South and Burnaby South, and the Tilbury Facility



G.3.3 Modelled Wind Fields

Winds in the study area result from a combination of large-scale synoptic patterns, thermal circulations (land-sea breezes), and terrain driven circulations (upslope during daytime, downslope and channeling during nighttime). WRF winds, at 4 km resolution, capture the synoptic and thermal circulations well, and some of the terrain-induced circulations (to the extent they are resolved at the WRF spatial resolution of 4 km). CALMET refines the terrain effects further at the finer scale of 200 m used in the current modelling.

How well the model captures key meteorological patterns is best exemplified with wind vector plots, displaying the modelled wind speed and direction as arrows along the flow (with arrow length proportional to the wind speed, and arrows pointing downwind).

Modelled wind fields vector plots are illustrated in Figure G.14, for representative unstable, neutral, and stable conditions. CALMET-derived wind fields follow the expected terrain flows under various stability and flow regimes, with some channeling by the terrain during stable conditions, and flowing upslope during unstable, daytime conditions and downslope during stable, night-time conditions. Also, a strong sea breeze penetration can be seen midday in the summer near the surface. Under neutral conditions, the characteristic high wind speeds result in less noticeable terrain effects and wind fields reflect larger mesoscale wind patterns across the model domain.

Modelled wind fields vector plots at 10 m, 230 m and 2600 m above ground level are illustrated in Figure G.15. at noon on July 18, 2014. The surface sea breeze in the middle of the inlet does not extent yet to the 230 m level at that time of the day. The wind fields aloft (2600 m), are stronger and more uniform, as expected at higher levels and above the convective boundary layer.

Modelled wind speed isopleth plots during periods where thermally driven flows are expected are illustrated in Figure G.16. Stronger wind speeds are shown at elevated terrain including the north shore mountains and Burnaby Mountain as expected, although higher winds were predicted over water due to sea breeze.

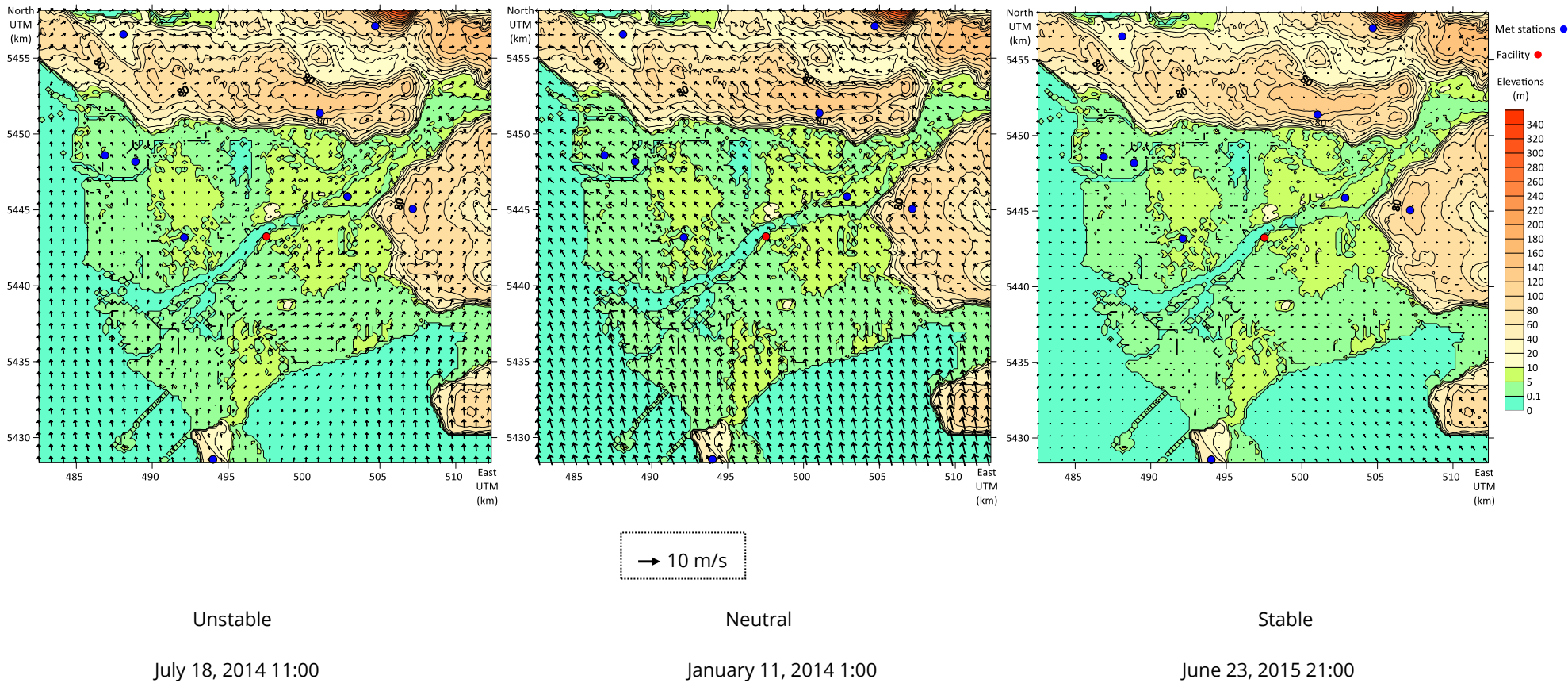


Figure G.14: Modelled wind fields at 10 m above ground level during unstable, neutral, and stable conditions (overlying terrain contours). The facility is located in the center of the modelling domain (red dot)

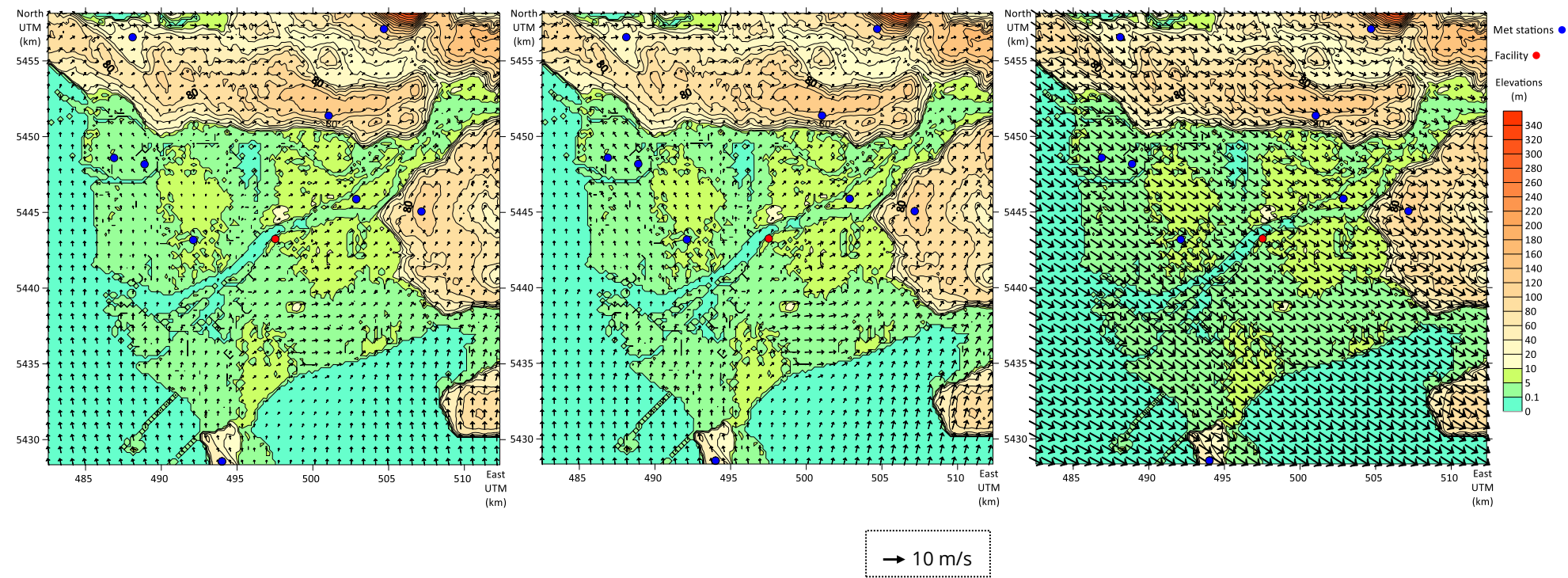


Figure G.15: Modelled wind fields at 10m (left) 230 m (center) and 2600 m (right) above ground level 11 am-noon on July 18, 2014, over the modelling domain

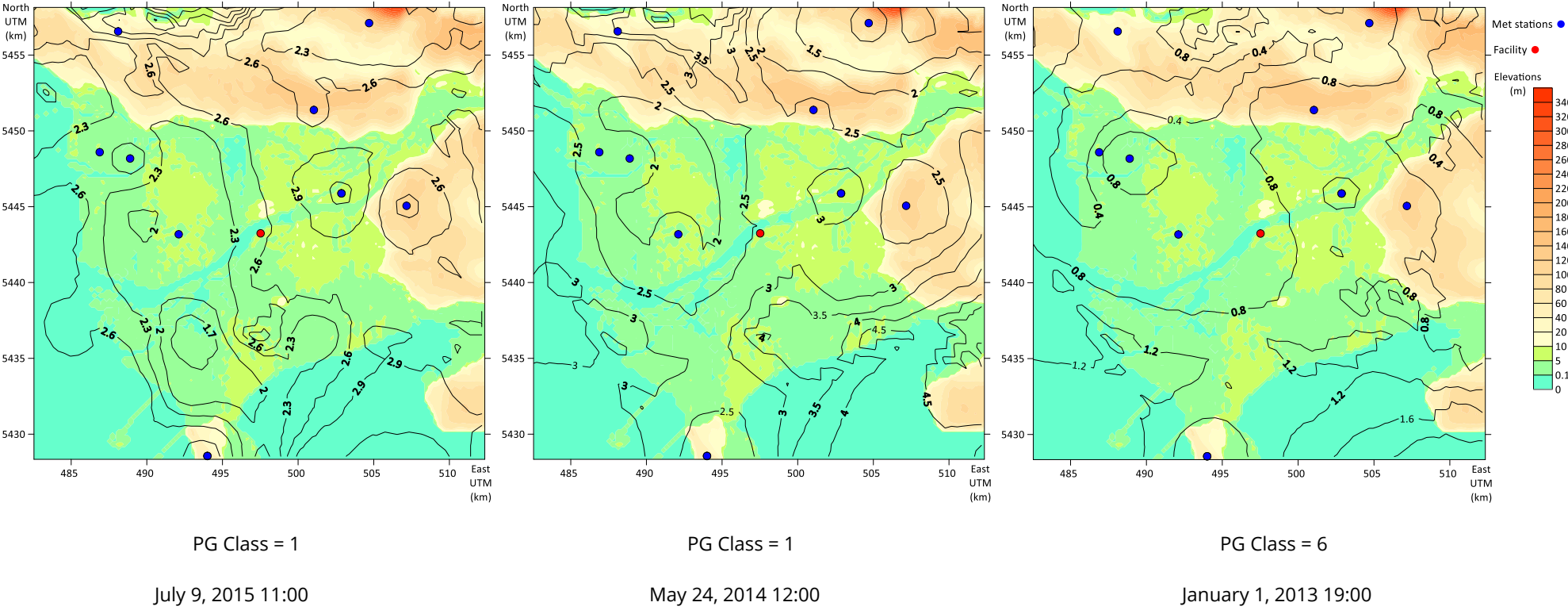


Figure G.16: Modelled wind speed isopleths during period with thermally driven flow



G.3.4 Mixing Heights

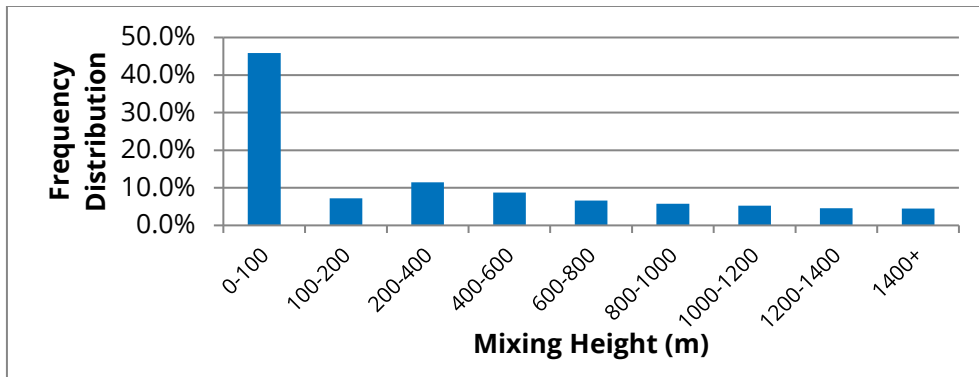
Mixing heights are estimated in CALMET through methods that are based on either surface heat flux (thermal turbulence) and vertical temperature profiles, or friction velocities (mechanical turbulence). Table G.5 shows the average modelled mixing heights by Pasquill-Gifford stability class. Overall, the highest mixing heights are associated with unstable conditions (Classes A, B and C), while the lowest mixing heights are associated with stable conditions (Classes E and F), when both convective and mechanical turbulence are at their lowest. During unstable conditions, mixing heights at Tilbury, which is close to the water, tend to be somewhat lower than at the nearby stations, which are located further inland; this is consistent with lower overwater daytime mixing heights influencing the nearshore locations.

The frequency distribution of mixing heights at T13 North Delta, T17 Richmond South and T18 Burnaby South stations are shown in Figure G.17. The greatest frequency of mixing heights is below 100 m associated with stable conditions.

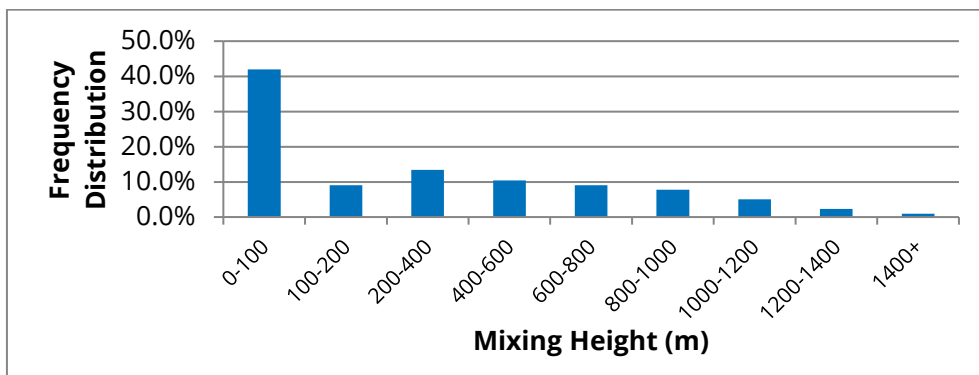
Diurnal variations in mixing heights are shown in Figure G.18 (at observation stations) and Figure G.19 (at the Facility), respectively for a typical summer day (July 7, 2014) and a typical winter day (December 31, 2014). Mixing heights increase after sunrise due to solar heating and enhanced convection; growth is sometimes hindered by cloud (reduced insolation). Convective mixing heights crash abruptly at sunset (i.e., earlier in winter than in summer) and wind driven mechanical turbulence then dominates during the night, with mixing height correlating with wind speed (And roughness length). Daytime mixing heights may be suppressed during stable winter conditions due to weak solar insolation, high reflectivity of snow-covered surfaces, low wind speeds and synoptic subsidence.

Table G.5: Average modelled mixing height by Pasquill-Gifford Stability Class (in m)

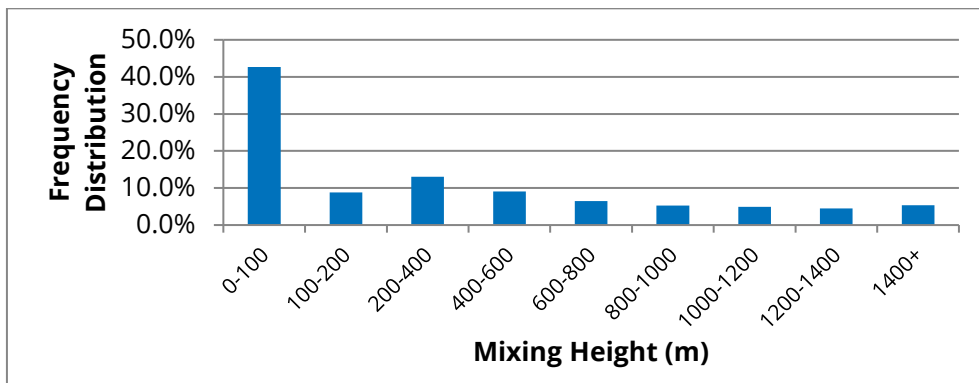
Station	A	B	C	D	E	F
T13 North Delta	1,233	888	611	411	288	58
T17 Richmond South	1,013	787	542	369	348	64
T18 Burnaby South	1,340	935	630	413	223	60
Tilbury Facility	843	647	523	366	239	65



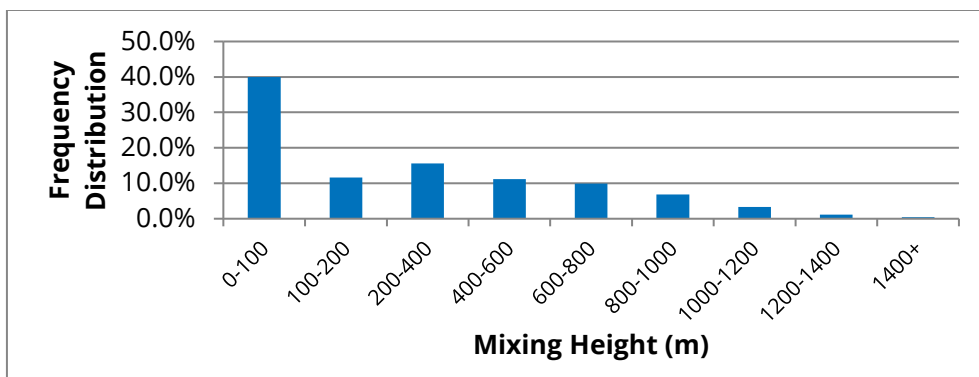
North Delta



Richmond South

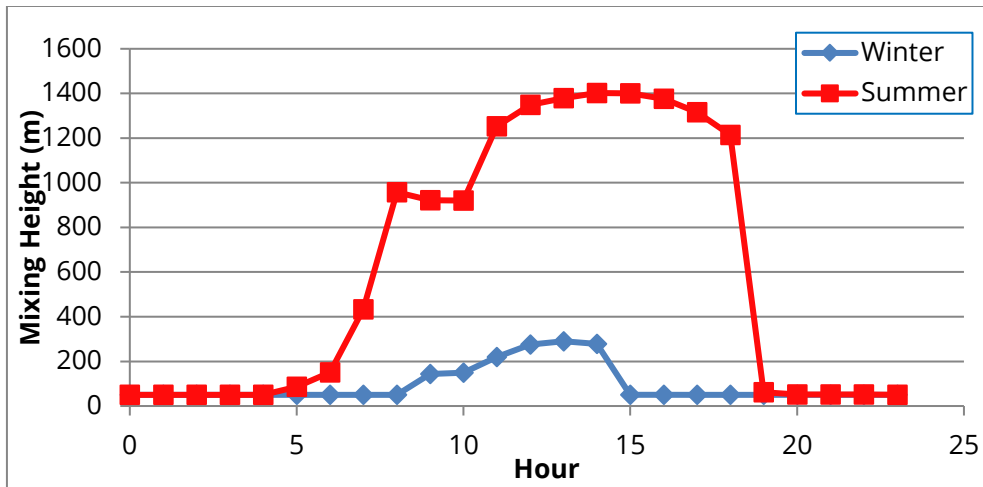


Burnaby South

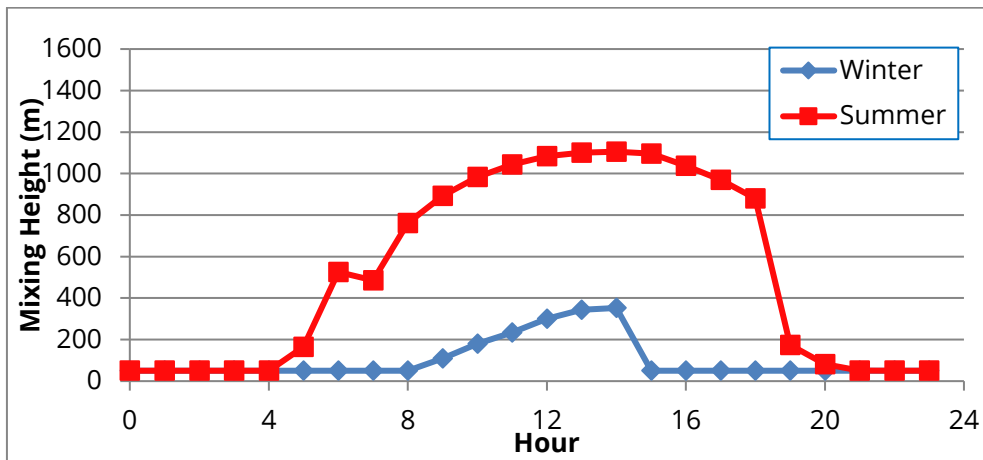


Tilbury

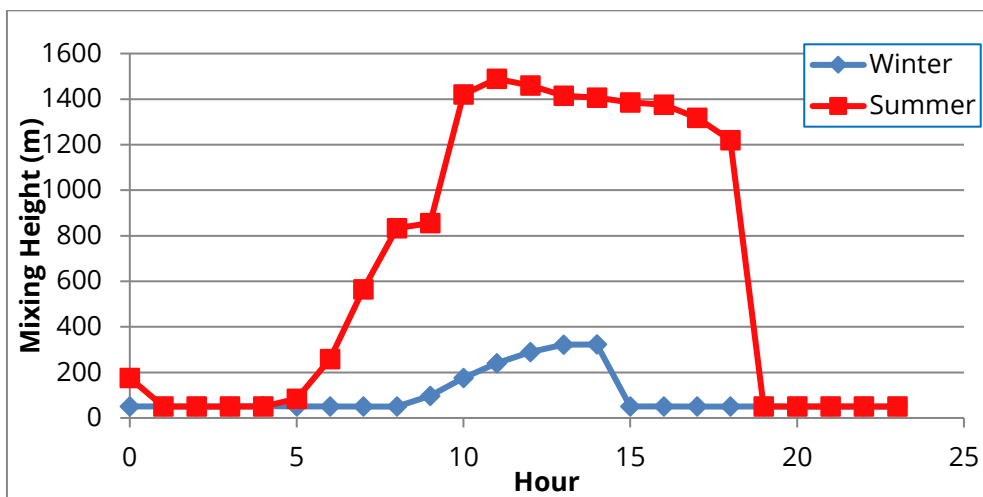
Figure G.17: Frequency distribution of modelled mixing heights at North Delta, Richmond South, and Burnaby South, and the Tilbury Facility



North Delta



Richmond South



Burnaby South

Figure G.18: Diurnal variation of modelled mixing heights at North Delta, Richmond South, and Burnaby South on a typical summer day (July 7, 2014) and winter day (December 31, 2014)

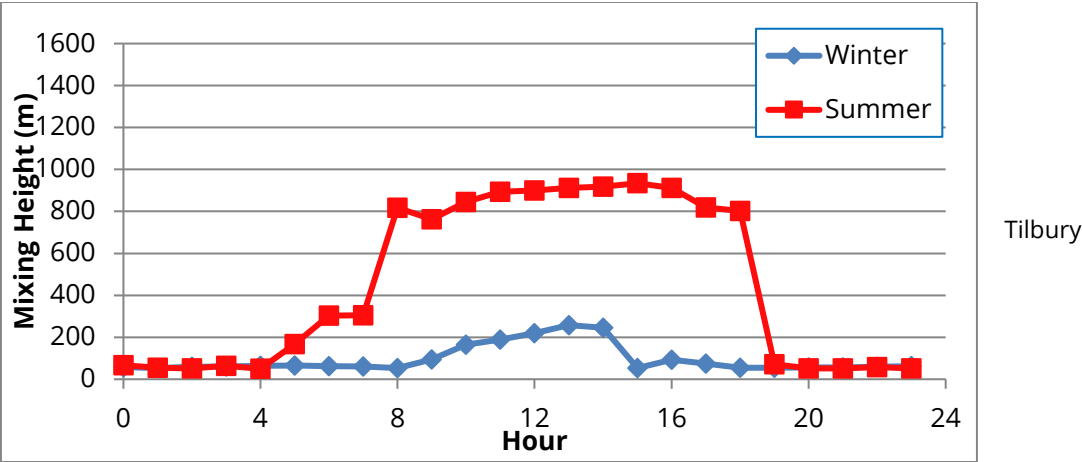


Figure G.19: Diurnal variation of modelled mixing heights at the Facility on a typical summer day (July 7, 2014) and winter day (December 31, 2014)



G.3.5 Surface temperature

The monthly minimum, maximum and average CALMET temperatures at the Facility are included in Figure G.20 with the temperature normals (1981-2010 from Richmond Nature Park). Peak summer months temperatures were a bit higher in the model period, and minimum temperatures a bit colder than their respective long-term average, but the average temperature during the model period closely followed the 30-year normal. Diurnal variation of average modelled surface temperature for summer and winter are shown in Figure G.21.

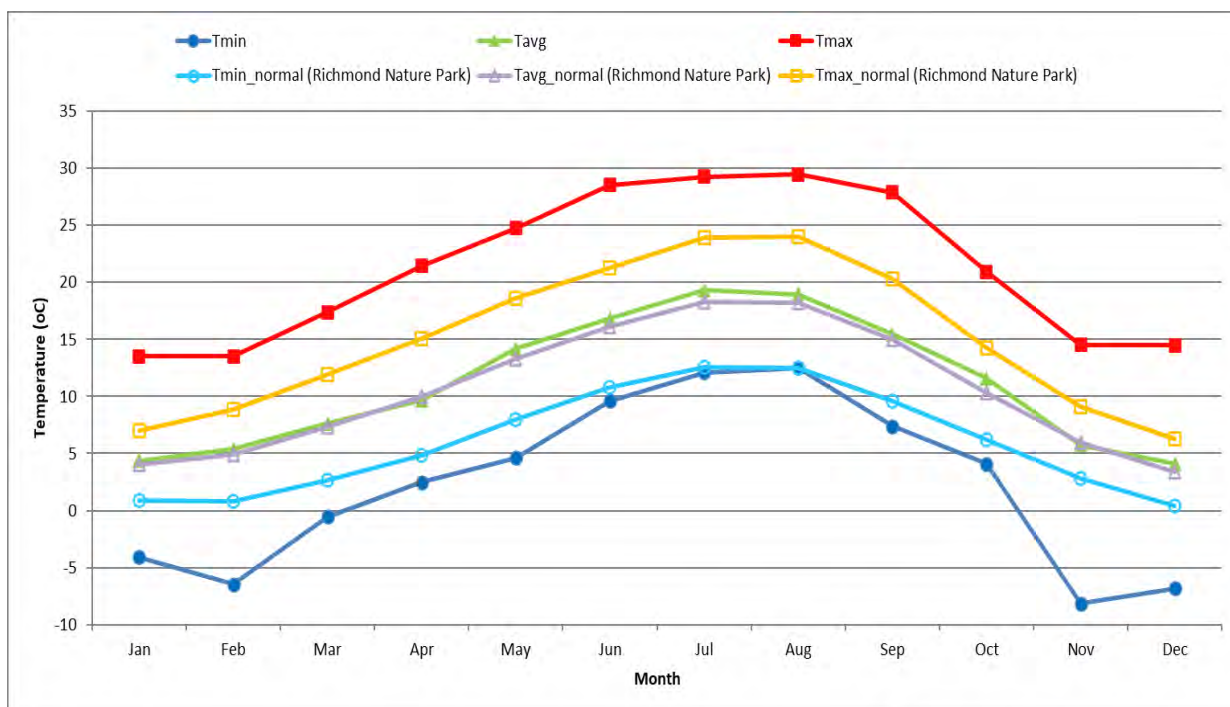


Figure G.20: Monthly distribution of minimum, maximum, and average CALMET surface temperature at the Facility (2013-2015)

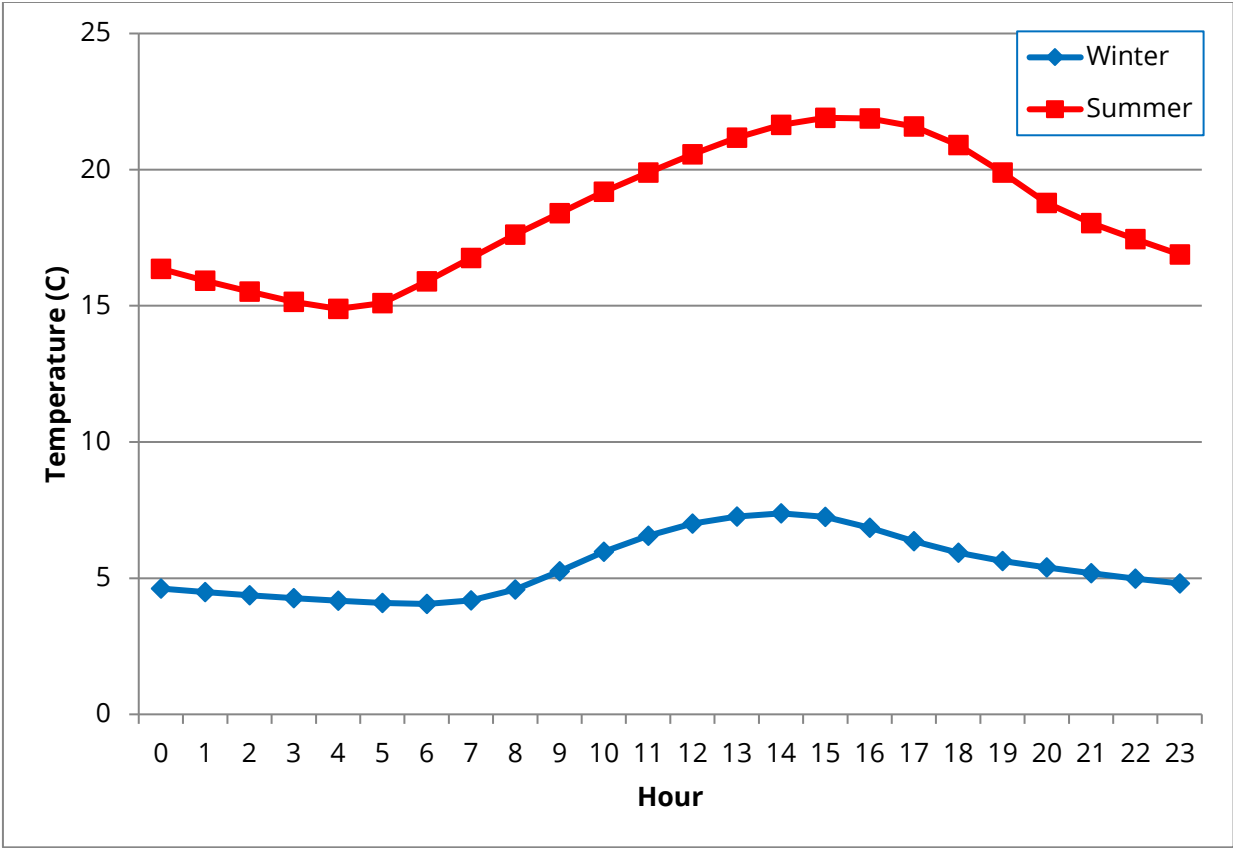


Figure G.21: Average summer (June-August) and Winter (November-March) CALMET surface temperature by time of the day at the Facility (2013-2015)



G.4 REFERENCES

- BC MOE (BC Ministry of Environment). 2022. British Columbia Air Quality Dispersion Modelling Guideline.
- Environment and Climate Change Canada. 2018. Canadian Climate Normals 1981-2010.
- Metro Vancouver (Metro Vancouver). 2012. Station Information: Lower Fraser Valley Air Quality Monitoring Network. 66 pages.
- Scire J.S., F.R. Robe, M.E. Fernau, R.J. Yamartino; 2000: A User's Guide for the CALMET Meteorological Model, Earth Tech Inc.
- United States Environmental Protection Agency, 2008: AERSURFACE User's Guide, EPA-454/B-08-001.
- Zhang, L., Moran, M.D., Makar, P.A., Brook, J.R., and Gong, S. 2002. Modelling gaseous dry deposition in AURAMS: a unified regional air-quality modelling system. *Atmospheric Environment* 36: 537-560.
- Zhang, L., Brook, J.R., and Vet, R. 2003. A revised parameterization of gaseous dry deposition in air-quality models. *Atmospheric Chemistry and Physics* 3: 2067-2082.



AQ-APPENDIX H CALPUFF DETAILS



This Appendix provides details on CALPUFF inputs and modelling methodology.

CALPUFF model (version 7.2.1) was selected as required by the BC Air Quality Dispersion Modelling Guideline (AQDMG - ENV, 2022) and Metro Vancouver (MV) for a refined assessment.

The modelling approach and technical details are consistent with the BC AQDMG (ENV, 2022) and the MV Dispersion Modelling Plan developed for the Project in consultation with MV (*Appendix A*). Three-Dimensional meteorological input to CALPUFF was provided by CALMET. Details are provided in *Appendix G*.

Emissions and other source characteristics are provided in the main TDR. Source locations are provided in Table H.1 and Table H.2. CALPUFF switch settings are provided in Table H.3.

Gridded receptors were consistent with the AQDMG requirements. All childcares, schools and seniors' facilities within a 5 km radius were explicitly modelled as discrete sensitive receptors. The historical site of the First Nations village of Tl'uqtnus was also included as a sensitive receptor. As most of the RAA is a heavily populated urban environment, all gridded receptors located in a residential or business area (i.e., over 9,000 receptors) were identified as residential and/or business sensitive receptors, and, considered when reporting maximum values for their respective category. A list of discrete sensitive receptors (school, childcare and senior facility) as well as the locations of the closest residence and business are provided in Table H.4.

Building coordinates and other information are provided in the BPIP input file at the end of this appendix.

Table H.1: Source Locations for the Project

Project Source	ID	UTMx (km)	UTMy (km)	Base Elevation (m)
Phase 2 Hot Oil Heater	T2_HOH	497.306	5443.135	5.2
Phase 2 Thermal Oxidizer	T2_TO	497.328	5443.112	5.2
Phase 2 Ground Flare	T2_GF	497.367	5443.076	6
Phase 2 Emergency Generator	T2_EG	497.488	5443.328	5

Table H.2: Source Locations for T1A and T1B

Project Source	ID	UTMx (km)	UTMy (km)	Base Elevation (m)
T1A_Heater	T1A_HEA	497.759	5443.091	5
T1A_Regen	T1A_REGE	497.741	5443.098	5
T1A_Incinerator	T1A_INCI	497.748	5443.100	5
T1A_Emergency Generator	T1A_EG	497.783	5443.065	4
T1B_Hot Oil Heater	T1B_HOH	497.426	5443.019	5
T1B_Thermal_Oxidizer	T1B_TO	497.451	5443.032	6
T1B_Ground_Flare	T1B_GF	497.399	5443.047	5



Table H.3: CALPUFF model switch settings¹

Parameter	Default	Project	Comments
METFM	1	1	CALMET meteorological input
MGAUSS	1	1	Gaussian distribution used in near field
MCTADJ	3	3	Partial plume path terrain adjustment
MCTSG	0	0	Sub-grid scale complex terrain not modelled
MSLUG	0	0	Near-field puffs not modelled as elongated
MTRANS	1	1	Transitional plume rise modelled
MTIP	1	1	Stack tip downwash used
MRISE	1	1	Briggs plume rise used
MBDW	1	2	PRIME method used (Guideline)
MSHEAR	0	0	Explicit meteorology (not parameterized wind shear about stack top)
MSPLIT	0	0	Puffs are not split (short range)
MCHEM	1	0	Chemical transformation not modelled
MAQCHEM	0	0	Aqueous phase transformation not modelled
MLWC	1	1	irrelevant because MAQCHEM = 0
MWET	1	0	Wet removal not modelled (conservative for ambient concentrations)
MDRY	1	0	Dry deposition not modelled (conservative for ambient concentrations)
MTILT	0	0	Gravitational settling not modelled (small size PM only)
MDISP	3	2	Near-field dispersion coefficients internally calculated from sigma-v, sigma-w using micrometeorological variables as recommended by Guideline
MTURBVW	3	3	Not applicable because MDISP = 2
MDISP2	3	3	Not applicable because MDISP = 2
MTAULY	0	0	Lagrangian timescale (617.284s)
MTAUADV	0	0	No turbulence advection used
MCTURB	1	1	Standard CALPUFF subroutines used to compute turbulence sigma-v & sigma-w
MROUGH	0	0	Adjustment for surface roughness not used
MPARTL	1	1	Partial plume penetration of elevated inversion
MPARTLBA	1	1	Partial plume penetration into elevated inversion
MTINV	0	0	Strength of temperature inversion computed from measured/default gradients
MPDF	0	1	PDF used for dispersion under convective conditions as recommended for MDISP = 2
MSGTIBL	0	0	No Sub-grid TIBL module
MBCON	0	0	Boundary concentration conditions not modelled (uniform background concentrations added)
MFOG	0	0	FOG model not run
MREG	1	0	Do not test options specified to see if they conform to United States Environmental Protection Agency regulatory values

¹ Settings for ambient air quality modelling study – MCHEM, MWET,MDRY and height of receptors are different for the deposition study (See Appendix K)



Table H.4: List of Discrete Sensitive Receptors

Receptor #	UTM X (km)	UTM Y (km)	Category
2394	496.512	5443.724	First Nations village of Tl'uqtinus
2697	493.548	5444.449	School
9165	500.824	5445.694	School
9166	494.891	5443.274	Childcare
9167	492.902	5442.042	Childcare
9168	493.352	5442.055	Childcare
9169	493.338	5442.47	Childcare
9170	492.439	5442.53	Childcare
9171	495.313	5442.392	Childcare
9172	492.746	5441.868	Childcare
9173	493.158	5442.654	Childcare
9174	493.046	5442.689	Childcare
9175	492.953	5442.768	Childcare
9176	492.864	5442.882	Childcare
9177	492.873	5442.932	Childcare
9178	492.778	5442.948	Childcare
9179	492.802	5443.118	Childcare
9180	492.663	5443.429	Childcare
9181	493.04	5443.594	Childcare
9182	493.379	5443.954	Childcare
9183	493.469	5444.276	School/Childcare
9184	493.445	5444.793	Childcare
9185	494.735	5447.058	Childcare
9186	494.903	5446.709	Childcare
9187	494.938	5446.315	Childcare
9188	492.437	5442.508	School
9189	492.958	5442.787	School
9190	493.069	5443.621	School
9191	493.325	5441.989	Senior's Facility
9192	501.854	5445.588	School
9193	500.371	5446.381	School
9194	493.39	5442.736	School
9195	493.407	5443.957	School
9196	494.646	5439.236	School
9197	500.795	5445.8	School
9198	502.144	5445.588	School

'C:\Users\Public\KJH\Tilbury\Tilbury\Tilbury.isc'

'P'

'METERS' 1.00000000

'UTMY' 0.0000

30

'Neighbour' 1 5.27 'Neighbour'

6	12.20	
497508.32		5442926.62
497605.57		5442852.82
497549.42		5442779.77
497534.81		5442791.66
497497.37		5442743.45
497415.60		5442806.41

'LNG1' 1 4.33 'LNG1'

8	41.22	
497687.00		5443044.90
497668.69		5443037.31
497661.10		5443019.00
497668.69		5443000.69
497687.00		5442993.10
497705.31		5443000.69
497712.90		5443019.00
497705.31		5443037.31

'T1A CONTROL BUILDING' 1 4.00 'T1a Control Building - R-192001'

4	5.00	
497797.94		5443063.24
497781.97		5443075.27
497791.00		5443087.25
497806.97		5443075.22

'T1A DRIVERS QUARTERS' 1 3.00 'T1a Drivers Quarters - R-192004'

4	3.00	
497723.53		5442980.11
497717.94		5442984.32
497720.95		5442988.32
497726.54		5442984.10

'T1A ELECTRICAL BUILDING' 1 4.00 'T1a Electrical Building - R-192002'

4	3.70	
497755.08		5443027.05
497749.25		5443031.44
497768.93		5443057.56
497774.76		5443053.17

'T1A VFD BUILDING' 1 4.00 'T1A VFD Building - R-192003'

4	3.70	
497782.72		5443052.73
497771.54		5443061.16
497775.93		5443066.99
497787.11		5443058.56

'FANS1' 1 6.00 'Large fans visible from the public road'

4	9.60	
497630.16		5443127.76

		497641.32	5443142.75	
		497649.33	5443136.87	
		497636.81	5443121.80	
'FANS2'	1	6.00		'Large fans visible from the public road'
	4	9.60		
		497636.81	5443121.80	
		497644.64	5443131.17	
		497651.97	5443125.46	
		497644.56	5443115.24	
'W_BLD'	1	6.00		'Building west of the large tower'
	4	12.80		
		497651.38	5443108.65	
		497665.71	5443126.79	
		497673.83	5443120.37	
		497659.60	5443101.93	
'TOWER'	1	5.00		'Large tower visible from the road'
	4	25.60		
		497669.41	5443097.25	
		497672.46	5443101.13	
		497677.04	5443097.66	
		497673.99	5443093.64	
'E_BLD'	1	5.00		'Building east of the large tower'
	4	9.60		
		497684.07	5443088.80	
		497693.06	5443101.11	
		497700.51	5443095.76	
		497691.21	5443083.44	
'T1B65_GF'	1	5.00		'T1B 0.65 MTPA Ground Flare Building'
	8	23.55		
		497398.62	5443055.10	
		497392.89	5443052.73	
		497390.51	5443046.99	
		497392.89	5443041.26	
		497398.62	5443038.88	
		497404.36	5443041.26	
		497406.73	5443046.99	
		497404.36	5443052.73	
'T1A_EMERGENCY_GENERATOR'	1	4.00		'T1A_Emergency_Generator Building'
EG-100401'	4	4.10		
		497776.08	5443067.35	
		497778.28	5443070.27	
		497790.57	5443061.01	
		497788.37	5443058.09	
'T3_TANK_CENTR'	1	5.13		'T3 Tank (Largest)'
	8	53.00		
		497591.07	5443054.71	
		497563.84	5443043.44	
		497552.57	5443016.21	
		497563.84	5442988.99	

		497591.07	5442977.71
		497618.29	5442988.99
		497629.57	5443016.21
		497618.29	5443043.44
'T2_GF'	1	6.00	'T2 Ground Flare'
8		33.80	
		497366.56	5443086.34
		497359.23	5443083.30
		497356.19	5443075.97
		497359.23	5443068.64
		497366.56	5443065.61
		497373.88	5443068.64
		497376.92	5443075.97
		497373.88	5443083.30
'T1B_MH'	1	4.00	'T1B Machine House'
4		24.00	
		497619.85	5443106.06
		497604.55	5443086.40
		497547.65	5443130.17
		497562.82	5443149.80
'BOG_COM2'	1	4.50	'BOG Compressors Building 2'
4		6.50	
		497647.67	5442996.77
		497635.51	5442980.91
		497677.26	5442948.99
		497689.44	5442964.64
'ELEC_BLD'	1	5.00	'230KV substation building'
4		10.00	
		497707.62	5442881.04
		497699.39	5442870.19
		497676.20	5442888.10
		497684.48	5442898.81
'T1B_RG'	1	5.00	'T1B and Regasification package substation'
4		8.00	
		497473.16	5443018.98
		497465.86	5443009.59
		497506.93	5442977.88
		497514.18	5442987.22
'ELE_SUB'	1	5.00	'Electrical Substation'
4		3.50	
		497532.56	5442973.06
		497528.14	5442967.43
		497547.28	5442952.71
		497551.54	5442958.42
'IA_PACK'	1	5.20	'IA and PSA Package 1'
4		3.50	
		497560.13	5442953.11
		497569.87	5442945.52
		497566.95	5442941.72
		497557.16	5442949.26

'PSA_PACK'	1	5.20	'IA and PSA Package 2'
4	3.50		
	497574.41		5442941.90
	497571.28		5442937.78
	497574.58		5442935.36
	497577.66		5442939.48
'T1B_EMERGENCY_GENERATOR'	1	5.20	'This is in fact TLSE Emergency
Generator Building'			
6	11.30		
	497616.98		5442914.06
	497609.72		5442904.65
	497596.57		5442914.56
	497595.69		5442913.40
	497590.41		5442917.47
	497598.77		5442927.98
'SOLVENT WASH COLUMN'	1	5.00	'VT-203001 SOLVENT WASH COLUMN'
8	28.30		
	497435.09		5443092.10
	497433.22		5443091.32
	497432.44		5443089.45
	497433.22		5443087.58
	497435.09		5443086.80
	497436.96		5443087.58
	497437.74		5443089.45
	497436.96		5443091.32
'SOLVENT STRIP COLUMN'	1	5.00	'VT-203002 SOLVENT STRIP COLUMN'
8	25.00		
	497427.21		5443097.69
	497425.65		5443097.05
	497425.01		5443095.49
	497425.65		5443093.94
	497427.21		5443093.29
	497428.76		5443093.94
	497429.41		5443095.49
	497428.76		5443097.05
'HEAT EXCHANGER I'	1	5.20	'Main Cryogenic Heat Exchanger I'
8	28.13		
	497393.95		5443183.70
	497392.46		5443183.08
	497391.85		5443181.60
	497392.46		5443180.11
	497393.95		5443179.50
	497395.43		5443180.11
	497396.05		5443181.60
	497395.43		5443183.08
'HEAT EXCHANGER II'	1	5.00	'Main Cryogenic Heat Exchanger II'
8	52.08		
	497407.37		5443201.47
	497405.67		5443200.77
	497404.97		5443199.07

	497405.67	5443197.37		
	497407.37	5443196.67		
	497409.07	5443197.37		
	497409.77	5443199.07		
	497409.07	5443200.77		
'T2_MH' 1	4.63		'T2 Machine House'	
4	22.60			
	497476.18	5443288.58		
	497454.27	5443260.05		
	497546.10	5443189.40		
	497568.07	5443217.99		
'T2 EMREGENCY GENERATOR' 1	5.00		'T2 Emergency Generator Skid'	
4	4.00			
	497491.22	5443337.11		
	497479.44	5443322.31		
	497484.20	5443318.50		
	497495.98	5443333.64		
'T2_SUB' 1	5.33		'T2 Substation'	
4	12.60			
	497503.86	5443332.81		
	497490.02	5443314.46		
	497584.87	5443241.51		
	497598.96	5443259.86		
11				
'T1A_INCI'	5.00	16.82	497747.99	5443100.00 'T1A
incinerator'				
'T1A_HEAT'	5.00	6.10	497758.66	5443091.20 'T1A oil
heater'				
'T1A_REGE'	5.00	5.63	497741.03	5443098.45 'T1A regen'
'T1B65HEA'	5.00	29.00	497425.84	5443019.42 'T1B 0.65
MTPA oil heater'				
'T1B65THE'	6.00	19.20	497451.01	5443032.48 'T1B 0.65
MTPA thermal oxidizer'				
'T1B65GFL'	5.00	23.55	497398.62	5443046.99 'T1B 0.65
MTPA Gound Flare'				
'T2_EG'	5.00	5.94	497487.71	5443327.89 'T2
Emergency Generator'				
'T2_HEAT'	5.20	61.50	497305.96	5443134.92 'T2 oil
heater'				
'T2THERMA'	5.20	22.31	497327.87	5443111.76 'T2 thermal
oxidizer'				
'T2FLARE'	6.00	33.80	497366.56	5443075.97 'T2 Ground
Flare'				
'T1A_EG'	4.00	5.94	497782.62	5443064.71 'T1A
Emergency Generator'				

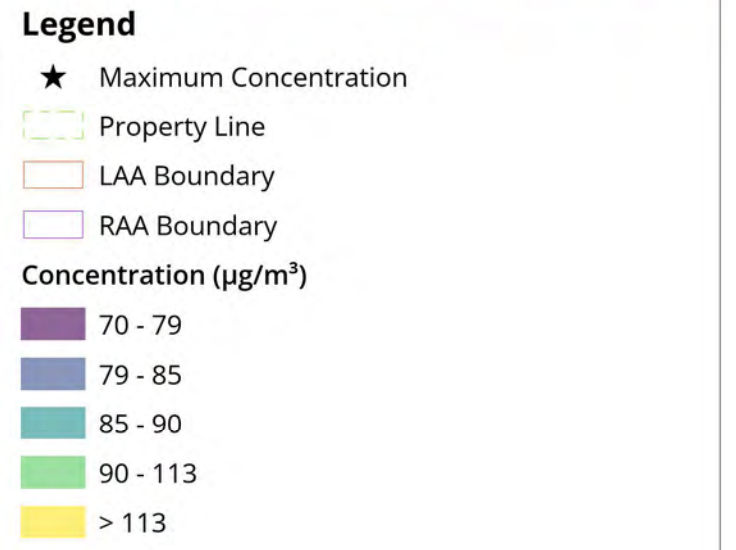
APPENDIX I

CONTOUR PLOTS



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Background concentration: 58.1 µg/m³
1-Hour NO₂ Previous MV AAQO: 113 µg/m³
1-Hour NO₂ Current MV AAQO and CAAQS-2025: 79 µg/m³

Predicted Annual 98th Percentile of D1HM NO₂ (OLM) Concentrations Averaged over 2013-2015 - Base Case

Service Layer Credits: World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, Parks Canada
World Imagery: Earthstar Geographics
Tilbury LNG - Delta, B.C.

True North

Drawn by: PIP

Figure: I.1

Approx. Scale: 1:150,000

Date Revised: Nov 15, 2023

Map Projection: NAD 1983 UTM Zone 10N

Project #: 2000436



Legend

- ★ Maximum Concentration
- Property Line
- LAA Boundary
- RAA Boundary

Concentration ($\mu\text{g}/\text{m}^3$)

- 21.3 - 21.5
- 21.5 - 22
- 22 - 22.6
- 22.6 - 23
- 23 - 32
- > 32

Background concentration: $21.1 \mu\text{g}/\text{m}^3$
Annual NO_2 Previous MV AAQO: $32 \mu\text{g}/\text{m}^3$
Annual NO_2 Current MV AAQO and CAAQS-2025: $22.6 \mu\text{g}/\text{m}^3$

Predicted Annual Average NO_2 (OLM) Concentrations Averaged over 2013-2015 - Base Case

Service Layer Credits: World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, Parks Canada
World Imagery: Earthstar Geographics
Tilbury LNG - Delta, B.C.

True North

Drawn by: PIP

Figure: I.2

Approx. Scale: 1:150,000

Date Revised: Nov 15, 2023

Map Projection: NAD 1983 UTM Zone 10N

Project #: 2000436



Legend

- ★ Maximum Concentration
- Property Line
- LAA Boundary
- RAA Boundary

Concentration ($\mu\text{g}/\text{m}^3$)

- 30 - 45
- 45 - 60
- 60 - 106
- 106 - 170
- 170 - 183
- > 183

Background concentration: $3.64 \mu\text{g}/\text{m}^3$
1-Hour SO_2 MV AAQO: $183 \mu\text{g}/\text{m}^3$

Predicted Annual 100th Percentile of 1-Hour SO_2 Concentrations Averaged over 2013-2015 - Base Case

Service Layer Credits: World Imagery: VFPA, Earthstar Geographics
World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, Parks Canada
Tilbury LNG - Delta, B.C.

True North

Drawn by: PIP

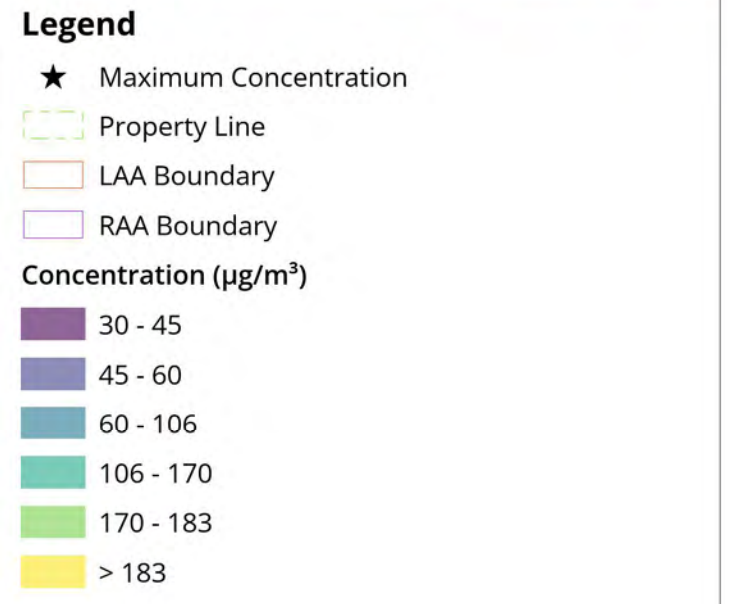
Figure: I.3

Approx. Scale: 1:150,000

Date Revised: Nov 10, 2023

Map Projection: NAD 1983 UTM Zone 10N

Project #: 2000436



Background concentration: $3.64 \mu\text{g}/\text{m}^3$
1-Hour SO_2 CAAQS-2025: $170 \mu\text{g}/\text{m}^3$

Predicted Annual 99th Percentile of D1HM SO_2 Concentrations Averaged over 2013-2015 - Base Case

Service Layer Credits: World Imagery: VFPA, Earthstar Geographics
World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, Parks Canada
Tilbury LNG - Delta, B.C.

True North

Drawn by: PIP

Figure: I.4

Approx. Scale: 1:150,000

Date Revised: Nov 15, 2023

Map Projection: NAD 1983 UTM Zone 10N

Project #: 2000436



- Legend**
- ★ Maximum Concentration
 - Property Line
 - LAA Boundary
 - RAA Boundary
- Concentration ($\mu\text{g}/\text{m}^3$)**
- 1 - 1.6
 - 1.6 - 2.8
 - 2.8 - 3.2
 - 3.2 - 10.5
 - 10.5 - 13
 - > 13

Background concentration: $0.63 \mu\text{g}/\text{m}^3$
Annual SO_2 Previous MV AAQO: $13 \mu\text{g}/\text{m}^3$
Annual SO_2 Current MV AAQO and CAAQS-2025: $10.5 \mu\text{g}/\text{m}^3$

Predicted Annual Average SO_2 Concentrations Averaged over 2013-2015 - Base Case

Service Layer Credits: World Imagery: VFPA, Earthstar Geographics
World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, Parks Canada
Tilbury LNG - Delta, B.C.

True North

Drawn by: PIP

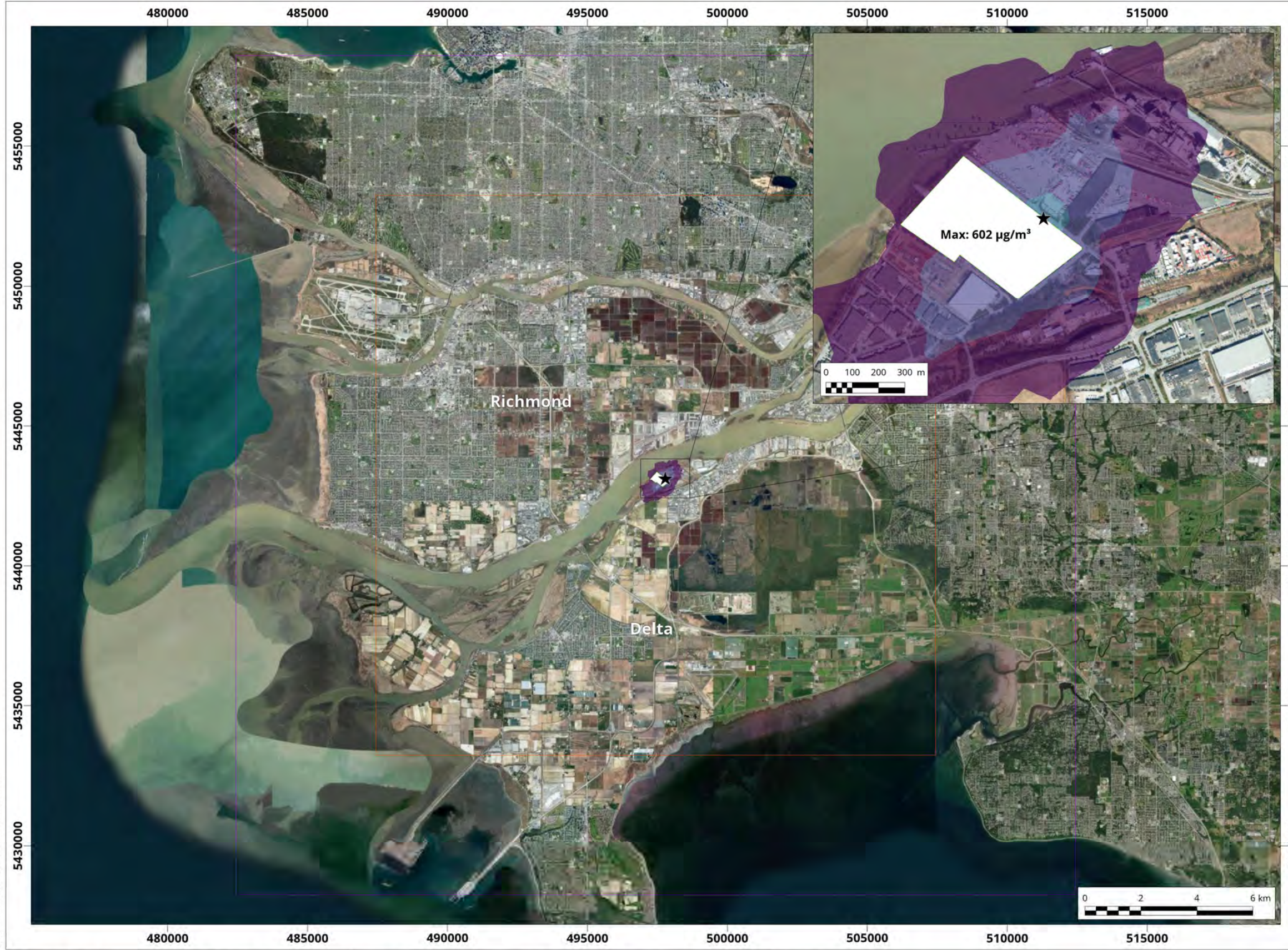
Figure: 1.5

Approx. Scale: 1:150,000

Date Revised: Nov 15, 2023

Map Projection: NAD 1983 UTM Zone 10N

Project #: 2000436



Legend

- ★ Maximum Concentration
- Property Line
- LAA Boundary
- RAA Boundary

Concentration ($\mu\text{g}/\text{m}^3$)

- 565 - 570
- 570 - 580
- 580 - 600
- 600 - 1,000
- 1,000 - 5,000
- 5,000 - 14,900
- > 14,900

Background concentration: 557 $\mu\text{g}/\text{m}^3$
1-Hour CO MV AAQO: 14,900 $\mu\text{g}/\text{m}^3$

Predicted Annual 100th Percentile of 1-Hour CO Concentrations Averaged over 2013-2015 - Base Case

Service Layer Credits: World Imagery: VFPA, Earthstar Geographics
World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, Parks Canada
Tilbury LNG - Delta, B.C.

True North

Drawn by: PIP

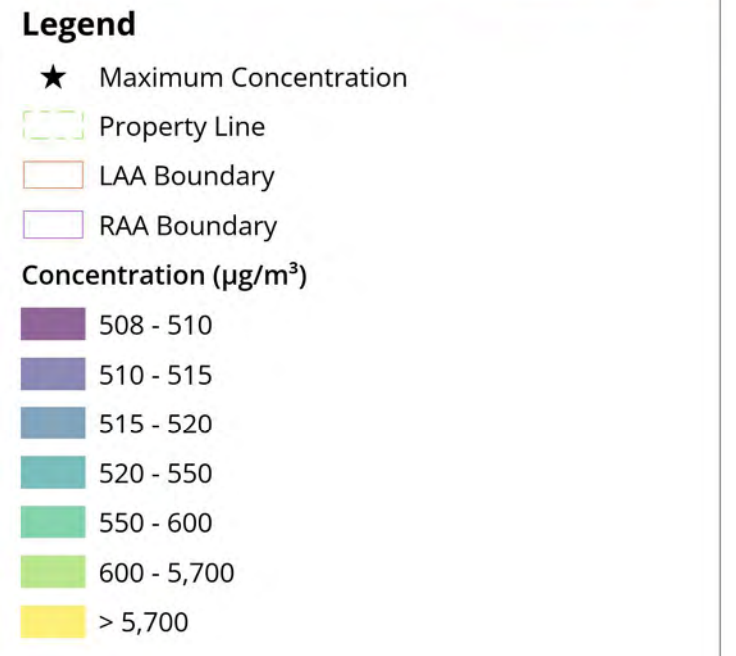
Figure: I.6

Approx. Scale: 1:150,000

Date Revised: Nov 10, 2023

Map Projection: NAD 1983 UTM Zone 10N

Project #: 2000436



Background concentration: 505 $\mu\text{g}/\text{m}^3$
8-Hour CO MV AAQO: 5,700 $\mu\text{g}/\text{m}^3$

Predicted Annual 100th Percentile of 8-HRA CO Concentrations Averaged over 2013-2015 - Base Case

Service Layer Credits: World Imagery: VFPA, Earthstar Geographics
World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, Parks Canada
Tilbury LNG - Delta, B.C.

True North

Drawn by: PIP

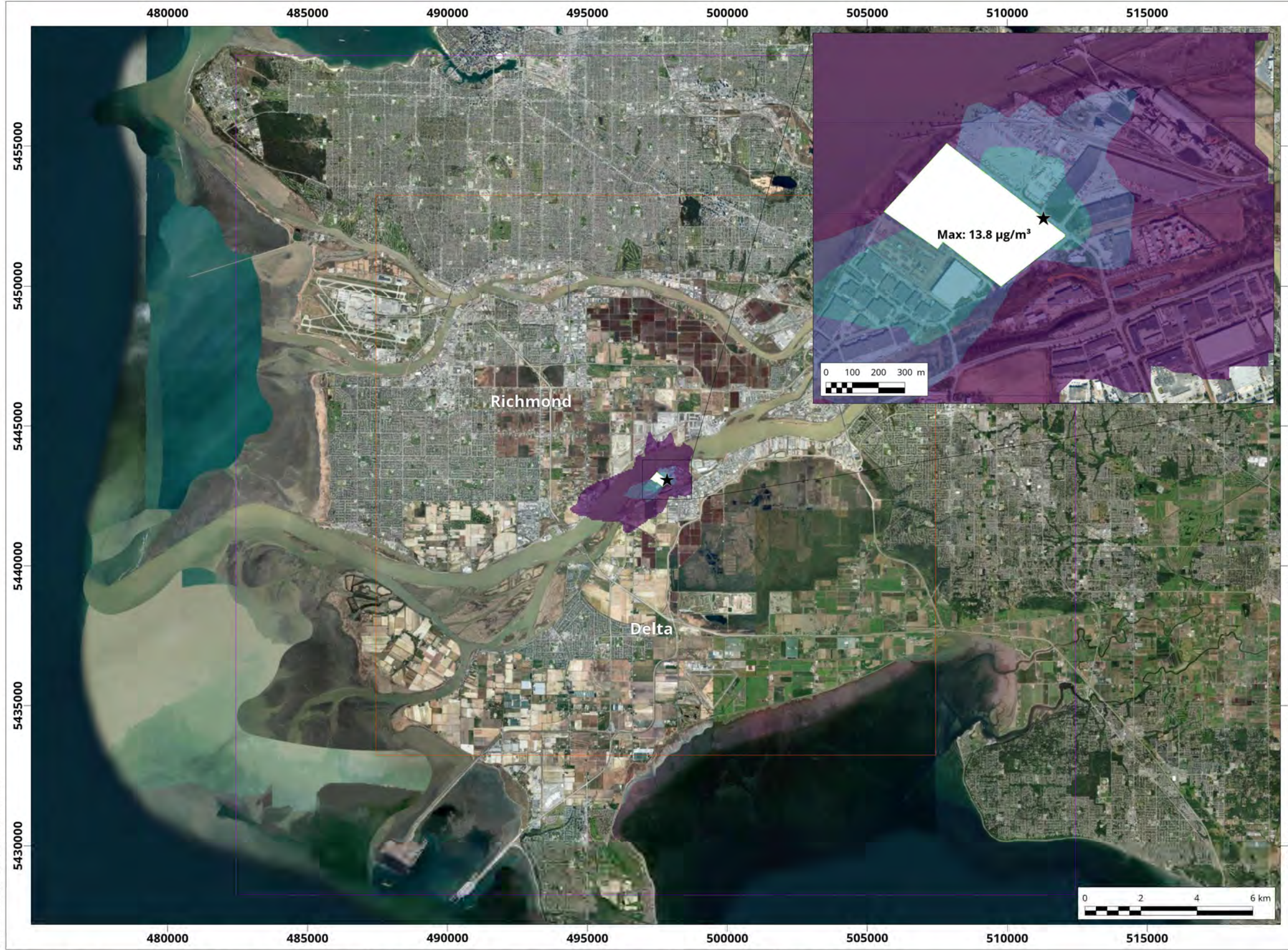
Figure: 1.7

Approx. Scale: 1:150,000

Date Revised: Nov 10, 2023

Map Projection: NAD 1983 UTM Zone 10N

Project #: 2000436



- Legend**
- ★ Maximum Concentration
 - Property Line
 - LAA Boundary
 - RAA Boundary
- Concentration ($\mu\text{g}/\text{m}^3$)**
- 12.1 - 12.3
 - 12.3 - 12.5
 - 12.5 - 15
 - 15 - 20
 - 20 - 25
 - > 25

Background concentration: $12.0 \mu\text{g}/\text{m}^3$
24-Hour $\text{PM}_{2.5}$ MV AAQO: $25 \mu\text{g}/\text{m}^3$

Predicted Annual 100th Percentile of 24-HRA $\text{PM}_{2.5}$ Concentrations Averaged over 2013-2015 - Base Case

Service Layer Credits: World Imagery: VFPA, Earthstar Geographics
World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, Parks Canada
Tilbury LNG - Delta, B.C.

True North

Drawn by: PIP

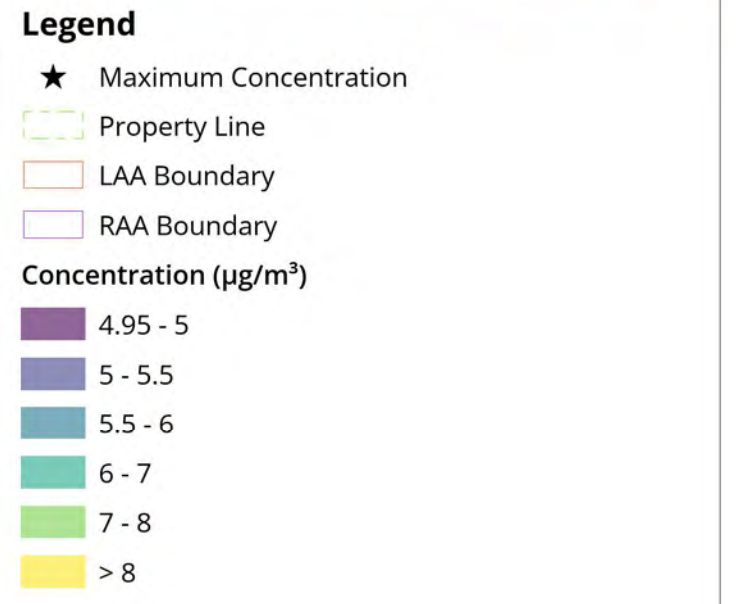
Figure: 1.8

Approx. Scale: 1:150,000

Date Revised: Nov 10, 2023

Map Projection: NAD 1983 UTM Zone 10N

Project #: 2000436



Background concentration: $4.91 \mu\text{g}/\text{m}^3$
Annual $\text{PM}_{2.5}$ MV AAQO: $8 (6)^{[1]} \mu\text{g}/\text{m}^3$

^[1] Metro Vancouver's annual $\text{PM}_{2.5}$ planning goal of $6 \mu\text{g}/\text{m}^3$ is a longer term aspirational target to support continuous improvement.

Predicted Annual Average $\text{PM}_{2.5}$ Concentrations Averaged over 2013-2015 - Base Case

Service Layer Credits: World Imagery: VFPA, Earthstar Geographics
World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, Parks Canada
Tilbury LNG - Delta, B.C.

True North

Drawn by: PIP

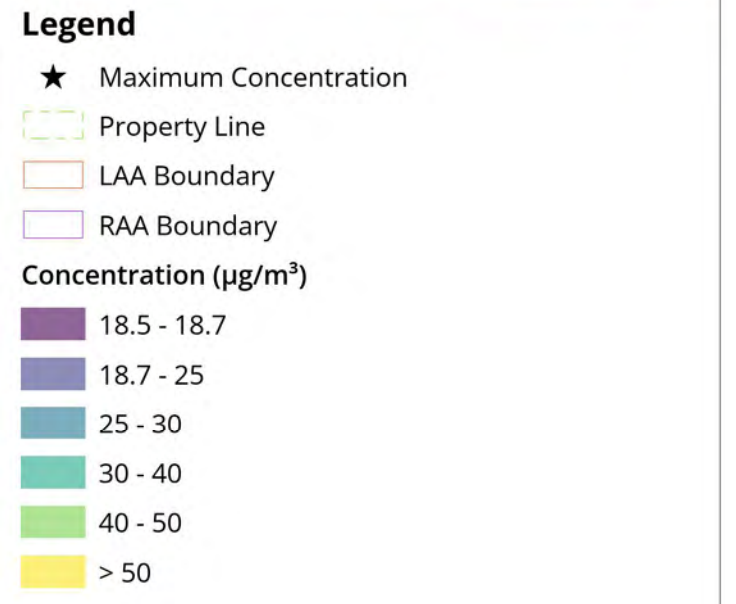
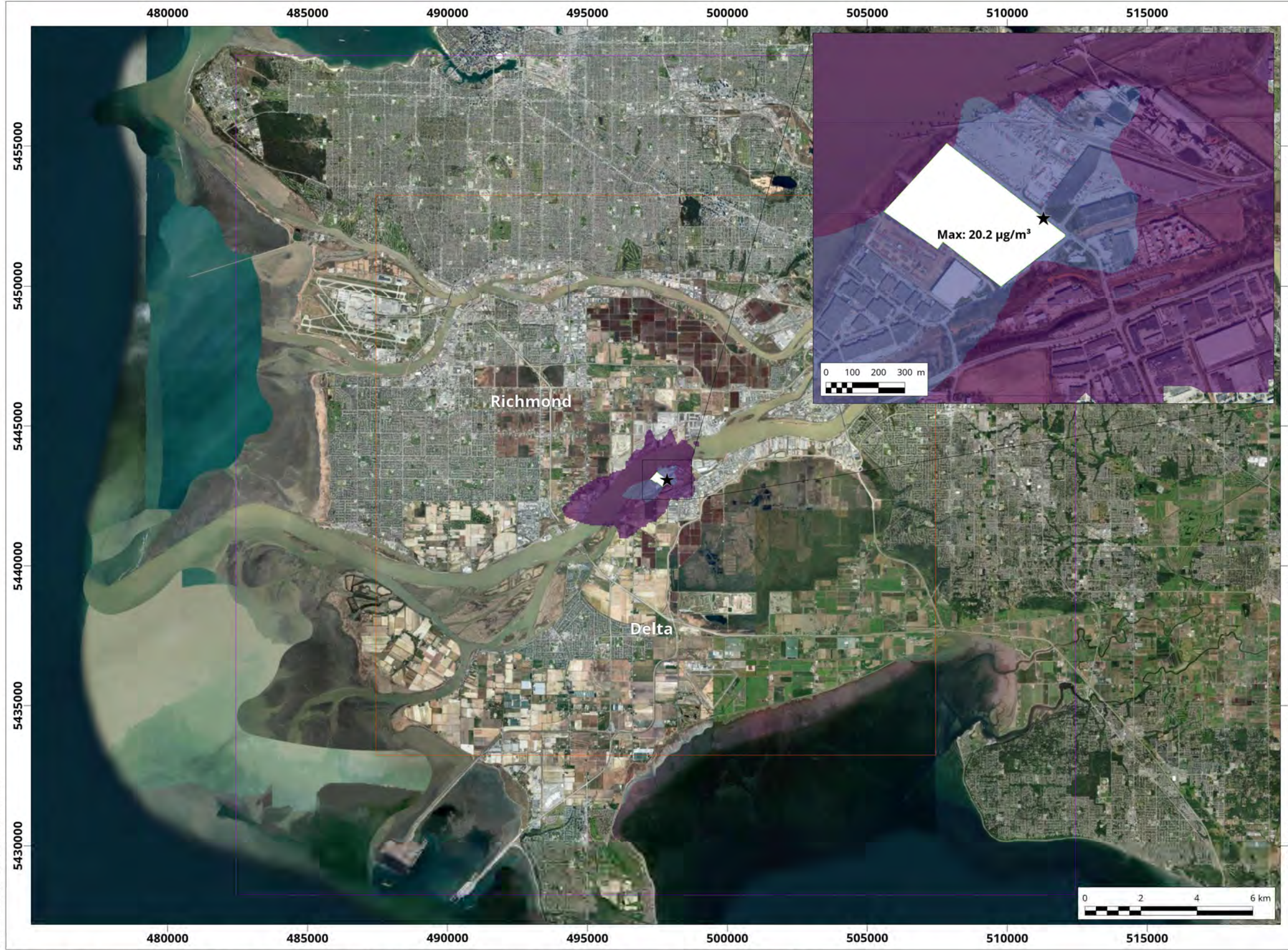
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Approx. Scale: 1:150,000

Date Revised: Nov 10, 2023

Map Projection: NAD 1983 UTM Zone 10N

Project #: 2000436



Background concentration: $18.4 \mu\text{g}/\text{m}^3$
24-Hour PM_{10} MV AAQO: $50 \mu\text{g}/\text{m}^3$

Predicted Annual 100th Percentile of 24-HRA PM_{10} Concentrations Averaged over 2013-2015 - Base Case

Service Layer Credits: World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, Parks Canada
World Imagery: Earthstar Geographics
Tilbury LNG - Delta, B.C.

True North

Drawn by: PIP

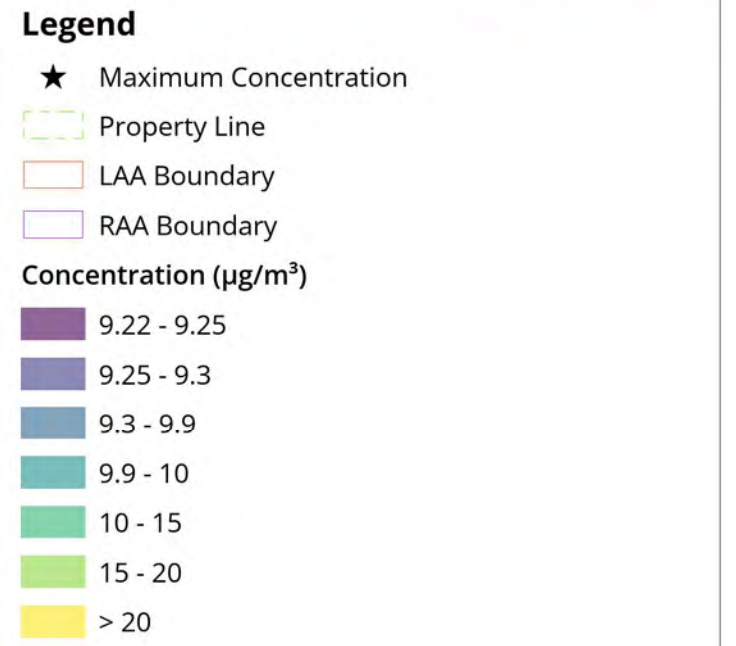
Figure: I.10

Approx. Scale: 1:150,000

Date Revised: Nov 10, 2023

Map Projection: NAD 1983 UTM Zone 10N

Project #: 2000436



Background concentration: $9.19 \mu\text{g}/\text{m}^3$
Annual PM_{10} MV AAQO: $20 \mu\text{g}/\text{m}^3$

Predicted Annual Average PM_{10} Concentrations Averaged over 2013-2015 - Base Case

Service Layer Credits: World Imagery: VFPA, Earthstar Geographics
World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, Parks Canada
Tilbury LNG - Delta, B.C.

True North

Drawn by: PIP

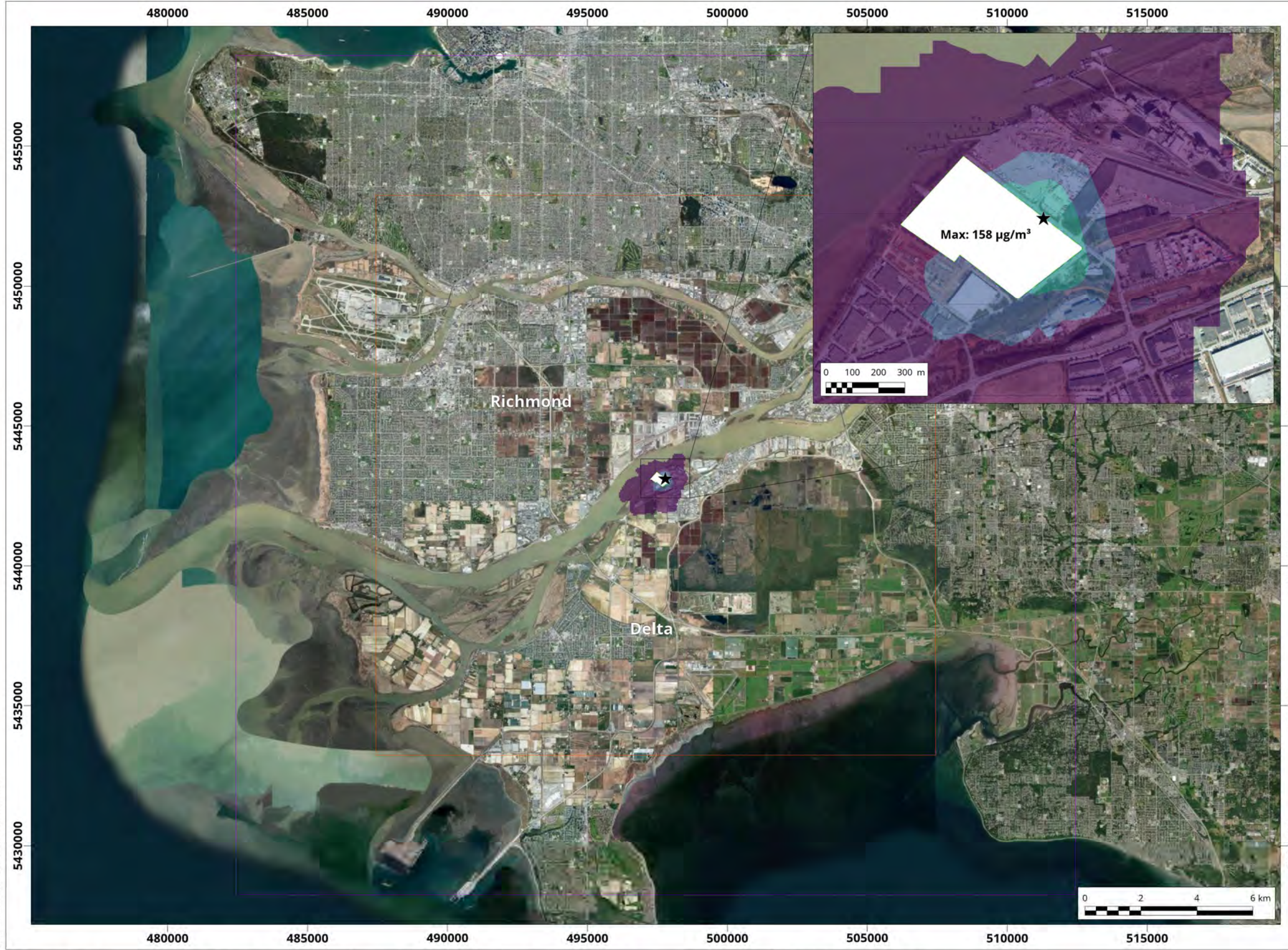
Figure: I.11

Approx. Scale: 1:150,000

Date Revised: Nov 10, 2023

Map Projection: NAD 1983 UTM Zone 10N

Project #: 2000436



Legend

- ★ Maximum Concentration
- Property Line
- LAA Boundary
- RAA Boundary

Concentration ($\mu\text{g}/\text{m}^3$)

- 151.5 - 153
- 153 - 154
- 154 - 160
- 160 - 170
- > 170

Background concentration: 150 $\mu\text{g}/\text{m}^3$

Predicted Annual 100th Percentile of 1-Hour Total VOC Concentrations Averaged over 2013-2015 - Base Case

Service Layer Credits: World Imagery: VFPA, Earthstar Geographics
World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, Parks Canada
Tilbury LNG - Delta, B.C.

True North

Drawn by: PIP

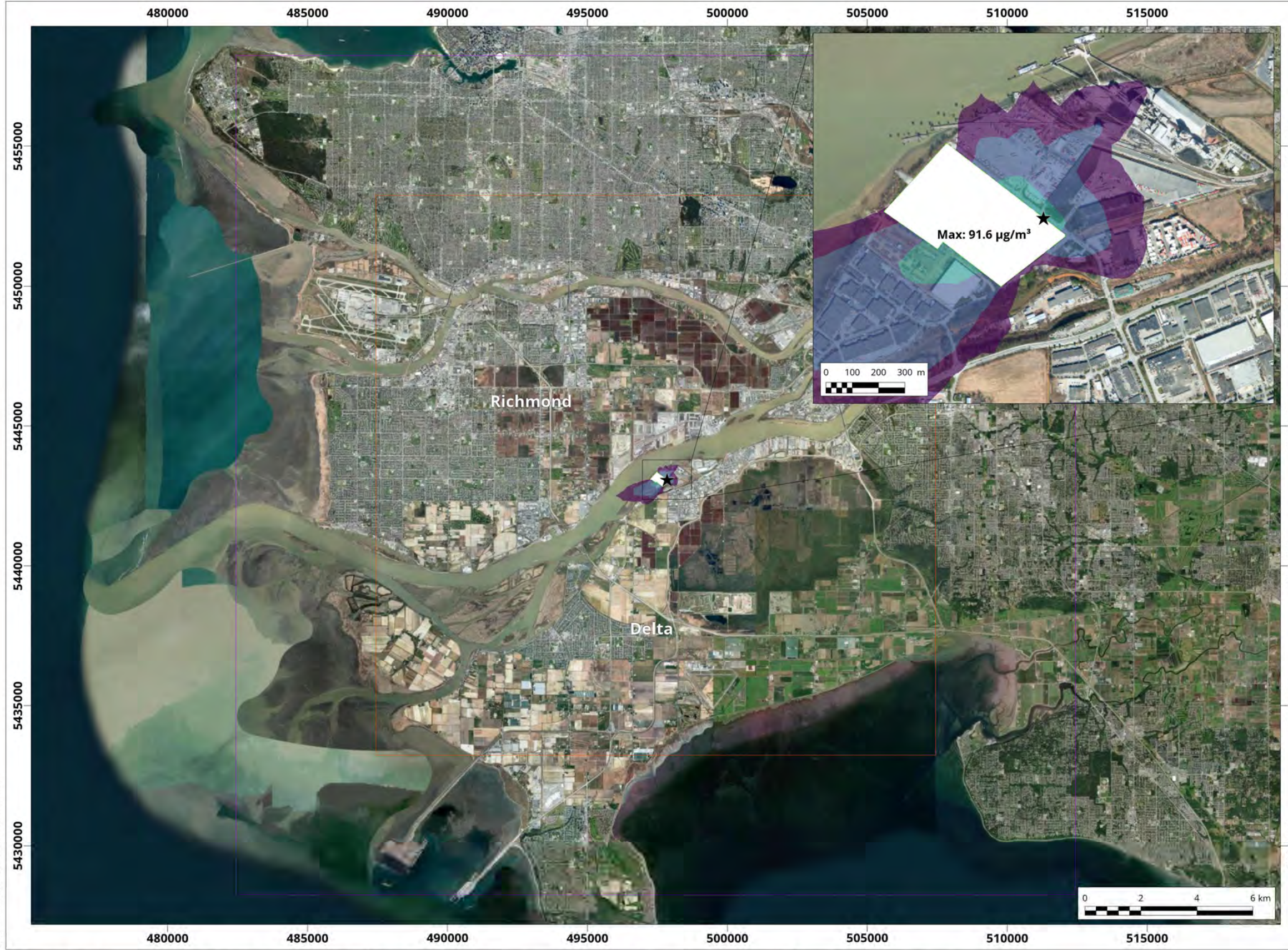
Figure: I.12

Approx. Scale: 1:150,000

Date Revised: Nov 10, 2023

Map Projection: NAD 1983 UTM Zone 10N

Project #: 2000436



Legend

- ★ Maximum Concentration
- Property Line
- LAA Boundary
- RAA Boundary

Concentration ($\mu\text{g}/\text{m}^3$)

- 90.5 - 90.6
- 90.6 - 91
- 91 - 92
- 92 - 95
- > 95

Background concentration: $90.2 \mu\text{g}/\text{m}^3$



- Legend**
- ★ Maximum Concentration
 - Property Line
 - LAA Boundary
 - RAA Boundary
 - Concentration ($\mu\text{g}/\text{m}^3$)
 - 32.96 - 33.13
 - > 33.13
- Contour levels represent 0.5% and 1% above background concentrations, respectively.

Background concentration: 32.8 $\mu\text{g}/\text{m}^3$

Predicted Annual Average Total VOC Concentrations Averaged over 2013-2015 - Base Case

Service Layer Credits: World Imagery: VFPA, Earthstar Geographics
World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, Parks Canada
Tilbury LNG - Delta, B.C.

True North ↑	Drawn by: PIP	Figure: I.14
	Approx. Scale: 1:150,000	
	Date Revised: Nov 10, 2023	

Map Projection: NAD 1983 UTM Zone 10N
Project #: 2000436





- Legend**
- ★ Maximum Concentration
 - Property Line
 - LAA Boundary
 - RAA Boundary
- Concentration ($\mu\text{g}/\text{m}^3$)**
- 70 - 79
 - 79 - 85
 - 85 - 90
 - 90 - 113
 - > 113

Background concentration: $58.1 \mu\text{g}/\text{m}^3$
1-Hour NO_2 Previous MV AAQO: $113 \mu\text{g}/\text{m}^3$
1-Hour NO_2 Current MV AAQO and CAAQS-2025: $79 \mu\text{g}/\text{m}^3$

Predicted Annual 98th Percentile of D1HM NO_2 (OLM) Concentrations Averaged over 2013-2015 - Base Case + Project

Service Layer Credits: World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, Parks Canada
World Imagery: Earthstar Geographics
Tilbury LNG - Delta, B.C.

True North
Drawn by: PIP
Figure: I.15
Approx. Scale: 1:150,000
Map Projection: NAD 1983 UTM Zone 10N
Project #: 2000436
Date Revised: Nov 15, 2023





- Legend**
- ★ Maximum Number of Exceedances per Year
 - Property Line
 - LAA Boundary
 - RAA Boundary
- Number of Exceedances per Year**
- 1 - 10
 - 10 - 15
 - 15 - 20
 - > 20

Based on 98th Percentile of D1HM NO₂ (OLM) Concentrations

Background concentration: 58.1 µg/m³

1-Hour NO₂ Current MV AAQO and CAAQS-2025: 79 µg/m³



Legend

- ★ Maximum Concentration
- Property Line
- LAA Boundary
- RAA Boundary

Concentration ($\mu\text{g}/\text{m}^3$)

- 21.3 - 21.5
- 21.5 - 22
- 22 - 22.6
- 22.6 - 23
- 23 - 32
- > 32

Background concentration: $21.1 \mu\text{g}/\text{m}^3$
Annual NO_2 Previous MV AAQO: $32 \mu\text{g}/\text{m}^3$
Annual NO_2 Current MV AAQO and CAAQS-2025: $22.6 \mu\text{g}/\text{m}^3$

Predicted Annual Average NO_2 (OLM) Concentrations Averaged over 2013-2015 - Base Case + Project

Service Layer Credits: World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, Parks Canada
World Imagery: Earthstar Geographics
Tilbury LNG - Delta, B.C.

True North

Drawn by: PIP

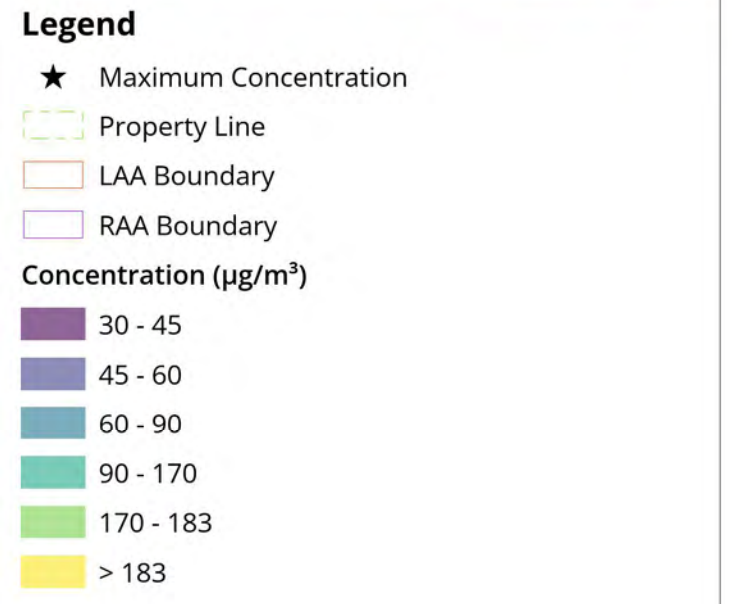
Figure: I.17

Approx. Scale: 1:150,000

Date Revised: Nov 15, 2023

Map Projection: NAD 1983 UTM Zone 10N

Project #: 2000436



Background concentration: $3.64 \mu\text{g}/\text{m}^3$
1-Hour SO_2 MV AAQO: $183 \mu\text{g}/\text{m}^3$

Predicted Annual 100th Percentile of 1-Hour SO_2 Concentrations Averaged over 2013-2015 - Base Case + Project

Service Layer Credits: World Imagery: VFPA, Earthstar Geographics
World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, Parks Canada
Tilbury LNG - Delta, B.C.

True North

Drawn by: PIP

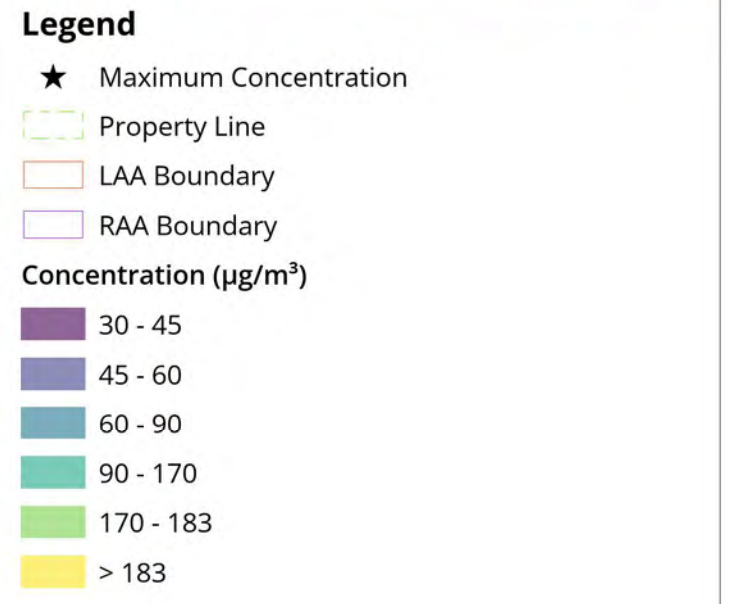
Figure: I.18

Approx. Scale: 1:150,000

Date Revised: Nov 10, 2023

Map Projection: NAD 1983 UTM Zone 10N

Project #: 2000436



Background concentration: $3.64 \mu\text{g}/\text{m}^3$
1-Hour SO_2 CAAQS-2025: $170 \mu\text{g}/\text{m}^3$

Predicted Annual 99th Percentile of D1HM SO_2 Concentrations Averaged over 2013-2015 - Base Case + Project

Service Layer Credits: World Imagery: VFPA, Earthstar Geographics
World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, Parks Canada
Tilbury LNG - Delta, B.C.

True North

Drawn by: PIP

Figure: I.19

Approx. Scale: 1:150,000

Date Revised: Nov 15, 2023

Map Projection: NAD 1983 UTM Zone 10N

Project #: 2000436



Legend

- ★ Maximum Concentration
- Property Line
- LAA Boundary
- RAA Boundary

Concentration ($\mu\text{g}/\text{m}^3$)

- 1 - 1.6
- 1.6 - 2.8
- 2.8 - 3.2
- 3.2 - 10.5
- 10.5 - 13
- > 13

Background concentration: $0.63 \mu\text{g}/\text{m}^3$
Annual SO_2 Previous MV AAQO: $13 \mu\text{g}/\text{m}^3$
Annual SO_2 Current MV AAQO and CAAQS-2025: $10.5 \mu\text{g}/\text{m}^3$

Predicted Annual Average SO_2 Concentrations Averaged over 2013-2015 - Base Case + Project

Service Layer Credits: World Imagery: VFPA, Earthstar Geographics
World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, Parks Canada
Tilbury LNG - Delta, B.C.

True North

Drawn by: PIP

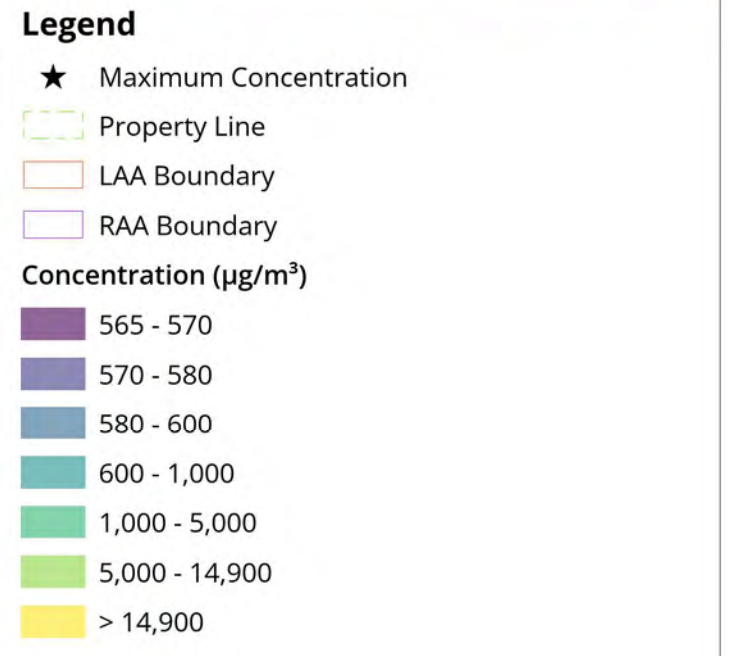
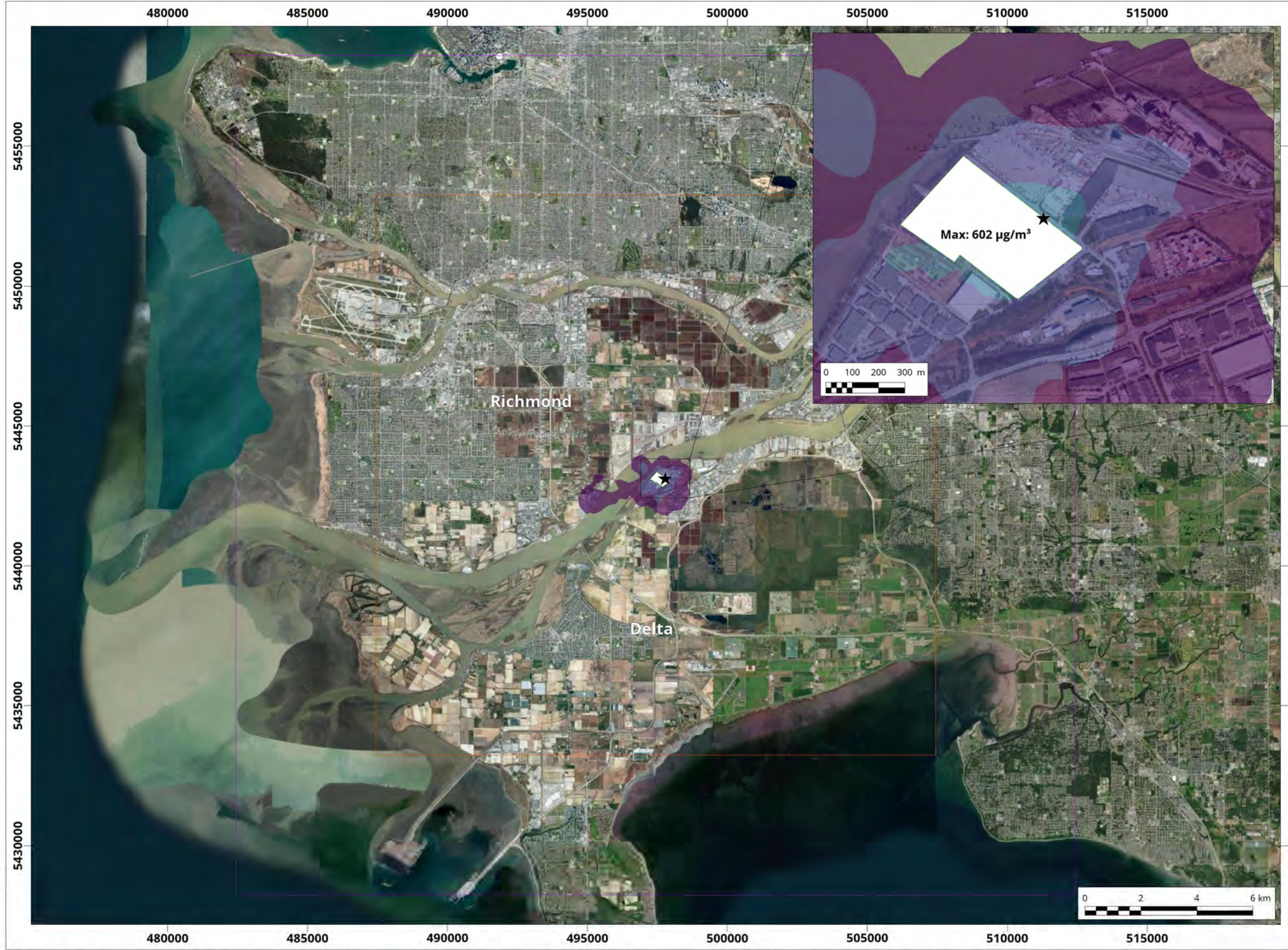
Figure: I.20

Approx. Scale: 1:150,000

Date Revised: Nov 15, 2023

Map Projection: NAD 1983 UTM Zone 10N

Project #: 2000436



Background concentration: 557 $\mu\text{g}/\text{m}^3$
1-Hour CO MV AAQO: 14,900 $\mu\text{g}/\text{m}^3$

Predicted Annual 100th Percentile of 1-Hour CO Concentrations Averaged over 2013-2015 - Base Case + Project

Service Layer Credits: World Imagery: VFPA, Earthstar Geographics
World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, Parks Canada
Tilbury LNG - Delta, B.C.

True North

Drawn by: PIP

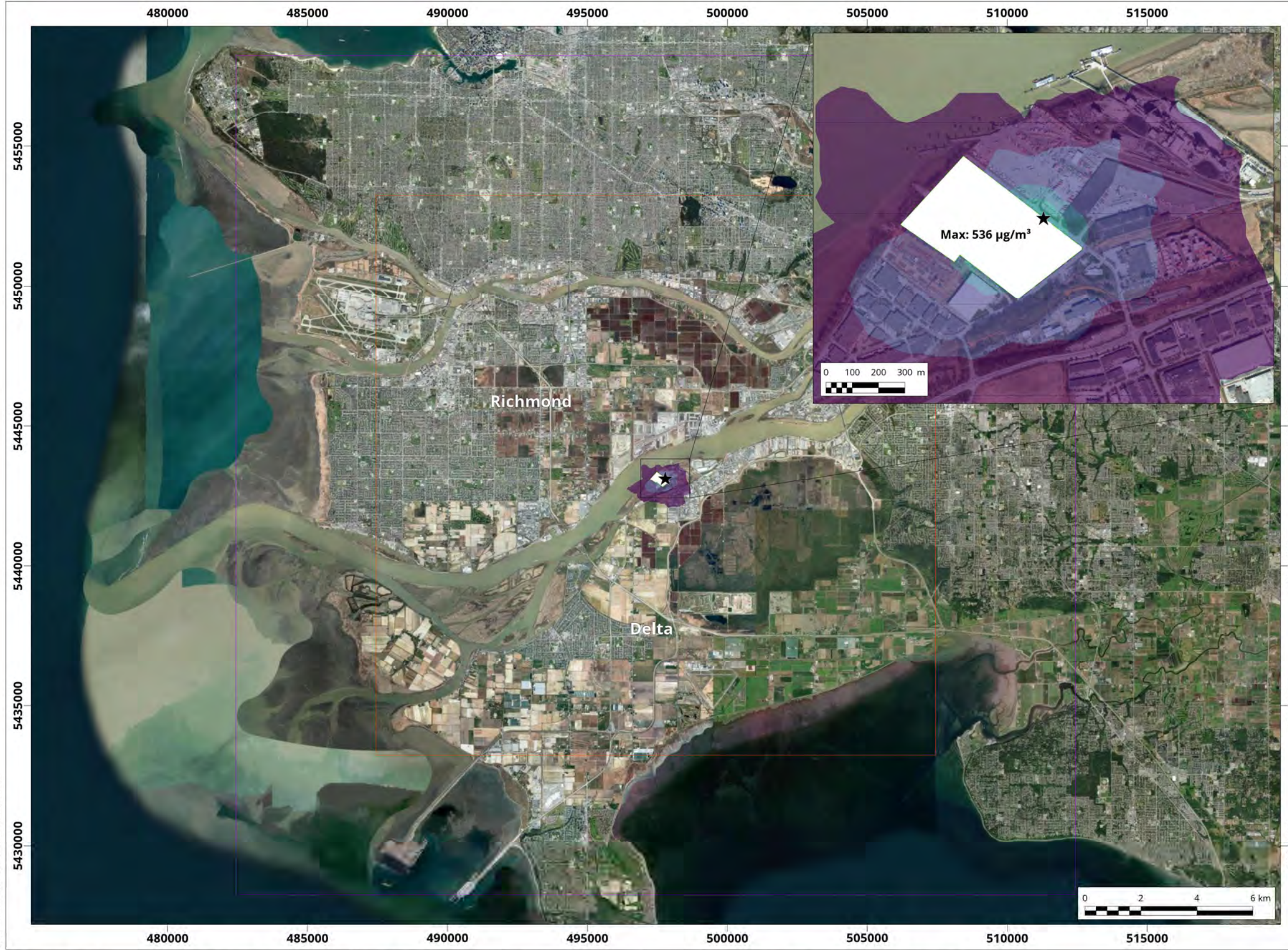
Figure: I.21

Approx. Scale: 1:150,000

Date Revised: Nov 10, 2023

Map Projection: NAD 1983 UTM Zone 10N

Project #: 2000436



- Legend**
- ★ Maximum Concentration
 - Property Line
 - LAA Boundary
 - RAA Boundary
- Concentration ($\mu\text{g}/\text{m}^3$)**
- 508 - 510
 - 510 - 515
 - 515 - 520
 - 520 - 550
 - 550 - 600
 - 600 - 5,700
 - > 5,700

Background concentration: 505 $\mu\text{g}/\text{m}^3$
8-Hour CO MV AAQO: 5,700 $\mu\text{g}/\text{m}^3$

Predicted Annual 100th Percentile of 8-HRA CO Concentrations Averaged over 2013-2015 - Base Case + Project

Service Layer Credits: World Imagery: VFPA, Earthstar Geographics
World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, Parks Canada
Tilbury LNG - Delta, B.C.

True North

Drawn by: PIP

Figure: I.22

Approx. Scale: 1:150,000

Date Revised: Nov 10, 2023

Map Projection: NAD 1983 UTM Zone 10N

Project #: 2000436



Legend

- ★ Maximum Concentration
- Property Line
- LAA Boundary
- RAA Boundary

Value

- 12.1 - 12.3
- 12.3 - 12.5
- 12.5 - 15
- 15 - 20
- 20 - 25
- > 25

Background concentration: 12.0 µg/m³
24-Hour PM_{2.5} MV AAQO: 25 µg/m³



- Legend**
- ★ Maximum Concentration
 - Property Line
 - LAA Boundary
 - RAA Boundary
- Concentration ($\mu\text{g}/\text{m}^3$)**
- 4.95 - 5
 - 5 - 5.5
 - 5.5 - 6
 - 6 - 7
 - 7 - 8
 - > 8

Background concentration: $4.91 \mu\text{g}/\text{m}^3$
Annual $\text{PM}_{2.5}$ MV AAQO: $8 (6)^{[1]} \mu\text{g}/\text{m}^3$

^[1] Metro Vancouver's annual $\text{PM}_{2.5}$ planning goal of $6 \mu\text{g}/\text{m}^3$ is a longer term aspirational target to support continuous improvement.

Predicted Annual Average $\text{PM}_{2.5}$ Concentrations Averaged over 2013-2015 - Base Case + Project

Service Layer Credits: World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, Parks Canada
World Imagery: Earthstar Geographics
Tilbury LNG - Delta, B.C.

True North

Drawn by: PIP

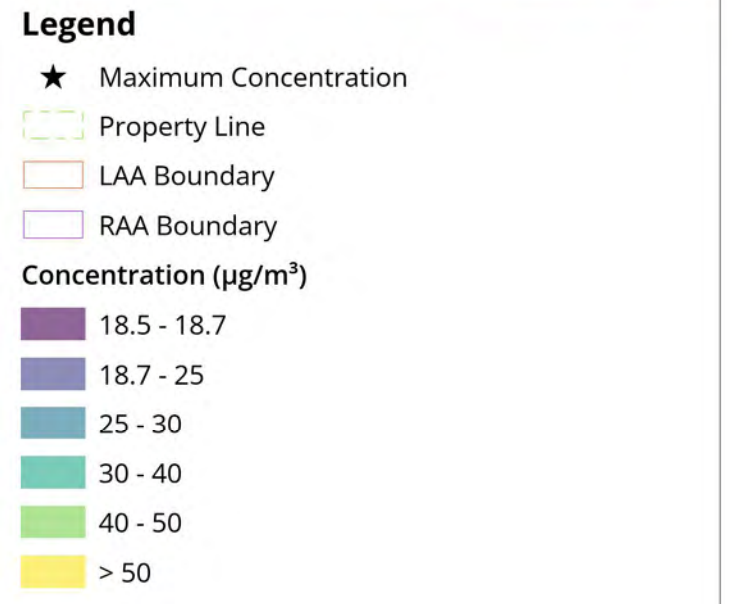
Figure: I.24

Approx. Scale: 1:150,000

Date Revised: Nov 10, 2023

Map Projection: NAD 1983 UTM Zone 10N

Project #: 2000436



Background concentration: $18.4 \mu\text{g}/\text{m}^3$
24-Hour PM_{10} MV AAQO: $50 \mu\text{g}/\text{m}^3$

Predicted Annual 100th Percentile of 24-HRA PM_{10} Concentrations Averaged over 2013-2015 - Base Case + Project

Service Layer Credits: World Imagery: VFPA, Earthstar Geographics
World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, Parks Canada
Tilbury LNG - Delta, B.C.

True North

Drawn by: PIP

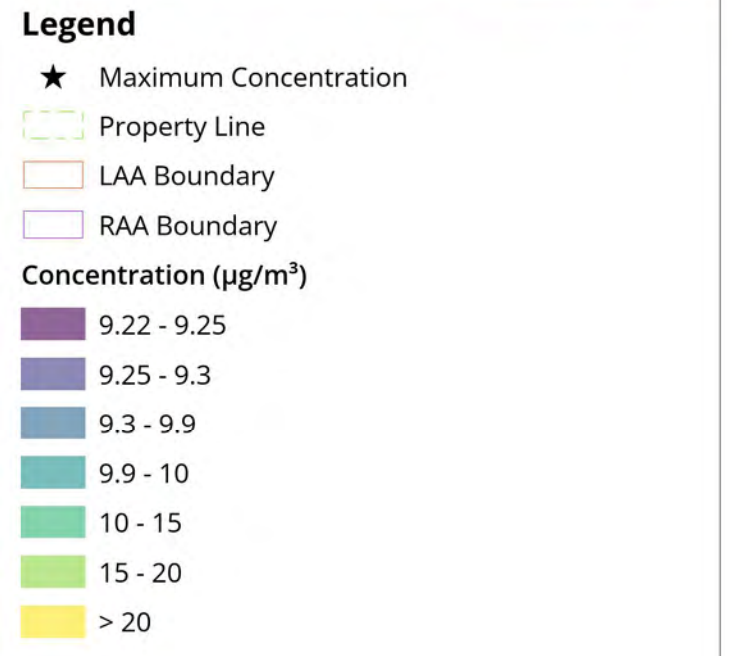
Figure: I.25

Approx. Scale: 1:150,000

Date Revised: Nov 10, 2023

Map Projection: NAD 1983 UTM Zone 10N

Project #: 2000436

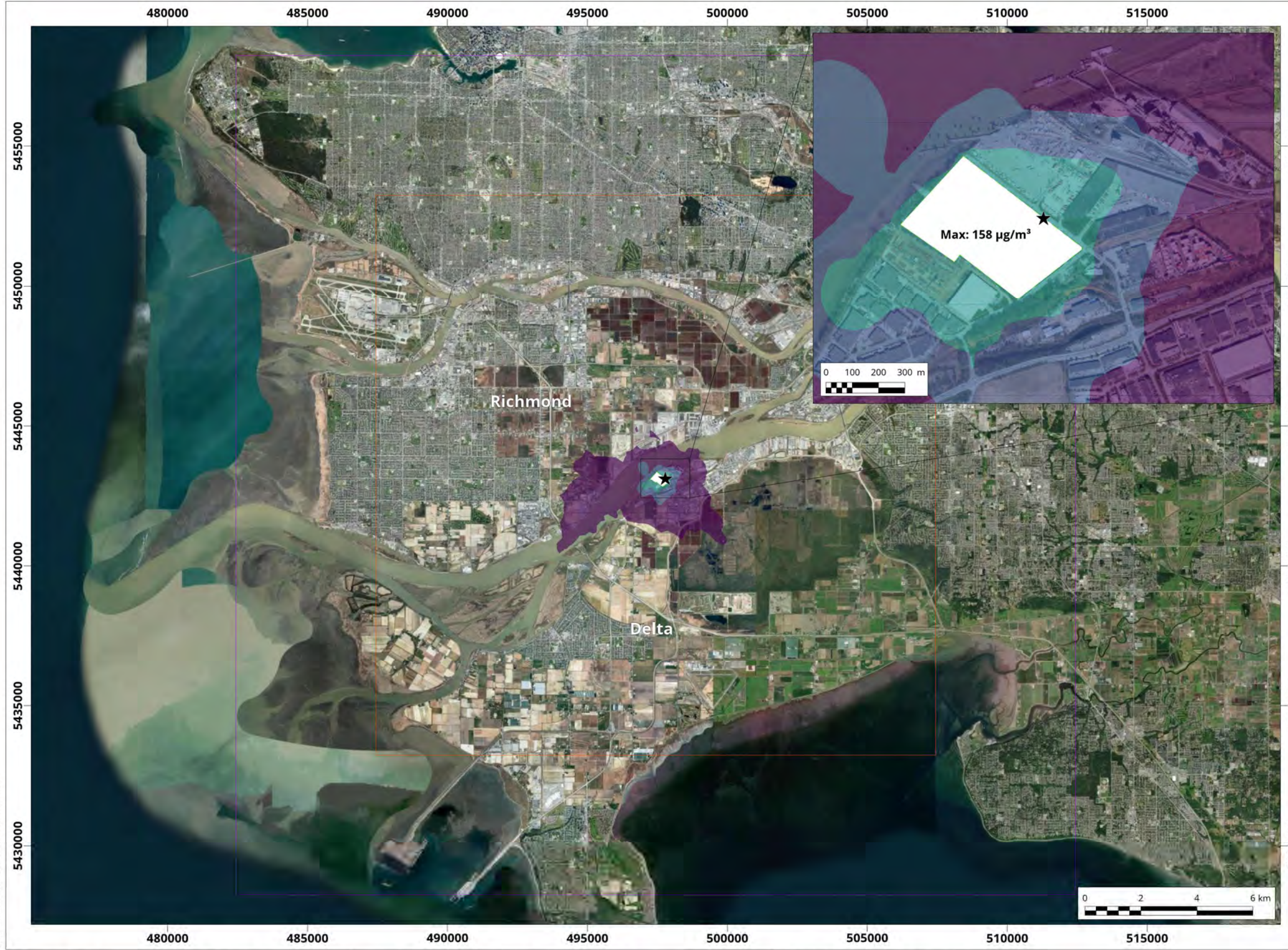


Background concentration: $9.19 \mu\text{g}/\text{m}^3$
Annual PM_{10} MV AAQO: $20 \mu\text{g}/\text{m}^3$

Predicted Annual Average PM_{10} Concentrations Averaged over 2013-2015 - Base Case + Project

Service Layer Credits: World Imagery: VFPA, Earthstar Geographics
World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, Parks Canada
Tilbury LNG - Delta, B.C.





Legend

- ★ Maximum Concentration
- Property Line
- LAA Boundary
- RAA Boundary

Concentration ($\mu\text{g}/\text{m}^3$)

- 151.5 - 153
- 153 - 154
- 154 - 160
- 160 - 170
- > 170

Background concentration: $150 \mu\text{g}/\text{m}^3$



Legend

- ★ Maximum Concentration
- Property Line
- LAA Boundary
- RAA Boundary

Concentration ($\mu\text{g}/\text{m}^3$)

- 90.5 - 90.6
- 90.6 - 91
- 91 - 92
- 92 - 95
- > 95

Background concentration: 90.2 $\mu\text{g}/\text{m}^3$

Predicted Annual 100th Percentile of 24-HRA Total VOC Concentrations Averaged over 2013-2015 - Base Case + Project

Service Layer Credits: World Imagery: VFPA, Earthstar Geographics
World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, Parks Canada
Tilbury LNG - Delta, B.C.

True North

Drawn by: PIP

Figure: I.28

Approx. Scale: 1:150,000

Date Revised: Nov 10, 2023

Map Projection: NAD 1983 UTM Zone 10N

Project #: 2000436





- Legend**
- ★ Maximum Concentration
 - Property Line
 - LAA Boundary
 - RAA Boundary
 - Concentration ($\mu\text{g}/\text{m}^3$)
 - 32.96 - 33.13
 - > 33.13
- Contour levels represent 0.5% and 1% above background concentrations, respectively.

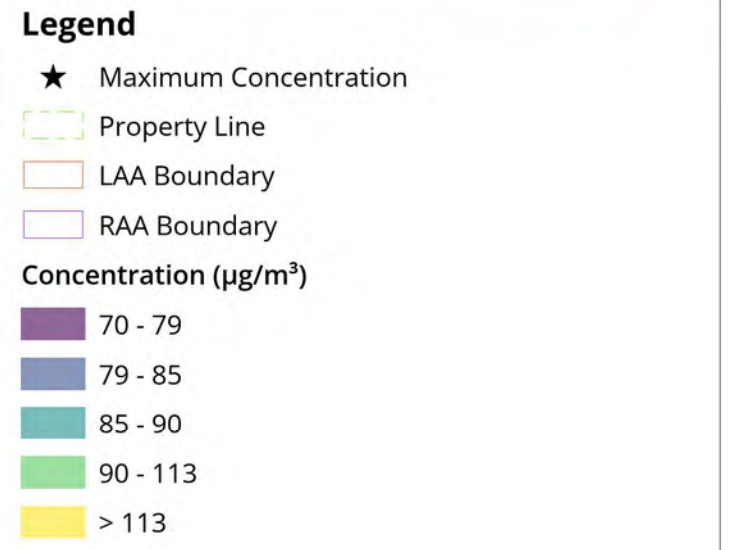
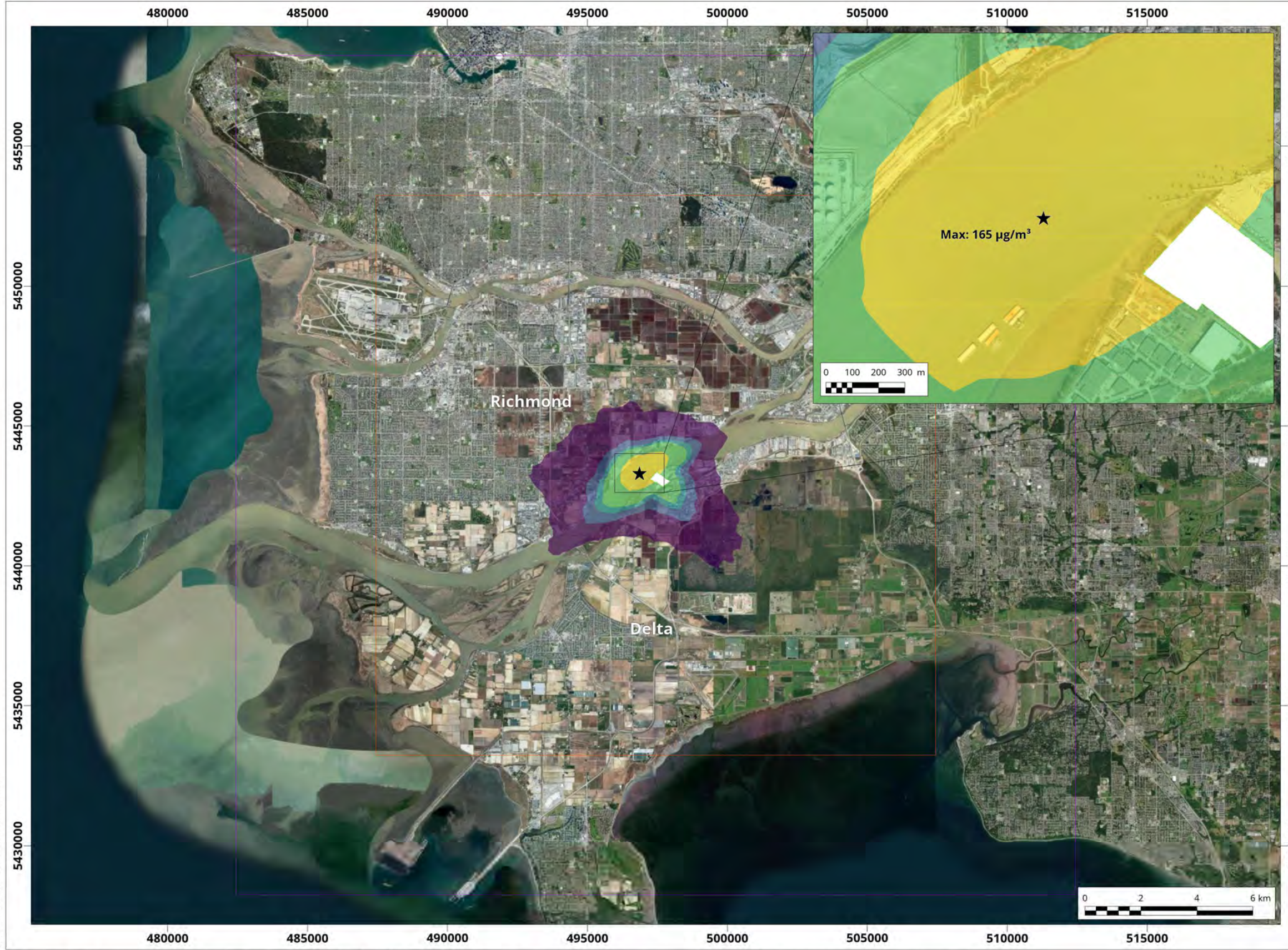
Background concentration: $32.8 \mu\text{g}/\text{m}^3$

Predicted Annual Average Total VOC Concentrations Averaged over 2013-2015 - Base Case + Project

Service Layer Credits: World Imagery: VFPA, Earthstar Geographics
World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, Parks Canada
Tilbury LNG - Delta, B.C.

True North
Drawn by: PIP
Figure: I.29
Approx. Scale: 1:150,000
Map Projection: NAD 1983 UTM Zone 10N
Project #: 2000436
Date Revised: Nov 15, 2023





Background concentration: $58.1 \mu\text{g}/\text{m}^3$
1-Hour NO_2 Previous MV AAQO: $113 \mu\text{g}/\text{m}^3$
1-Hour NO_2 Current MV AAQO and CAAQS-2025: $79 \mu\text{g}/\text{m}^3$

Predicted Annual 98th Percentile of D1HM NO_2 (OLM) Concentrations Averaged over 2013-2015 - Cumulative Case

Service Layer Credits: World Imagery: VFPA, Earthstar Geographics
World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, Parks Canada
Tilbury LNG - Delta, B.C.

True North

Drawn by: PIP

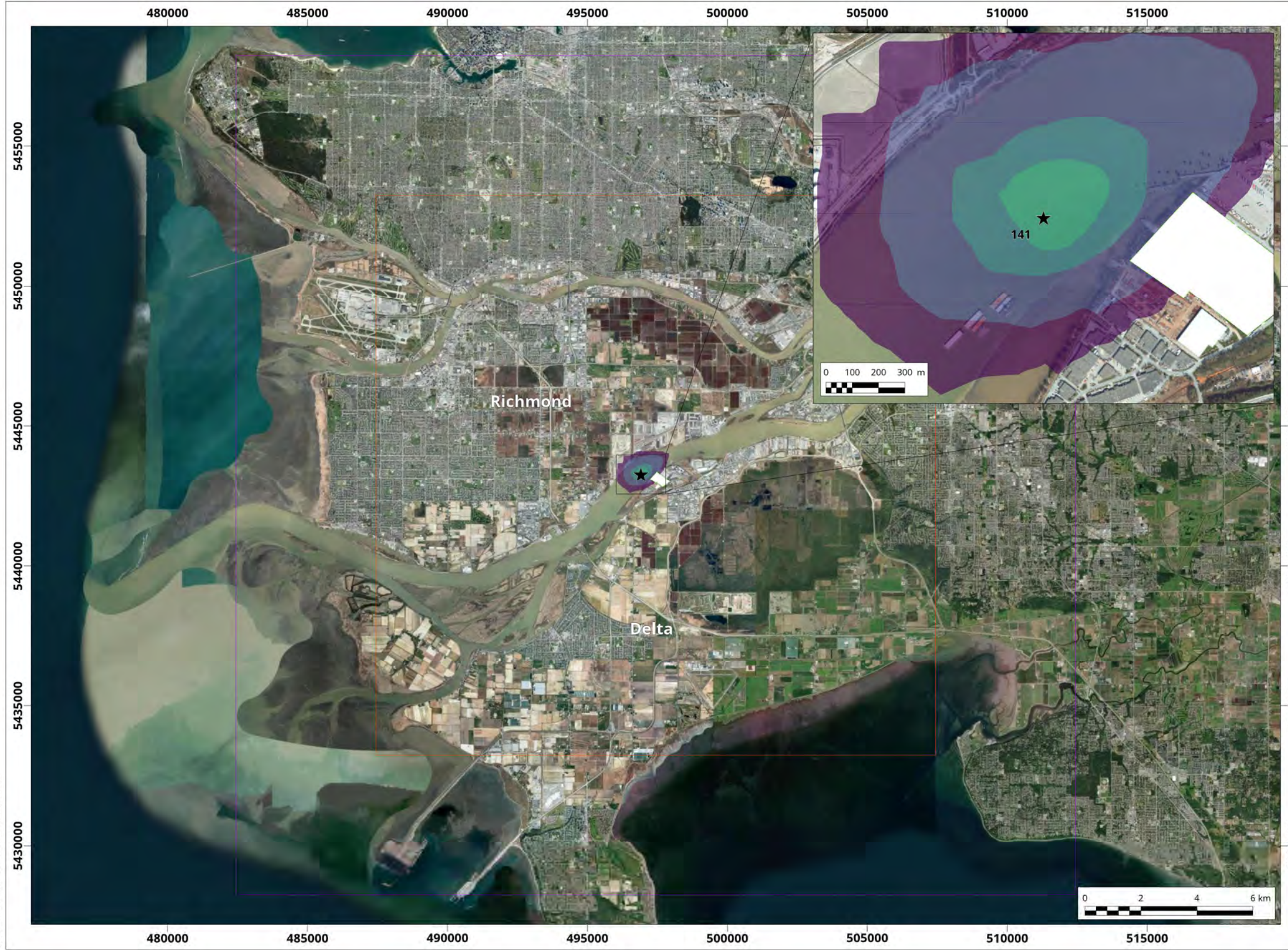
Figure: I.30

Approx. Scale: 1:150,000

Date Revised: Nov 15, 2023

Map Projection: NAD 1983 UTM Zone 10N

Project #: 2000436



- Legend**
- ★ Maximum Number of Exceedances per Year
 - Property Line
 - LAA Boundary
 - RAA Boundary
- Number of Exceedances per Year**
- 1 - 10
 - 10 - 50
 - 50 - 100
 - 100 - 150
 - 150 - 200
 - > 200

Based on 98th Percentile of D1HM NO₂ (OLM) Concentrations

Background concentration: 58.1 µg/m³

1-Hour NO₂ Previous MV AAQO: 113 µg/m³

Predicted Number of Exceedances of Previous MV AAQO for NO₂ 1-Hour averaged over 2013-2015 - Cumulative Case

Service Layer Credits: World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCan, Parks Canada
World Imagery: Earthstar Geographics
Tilbury LNG - Delta, B.C.

True North

Drawn by: PIP

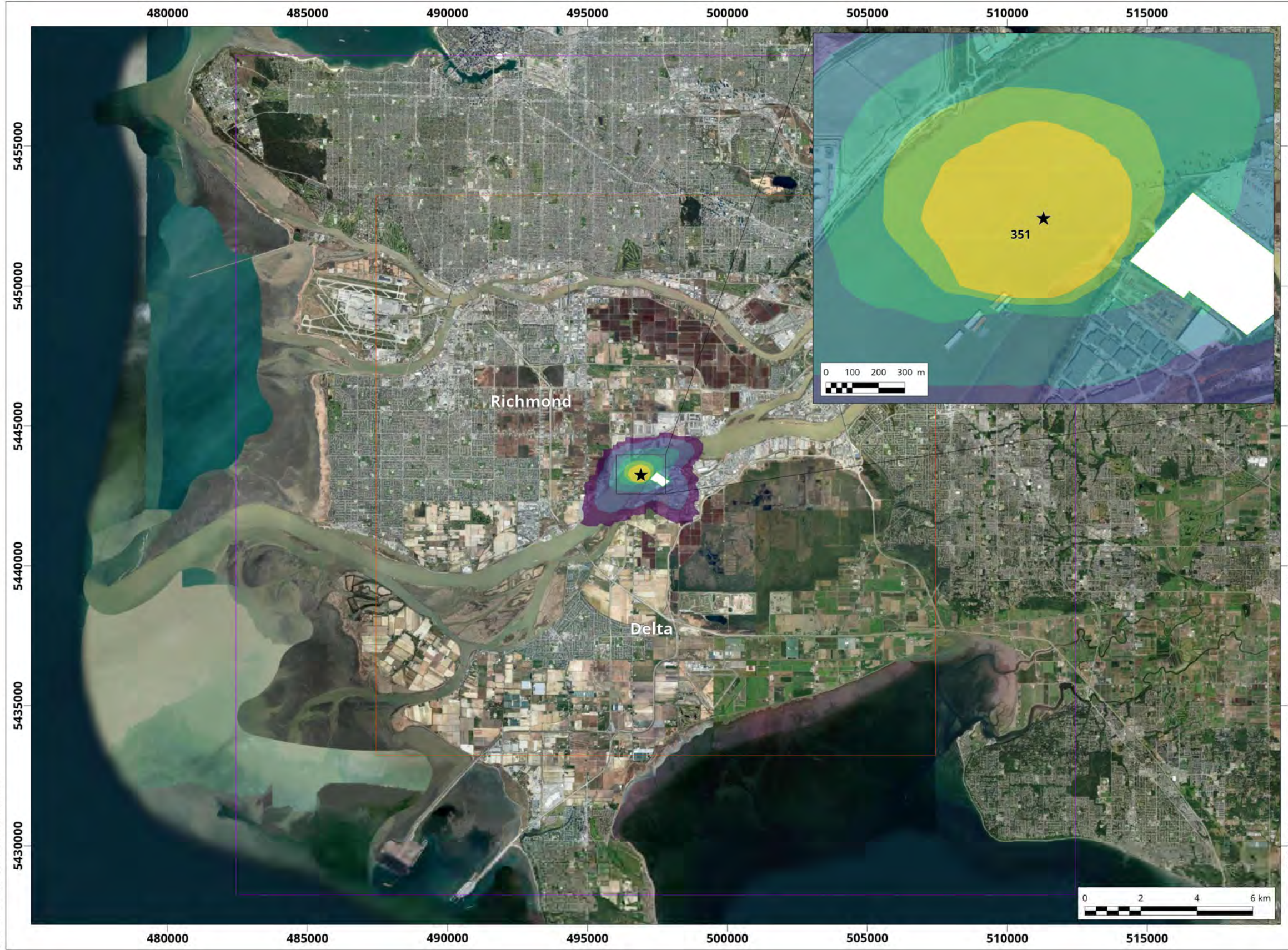
Figure: I.31

Approx. Scale: 1:150,000

Date Revised: Nov 10, 2023

Map Projection: NAD 1983 UTM Zone 10N

Project #: 2000436

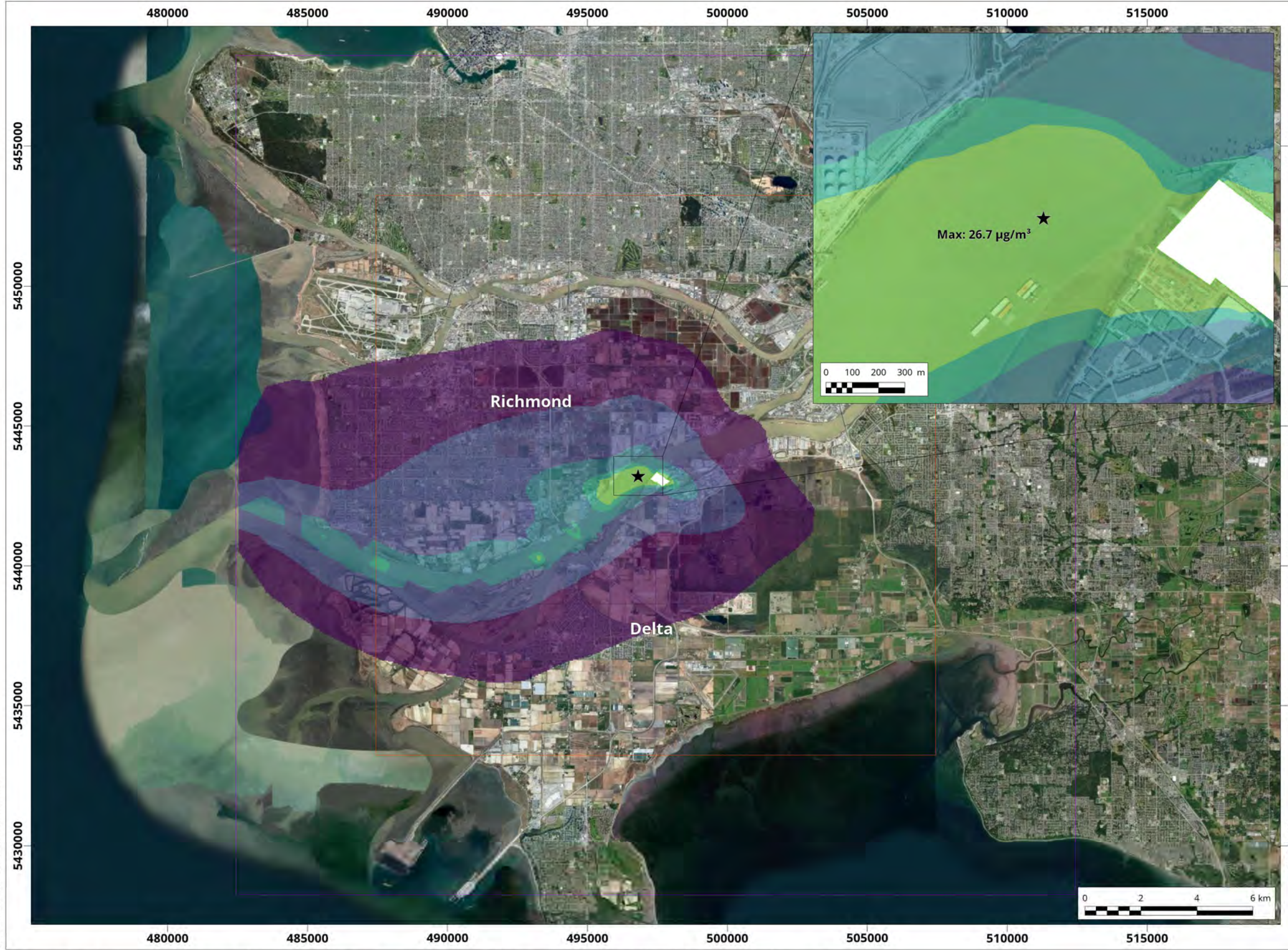


- Legend**
- ★ Maximum Number of Exceedances per Year
 - Property Line
 - LAA Boundary
 - RAA Boundary
- Number of Exceedances per Year**
- 1 - 10
 - 10 - 50
 - 50 - 100
 - 100 - 150
 - 150 - 200
 - > 200

Based on 98th Percentile of D1HM NO₂ (OLM) Concentrations

Background concentration: 58.1 µg/m³

1-Hour NO₂ Current MV AAQO and CAAQS-2025: 79 µg/m³



Background concentration: $21.1 \mu\text{g}/\text{m}^3$
Annual NO_2 Previous MV AAQO: $32 \mu\text{g}/\text{m}^3$
Annual NO_2 Current MV AAQO and CAAQS-2025: $22.6 \mu\text{g}/\text{m}^3$

Predicted Annual Average NO_2 (OLM) Concentrations Averaged over 2013-2015 - Cumulative Case

Service Layer Credits: World Imagery: VFPA, Earthstar Geographics
World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, Parks Canada
Tilbury LNG - Delta, B.C.

True North

Drawn by: PIP

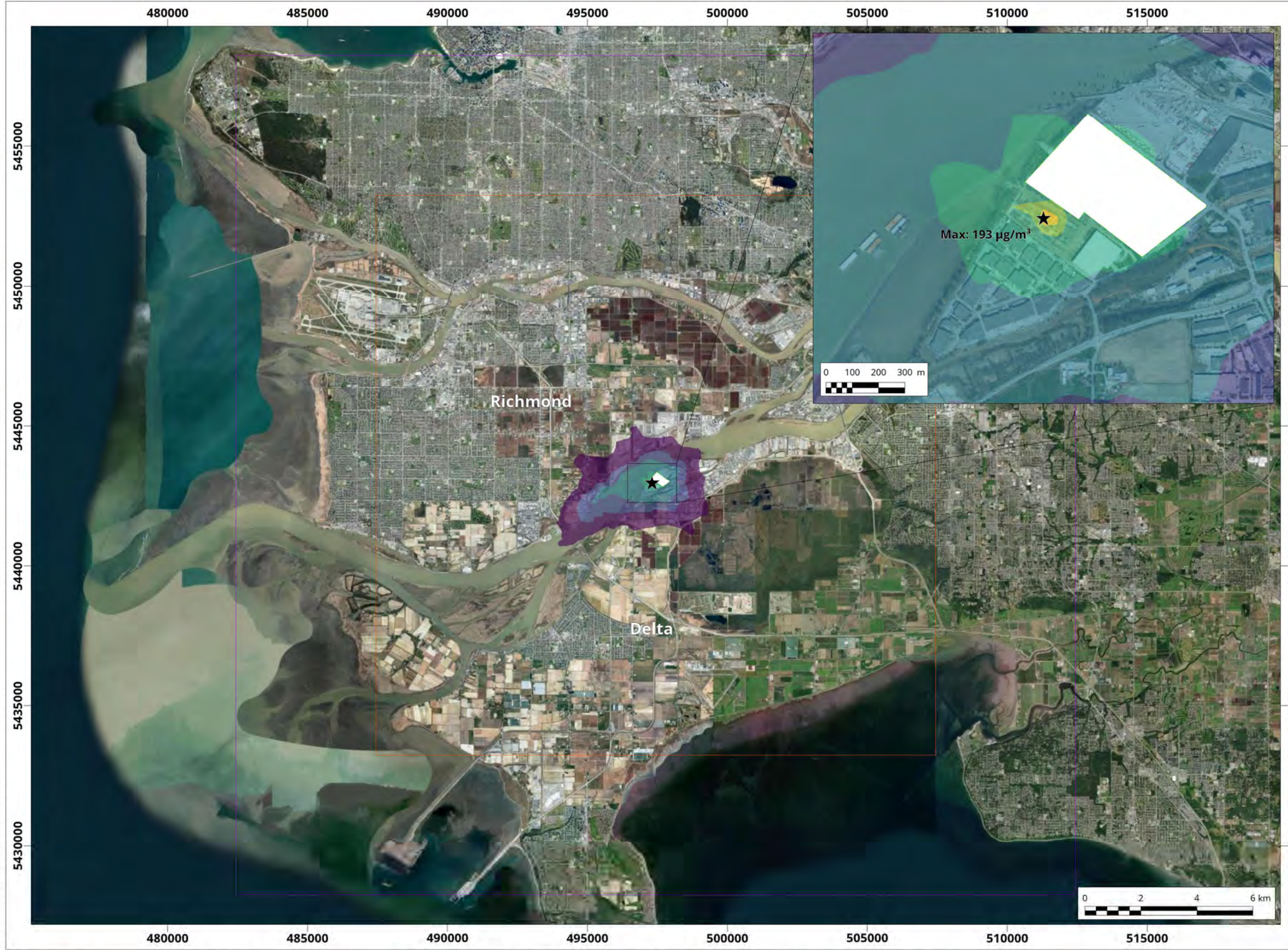
Figure: I.33

Approx. Scale: 1:150,000

Date Revised: Nov 15, 2023

Map Projection: NAD 1983 UTM Zone 10N

Project #: 2000436



Legend

- ★ Maximum Concentration
- Property Line
- LAA Boundary
- RAA Boundary

Concentration ($\mu\text{g}/\text{m}^3$)

- 30 - 45
- 45 - 60
- 60 - 106
- 106 - 170
- 170 - 183
- > 183

Background concentration: $3.64 \mu\text{g}/\text{m}^3$
1-Hour SO_2 MV AAQO: $183 \mu\text{g}/\text{m}^3$

Predicted Annual 100th Percentile of 1-Hour SO_2 Concentrations Averaged over 2013-2015 - Cumulative Case

Service Layer Credits: World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCan, Parks Canada
World Imagery: Earthstar Geographics
Tilbury LNG - Delta, B.C.

True North

Drawn by: PIP

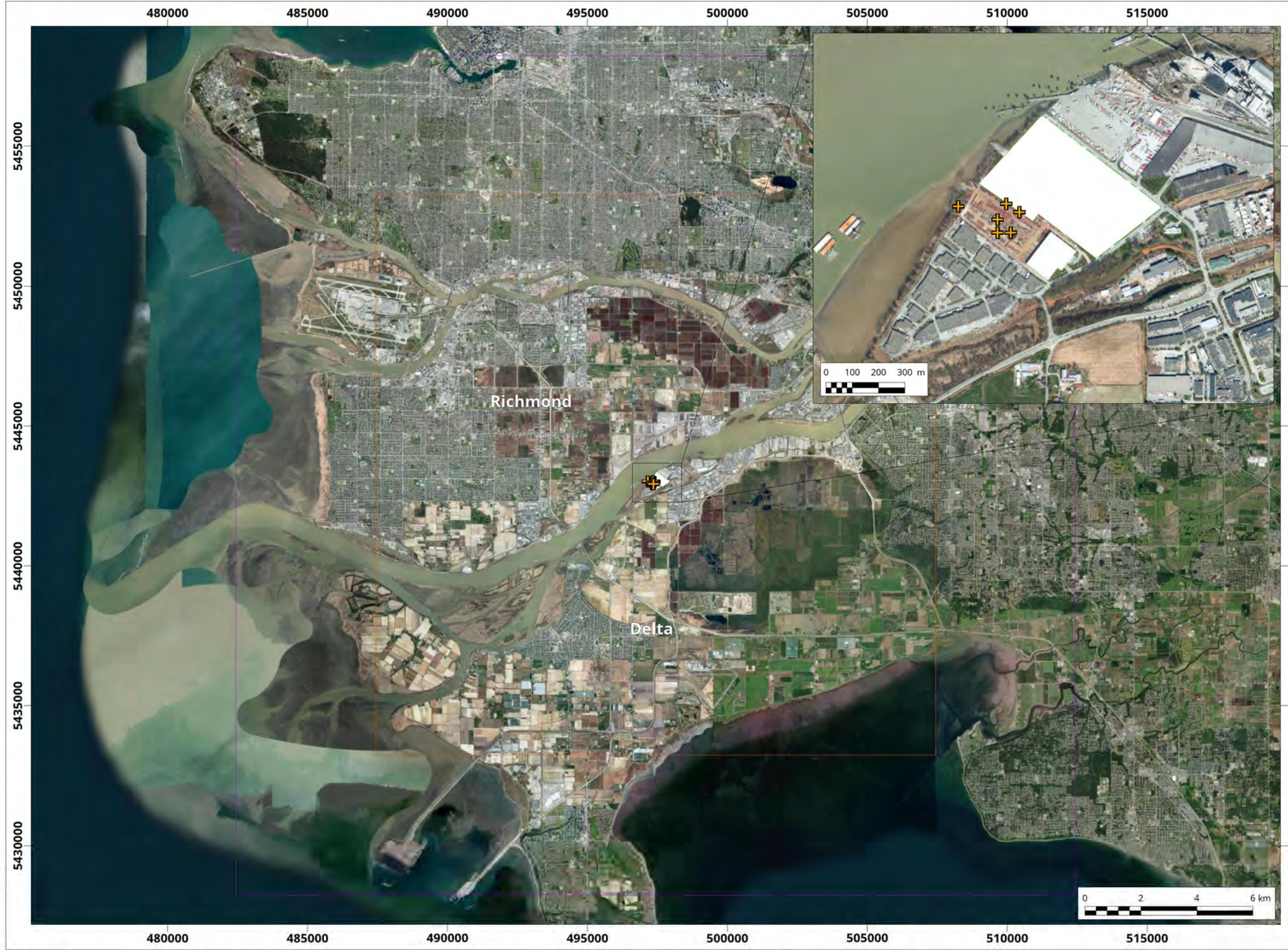
Figure: I.34

Approx. Scale: 1:150,000

Date Revised: Nov 10, 2023

Map Projection: NAD 1983 UTM Zone 10N

Project #: 2000436



- Legend**
- Receptors with Exceedances (1 hour/ year max.)
 - Property Line
 - LAA Boundary
 - RAA Boundary

Based on 100th Percentile of
1-Hour SO₂ Concentrations

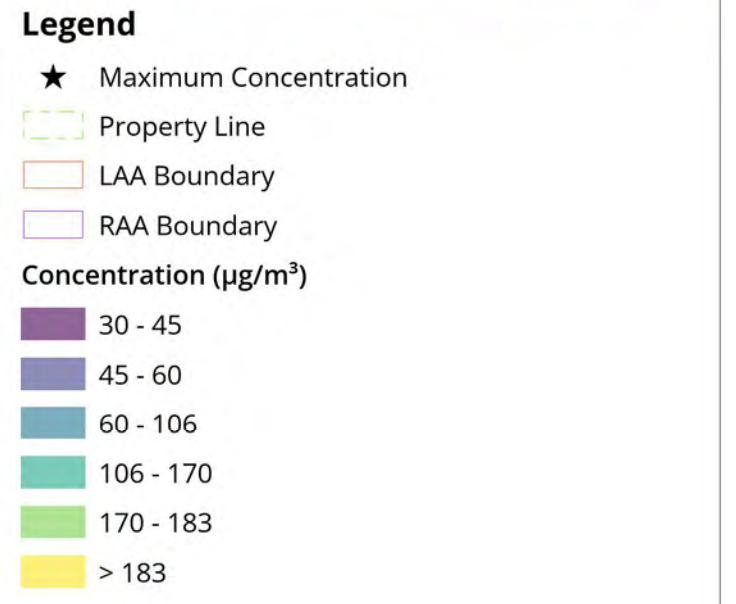
Background concentration: 3.64 µg/m³
1-Hour SO₂ MV AAQO: 183 µg/m³

Predicted Number of Exceedances of MV AAQO for SO₂ 1-Hour averaged over 2013-2015 - Cumulative Case

Service Layer Credits: World Imagery: VFPA, Earthstar Geographics
World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, Parks Canada
Tilbury LNG - Delta, B.C.

True North
Drawn by: PIP
Figure: I.35
Approx. Scale: 1:150,000
Map Projection: NAD 1983 UTM Zone 10N
Project #: 2000436
Date Revised: Nov 10, 2023





Background concentration: $3.64 \mu\text{g}/\text{m}^3$
1-Hour SO_2 CAAQS-2025: $170 \mu\text{g}/\text{m}^3$

Predicted Annual 99th Percentile of D1HM SO_2 Concentrations Averaged over 2013-2015 - Cumulative Case

Service Layer Credits: World Imagery: VFPA, Earthstar Geographics
World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, Parks Canada
Tilbury LNG - Delta, B.C.

True North

Drawn by: PIP

Figure: I.36

Approx. Scale: 1:150,000

Date Revised: Nov 15, 2023

Map Projection: NAD 1983 UTM Zone 10N

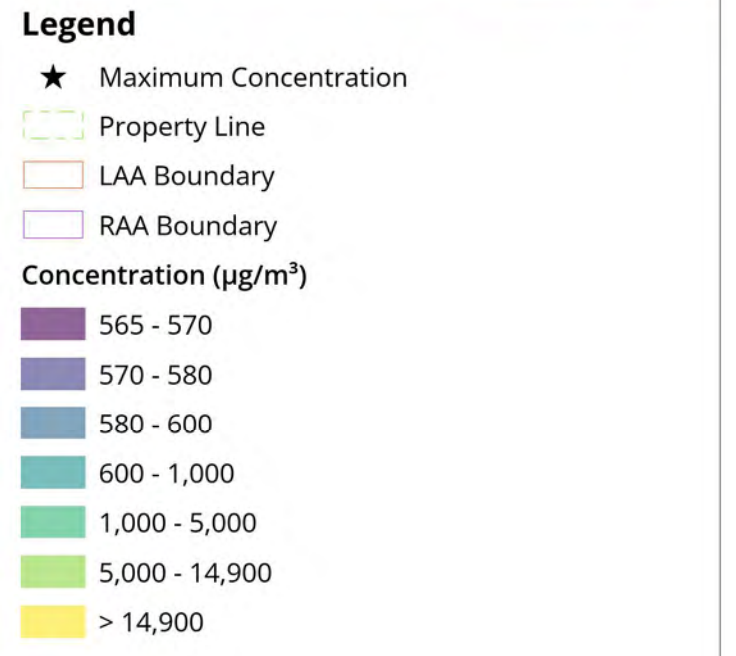
Project #: 2000436



Background concentration: $0.63 \mu\text{g}/\text{m}^3$
Annual SO_2 Previous MV AAQO: $13 \mu\text{g}/\text{m}^3$
Annual SO_2 Current MV AAQO and CAAQS-2025: $10.5 \mu\text{g}/\text{m}^3$

Predicted Annual Average SO_2 Concentrations Averaged over 2013-2015 - Cumulative Case

Service Layer Credits: World Imagery: VFPA, Earthstar Geographics
World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, Parks Canada
Tilbury LNG - Delta, B.C.



Background concentration: 557 $\mu\text{g}/\text{m}^3$
1-Hour CO MV AAQO: 14,900 $\mu\text{g}/\text{m}^3$

Predicted Annual 100th Percentile of 1-Hour CO Concentrations Averaged over 2013-2015 - Cumulative Case

Service Layer Credits: World Imagery: VFPA, Earthstar Geographics
World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, Parks Canada
Tilbury LNG - Delta, B.C.

True North

Drawn by: PIP

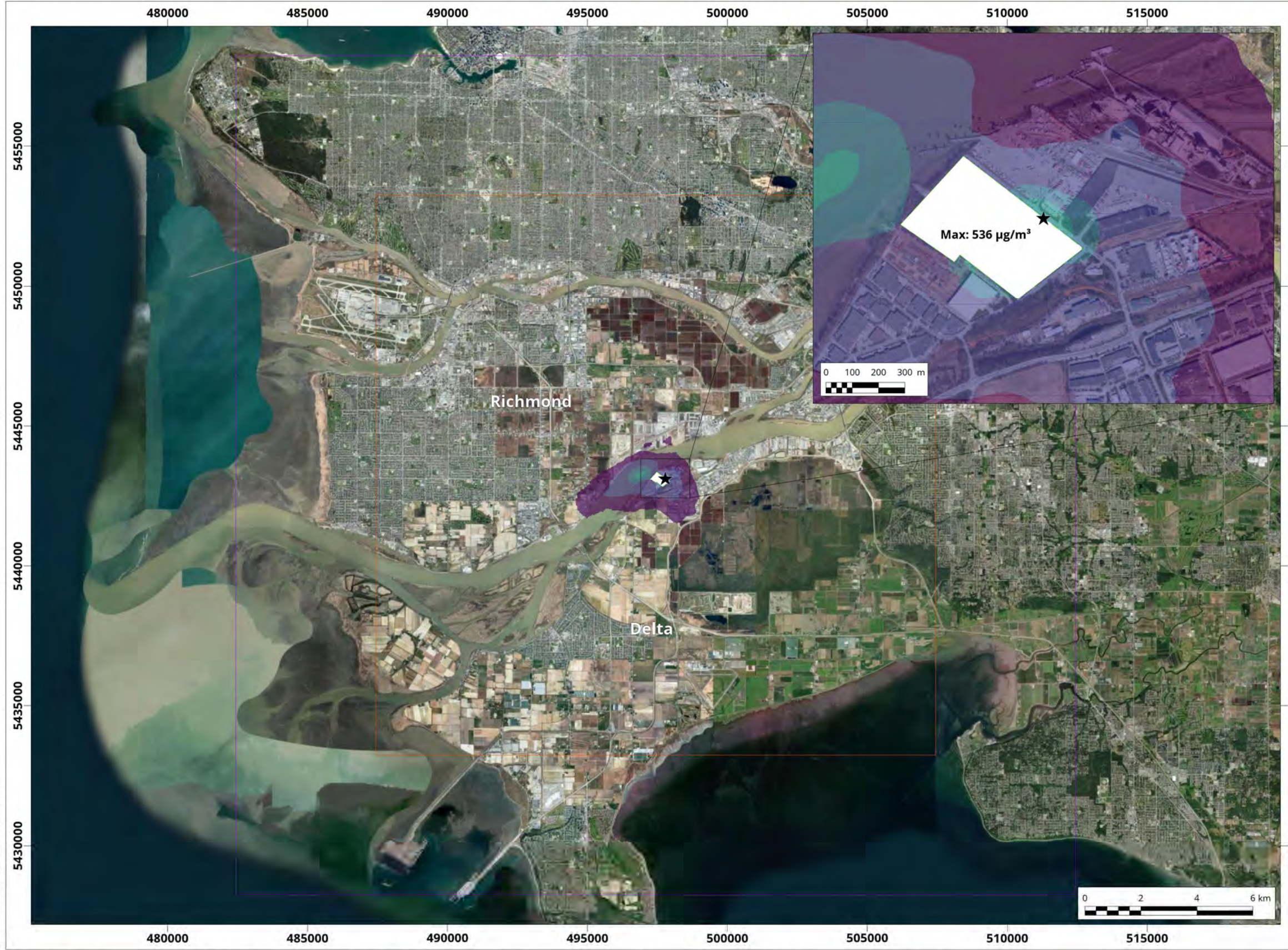
Figure: I.38

Approx. Scale: 1:150,000

Date Revised: Nov 10, 2023

Map Projection: NAD 1983 UTM Zone 10N

Project #: 2000436



- Legend**
- ★ Maximum Concentration
 - Property Line
 - LAA Boundary
 - RAA Boundary
- Concentration ($\mu\text{g}/\text{m}^3$)**
- 508 - 510
 - 510 - 515
 - 515 - 520
 - 520 - 550
 - 550 - 600
 - 600 - 5,700
 - > 5,700

Background concentration: 505 $\mu\text{g}/\text{m}^3$
8-Hour CO MV AAQO: 5,700 $\mu\text{g}/\text{m}^3$

Predicted Annual 100th Percentile of 8-HRA CO Concentrations Averaged over 2013-2015 - Cumulative Case

Service Layer Credits: World Imagery: VFPA, Earthstar Geographics
World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, Parks Canada
Tilbury LNG - Delta, B.C.

True North

Drawn by: PIP

Figure: I.39

Approx. Scale: 1:150,000

Date Revised: Nov 10, 2023

Map Projection: NAD 1983 UTM Zone 10N

Project #: 2000436



- Legend**
- ★ Maximum Concentration
 - Property Line
 - LAA Boundary
 - RAA Boundary
- Concentration ($\mu\text{g}/\text{m}^3$)**
- 12.1 - 12.3
 - 12.3 - 12.5
 - 12.5 - 15
 - 15 - 20
 - 20 - 25
 - > 25

Background concentration: $12.0 \mu\text{g}/\text{m}^3$
24-Hour $\text{PM}_{2.5}$ MV AAQO: $25 \mu\text{g}/\text{m}^3$

Predicted Annual 100th Percentile of 24-HRA $\text{PM}_{2.5}$ Concentrations Averaged over 2013-2015 - Cumulative Case

Service Layer Credits: World Imagery: VFPA, Earthstar Geographics
World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, Parks Canada
Tilbury LNG - Delta, B.C.

True North

Drawn by: PIP

Figure: I.40

Approx. Scale: 1:150,000

Date Revised: Nov 10, 2023

Map Projection: NAD 1983 UTM Zone 10N

Project #: 2000436



Legend

- ★ Maximum Concentration
- Property Line
- LAA Boundary
- RAA Boundary

Concentration ($\mu\text{g}/\text{m}^3$)

- 4.95 - 5
- 5 - 5.5
- 5.5 - 6
- 6 - 7
- 7 - 8
- > 8

Background concentration: $4.91 \mu\text{g}/\text{m}^3$
Annual $\text{PM}_{2.5}$ MV AAQO: $8 (6)^{[1]} \mu\text{g}/\text{m}^3$

[1] Metro Vancouver's annual $\text{PM}_{2.5}$ planning goal of $6 \mu\text{g}/\text{m}^3$ is a longer term aspirational target to support continuous improvement.

Predicted Annual Average $\text{PM}_{2.5}$ Concentrations Averaged over 2013-2015 - Cumulative Case

Service Layer Credits: World Imagery: VFPA, Earthstar Geographics
World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, Parks Canada
Tilbury LNG - Delta, B.C.

True North

Drawn by: PIP

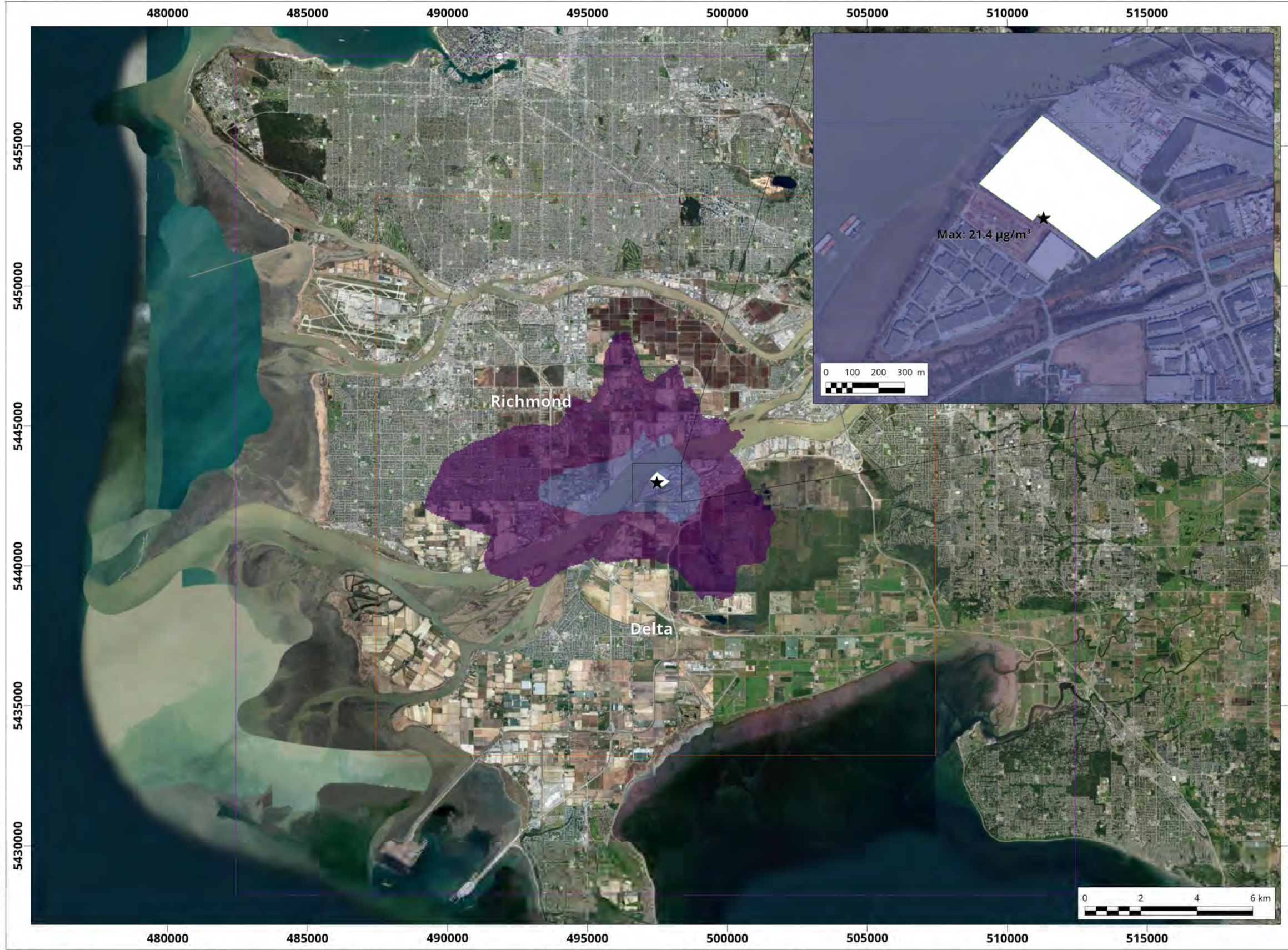
Figure: I.41

Approx. Scale: 1:150,000

Date Revised: Nov 10, 2023

Map Projection: NAD 1983 UTM Zone 10N

Project #: 2000436



- Legend**
- ★ Maximum Concentration
 - Property Line
 - LAA Boundary
 - RAA Boundary
- Concentration ($\mu\text{g}/\text{m}^3$)**
- 18.5 - 18.7
 - 18.7 - 25
 - 25 - 30
 - 30 - 40
 - 40 - 50
 - > 50

Background concentration: $18.4 \mu\text{g}/\text{m}^3$
24-Hour PM_{10} MV AAQO: $50 \mu\text{g}/\text{m}^3$

Predicted Annual 100th Percentile of 24-HRA PM_{10} Concentrations Averaged over 2013-2015 - Cumulative Case

Service Layer Credits: World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, Parks Canada
World Imagery: Earthstar Geographics
Tilbury LNG - Delta, B.C.

True North

Drawn by: PIP

Figure: I.42

Approx. Scale: 1:150,000

Date Revised: Nov 10, 2023

Map Projection: NAD 1983 UTM Zone 10N

Project #: 2000436



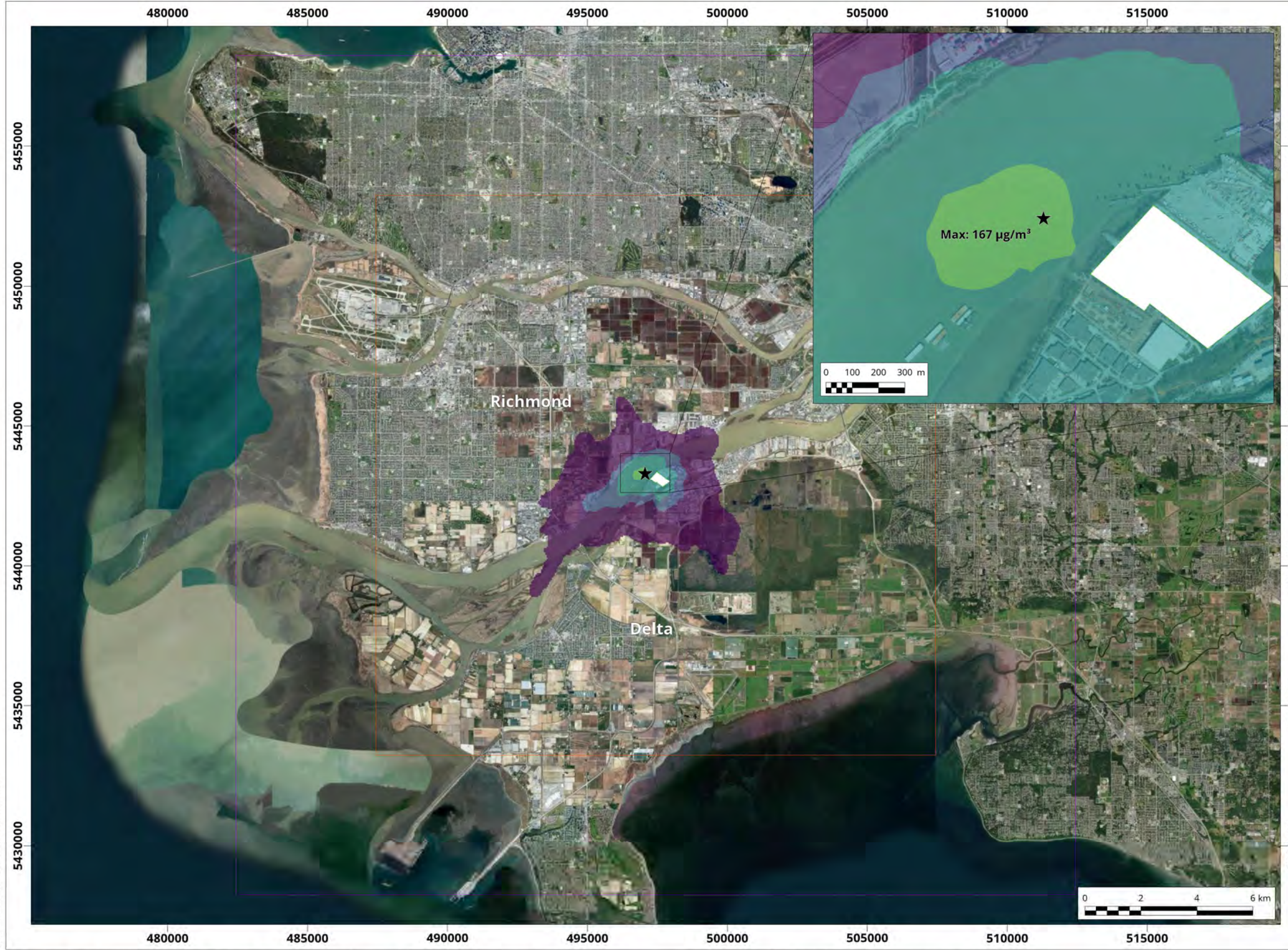
Legend

- ★ Maximum Concentration
- Property Line
- LAA Boundary
- RAA Boundary

Concentration ($\mu\text{g}/\text{m}^3$)

- 9.22 - 9.25
- 9.25 - 9.3
- 9.3 - 9.9
- 9.9 - 10
- 10 - 15
- 15 - 20
- > 20

Background concentration: $9.19 \mu\text{g}/\text{m}^3$
Annual PM_{10} MV AAQO: $20 \mu\text{g}/\text{m}^3$



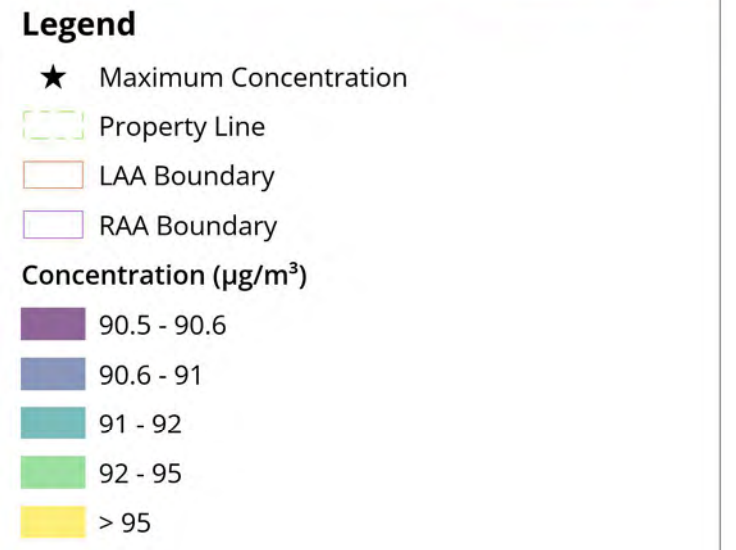
Legend

- ★ Maximum Concentration
- Property Line
- LAA Boundary
- RAA Boundary

Concentration ($\mu\text{g}/\text{m}^3$)

- 151.5 - 153
- 153 - 154
- 154 - 160
- 160 - 170
- > 170

Background concentration: 150 $\mu\text{g}/\text{m}^3$



Background concentration: $90.2 \mu\text{g}/\text{m}^3$



- Legend**
- ★ Maximum Concentration
 - Property Line
 - LAA Boundary
 - RAA Boundary
 - Concentration ($\mu\text{g}/\text{m}^3$)
 - 32.96 - 33.13
 - > 33.13
- Contour levels represent 0.5% and 1% above background concentrations, respectively.

Background concentration: $32.8 \mu\text{g}/\text{m}^3$

Predicted Annual Average Total VOC Concentrations Averaged over 2013-2015 - Cumulative Case

Service Layer Credits: World Imagery: VFPA, Earthstar Geographics
World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, Parks Canada
Tilbury LNG - Delta, B.C.

True North
Drawn by: PIP
Figure: I.46
Approx. Scale: 1:150,000
Map Projection: NAD 1983 UTM Zone 10N
Project #: 2000436
Date Revised: Nov 10, 2023



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Table J.1: Maximum Predicted Concentrations without Background at Each Sensitive Receptor Category Averaged over the Three Modelled Years ¹

Air Contaminant	Averaging Period	Background	Maximum over RAA			Residence			Childcare			School			Senior's Facility			Business			Historic Indigenous Village Site			Objective or Standard	
			Base.	T2+Base.	Cuml.	Base.	T2+Base.	Cuml.	Base.	T2+Base.	Cuml.	Base.	T2+Base.	Cuml.	Base.	T2+Base.	Cuml.	Base.	T2+Base.	Cuml.	Base.	T2+Base.	Cuml.	Value	Name
NO ₂ (total conversion)	1-hour ²	58.1	36.4	53.4	361	9.91	29.9	49.2	4.57	17.0	39.7	1.87	12.0	14.0	2.16	9.05	12.1	23.4	48.3	183	4.04	11.41	99.49	113	Previous MV AAQO
	Annual	21.1	1.89	4.23	6.67	0.17	0.45	2.76	0.15	0.39	2.12	0.07	0.29	1.15	0.07	0.20	1.06	1.34	2.95	3.99	0.10	0.24	1.63	32	
	1-hour ²	58.1	36.4	53.4	361	9.91	29.9	49.2	4.57	17.0	39.7	1.87	12.0	14.0	2.16	9.05	12.1	23.4	48.3	183	4.04	11.41	99.49	79	Current MV AAQO and CAAQS 2025
	Annual	21.1	1.89	4.23	6.67	0.17	0.45	2.76	0.15	0.39	2.12	0.07	0.29	1.15	0.07	0.20	1.06	1.34	2.95	3.99	0.10	0.24	1.63	22.6	
NO ₂ (OLM)	1-hour ²	58.1	32.3	42.9	107	8.72	23.7	31.7	3.89	14.6	27.2	1.69	10.7	12.1	1.93	8.15	10.6	20.6	38.1	69.6	3.53	9.34	62.79	113	Previous MV AAQO
	Annual	21.1	1.69	3.38	5.57	0.15	0.40	2.30	0.13	0.35	1.78	0.06	0.26	1.01	0.06	0.18	0.93	1.19	2.34	3.20	0.09	0.22	1.42	32	
	1-hour ²	58.1	32.3	42.9	107	8.72	23.7	31.7	3.89	14.6	27.2	1.69	10.7	12.1	1.93	8.15	10.6	20.6	38.1	69.6	3.53	9.34	62.79	79	Current MV AAQO and CAAQS 2025
	Annual	21.1	1.69	3.38	5.57	0.15	0.40	2.30	0.13	0.35	1.78	0.06	0.26	1.01	0.06	0.18	0.93	1.19	2.34	3.20	0.09	0.22	1.42	22.6	
SO ₂	1-hour	3.64	87.5	154	189	24.0	52.9	65.9	12.0	49.3	58.3	5.45	14.5	17.2	4.80	16.0	19.6	57.9	154	189	13.14	32.92	37.36	183	MV AAQO
	Annual	0.63	1.39	5.74	5.99	0.22	0.60	0.94	0.19	0.50	0.69	0.08	0.32	0.46	0.09	0.25	0.33	1.15	3.86	4.08	0.12	0.32	0.55	13	Previous MV AAQO
	1-hour ³	3.64	56.9	86.0	109	17.9	37.2	47.6	7.77	27.6	34.2	3.26	9.91	12.5	3.86	9.87	12.0	34.7	84.3	105	7.79	25.13	30.13	170	CAAQS 2025
	Annual	0.63	1.39	5.74	5.99	0.22	0.60	0.94	0.19	0.50	0.69	0.08	0.32	0.46	0.09	0.25	0.33	1.15	3.86	4.08	0.12	0.32	0.55	10.5	Current MV AAQO and CAAQS 2025
CO	1-hour	557	44.5	44.7	48.8	8.57	15.0	17.4	3.60	11.2	14.8	1.77	3.33	4.22	1.61	3.64	4.87	25.7	31.3	44.4	3.52	7.11	10.30	14900	MV AAQO
	8-hour ⁴	505	31.2	31.0	31.1	3.16	3.93	5.24	1.70	3.07	4.77	0.88	1.63	1.97	0.89	1.18	1.81	16.9	16.8	18.3	1.48	1.65	4.63	5700	
PM _{2.5}	24-hour ⁴	12.0	1.81	3.00	3.00	0.26	0.37	0.64	0.19	0.33	0.54	0.09	0.22	0.34	0.10	0.17	0.26	1.31	2.48	2.48	0.14	0.17	0.56	25	MV AAQO
	Annual	4.91	0.27	0.52	0.56	0.02	0.04	0.10	0.02	0.03	0.08	0.01	0.02	0.05	0.01	0.02	0.04	0.19	0.35	0.39	0.01	0.02	0.06	8 (6) ⁵	
PM ₁₀	24-hour ⁴	18.4	1.81	3.00	3.00	0.26	0.37	0.65	0.19	0.33	0.55	0.09	0.22	0.35	0.10	0.17	0.26	1.31	2.48	2.48	0.14	0.17	0.60	50	MV AAQO
	Annual	9.19	0.27	0.52	0.56	0.02	0.04	0.10	0.02	0.03	0.08	0.01	0.02	0.05	0.01	0.02	0.04	0.19	0.35	0.39	0.01	0.02	0.06	20	
VOC	1-hour	150	7.52	7.56	16.2	1.76	3.26	3.93	0.84	2.44	3.40	0.41	0.71	0.97	0.35	0.80	1.12	4.49	5.61	7.73	0.85	1.57	3.63	N/A	N/A
	24-hour ⁴	90.2	1.37	2.62	2.62	0.23	0.35	0.46	0.17	0.30	0.38	0.08	0.20	0.27	0.09	0.15	0.19	1.09	2.17	2.17	0.12	0.15	0.24		
	Annual	32.8	0.20	0.45	0.52	0.02	0.03	0.28	0.02	0.03	0.21	0.01	0.02	0.10	0.01	0.01	0.11	0.15	0.31	0.37	0.01	0.02	0.11		

Notes:

- 1 All values in the table are in µg/m³.
- 2 Based on 98th percentile of the daily maximum 1-hour predictions.
- 3 Based on 99th percentile of the daily maximum 1-hour predictions.
- 4 Based on rolling average.
- 5 Metro Vancouver's annual PM_{2.5} planning goal of 6 µg/m³ is a longer-term aspirational target to support continuous improvement.
- 6 **Bold** text indicates an exceedance of the Objective or Standard.



Table J.2: Maximum Predicted Concentrations with Background at Each Sensitive Receptor Category Averaged over the Three Modelled Years ¹

Air Contaminant	Averaging Period	Background	Maximum over RAA			Residence			Childcare			School			Senior's Facility			Business			Historic Indigenous Village Site			Objective or Standard	
			Base.	T2+Base.	Cuml.	Base.	T2+Base.	Cuml.	Base.	T2+Base.	Cuml.	Base.	T2+Base.	Cuml.	Base.	T2+Base.	Cuml.	Base.	T2+Base.	Cuml.	Base.	T2+Base.	Cuml.	Value	Name
NO ₂ (total conversion)	1-hour ²	58.1	94.6	112	419	68.0	88.0	107	62.7	75.2	97.8	60.0	70.1	72.2	60.3	67.2	70.2	81.5	106	241	62.2	69.5	158	113	Previous MV AAQO
	Annual	21.1	23.0	25.3	27.8	21.3	21.6	23.9	21.3	21.5	23.2	21.2	21.4	22.3	21.2	21.3	22.2	22.4	24.1	25.1	21.2	21.4	22.7	32	
	1-hour ²	58.1	94.6	112	419	68.0	88.0	107	62.7	75.2	97.8	60.0	70.1	72.2	60.3	67.2	70.2	81.5	106	241	62.2	69.5	158	79	Current MV AAQO and CAAQS 2025
	Annual	21.1	23.0	25.3	27.8	21.3	21.6	23.9	21.3	21.5	23.2	21.2	21.4	22.3	21.2	21.3	22.2	22.4	24.1	25.1	21.2	21.4	22.7	22.6	
NO ₂ (OLM)	1-hour ²	58.1	90.5	101	165	66.9	81.9	89.8	62.0	72.7	85.4	59.8	68.8	70.2	60.1	66.3	68.8	78.8	96.3	128	61.7	67.5	121	113	Previous MV AAQO
	Annual	21.1	22.8	24.5	26.7	21.3	21.5	23.4	21.2	21.5	22.9	21.2	21.4	22.1	21.2	21.3	22.0	22.3	23.4	24.3	21.2	21.3	22.5	32	
	1-hour ²	58.1	90.5	101	165	66.9	81.9	89.8	62.0	72.7	85.4	59.8	68.8	70.2	60.1	66.3	68.8	78.8	96.3	128	61.7	67.5	121	79	Current MV AAQO and CAAQS 2025
	Annual	21.1	22.8	24.5	26.7	21.3	21.5	23.4	21.2	21.5	22.9	21.2	21.4	22.1	21.2	21.3	22.0	22.3	23.4	24.3	21.2	21.3	22.5	22.6	
SO ₂	1-hour	3.64	91.1	157	193	27.6	56.5	69.6	15.7	53.0	61.9	9.09	18.2	20.9	8.43	19.7	23.2	61.5	157	193	16.8	36.6	41.0	183	MV AAQO
	Annual	0.63	2.02	6.37	6.62	0.84	1.22	1.57	0.82	1.12	1.32	0.71	0.95	1.09	0.72	0.87	0.95	1.78	4.49	4.71	0.74	0.95	1.18	13	Previous MV AAQO
	1-hour ³	3.64	60.5	89.6	113	21.5	40.8	51.2	11.4	31.2	37.9	6.90	13.6	16.1	7.50	13.5	15.7	38.3	88.0	109	11.4	28.8	34	170	CAAQS 2025
	Annual	0.63	2.02	6.37	6.62	0.84	1.22	1.57	0.82	1.12	1.32	0.71	0.95	1.09	0.72	0.87	0.95	1.78	4.49	4.71	0.74	0.95	1.18	10.5	Current MV AAQO and CAAQS 2025
CO	1-hour	557	602	602	606	566	572	575	561	568	572	559	560	561	559	561	562	583	588	602	561	564	567	14900	MV AAQO
	8-hour ⁴	505	536	536	536	508	509	510	506	508	510	506	506	507	506	506	507	522	522	523	506	506	509	5700	
PM _{2.5}	24-hour ⁴	12.0	13.8	15.0	15.0	12.2	12.3	12.6	12.1	12.3	12.5	12.0	12.2	12.3	12.1	12.1	12.2	13.3	14.4	14.4	12.1	12.1	12.5	25	MV AAQO
	Annual	4.91	5.19	5.43	5.47	4.94	4.95	5.02	4.93	4.95	5.00	4.92	4.94	4.96	4.92	4.93	4.95	5.10	5.27	5.30	4.93	4.94	4.97	8 (6) ⁵	
PM ₁₀	24-hour ⁴	18.4	20.2	21.4	21.4	18.6	18.7	19.0	18.6	18.7	18.9	18.5	18.6	18.7	18.5	18.5	18.6	19.7	20.9	20.9	18.5	18.5	19.0	50	MV AAQO
	Annual	9.19	9.47	9.71	9.75	9.22	9.23	9.30	9.21	9.23	9.28	9.20	9.22	9.24	9.20	9.21	9.23	9.38	9.55	9.58	9.21	9.22	9.25	20	
VOC	1-hour	150	158	158	167	152	154	154	151	153	154	151	151	151	151	151	152	155	156	158	151	152	154	N/A	N/A
	24-hour ⁴	90.2	91.6	92.9	92.9	90.5	90.6	90.7	90.4	90.5	90.6	90.3	90.4	90.5	90.3	90.4	90.4	91.3	92.4	92.4	90.4	90.4	90.5		
	Annual	32.8	33.0	33.3	33.4	32.9	32.9	33.1	32.9	32.9	33.1	32.9	32.9	32.9	32.9	32.9	32.9	33.0	33.1	33.2	32.9	32.9	32.9		

Notes:

- 1 All values in the table are in µg/m³.
- 2 Based on 98th percentile of the daily maximum 1-hour predictions.
- 3 Based on 99th percentile of the daily maximum 1-hour predictions.
- 4 Based on rolling average.
- 5 Metro Vancouver's annual PM_{2.5} planning goal of 6 µg/m³ is a longer-term aspirational target to support continuous improvement.



Table J.3: Maximum Predicted Concentrations of NO₂ over the RAA and at Each Sensitive Receptor Category for Each Modelled Year¹ – Base Case ²³

Pollutant	Averaging Period ²	Background (BG)	over RAA	over RAA + BG	Residence	Residence + BG	Childcare	Childcare + BG	School	School + BG	Seniors' Facility	Seniors' Facility + BG	Business	Business + BG	Objective or Standard	
															Value	Name
Year 1																
NO ₂ (Total Conversion)	1-hr	58.1	37.8	95.9	9.43	67.6	4.41	62.5	1.91	60.0	2.18	60.3	23.0	81.1	113	Previous MV AAQO
NO ₂ (Total Conversion)	Annual	21.1	1.89	23.0	0.18	21.3	0.16	21.3	0.07	21.2	0.08	21.2	1.36	22.5	32	
NO ₂ (Total Conversion)	1-hr	58.1	37.8	95.9	9.4	67.6	4.41	62.5	1.91	60.0	2.18	60.3	23.0	81.1	79	Current MV AAQO and CAAQS 2025
NO ₂ (Total Conversion)	Annual	21.1	1.89	23.0	0.18	21.3	0.16	21.3	0.07	21.2	0.08	21.2	1.36	22.5	22.6	
NO ₂ (OLM)	1-hr	58.1	32.4	90.5	8.42	66.6	3.68	61.8	1.72	59.9	1.91	60.0	20.3	78.5	113	Previous MV AAQO
NO ₂ (OLM)	Annual	21.1	1.69	22.8	0.16	21.3	0.14	21.3	0.07	21.2	0.07	21.2	1.21	22.3	32	
NO ₂ (OLM)	1-hr	58.1	32.4	90.5	8.42	66.6	3.68	61.8	1.72	59.9	1.91	60.0	20.3	78.5	79	Current MV AAQO and CAAQS 2025
NO ₂ (OLM)	Annual	21.1	1.69	22.8	0.16	21.3	0.14	21.3	0.07	21.2	0.07	21.2	1.21	22.3	22.6	
Year 2																
NO ₂ (Total Conversion)	1-hr	58.1	37.4	95.6	10.5	68.7	4.30	62.4	1.86	60.0	1.98	60.1	24.5	82.7	113	Previous MV AAQO
NO ₂ (Total Conversion)	Annual	21.1	1.83	22.9	0.16	21.3	0.14	21.3	0.07	21.2	0.06	21.2	1.31	22.4	32	
NO ₂ (Total Conversion)	1-hr	58.1	37.4	95.6	10.5	68.7	4.30	62.4	1.86	60.0	1.98	60.1	24.5	82.7	79	Current MV AAQO and CAAQS 2025
NO ₂ (Total Conversion)	Annual	21.1	1.83	22.9	0.16	21.3	0.14	21.3	0.07	21.2	0.06	21.2	1.31	22.4	22.6	
NO ₂ (OLM)	1-hr	58.1	33.7	91.8	9.12	67.3	3.77	61.9	1.67	59.8	1.78	59.9	21.3	79.5	113	Previous MV AAQO
NO ₂ (OLM)	Annual	21.1	1.64	22.7	0.15	21.3	0.13	21.2	0.06	21.2	0.06	21.2	1.17	22.3	32	
NO ₂ (OLM)	1-hr	58.1	33.7	91.8	9.12	67.3	3.77	61.9	1.67	59.8	1.78	59.9	21.3	79.5	79	Current MV AAQO and CAAQS 2025
NO ₂ (OLM)	Annual	21.1	1.64	22.7	0.15	21.3	0.13	21.2	0.06	21.2	0.06	21.2	1.17	22.3	22.6	
Year 3																
NO ₂ (Total Conversion)	1-hr	58.1	34.4	92.5	9.77	67.9	5.00	63.1	1.94	60.1	2.33	60.5	23.2	81.3	113	Previous MV AAQO
NO ₂ (Total Conversion)	Annual	21.1	1.99	23.1	0.17	21.3	0.15	21.3	0.07	21.2	0.07	21.2	1.34	22.4	32	
NO ₂ (Total Conversion)	1-hr	58.1	34.4	92.5	9.77	67.9	5.00	63.1	1.94	60.1	2.33	60.5	23.2	81.3	79	Current MV AAQO and CAAQS 2025
NO ₂ (Total Conversion)	Annual	21.1	1.99	23.1	0.17	21.3	0.15	21.3	0.07	21.2	0.07	21.2	1.34	22.4	22.6	
NO ₂ (OLM)	1-hr	58.1	31.0	89.1	8.63	66.8	4.22	62.4	1.74	59.9	2.10	60.2	20.2	78.4	113	Previous MV AAQO
NO ₂ (OLM)	Annual	21.1	1.79	22.9	0.15	21.3	0.13	21.2	0.06	21.2	0.06	21.2	1.20	22.3	32	
NO ₂ (OLM)	1-hr	58.1	31.0	89.1	8.63	66.8	4.22	62.4	1.74	59.9	2.10	60.2	20.2	78.4	79	Current MV AAQO and CAAQS 2025
NO ₂ (OLM)	Annual	21.1	1.79	22.9	0.15	21.3	0.13	21.2	0.06	21.2	0.06	21.2	1.20	22.3	22.6	

Notes:
1 Using meteorology from 2013 (year 1), 2014 (year 2), and 2015 (year 3); background concentrations are based on 2019-2021 monitoring data and identical for all three modelled years.
2 All values in the table are in µg/m³.
3 1-hour results are based on 98th percentile of the daily maximum 1-hour predictions.



Table J.4: Maximum Predicted Concentrations of SO₂ over the RAA and at Each Sensitive Receptor Category for Each Modelled Year¹ – Base Case²

Pollutant	Averaging Period	Background (BG)	over RAA	over RAA + BG	Residence	Residence + BG	Childcare	Childcare + BG	School	School + BG	Seniors' Facility	Seniors' Facility + BG	Business	Business + BG	Objective or Standard	
															Value	Name
Year 1																
SO ₂	1-hr	3.64	102	105	24.5	28.2	8.79	12.4	5.80	9.43	4.47	8.11	73.2	76.9	183	MV AAQO
SO ₂	Annual	0.63	1.32	1.95	0.24	0.87	0.21	0.84	0.09	0.72	0.11	0.73	1.26	1.88	13	Previous MV AAQO
SO ₂	1-hr ³	3.64	61.5	65.1	19.1	22.8	7.45	11.1	3.43	7.06	4.01	7.65	42.5	46.2	170	CAAQS 2025
SO ₂	Annual	0.63	1.32	1.95	0.24	0.87	0.21	0.84	0.09	0.72	0.11	0.73	1.26	1.88	11	Current MV AAQO and CAAQS 2025
Year 2																
SO ₂	1-hr	3.64	89.4	93.1	24.3	27.9	11.3	15.0	7.24	10.9	4.23	7.86	61.0	64.7	183	MV AAQO
SO ₂	Annual	0.63	1.35	1.98	0.20	0.83	0.18	0.80	0.08	0.71	0.08	0.70	1.12	1.75	13	Previous MV AAQO
SO ₂	1-hr ³	3.64	48.4	52.0	19.1	22.7	7.75	11.4	3.33	6.97	3.43	7.06	36.7	40.3	170	CAAQS 2025
SO ₂	Annual	0.63	1.35	1.98	0.20	0.83	0.18	0.80	0.08	0.71	0.08	0.70	1.12	1.75	11	Current MV AAQO and CAAQS 2025
Year 3																
SO ₂	1-hr	3.64	79.3	82.9	27.3	30.9	16.5	20.1	5.18	8.8	5.70	9.33	63.8	67.5	183	MV AAQO
SO ₂	Annual	0.63	1.51	2.14	0.21	0.84	0.19	0.82	0.08	0.70	0.09	0.71	1.18	1.81	13	Previous MV AAQO
SO ₂	1-hr ³	3.64	61.3	64.9	17.9	21.5	8.10	11.7	3.11	6.75	4.15	7.79	39.4	43.1	170	CAAQS 2025
SO ₂	Annual	0.63	1.51	2.14	0.21	0.84	0.19	0.82	0.08	0.70	0.09	0.71	1.18	1.81	11	Current MV AAQO and CAAQS 2025

Note:
1 Using meteorology from 2013 (year 1), 2014 (year 2), and 2015 (year 3); background concentrations are based on 2019-2021 monitoring data and identical for all three modelled years.
2 All values in the table are in µg/m³.
3 Based on 99th percentile of the daily maximum 1-hour predictions.



Table J.5: Maximum Predicted Concentrations of CO over the RAA and at Each Sensitive Receptor Category for Each Modelled Year¹ - Base Case²

Pollutant	Averaging Period	Background (BG)	over RAA	over RAA + BG	Residence	Residence + BG	Childcare	Childcare + BG	School	School + BG	Seniors' Facility	Seniors' Facility + BG	Business	Business + BG	Objective or Standard	
															Value	Name
Year 1																
CO	1-hr	557	46.5	604	8.71	566	2.86	560	1.73	559	1.71	559	29.8	587	14900	MV AAQO
CO	8-hr ^{3]}	505	32.6	537	4.63	509	1.51	506	0.92	506	0.80	506	17.2	522	5700	MV AAQO
Year 2																
CO	1-hr	557	49.6	607	8.80	566	3.59	561	2.31	559	1.34	559	28.6	586	14900	MV AAQO
CO	8-hr ³	505	31.8	537	3.40	508	1.31	506	0.93	506	0.75	505	17.0	522	5700	MV AAQO
Year 3																
CO	1-hr	557	43.7	601	8.81	566	4.35	562	1.64	559	1.77	559	24.8	582	14900	MV AAQO
CO	8-hr ³	505	29.2	534	2.38	507	2.29	507	0.96	506	1.12	506	16.4	521	5700	MV AAQO

Notes:
1 Using meteorology from 2013 (year 1), 2014 (year 2), and 2015 (year 3); background concentrations are based on 2019-2021 monitoring data and identical for all three modelled years.
2 All values in the table are in µg/m³.
3 Based on rolling average.



Table J.6: Maximum Predicted Concentrations of PM_{2.5} over the RAA and at Each Sensitive Receptor Category for Each Modelled Year¹ - Base Case²

Pollutant	Averaging Period	Background (BG)	over RAA	over RAA + BG	Residence	Residence + BG	Childcare	Childcare + BG	School	School + BG	Seniors' Facility	Seniors' Facility + BG	Business	Business + BG	Objective or Standard	
															Value	Name
Year 1																
PM _{2.5}	24-hr ³	12.0	1.91	13.9	0.29	12.2	0.21	12.2	0.12	12.1	0.12	12.1	1.62	13.6	25	MV AAQO
PM _{2.5}	annual	4.91	0.27	5.19	0.02	4.94	0.02	4.93	0.01	4.92	0.01	4.92	0.19	5.11	8 (6) ⁴	MV AAQO
Year 2																
PM _{2.5}	24-hr ³	12.0	1.67	13.6	0.31	12.3	0.18	12.1	0.08	12.0	0.08	12.0	1.23	13.2	25	MV AAQO
PM _{2.5}	annual	4.91	0.26	5.18	0.02	4.94	0.02	4.93	0.01	4.92	0.01	4.92	0.18	5.10	8 (6) ⁴	MV AAQO
Year 3																
PM _{2.5}	24-hr ³	12.0	2.04	14.0	0.23	12.2	0.19	12.1	0.08	12.0	0.10	12.1	1.40	13.4	25	MV AAQO
PM _{2.5}	annual	4.91	0.28	5.20	0.02	4.94	0.02	4.93	0.01	4.92	0.01	4.92	0.19	5.10	8 (6) ⁴	MV AAQO

Notes:

1 Using meteorology from 2013 (year 1), 2014 (year 2), and 2015 (year 3); background concentrations are based on 2019-2021 monitoring data and identical for all three modelled years.

2 All values in the table are in µg/m³.

3 Based on rolling average.

4 Metro Vancouver's annual PM_{2.5} planning goal of 6 µg/m³ is a longer-term aspirational target to support continuous improvement.



Table J.7: Maximum Predicted Concentrations of PM₁₀ over the RAA and at Each Sensitive Receptor Category for Each Modelled Year¹ - Base Case²

Pollutant	Averaging Period	Background (BG)	over RAA	over RAA + BG	Residence	Residence + BG	Childcare	Childcare + BG	School	School + BG	Seniors' Facility	Seniors' Facility + BG	Business	Business + BG	Objective or Standard	
															Value	Name
Year 1																
PM ₁₀	24-hr ³	18.4	1.91	20.3	0.29	18.7	0.21	18.6	0.12	18.5	0.12	18.5	1.62	20.0	50	MV AAQO
PM ₁₀	annual	9.19	0.27	9.47	0.02	9.22	0.02	9.21	0.01	9.20	0.01	9.20	0.19	9.39	20	MV AAQO
Year 2																
PM ₁₀	24-hr ³	18.4	1.67	20.0	0.31	18.7	0.18	18.5	0.08	18.4	0.08	18.5	1.23	19.6	50	MV AAQO
PM ₁₀	annual	9.19	0.26	9.46	0.02	9.22	0.02	9.21	0.01	9.20	0.01	9.20	0.18	9.38	20	MV AAQO
Year 3																
PM ₁₀	24-hr ³	18.4	2.04	20.4	0.23	18.6	0.19	18.6	0.08	18.4	0.10	18.5	1.40	19.8	50	MV AAQO
PM ₁₀	annual	9.19	0.28	9.48	0.02	9.22	0.02	9.21	0.01	9.20	0.01	9.20	0.19	9.38	20	MV AAQO

Notes:
1 Using meteorology from 2013 (year 1), 2014 (year 2), and 2015 (year 3); background concentrations are based on 2019-2021 monitoring data and identical for all three modelled years.
2 All values in the table are in µg/m³.
3 Based on rolling average.



Table J.8: Maximum Predicted Concentrations of VOC over the RAA and at Each Sensitive Receptor Category for Each Modelled Year¹- Base Case²

Pollutant	Averaging Period	Background (BG)	over RAA	over RAA + BG	Residence	Residence + BG	Childcare	Childcare + BG	School	School + BG	Seniors' Facility	Seniors' Facility + BG	Business	Business + BG	Objective or Standard	
															Value	Name
Year 1																
Total VOCs	1-hr	150	7.59	158	1.87	152	0.58	151	0.42	151	0.32	151	5.72	156	--	--
Total VOCs	24-hr ³	90.2	1.37	91.6	0.26	90.5	0.19	90.4	0.10	90.3	0.11	90.3	1.25	91.5	--	--
Total VOCs	Annual	32.8	0.20	33.0	0.02	32.9	0.02	32.9	0.01	32.9	0.01	32.9	0.15	33.0	--	--
Year 2																
Total VOCs	1-hr	150	7.94	158	1.77	152	0.84	151	0.54	151	0.31	151	4.53	155	--	--
Total VOCs	24-hr ³	90.2	1.30	91.5	0.28	90.5	0.15	90.4	0.06	90.3	0.07	90.3	1.02	91.2	--	--
Total VOCs	Annual	32.8	0.20	33.0	0.02	32.9	0.02	32.9	0.01	32.9	0.01	32.8	0.14	33.0	--	--
Year 3																
Total VOCs	1-hr	150	7.03	157	2.04	152	1.10	151	0.37	151	0.42	151	4.76	155	--	--
Total VOCs	24-hr ³	90.2	1.58	91.8	0.20	90.4	0.17	90.4	0.07	90.3	0.09	90.3	1.20	91.4	--	--
Total VOCs	Annual	32.8	0.22	33.1	0.02	32.9	0.02	32.9	0.01	32.9	0.01	32.9	0.15	33.0	--	--

Note:
1 Using meteorology from 2013 (year 1), 2014 (year 2), and 2015 (year 3); background concentrations are based on 2019-2021 monitoring data and identical for all three modelled years.
2 All values in the table are in µg/m³.
3 Based on rolling average.



Table J.9: Maximum Predicted Concentrations of NO₂ over the RAA and at Each Sensitive Receptor Category for Each Modelled Year¹ – Project + Base Case²³

Pollutant	Averaging Period ²	Background d (BG)	over RAA	over RAA + BG	Residence	Residence + BG	Childcare	Childcare + BG	School	School + BG	Seniors' Facility	Seniors' Facility + BG	Business	Business + BG	Objective or Standard	
															Value	Name
Year 1																
NO ₂ (Total Conversion)	1-hr	58.1	56.9	115	23.7	81.9	19.3	77.4	11.3	69.4	9.4	67.5	50.2	108	113	Previous MV AAQO
NO ₂ (Total Conversion)	Annual	21.1	4.44	25.5	0.50	21.6	0.42	21.5	0.32	21.4	0.23	21.3	3.21	24.3	32	
NO ₂ (Total Conversion)	1-hr	58.1	56.9	115	23.7	81.9	19.3	77.4	11.3	69.4	9.39	67.5	50.2	108	79	Current MV AAQO and CAAQS 2025
NO ₂ (Total Conversion)	Annual	21.1	4.44	25.5	0.50	21.6	0.42	21.5	0.32	21.4	0.23	21.3	3.21	24.3	22.6	
NO ₂ (OLM)	1-hr	58.1	44.7	103	18.8	77.0	17.1	75.2	10.1	68.2	8.45	66.6	36.8	95.0	113	Previous MV AAQO
NO ₂ (OLM)	Annual	21.1	3.38	24.5	0.44	21.5	0.36	21.5	0.29	21.4	0.20	21.3	2.44	23.6	32	
NO ₂ (OLM)	1-hr	58.1	44.7	103	18.8	77.0	17.1	75.2	10.1	68.2	8.45	66.6	36.8	95.0	79	Current MV AAQO and CAAQS 2025
NO ₂ (OLM)	Annual	21.1	3.38	24.5	0.44	21.5	0.36	21.5	0.29	21.4	0.20	21.3	2.44	23.6	22.6	
Year 2																
NO ₂ (Total Conversion)	1-hr	58.1	55.2	113	29.3	87.5	16.1	74.3	13.5	71.6	9.23	67.4	48.9	107	113	Previous MV AAQO
NO ₂ (Total Conversion)	Annual	21.1	4.22	25.3	0.48	21.6	0.44	21.5	0.31	21.4	0.19	21.3	2.78	23.9	32	
NO ₂ (Total Conversion)	1-hr	58.1	55.2	113	29.3	87.5	16.1	74.3	13.5	71.6	9.23	67.4	48.9	107	79	Current MV AAQO and CAAQS 2025
NO ₂ (Total Conversion)	Annual	21.1	4.22	25.3	0.48	21.6	0.44	21.5	0.31	21.4	0.19	21.3	2.78	23.9	22.6	
NO ₂ (OLM)	1-hr	58.1	42.3	100	25.9	84.1	14.4	72.5	11.8	70.0	8.31	66.4	38.3	96.4	113	Previous MV AAQO
NO ₂ (OLM)	Annual	21.1	3.45	24.6	0.43	21.5	0.39	21.5	0.28	21.4	0.17	21.3	2.23	23.3	32	
NO ₂ (OLM)	1-hr	58.1	42.3	100	25.9	84.1	14.4	72.5	11.8	70.0	8.31	66.4	38.3	96.4	79	Current MV AAQO and CAAQS 2025
NO ₂ (OLM)	Annual	21.1	3.45	24.6	0.43	21.5	0.39	21.5	0.28	21.4	0.17	21.3	2.23	23.3	22.6	
Year 3																
NO ₂ (Total Conversion)	1-hr	58.1	56.9	115	36.5	94.7	16.1	74.3	12.0	70.1	8.53	66.7	52.8	111.0	113	Previous MV AAQO
NO ₂ (Total Conversion)	Annual	21.1	4.02	25.1	0.38	21.5	0.34	21.5	0.25	21.4	0.18	21.3	2.84	24.0	32	
NO ₂ (Total Conversion)	1-hr	58.1	56.9	115	36.5	94.7	16.1	74.3	12.0	70.1	8.53	66.7	52.8	111	79	Current MV AAQO and CAAQS 2025
NO ₂ (Total Conversion)	Annual	21.1	4.02	25.1	0.38	21.5	0.34	21.5	0.25	21.4	0.18	21.3	2.84	24.0	22.6	
NO ₂ (OLM)	1-hr	58.1	49.0	107	26.4	84.5	13.9	72.1	10.8	68.9	7.68	65.8	43.0	101	113	Previous MV AAQO
NO ₂ (OLM)	Annual	21.1	3.30	24.4	0.34	21.5	0.30	21.4	0.22	21.3	0.16	21.3	2.33	23.4	32	
NO ₂ (OLM)	1-hr	58.1	49.0	107	26.4	84.5	13.9	72.1	10.8	68.9	7.68	65.8	43.0	101	79	Current MV AAQO and CAAQS 2025
NO ₂ (OLM)	Annual	21.1	3.30	24.4	0.34	21.5	0.30	21.4	0.22	21.3	0.16	21.3	2.33	23.4	22.6	

Notes:
1 Using meteorology from 2013 (year 1), 2014 (year 2), and 2015 (year 3); background concentrations are based on 2019-2021 monitoring data and identical for all three modelled years.
2 All values in the table are in µg/m³.
3 1-hour results are based on 98th percentile of the daily maximum 1-hour predictions.



Table J.10: Maximum Predicted Concentrations of SO₂ over the RAA and at Each Sensitive Receptor Category for Each Modelled Year¹ – Project + Base Case²

Pollutant	Averaging Period	Background (BG)	over RAA	over RAA + BG	Residence	Residence + BG	Childcare	Childcare + BG	School	School + BG	Seniors' Facility	Seniors' Facility + BG	Business	Business + BG	Objective or Standard	
															Value	Name
Year 1																
SO ₂	1-hr	3.64	191	194	61.5	65.1	52.4	56.0	16.0	19.6	18.5	22.1	129	132	183	MV AAQO
SO ₂	Annual	0.63	5.99	6.62	0.63	1.25	0.54	1.17	0.35	0.97	0.28	0.91	4.21	4.84	13	Previous MV AAQO
SO ₂	1-hr ³	3.64	88.3	91.9	41.1	44.7	28.9	32.5	10.3	14.0	10.1	13.7	81.7	85.4	170	CAAQS 2025
SO ₂	Annual	0.63	5.99	6.62	0.63	1.25	0.54	1.17	0.35	0.97	0.28	0.91	4.21	4.84	10.5	Current MV AAQO and CAAQS 2025
Year 2																
SO ₂	1-hr	3.64	224	228	45.4	49.0	38.8	42.4	14.1	17.7	15.7	19.3	224	228	183	MV AAQO
SO ₂	Annual	0.63	5.72	6.35	0.65	1.28	0.49	1.12	0.34	0.96	0.23	0.86	3.62	4.25	13	Previous MV AAQO
SO ₂	1-hr ³	3.64	95.2	98.8	35.6	39.2	27.9	31.6	11.3	14.9	9.87	13.5	95.2	98.8	170	CAAQS 2025
SO ₂	Annual	0.63	5.72	6.35	0.65	1.28	0.49	1.12	0.34	0.96	0.23	0.86	3.62	4.25	10.5	Current MV AAQO and CAAQS 2025
Year 3																
SO ₂	1-hr	3.64	175	178	56.8	60.5	56.8	60.5	13.6	17.2	14.0	17.6	175	178	183	MV AAQO
SO ₂	Annual	0.63	5.51	6.13	0.54	1.17	0.47	1.10	0.29	0.91	0.22	0.85	3.76	4.38	13	Previous MV AAQO
SO ₂	1-hr ³	3.64	117	121	36.7	40.3	25.9	29.6	9.48	13.1	9.66	13.3	117	121	170	CAAQS 2025
SO ₂	Annual	0.63	5.51	6.13	0.54	1.17	0.47	1.10	0.29	0.91	0.22	0.85	3.76	4.38	10.5	Current MV AAQO and CAAQS 2025

Notes:
1 Using meteorology from 2013 (year 1), 2014 (year 2), and 2015 (year 3); background concentrations are based on 2019-2021 monitoring data and identical for all three modelled years.
2 All values in the table are in µg/m³.
3 Based on 99th percentile of the daily maximum 1-hour predictions.



Table J.11: Maximum Predicted Concentrations of CO over the RAA and at Each Sensitive Receptor Category for Each Modelled Year¹ – Project + Base Case²

Pollutant	Averaging Period	Background (BG)	over RAA	over RAA + BG	Residence	Residence + BG	Childcare	Childcare + BG	School	School + BG	Seniors' Facility	Seniors' Facility + BG	Business	Business + BG	Objective or Standard	
															Value	Name
Year 1																
CO	1-hr	557	46.5	604	18.6	576	18.6	576	3.37	561	3.56	561	36.5	594	14900	MV AAQO
CO	8-hr ³	505	32.6	537	4.47	509	4.47	509	1.55	506	1.19	506	17.2	522	5700	MV AAQO
Year 2																
CO	1-hr	557	50.1	607	13.9	571	9.00	566	3.65	561	5.05	562	33.6	591	14900	MV AAQO
CO	8-hr ³	505	31.1	536	4.32	509	2.06	507	1.71	506	1.06	506	16.7	521	5700	MV AAQO
Year 3																
CO	1-hr	557	43.7	601	16.1	573	6.10	563	3.27	560	2.32	559	34.0	591	14900	MV AAQO
CO	8-hr ³	505	29.2	534	3.28	508	2.67	507	1.77	507	1.30	506	16.8	522	5700	MV AAQO

Notes:
1 Using meteorology from 2013 (year 1), 2014 (year 2), and 2015 (year 3); background concentrations are based on 2019-2021 monitoring data and identical for all three modelled years.
2 All values in the table are in µg/m³.
3 Based on rolling average.



Table J.12: Maximum Predicted Concentrations of PM_{2.5} over the RAA and at Each Sensitive Receptor Category for Each Modelled Year¹ – Project + Base Case²

Pollutant	Averaging Period	Background (BG)	over RAA	over RAA + BG	Residence	Residence + BG	Childcare	Childcare + BG	School	School + BG	Seniors' Facility	Seniors' Facility + BG	Business	Business + BG	Objective or Standard	
															Value	Name
Year 1																
PM _{2.5}	24-hr ³	12.0	3.26	15.2	0.40	12.4	0.39	12.3	0.19	12.1	0.17	12.1	2.80	14.8	25	MV AAQO
PM _{2.5}	annual	4.91	0.55	5.46	0.04	4.95	0.04	4.95	0.02	4.94	0.02	4.93	0.39	5.31	8 (6) ⁴	MV AAQO
Year 2																
PM _{2.5}	24-hr ³	12.0	2.81	14.8	0.35	12.3	0.30	12.3	0.23	12.2	0.16	12.1	2.08	14.0	25	MV AAQO
PM _{2.5}	annual	4.91	0.52	5.43	0.04	4.95	0.03	4.95	0.02	4.94	0.02	4.93	0.33	5.25	8 (6) ⁴	MV AAQO
Year 3																
PM _{2.5}	24-hr ³	12.0	2.95	14.9	0.38	12.3	0.28	12.2	0.23	12.2	0.17	12.1	2.57	14.5	25	MV AAQO
PM _{2.5}	annual	4.91	0.49	5.40	0.04	4.95	0.03	4.95	0.02	4.93	0.02	4.93	0.34	5.25	8 (6) ⁴	MV AAQO

Notes:

1 Using meteorology from 2013 (year 1), 2014 (year 2), and 2015 (year 3); background concentrations are based on 2019-2021 monitoring data and identical for all three modelled years.

2 All values in the table are in µg/m³.

3 Based on rolling average.

4 Metro Vancouver’s annual PM_{2.5} planning goal of 6 µg/m³ is a longer-term aspirational target to support continuous improvement.



Table J.13: Maximum Predicted Concentrations of PM₁₀ over the RAA and at Each Sensitive Receptor Category for Each Modelled Year¹ – Project + Base Case²

Pollutant	Averaging Period	Background (BG)	over RAA	over RAA + BG	Residence	Residence + BG	Childcare	Childcare + BG	School	School + BG	Seniors' Facility	Seniors' Facility + BG	Business	Business + BG	Objective or Standard	
															Value	Name
Year 1																
PM ₁₀	24-hr ³	18.4	3.26	21.6	0.40	18.8	0.39	18.8	0.19	18.6	0.17	18.5	2.80	21.2	50	MV AAQO
PM ₁₀	annual	9.19	0.55	9.74	0.04	9.23	0.04	9.23	0.02	9.22	0.02	9.21	0.39	9.59	20	MV AAQO
Year 2																
PM ₁₀	24-hr ³	18.4	2.81	21.2	0.35	18.7	0.30	18.7	0.23	18.6	0.16	18.5	2.08	20.4	50	MV AAQO
PM ₁₀	annual	9.19	0.52	9.71	0.04	9.23	0.03	9.23	0.02	9.22	0.02	9.21	0.33	9.53	20	MV AAQO
Year 3																
PM ₁₀	24-hr ³	18.4	2.95	21.3	0.38	18.8	0.28	18.7	0.23	18.6	0.17	18.5	2.57	20.9	50	MV AAQO
PM ₁₀	annual	9.19	0.49	9.68	0.04	9.23	0.03	9.23	0.02	9.21	0.02	9.21	0.34	9.53	20	MV AAQO

Notes:
1 Using meteorology from 2013 (year 1), 2014 (year 2), and 2015 (year 3); background concentrations are based on 2019-2021 monitoring data and identical for all three modelled years.
2 All values in the table are in µg/m³.
3 Based on rolling average.



Table J.14: Maximum Predicted Concentrations of VOC over the RAA and at Each Sensitive Receptor Category for Each Modelled Year¹ – Project + Base Case²

Pollutant	Averaging Period	Background (BG)	over RAA	over RAA + BG	Residence	Residence + BG	Childcare	Childcare + BG	School	School + BG	Seniors' Facility	Seniors' Facility + BG	Business	Business + BG	Objective or Standard	
															Value	Name
Year 1																
Total VOCs	1-hr	150	7.59	158	4.00	154	4.00	154	0.72	151	0.77	151	5.93	156	--	--
Total VOCs	24-hr ³	90.2	2.84	93.1	0.38	90.6	0.37	90.6	0.17	90.4	0.16	90.4	2.43	92.7	--	--
Total VOCs	Annual	32.8	0.47	33.3	0.04	32.9	0.03	32.9	0.02	32.9	0.02	32.9	0.34	33.2	--	--
Year 2																
Total VOCs	1-hr	150	8.05	158	2.99	153	2.00	152	0.78	151	1.10	151	6.36	157	--	--
Total VOCs	24-hr ³	90.2	2.47	92.7	0.32	90.6	0.27	90.5	0.22	90.5	0.14	90.4	1.82	92.1	--	--
Total VOCs	Annual	32.8	0.45	33.3	0.04	32.9	0.03	32.9	0.02	32.9	0.01	32.9	0.29	33.1	--	--
Year 3																
Total VOCs	1-hr	150	7.56	158	3.41	154	1.32	152	0.72	151	0.54	151	7.56	158	--	--
Total VOCs	24-hr ³	90.2	2.56	92.8	0.36	90.6	0.26	90.5	0.21	90.4	0.16	90.4	2.24	92.5	--	--
Total VOCs	Annual	32.8	0.42	33.3	0.03	32.9	0.03	32.9	0.02	32.9	0.01	32.9	0.29	33.1	--	--

Notes:
1 Using meteorology from 2013 (year 1), 2014 (year 2), and 2015 (year 3); background concentrations are based on 2019-2021 monitoring data and identical for all three modelled years.
2 All values in the table are in µg/m³.
3 Based on rolling average.



Table J.15: Maximum Predicted Concentrations of NO₂ over the RAA and at Each Sensitive Receptor Category for Each Modelled Year¹ – Cumulative Case²³

Pollutant	Averaging Period ²	Background (BG)	over RAA	over RAA + BG	Residence	Residence + BG	Childcare	Childcare + BG	School	School + BG	Seniors' Facility	Seniors' Facility + BG	Business	Business + BG	Objective or Standard	
															Value	Name
Year 1																
NO ₂ (Total Conversion)	1-hr	58.1	350	408	98.7	157	33.2	91.3	14.3	72.4	12.1	70.2	177	235	113	Previous MV AAQO
NO ₂ (Total Conversion)	Annual	21.1	6.75	27.9	2.81	23.9	2.19	23.3	1.17	22.3	1.11	22.2	4.15	25.3	32	
NO ₂ (Total Conversion)	1-hr	58.1	350	408	98.7	157	33.2	91.3	14.3	72.4	12.1	70.2	177	235	79	Current MV AAQO and CAAQS 2025
NO ₂ (Total Conversion)	Annual	21.1	6.75	27.9	2.81	23.9	2.19	23.3	1.17	22.3	1.11	22.2	4.15	25.3	22.6	
NO ₂ (OLM)	1-hr	58.1	100	159	61.1	119	25.9	84.0	11.3	69.4	10.6	68.7	67.8	126	113	Previous MV AAQO
NO ₂ (OLM)	Annual	21.1	5.54	26.6	2.29	23.4	1.81	22.9	1.01	22.1	0.96	22.1	3.20	24.3	32	
NO ₂ (OLM)	1-hr	58.1	100	159	61.1	119	25.9	84.0	11.3	69.4	10.6	68.7	67.8	126	79	Current MV AAQO and CAAQS 2025
NO ₂ (OLM)	Annual	21.1	5.54	26.6	2.29	23.4	1.81	22.9	1.01	22.1	0.96	22.1	3.20	24.3	22.6	
Year 2																
NO ₂ (Total Conversion)	1-hr	58.1	371	429	104	162	43.2	101	15.2	73.3	12.2	70.4	174	232	113	Previous MV AAQO
NO ₂ (Total Conversion)	Annual	21.1	6.89	28.0	2.79	23.9	2.11	23.2	1.22	22.3	1.07	22.2	3.77	24.9	32	
NO ₂ (Total Conversion)	1-hr	58.1	371	429	104	162	43.2	101	15.2	73.3	12.2	70.4	174	232	79	Current MV AAQO and CAAQS 2025
NO ₂ (Total Conversion)	Annual	21.1	6.89	28.0	2.79	23.9	2.11	23.2	1.22	22.3	1.07	22.2	3.77	24.9	22.6	
NO ₂ (OLM)	1-hr	58.1	94.8	153	63.4	122	28.9	87.1	12.9	71.1	10.6	68.8	70.9	129	113	Previous MV AAQO
NO ₂ (OLM)	Annual	21.1	5.82	26.9	2.35	23.5	1.79	22.9	1.08	22.2	0.94	22.1	3.06	24.2	32	
NO ₂ (OLM)	1-hr	58.1	94.8	153	63.4	122	28.9	87.1	12.9	71.1	10.6	68.8	70.9	129	79	Current MV AAQO and CAAQS 2025
NO ₂ (OLM)	Annual	21.1	5.82	26.9	2.35	23.5	1.79	22.9	1.08	22.2	0.94	22.1	3.06	24.2	22.6	
Year 3																
NO ₂ (Total Conversion)	1-hr	58.1	380	439	95.8	154	42.6	101	13.9	72.0	11.9	70.0	196	255	113	Previous MV AAQO
NO ₂ (Total Conversion)	Annual	21.1	6.37	27.5	2.68	23.8	2.06	23.2	1.07	22.2	1.00	22.1	4.03	25.1	32	
NO ₂ (Total Conversion)	1-hr	58.1	380	439	95.8	154	42.6	101	13.9	72.0	11.9	70.0	196	255	79	Current MV AAQO and CAAQS 2025
NO ₂ (Total Conversion)	Annual	21.1	6.37	27.5	2.68	23.8	2.06	23.2	1.07	22.2	1.00	22.1	4.03	25.1	22.6	
NO ₂ (OLM)	1-hr	58.1	127	185	63.9	122	26.9	85.1	12.5	70.6	10.7	68.8	72.3	130	113	Previous MV AAQO
NO ₂ (OLM)	Annual	21.1	5.37	26.5	2.25	23.4	1.75	22.9	0.95	22.1	0.88	22.0	3.34	24.5	32	
NO ₂ (OLM)	1-hr	58.1	127	185	63.9	122	26.9	85.1	12.5	70.6	10.7	68.8	72.3	130	79	Current MV AAQO and CAAQS 2025
NO ₂ (OLM)	Annual	21.1	5.37	26.5	2.25	23.4	1.75	22.9	0.95	22.1	0.88	22.0	3.34	24.5	22.6	

Notes:
1 Using meteorology from 2013 (year 1), 2014 (year 2), and 2015 (year 3); background concentrations are based on 2019-2021 monitoring data and identical for all three modelled years.
2 All values in the table are in µg/m³.
3 1-hour results are based on 98th percentile of the daily maximum 1-hour predictions.



Table J.16: Maximum Predicted Concentrations of SO₂ over the RAA and at Each Sensitive Receptor Category for Each Modelled Year¹ – Cumulative²

Pollutant	Averaging Period	Background (BG)	over RAA	over RAA + BG	Residence	Residence + BG	Childcare	Childcare + BG	School	School + BG	Seniors' Facility	Seniors' Facility + BG	Business	Business + BG	Objective or Standard	
															Value	Name
Year 1																
SO ₂	1-hr	3.64	210	213	80.2	83.9	59.2	62.9	19.3	23.0	22.3	25.9	197	200	183	MV AAQO
SO ₂	Annual	0.63	6.23	6.86	0.95	1.58	0.76	1.38	0.49	1.11	0.38	1.00	4.42	5.04	13	Previous MV AAQO
SO ₂	1-hr ³	3.64	103	107	52.4	56.0	30.5	34.1	13.0	16.6	12.1	15.8	98.2	102	170	CAAQS 2025
SO ₂	Annual	0.63	6.23	6.86	0.95	1.58	0.76	1.38	0.49	1.11	0.38	1.00	4.42	5.04	10.5	Current MV AAQO and CAAQS 2025
Year 2																
SO ₂	1-hr	3.64	239	242	55.6	59.2	48.7	52.3	15.3	19.0	19.4	23.0	239	242	183	MV AAQO
SO ₂	Annual	0.63	5.98	6.61	1.05	1.67	0.76	1.39	0.49	1.11	0.31	0.94	3.85	4.47	13	Previous MV AAQO
SO ₂	1-hr ³	3.64	136	140	47.2	50.8	33.1	36.8	13.9	17.5	12.3	15.9	136	140	170	CAAQS 2025
SO ₂	Annual	0.63	5.98	6.61	1.05	1.67	0.76	1.39	0.49	1.11	0.31	0.94	3.85	4.47	10.5	Current MV AAQO and CAAQS 2025
Year 3																
SO ₂	1-hr	3.64	192	196	72.5	76.2	66.9	70.6	17.0	20.6	17.0	20.7	192	196	183	MV AAQO
SO ₂	Annual	0.63	5.76	6.38	0.83	1.46	0.65	1.27	0.42	1.04	0.30	0.92	3.99	4.61	13	Previous MV AAQO
SO ₂	1-hr ³	3.64	121	125	44.0	47.7	39.1	42.7	11.2	14.9	11.7	15.3	121	125	170	CAAQS 2025
SO ₂	Annual	0.63	5.76	6.38	0.83	1.46	0.65	1.27	0.42	1.04	0.30	0.92	3.99	4.61	10.5	Current MV AAQO and CAAQS 2025

Notes:
1 Using meteorology from 2013 (year 1), 2014 (year 2), and 2015 (year 3); background concentrations are based on 2019-2021 monitoring data and identical for all three modelled years.
2 All values in the table are in µg/m³.
3 Based on 99th percentile of the daily maximum 1-hour predictions.



Table J.17: Maximum Predicted Concentrations of CO over the RAA and at Each Sensitive Receptor Category for Each Modelled Year¹ – Cumulative²

Polluta nt	Averagi ng Period	Backgr ound (BG)	over RAA	over RAA + BG	Reside nce	Reside nce + BG	Childca re	Childca re + BG	School	School + BG	Seniors + Facility	Seniors + Facility + BG	Busine ss	Busine ss + BG	Objective or Standard	
															Value	Name
Year 1																
CO	1-hr	557	48.5	606	20.6	578	20.6	578	4.55	562	4.66	562	36.6	594	14900	MV AAQO
CO	8-hr ³	505	32.8	538	5.95	511	5.95	511	1.87	507	1.75	506	18.5	523	5700	MV AAQO
Year 2																
CO	1-hr	557	50.4	608	16.7	574	11.0	568	4.28	561	6.29	563	37.6	595	14900	MV AAQO
CO	8-hr ³	505	31.1	536	5.17	510	3.35	508	1.98	507	1.61	506	17.7	522	5700	MV AAQO
Year 3																
CO	1-hr	557	91.4	649	18.7	576	12.9	570	3.83	561	3.66	561	76.8	634	14900	MV AAQO
CO	8-hr ³	505	29.9	535	5.91	511	5.00	510	2.09	507	2.06	507	18.7	523	5700	MV AAQO

Notes:
1 Using meteorology from 2013 (year 1), 2014 (year 2), and 2015 (year 3); background concentrations are based on 2019-2021 monitoring data and identical for all three modelled years.
2 All values in the table are in µg/m³.
3 Based on rolling average.



Table J.18: Maximum Predicted Concentrations of PM_{2.5} over the RAA and at Each Sensitive Receptor Category for Each Modelled Year¹ – Cumulative²

Pollutant	Averaging Period	Background (BG)	over RAA	over RAA + BG	Residence	Residence + BG	Childcare	Childcare + BG	School	School + BG	Seniors' Facility	Seniors' Facility + BG	Business	Business + BG	Objective or Standard	
															Value	Name
Year 1																
PM _{2.5}	24-hr ³	12.0	3.26	15.2	0.65	12.6	0.57	12.5	0.32	12.3	0.27	12.2	2.80	14.8	25	MV AAQO
PM _{2.5}	annual	4.91	0.58	5.50	0.11	5.02	0.09	5.00	0.05	4.96	0.04	4.96	0.42	5.34	8 (6) ⁴	MV AAQO
Year 2																
PM _{2.5}	24-hr ³	12.0	2.81	14.8	0.72	12.7	0.55	12.5	0.34	12.3	0.26	12.2	2.08	14.0	25	MV AAQO
PM _{2.5}	annual	4.91	0.56	5.47	0.10	5.02	0.08	4.99	0.05	4.97	0.04	4.95	0.37	5.28	8 (6) ⁴	MV AAQO
Year 3																
PM _{2.5}	24-hr ³	12.0	2.95	14.9	0.62	12.6	0.50	12.5	0.37	12.3	0.24	12.2	2.57	14.5	25	MV AAQO
PM _{2.5}	annual	4.91	0.53	5.45	0.10	5.01	0.08	4.99	0.04	4.96	0.04	4.95	0.38	5.29	8 (6) ⁴	MV AAQO

Notes:

1 Using meteorology from 2013 (year 1), 2014 (year 2), and 2015 (year 3); background concentrations are based on 2019-2021 monitoring data and identical for all three modelled years.

2 All values in the table are in µg/m³.

3 Based on rolling average.

4 Metro Vancouver’s annual PM_{2.5} planning goal of 6 µg/m³ is a longer-term aspirational target to support continuous improvement.



Table J.19: Maximum Predicted Concentrations of PM₁₀ over the RAA and at Each Sensitive Receptor Category for Each Modeled Year¹ – Cumulative ²

Pollutant	Averaging Period	Background (BG)	over RAA	over RAA + BG	Residence	Residence + BG	Childcare	Childcare + BG	School	School + BG	Seniors' Facility	Seniors' Facility + BG	Business	Business + BG	Objective or Standard	
															Value	Name
Year 1																
PM ₁₀	24-hr ³	18.4	3.26	21.6	0.67	19.0	0.57	18.9	0.32	18.7	0.27	18.6	2.80	21.2	50	MV AAQO
PM ₁₀	annual	9.19	0.58	9.78	0.11	9.30	0.09	9.28	0.05	9.24	0.04	9.24	0.42	9.62	20	MV AAQO
Year 2																
PM ₁₀	24-hr ³	18.4	2.81	21.2	0.74	19.1	0.56	18.9	0.35	18.7	0.27	18.6	2.08	20.4	50	MV AAQO
PM ₁₀	annual	9.19	0.56	9.76	0.11	9.30	0.08	9.27	0.05	9.25	0.04	9.23	0.37	9.56	20	MV AAQO
Year 3																
PM ₁₀	24-hr ³	18.4	2.95	21.3	0.64	19.0	0.52	18.9	0.37	18.7	0.24	18.6	2.57	20.9	50	MV AAQO
PM ₁₀	annual	9.19	0.53	9.73	0.10	9.29	0.08	9.27	0.05	9.24	0.04	9.23	0.38	9.57	20	MV AAQO

Notes:
1 Using meteorology from 2013 (year 1), 2014 (year 2), and 2015 (year 3); background concentrations are based on 2019-2021 monitoring data and identical for all three modelled years.
2 All values in the table are in µg/m³.
3 Based on rolling average.



Table J.20: Maximum Predicted Concentrations of VOC over the RAA and at Each Sensitive Receptor Category for Each Modelled Year¹ – Cumulative²

Pollutant	Averaging Period	Background (BG)	over RAA	over RAA + BG	Residence	Residence + BG	Childcare	Childcare + BG	School	School + BG	Seniors' Facility	Seniors' Facility + BG	Business	Business + BG	Objective or Standard	
															Value	Name
Year 1																
Total VOCs	1-hr	150	18.5	169	4.51	155	4.51	155	1.00	151	1.12	152	7.80	158	--	--
Total VOCs	24-hr ³	90.2	2.84	93.1	0.48	90.7	0.46	90.7	0.25	90.5	0.20	90.4	2.43	92.7	--	--
Total VOCs	Annual	32.8	0.54	33.4	0.28	33.1	0.21	33.1	0.10	32.9	0.11	33.0	0.40	33.2	--	--
Year 2																
Total VOCs	1-hr	150	17.3	168	3.79	154	2.70	153	1.02	151	1.38	152	7.70	158	--	--
Total VOCs	24-hr ³	90.2	2.47	92.7	0.45	90.7	0.32	90.6	0.28	90.5	0.17	90.4	1.82	92.1	--	--
Total VOCs	Annual	32.8	0.52	33.4	0.29	33.1	0.21	33.1	0.11	32.9	0.11	33.0	0.35	33.2	--	--
Year 3																
Total VOCs	1-hr	150	14.5	165	4.17	155	3.00	153	0.90	151	0.87	151	11.5	162	--	--
Total VOCs	24-hr ³	90.2	2.56	92.8	0.46	90.7	0.36	90.6	0.29	90.5	0.19	90.4	2.24	92.5	--	--
Total VOCs	Annual	32.8	0.50	33.3	0.27	33.1	0.21	33.0	0.09	32.9	0.10	32.9	0.37	33.2	--	--

Notes:
1 Using meteorology from 2013 (year 1), 2014 (year 2), and 2015 (year 3); background concentrations are based on 2019-2021 monitoring data and identical for all three modelled years.
2 All values in the table are in µg/m³.
3 Based on rolling average.

AQ-APPENDIX K NITROGEN AND ACID DEPOSITION CONSIDERATIONS



K.1 INTRODUCTION

Acid deposition predicted to be created by the proposed Project sources was quantified and compared to terrestrial and aquatic BC threshold values established by the BC Ministry of Environment (ENV). This screening study was undertaken with the purpose of determining whether a full cumulative study is warranted. Additional information and context regarding the susceptibility of nearby surface waters and soils are provided in the Nitrogen and Acid Deposition Receiving Environment Report (Jacobs, 2022) as part of the Application.

Annual nitrogen and acid total (dry + wet) deposition fluxes associated with the SO₂ and NO_x emissions from normal operation of Phase 2 thermal oxidizer (T2_TO), Phase 2 hot oil heater (T2_HOH), and Phase 2 totally enclosed ground flare (T2_GF) under the 2.5 MTPA scenario, were modelled with CALPUFF over 2013-2015. Modelled annual nitrogen and acid deposition fluxes averaged over 2013-2015 were then averaged over 1-ha squares for comparison with the BC terrestrial and aquatic threshold values (expressed in kg/ha/year and H⁺eq/ha/yr).

The next sections expand on the BC threshold values, modelling approach, emission parameters, and modelling results, and are followed by a discussion.

BC Threshold Values

BC Terrestrial Threshold Values

Screening total threshold values for terrestrial ecosystems are available in the BC ENV guidance document *Critical Load Screening Guidance for the Acidification and Eutrophication of Terrestrial Ecosystems* (ENV 2014). Per Table 2 of the BC ENV guidance document, the screening level deposition quantities for nitrogen eutrophication is 5 kilograms of nitrogen per hectare per year (kg N/ha/yr); acidification from sulphur (in the form of sulfate) is 7.5 kg SO₄/ha/yr, and total nitrogen and sulphur acid deposition is 150 equivalents per hectare per year (H⁺eq/ha/yr). In a study by Williston et al (2016), a deposition threshold of 150 eq/ha/year of modelled S and N was selected as the minimum deposition expected to cause negative effects to acid-sensitive ecosystems.

BC Aquatic Threshold Values

De Wit and Lindholm (2010) specified two threshold values for lake and river eutrophication: 3 kg of N/ha/yr (protective of dystrophic watercourses) and 5 kg N/ha/yr (protective of oligotrophic watercourses). The BC ENV guidance document on assessment of acidification and eutrophication on aquatic ecosystems states that the recommended study area boundary for assessing surface waters is delineated by the 100 equivalents/ha/year (S + N) or the 3 kg N/ha/year isopleth, whichever is greater (BC MOE, 2015a).



K.2 MODELLING APPROACH

CALPUFF (Version 7.2.1) was run with the RIVAD-ISOROPPIA chemistry module, with representative H₂O₂, O₃ and NH₃ background concentrations, dry and wet deposition with default CALPUFF deposition parameters and ground receptors, as per the BC AQDMG for acid deposition studies. The assessment was done over the LAA, with the same receptor grid as for the main study. For the acid deposition modelling receptors were set at ground level.

For O₃, maximum hourly concentrations measured at nearby MV monitoring stations (Richmond South and Delta) over 2013-2015 were used as the background. For H₂O₂, the default CALPUFF background concentration of 1 ppb was used, as there is no H₂O₂ monitoring data available in Metro Vancouver. Metro Vancouver does not monitor NH₃ in the urban airshed close to Tilbury Island, but (used to) monitor NH₃ in Abbotsford (Millar) and Chilliwack, which are somewhat influenced by nearby agricultural NH₃ emissions and not representative of the more urban environment in the close vicinity of the facility. For this assessment, the monthly ammonia background concentrations recommended in the *Alberta Air Quality Model Guideline* (Alberta Environment and Parks, AEP, 2021) for acid deposition modelling were considered more representative, and therefore used in the CALPUFF modelling. These monthly ammonia concentrations are summarized in Table K-1 below.

Table K-1: Monthly background NH₃ concentrations¹ (in ppb)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NH ₃ (ppb)	1.5	1.5	1.5	2.5	2.8	3.2	3.2	3.0	2.5	2.0	1.5	1.5

Note:

^[1] From Appendix G of *Alberta Air Quality Model Guideline* (AEP, 2021).

CALPUFF tracked six (6) species (SO₂, NO, NO₂, SO₄, NO₃ and HNO₃) and computed dry and wet deposition fluxes. All three project sources were modelled together in a single run to ensure NH₃ was consumed at the proper rate to create sulfates (preferentially) and nitrates. Further postprocessing of the deposition fluxes included summing dry and wet deposition fluxes, and tallying up the nitrogen deposition (from sulfates, nitrates, HNO₃, NO and NO₂), sulfur (from SO₂ and SO₄), and H⁺ equivalent (from SO₄, HNO₃, and NO₃). Postprocessing was done with POSTUTIL. Annual averages over 2013-2015 were computed at each receptor with CALPOST. Predicted annual effects were obtained by multiplying the annual modelling results by a factor of 345/365, representative of the maximum number of operating days at the facility (taking the three-week maintenance/shutdown period into account).



K.3 SOURCE CHARACTERISTICS

The emissions characteristics are summarized in Table 2. Buildings and emissions data are consistent with those used in the ambient air dispersion modelling of Phase 2 normal operations.

In the RIVAD chemistry module in CALPUFF, NO and NO₂ rates are explicitly modelled (transport, dispersion, chemical transformations, dry and wet deposition). NO_x emissions must therefore be apportioned explicitly between the two species. In-Stack-Ratio (ISR) of 0.4 was used for all sources, i.e., the molecular fraction of NO_x leaving the stack that is already NO₂, is 40%.

Table K-2: Source characteristics and emission rates for nitrogen acid deposition modelling

Sources	ID	Pollutant Emission Rates (g/s)						
		NO _x	NO ^[1]	NO ₂ ^[1]	SO ₂			
Phase 2_Heater	T2_HOH	6.84	2.68	2.73	0.63			
Phase 2_Thermal_Oxidizer	T2_TO	1.40	0.55	0.56	3.80			
Phase 2_Ground_Flare	T2_GF	0.03	0.01	0.01	0.006			
Sources	ID	Source Characteristics						
		Height [m]	Diam [m]	Base Elevation [m]	Exit_Vel [m/s]	Exit_Temp [K]	UTM coordinates	
							X (km)	Y (km)
Phase 2_Heater	T2_HOH	61.5	4.15	5.2	4.18	556.15	497.306	5,443.135
Phase 2_Thermal_Oxidizer	T2_TO	22.3	2.57	5.2	4.38	1,089.15	497.328	5,443.112
Phase 2_Ground_Flare	T2_GF	33.8	20.73	6.0	0.82	303.55	497.367	5443.076

Note:

^[1] Estimated from partitioning NO_x emission rates into NO and NO₂ and using an In-Stack-Ratio of 0.4. Note that NO_x mass is always expressed as NO₂ mass and the ISR pertains to mole fraction, not mass, so the sum of NO and NO₂ mass emission rates (in g/s) does not equal the NO_x max emission rate)



K.4 MODELLING RESULTS

Maximum modelled annual total (dry + wet) deposition fluxes are listed in Table K-3, over land and over water. To obtain the “per ha” values, the maximum deposition fluxes at all receptors located within each 100mx100m cell (1-ha- cell) were averaged for 1-ha-cells including more than one receptor.

Isopleths (based on values at all receptors but expressed in kg/yr/ha and H^+_{eq} /ha/year) are displayed in Figures K.1, K.2 and K.3 for nitrogen (N), Sulfates (SO_4) and H^+ equivalents, respectively. Fluxes averaged over the 1ha-cells in the close vicinity of the plant where the effects are maximum are displayed in Figure K.4.

Table K-3: Predicted Maximum Annual Average Deposition Fluxes, computed over 1-ha cells

Pollutant	Max Modelled Deposition Fluxes over land	Soil Threshold Value	Max Modelled Deposition Fluxes over water	Water Threshold Value	Units
N	5	5	14	3	kg/ha/yr
S ⁽¹⁾	7	-	20	-	kg/ha/yr
SO_4	15	7.5	46	-	kg/ha/yr
H^+ Equivalent	306	150	963	100	H^+_{eq} /ha/yr

Note:

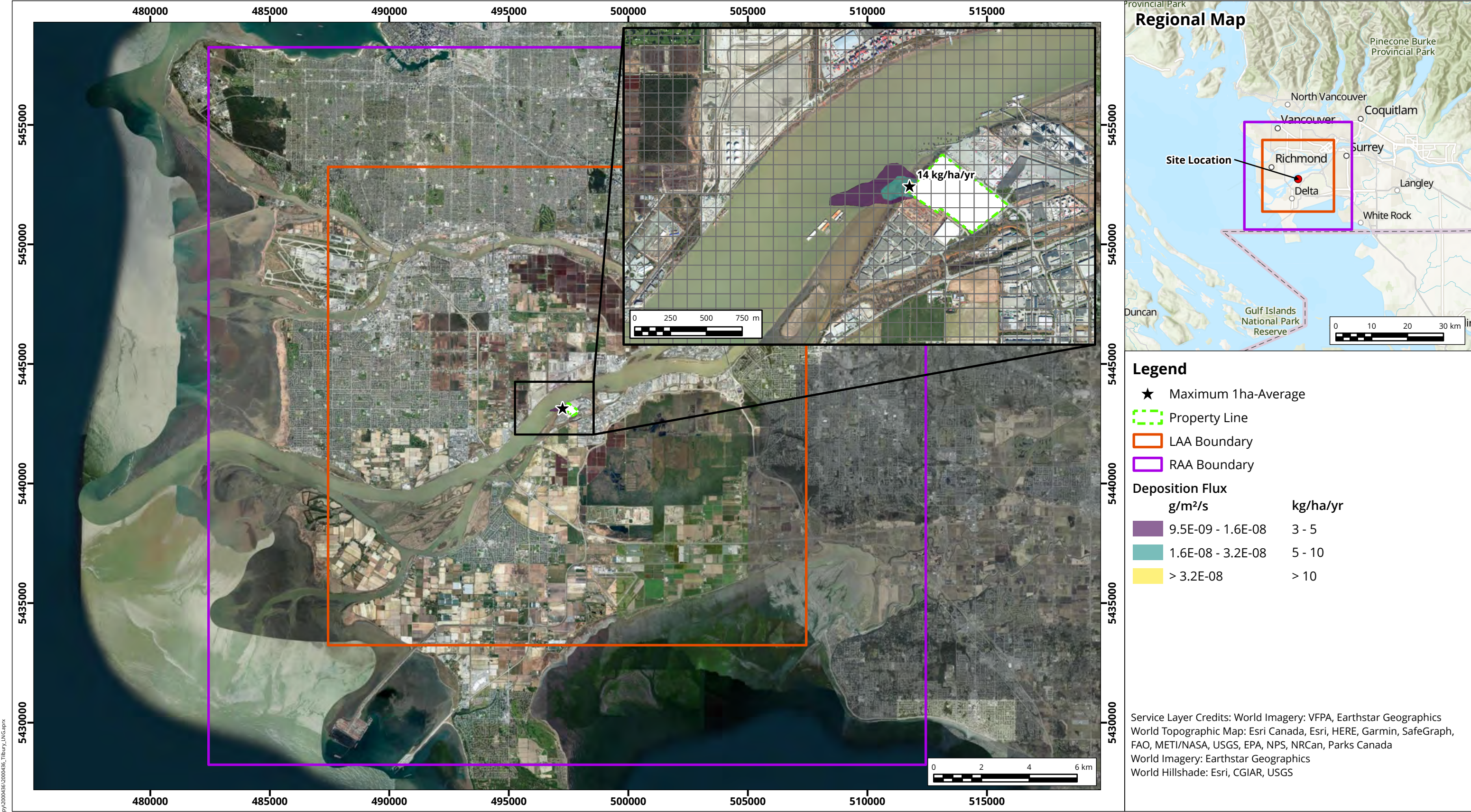
⁽¹⁾ There is no BC threshold value for S *per se*, but this value is often reported.

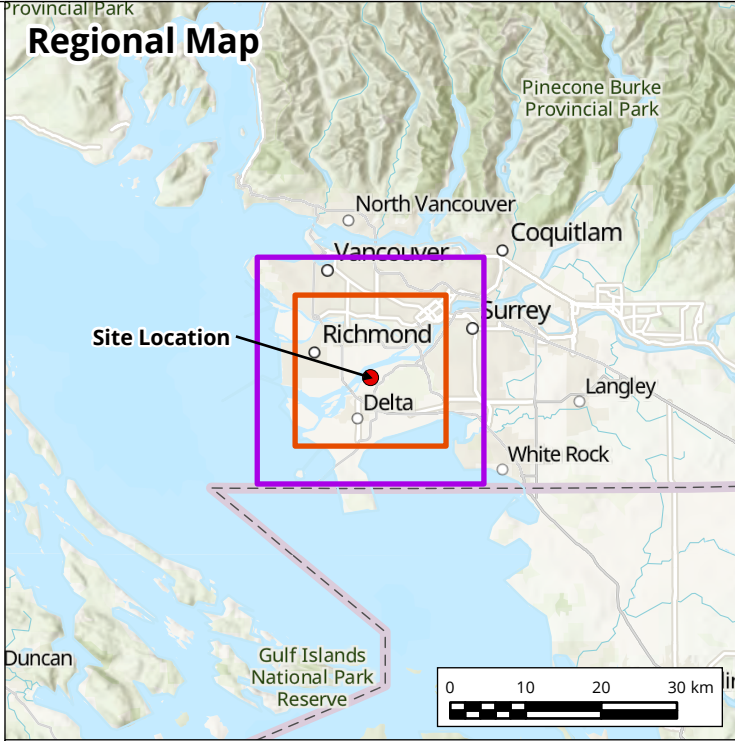
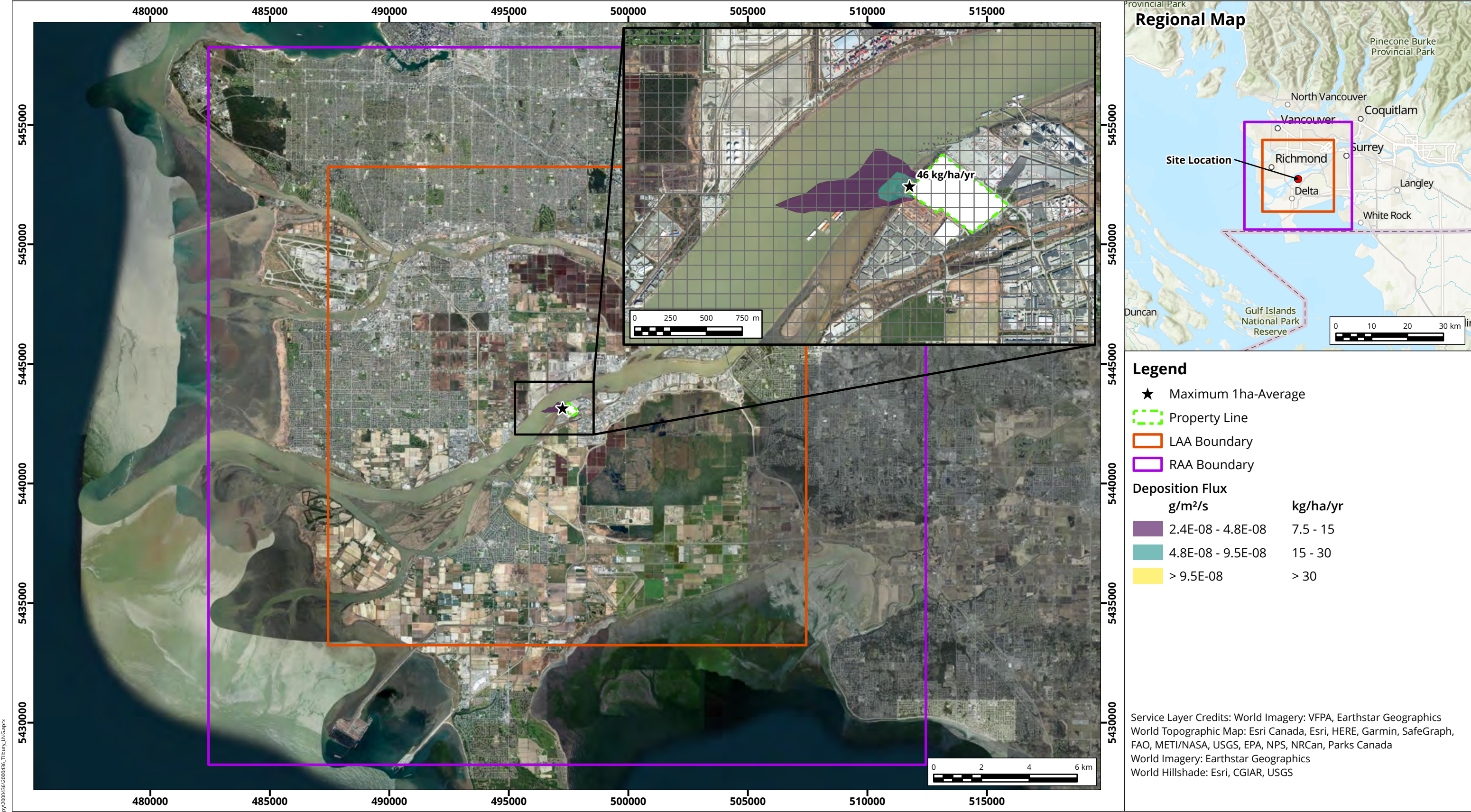
Apportionment of the nitrogen (N) deposition fluxes between sulfates, nitrates, and NO_x deposition fluxes indicates that about 98% of the nitrogen deposition fluxes in the maximum exceedance zone are in the form of sulfates ($(NH_4)_2 SO_4$).

Isopleths based on values at all receptors (i.e. not averaged over 1-ha cells but expressed in units /yr/ha) are displayed in Figures K.1 to K.3 for nitrogen (N), Sulfates (SO_4) and H^+ equivalents, respectively. Fluxes averaged over the 1-ha cells in the close vicinity of the plant where the effects are maximum are displayed in Figure K.4.

The maximum effect occurs within 100m of the facility. The threshold value for nitrogen over water is exceeded in a small area halfway across the river. The threshold value for H^+_{eq} over water is exceeded throughout the width of the river directly west of the facility.

The nitrogen threshold value for soil is not exceeded. Soil sulfate and H^+_{eq} threshold values are only exceeded in a couple of 1-ha cells on industrial land to the southwest of the facility.





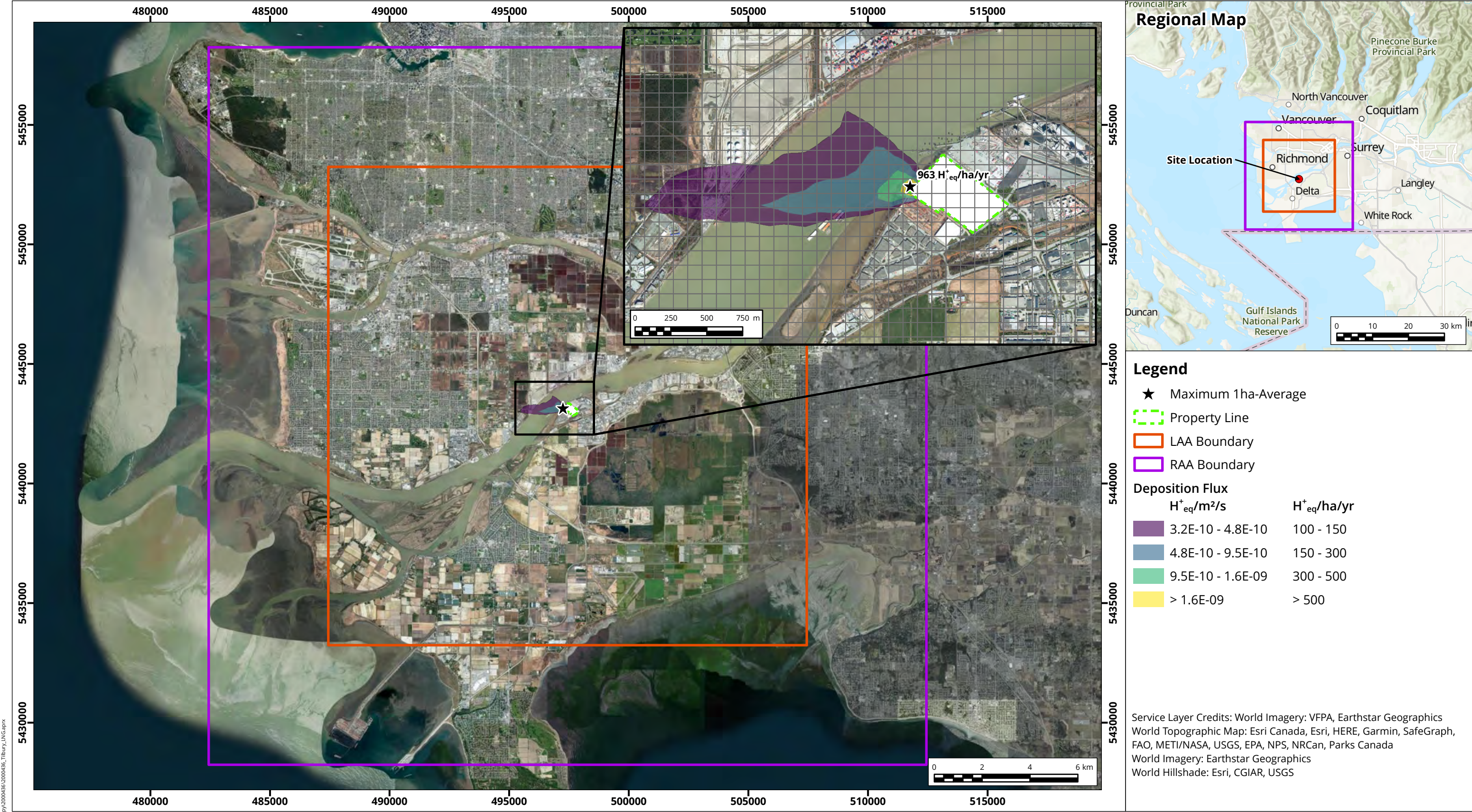
Legend

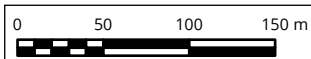
- ★ Maximum 1ha-Average
- Property Line
- LAA Boundary
- RAA Boundary

Deposition Flux

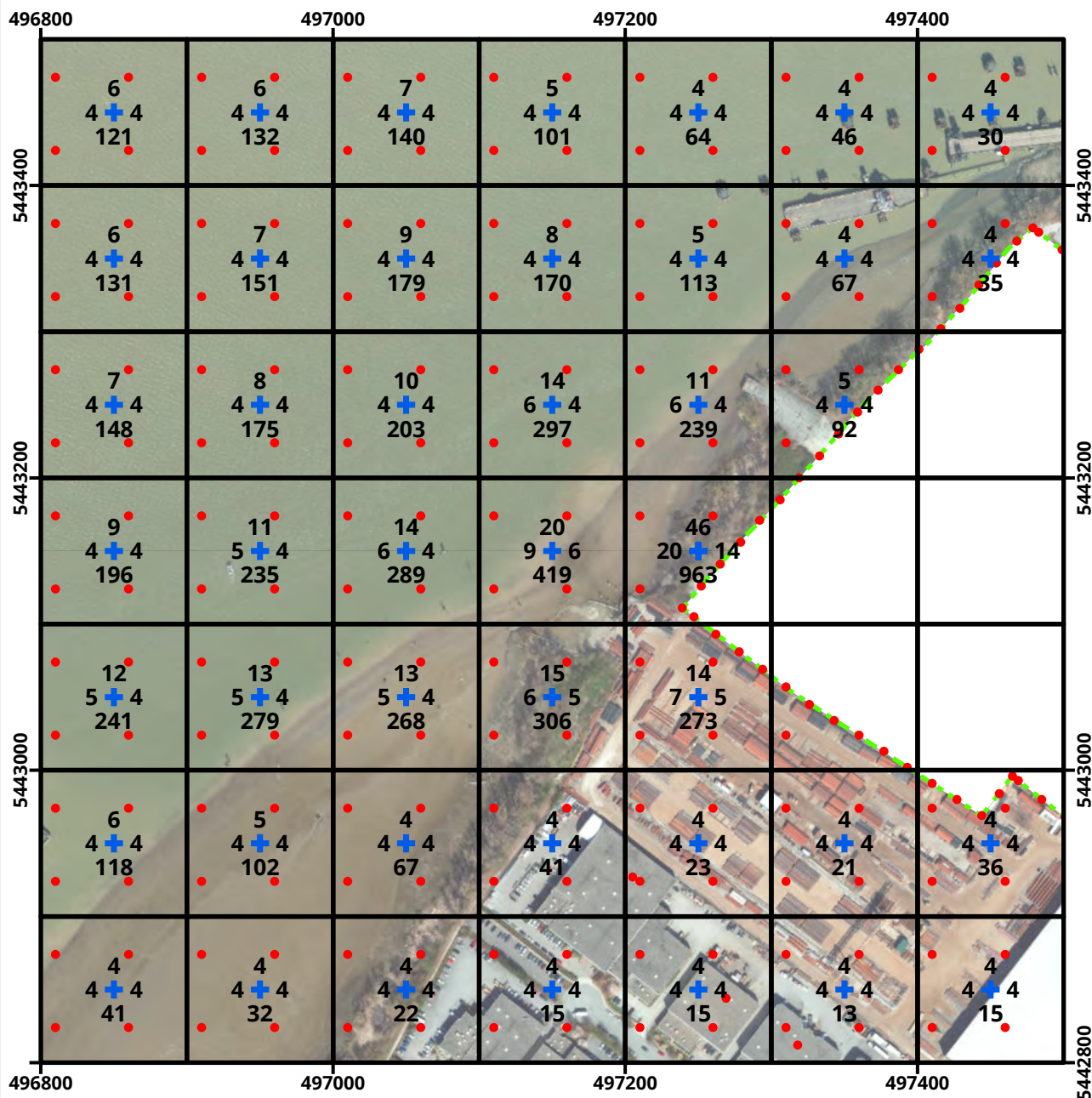
g/m ² /s	kg/ha/yr
2.4E-08 - 4.8E-08	7.5 - 15
4.8E-08 - 9.5E-08	15 - 30
> 9.5E-08	> 30

Service Layer Credits: World Imagery: VFPA, Earthstar Geographics
 World Topographic Map: Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, Parks Canada
 World Imagery: Earthstar Geographics
 World Hillshade: Esri, CGIAR, USGS





Service Layer Credits: World Imagery: VFPA, Maxar



Legend

- Receptors
- Property Line

SO₄

S + N
H⁺_{eq}

Soil BC Threshold

N = 5 kg/ha/yr
SO₄ = 7.5 kg/ha/yr
H⁺_{eq} = 150 H⁺_{eq}/ha/yr

Water BC Threshold

N = 3 kg/ha/yr
H⁺_{eq} = 100 H⁺_{eq}/ha/yr

Modelled Annual Deposition Fluxes Associated with Phase2 Normal Operations Averaged over 2013-2015, and Averaged over 1-ha Cells around Maximum Effect Area

N, S, SO₄ in kg/ha/yr and H⁺_{eq} in H⁺_{eq}/ha/yr

Tilbury LNG - Delta, B.C.

True North



Drawn by: DJH Figure: K.4

Approx. Scale: 1:4,400

Date Revised: Sep 21, 2022

Map Projection: NAD 1983 UTM Zone 10N
Project #: 2000436





K.5 REFERENCES

Alberta Environment and Parks. 2021. Air Quality Model Guideline. September 13, 2021.

ENV BC Ministry of Environment). 2014. Critical Load Screening Guidance for Acidification and Eutrophication of Terrestrial Ecosystems. November 21, 2014.

ENV. 2015. Guidance for the Assessment of Acidification and Eutrophication of Aquatic Ecosystems. June 25, 2015.

Jacobs. 2022. Nitrogen and Acid Deposition Receiving Environment Report, Supplemental Technical Data Report for Fortis BC Tilbury Phase 2 Environmental Assessment. Rev B. April 2022.

AQ-APPENDIX L CONCEPTUAL MITIGATED SCENARIO

L.1 INTRODUCTION

RWDI was retained by FortisBC Energy Inc. (FortisBC) to conduct a supplementary air quality assessment for the proposed Phase 2 expansion of storage and production capacity at its existing Tilbury liquefied natural gas (LNG) facility on Tilbury Island, in Delta, BC (the Project or T2).

An Application for an Environmental Assessment Certificate (the original Application) for the proposed Project was submitted to the Environmental Assessment Office (EAO) in November of 2024, including an Air Quality Technical Data Report (original TDR) detailing methods and results of the air quality assessment for the Project.

The original Application was reviewed by the EAO, Metro Vancouver (MV) and the Technical Advisory Committee (TAC). Following two rounds of Information Requests (IRs) from the EAO/MV/TAC and responses from FortisBC, it was concluded that the effectiveness of mitigation technologies on resulting air quality effects from the proposed Project should be quantitatively assessed through air dispersion modelling based on a conceptual representation of a mitigated scenario. An updated air dispersion modelling plan for a modelling amendment was submitted to and approved by MV (RWDI, 2025) to assess a conceptual mitigated scenario. The scope of the modelling amendment includes:

- Recent updates to the MV AAQO (MV, 2024a) in assessing proposed Project effects;
- Defining a conceptually achievable mitigation technology for NO₂ and SO₂;
- Developing emission parameters for the proposed Project based on a conceptually mitigated scenario;
- Assessing the effectiveness of proposed mitigation measures in reducing Project's impacts on ambient air quality, through quantitative analysis using air dispersion modelling;
- Updating background concentrations of NO₂ and SO₂ to reflect the 2022-2024 timeframe, and applying MV's latest guidance - Memorandum on NO₂ Background Calculation Considerations for Dispersion Modelling Purposes- to calculate background NO₂ concentrations (MV, 2024b), for the mitigated scenario only;
- Conducting air dispersion modelling for an additional mitigated cumulative case involving NO₂ and SO₂ emissions; and,
- Providing relevant inputs from the mitigated scenario to support the human health risk assessment.

This Appendix includes the methodology and results of the assessment for the conceptual mitigated scenario. The modelling approach and methodology for the conceptual mitigated scenario are generally consistent with those used in the original TDR. Any updates to methodology were reflected in the updated model plan (RWDI, 2025 – also included in *AQ-Appendix A* of the updated TDR), and are highlighted and explained in detail in the following sections.

The mitigation measures modelled in the conceptual scenario reflect currently available technological opportunities and are not intended to represent final design commitments or regulatory conditions. As a proof-of-concept, this scenario serves to demonstrate the potential effectiveness of mitigation based on present-day design considerations, recognizing that further refinements and advancements may be incorporated during final design development. This approach allows FortisBC to maintain flexibility while ensuring compliance with applicable ambient air quality standards.

L.1.1 The Conceptual Mitigated Scenario

As part of the proposed Phase 2 proof-of-concept design for the Tilbury liquefaction train, FortisBC is advancing an emissions mitigation strategy that demonstrates its technical capability and commitment to meeting applicable air quality standards. This conceptual design reflects a proactive and flexible approach to managing combustion-related emissions, specifically focused on reductions in nitrogen oxides (NO_x) and sulfur oxides (SO_x).

This strategy serves to demonstrate FortisBC's readiness to implement effective emissions controls as the proposed Project progresses from application review into the certification process, during which the final design will be considered and refined prior to permitting. While specific technologies are still under evaluation, the proof-of-concept framework is designed to remain adaptable—ensuring the final configuration meets regulatory requirements, accommodates site-specific conditions, and responds to evolving expectations for emissions management.

The preliminary design concept incorporates a sequence of emissions control technologies designed to treat exhaust gases prior to atmospheric release. For SO_x mitigation, a sulfur removal system is proposed downstream of the thermal oxidizer (T2_TO) and hot oil heater (T2_HOH), with final discharge routed through a single stack (T2_FGD). Technologies such as flue gas desulfurization (FGD) are under consideration due to their proven effectiveness in industrial applications. FGD systems typically operate by removing sulfur compounds from flue gases, often using alkaline reagents or absorbents to neutralize or capture SO₂.

To manage NO_x emissions, FortisBC is evaluating burner technologies capable of delivering low NO_x output across a range of operating conditions. These systems are designed to maintain consistent performance regardless of variations in fuel composition, furnace temperature, or air preheat levels—making them well-suited to the dynamic operating profile of liquefaction processes. More details on these technologies are provided in Appendix P of the Application. Ultra-low-NO_x burners are among the technologies under consideration due to their ability to reduce NO_x formation at the source, thereby minimizing downstream treatment requirements.

The proof-of-concept approach allows for flexibility in technology selection, ensuring the final design incorporates the most effective and practical solutions available at the time of implementation. This strategy reflects FortisBC's commitment to environmental stewardship and regulatory compliance through thoughtful, performance-based emissions management. Final technology selection will be guided by detailed engineering and regulatory permitting processes and may include alternative systems that offer equivalent or optimized performance. This approach ensures that FortisBC can respond to future compliance obligations while maintaining its environmental objectives.

While the design remains conceptual, the proposed mitigation measures, including the continued use of flue gas recirculation and other combustion controls, are not expected to result in increased emissions of carbon monoxide (CO), particulate matter (PM₁₀ and PM_{2.5}), or volatile organic compounds (VOCs). These measures are designed to maintain combustion efficiency and minimize the formation of secondary pollutants. As a result, emission levels for CO, PM₁₀, PM_{2.5}, and VOCs are anticipated to remain consistent with those observed in the unmitigated case presented in the original application. Accordingly, these pollutants are considered effectively managed, with no expected increase in emissions under the mitigated scenario.

L.2 METHODOLOGY

Modelling was conducted consistent with the updated modelling plan, dated June 12, 2025, approved by MV (RWDI, 2025). All modelling parameters and methodology remained consistent with the original modelling in the Application, with the following exceptions:

- Only **NO₂** and **SO₂** were assessed;
- A conceptual mitigation scenario including a Cumulative Mitigated Case was assessed, mitigation measures were applied to the proposed Phase 2 hot oil heater and thermal oxidizer under normal operations;
- Background concentrations for NO₂ and SO₂ were updated using measurements from 2022–2024 and applying MV's updated guidance for calculating NO₂ background values (MV, 2024b); and
- Updated MV AAQOs for NO₂ (1-hour and annual) and SO₂ (annual)—in line with CAAQS 2025, are reflected in the assessment.

All other methodology including model versions, meteorological modelling, model technical options and switches, modelled buildings, receptors and NO_x to NO₂ conversion method remained unchanged from the original TDR and Application. A summary of key methodology elements is provided in Table L.1 below.

Table L.1: Key Methodology Elements for the “Conceptual Mitigated Scenario

Methodology Element	Original TDR – 2024 Unmitigated Scenarios in Updated TDR	Mitigated Scenario in Updated TDR
Dispersion Modelling	Unchanged - CALMET version 6.5.0 and CALPUFF version 7.2.1	
Meteorological Modelling	Unchanged – using province-wide WRF data and surface observations from stations shown in Figure 4-1 of TDR	
Grid and sensitive receptors	Unchanged – see Figures 4-4 and 4-5 of TDR	
Modelled buildings and downwash algorithm	Unchanged – see Figure 4-2 of TDR	
NO _x to NO ₂ conversion method	Unchanged – OLM, using maximum of the hourly ozone observations at MV's T13 and T17 stations. See Section 4.3.1 of TDR	
Modelled Cases	Base Case Base Case + Project Cumulative Case	A Cumulative Mitigated Case was added. Updated methodology only applies to this scenario
Contaminants of Interest	NO ₂ , SO ₂ , CO, PM ₁₀ , PM _{2.5} , VOC	Only NO ₂ and SO ₂
Ambient Air Quality Objectives	MV 2020 AAQO and CAAQS 2025 were used. See Table 1-1 of TDR	Current MV AAQO (2024) and CAAQS 2025 were used. MV's objectives for NO ₂ were updated to 79 µg/m ³ for 1-hour and 22.6 µg/m ³ for annual averaging periods. MV objective for annual

Methodology Element	Original TDR – 2024 Unmitigated Scenarios in Updated TDR	Mitigated Scenario in Updated TDR
		SO ₂ concentration was updated to 10.5 µg/m ³ . See Table 1-1 of TDR
Background concentrations	See Table 2-1 of TDR Using 2019-2021 data from MV stations T13, T17, T31 and T18, and using BC's metrics for calculation of background value.	See Table 2-2 of TDR, and Table L.2 Using 2022-2024 data from the same stations, with NO ₂ metrics updated based on MV's new guidance (MV, 2024b)
Project and External Emissions and Source Parameters	See Tables 3-1 through 3-12, 4-1 through 4-3 and Figure 4-2 of TDR. Unmitigated normal operations from Project sources: T2_HOH, T2_TO and T2_TEGF External sources from T1A, T1B and TMJ were included.	See Tables 3-7, 4-2, and Figure 4-3 of TDR. Emissions from the T2_HOH, T2_TO are rerouted to an FGD system and exhausted from a common stack (T2_FGD). Pilot flare emissions unchanged. Modelled Project sources include Mitigated normal operations from T2_FGD and the T2_TEGF. External sources remain unchanged.

L.2.1 Modelled Scenario

The following cases were modelled:

Project-Only: T2 unmitigated and T2 mitigated sources were modelled, and the resulting predicted ambient concentrations (without background) were compared. This analysis provides a basis for evaluating the effectiveness of the proposed conceptual mitigation measures.

Base Case + Mitigated Project (Application Case): Existing T1A sources and the mitigated proposed Project sources were modelled together to assess the effect of the mitigated Project on existing ambient air quality during normal operations. The change in predicted ambient air concentrations was calculated for each receptor. This modelling exercise was conducted to confirm that the mitigated proposed Project is expected to have a minimal effect on existing ambient nitrogen dioxide (NO₂) levels.

Mitigated Cumulative Case: The Mitigated Cumulative Case was modelled for the Cumulative Effects Assessment for the proposed Project after incorporating conceptual mitigation measures. The Mitigated Cumulative Case included emissions from the existing sources (T1A), the proposed mitigated Project (Phase 2 continuous conceptual mitigated sources), and sources from Reasonably Foreseeable Projects (RFPs) defined in the TDR (T1B and TMJ). All external emission sources were assumed to remain unchanged from those used in the original (unmitigated) Cumulative Case modelling.

L.2.2 Ambient Air Quality Objectives

Maximum predicted concentrations from the modelled scenarios including ambient background were evaluated against the applicable AAQO and standards for the modelled pollutants for all applicable averaging periods. A summary of these objectives is provided in Table L.2.

In late 2024, MV formally adopted CAAQS 2025 for NO₂ as its AAQO; therefore, the modelling results were evaluated against Metro Vancouver's updated objectives (MV, 2024b). The 1-hour average NO₂ results were assessed using the 3-year average of the annual 98th percentile of daily 1-hour maximum (D1HM) concentrations at each receptor. For the annual averaging period, results were assessed using the 3-year average of annual mean concentrations at each receptor.

MV also adopted the annual SO₂ CAAQS 2025. For SO₂, for the 1-hour averaging period, model results are compared against both MV AAQO and CAAQS 2025. Note that, for comparison to MV AAQO, the 3-year average of the 100th percentile of hourly predicted concentrations in one year, were calculated at each receptor. For comparison with CAAQS, the 3-year average of the 99th percentile of D1HM predictions in each year were calculated at each receptor. For annual averaging period, for comparison to both metrics, the average of hourly predictions over 3 years were calculated at each receptor.

Table L.2: Ambient Air Quality Standards and Objectives

Air Contaminant	Averaging Period	CAAQS 2025		CAAQS 2020		BC AAQO		Previous MV AAQO		Current MV AAQO		Metric
		µg/m ³	ppb	µg/m ³	ppb	µg/m ³	ppb	µg/m ³	ppb	µg/m ³	ppb	
NO ₂	1-hour	79	42	113	60	113	60	113	60	79	42	3-year avg. of the annual 98 th percentile of D1HM
	Annual	22.6	12	32	17	32	17	32	17	22.6	12	3-year avg. of the annual avg. of hourly values
SO ₂	1-hour	170	65	183	70	183	70	183	70	183	70	CAAQS/BC: 3-year avg. of the annual 99 th percentile of D1HM MV: 100 th percentile of hourly values
	annual	10.5	4	13	5	13	5	13	5	10.5	4	Annual avg. of hourly values over one year



L.2.3 Updated Background Concentrations

For the mitigated scenario, the methodology and data used to calculate background concentrations for NO₂ and SO₂ were updated as directed in the Application review and IR process, and approved in the updated modelling plan (RWDI, 2025). Recent monitoring data from 2022 to 2024, collected from the same stations referenced in the original TDR were used in this assessment.

The metrics used for calculating background concentrations were based on guidance from the BC Air Quality Dispersion Modelling Guideline (AQDMG – BC Ministry of Environment and Parks or ENV, 2022), the MV Dispersion Modelling Template (MV, 2025), and the MV memorandum on NO₂ Background Calculation (MV, 2024a). The methodology to calculate background values for this assessment were approved by MV in the updated Dispersion Modelling Plan.

The NO₂ ambient background concentrations were calculated using the 3-year average of annual 98th, 90th, and 75th percentiles of hourly data for the 1-hour period and using the 3-year average of the annual 50th percentile of hourly data for the annual period based on the MV Memorandum on NO₂ Background Calculation (MV, 2024b). Hourly results have been shown with all three hourly background concentrations as per the guidance in the memorandum. These values are summarized in Table L.3 below.

Table L.3: Recently Calculated Background Concentrations – for Mitigated Scenario Only

Contaminant	Averaging Period	Background Concentration (µg/m ³)	Metric
Applicable to: The revised Application, mitigated scenario only - Based on 2022-2024 monitoring data			
NO₂	1-hour 98 th percentile	54.96	Annual 98 th percentile of hourly values averaged over 3 years
	1-hour 90 th percentile	40.87	Annual 90 th percentile of hourly values averaged over 3 years
	1-hour 75 th percentile	29.54	Annual 75 th percentile of hourly values averaged over 3 years
	Annual	17.23	Annual 50 th percentile of the hourly values averaged over 3 years
SO₂	1-hour	3.14	Annual 99 th percentile of hourly values averaged over 3 years
	Annual	0.59	Average of hourly values over three years

Notes:

- Background values are based on MV metrics for baseline concentrations.
- Values calculated based on 2022 to 2024 data from four MV air monitoring stations: North Delta (T13), Richmond South (T17), Richmond Airport (T31) and Burnaby South (T18).

L.2.4 Emissions

FortisBC developed preliminary source characteristics and emission rates based on the conceptual assessment framework, vendor-supplied information, and relevant engineering considerations. Assuming the facility will operate 345 days per year, annual emission rates for all sources were scaled to reflect this operational schedule.

Note that based on the preliminary design, emission of CO, PM₁₀, PM_{2.5} and VOCs are not affected by the conceptual mitigation measures. Emissions data for this scenario are provided in Table L.4. Further details are provided in Section 3.3 of the TDR. Note that only NO₂ and SO₂ were modelled for the conceptual mitigated scenario.

Table L.4: Proposed Project Conceptual Mitigated Sources and Emission Rates during Normal Operations – Mitigated Scenario

Source	ID	NO _x	SO ₂	CO ¹	PM _{2.5} ^{1,2}	PM ₁₀ ^{1,2}	VOC ¹
Maximum Hourly Emissions (in g/s)							
Phase 2 – Hot Oil Heater	Stacks removed and emissions redirected to the T2_FGD						
Phase 2 – Thermal Oxidizer							
Phase 2 – Flue Desulphurization Unit	T2_FGD	1.269	2.473	1.563	0.334	0.334	0.334
Phase 2 – Totally Enclosed Ground Flare	T2_GF	0.031	0.006	0.012	0.010	0.010	0.001
Annual Emissions (in Tonnes/year) ³							
Phase 2 – Hot Oil Heater	Stacks removed and emissions redirected to the T2_FGD						
Phase 2 – Thermal Oxidizer							
Phase 2 – Flue Desulphurization Unit	T2_FGD	37.83	73.72	46.59	9.96	9.96	9.96
Phase 2 – Ground Flare	T2_GF	0.92	0.18	0.35	0.30	0.30	0.03
Total Phase 2 Annual Conceptual Mitigated Emissions		38.75	73.90	46.93	10.25	10.25	9.99

Notes: ¹ No change to emissions occur as a result of mitigation measures. i.e. T2_FGD emissions equals the sum of T2_HOH and T2_TO unmitigated emissions.

² Assumed all particulate matter is PM_{2.5}.

³ Facility operates 345 days per year. Annual emissions were scaled accordingly from maximum hourly emissions.

For the Mitigated Cumulative Case, hourly emission rates for all other sources from the Tilbury T1A and T1B project sources as well as TMJ sources remain unchanged from the previously assessed unmitigated scenarios. Refer to Tables 3-10 and 3-12 in the TDR for more details.

L.2.5 Other inputs and settings

As described in Table L.1 other technical inputs and settings including model versions, meteorological modelling, receptor configuration, modelled buildings, downwash algorithm, and NO_x to NO₂ conversion method remain unchanged relative to the original TDR and the previously assessed unmitigated scenarios.

L.3 MODEL RESULTS

L.3.1 Effects of Mitigation

C.3.1.1 NO₂

Predicted NO₂ concentrations from the proposed Project sources alone under both unmitigated and mitigated scenarios are provided in Table L.5. Unmitigated Project sources include the T2_HOH, T2_TO and T2_TEGF while the mitigated proposed Project sources include the T2_FGD and T2_TEGF. For comparison, background concentrations, current MV AAQO and CAAQS 2025 are also provided.

Based on the modelling results, the conceptual mitigation measures are predicted to reduce proposed Project's contribution to maximum predicted ambient NO₂ concentration by more than 80% for both 1-hour and annual averaging periods. Figure L. 1 and Figure L. 2 illustrate concentration contours from the proposed Project-only sources for the unmitigated and mitigated scenarios, corresponding to the 1-hour and annual averaging periods, respectively. Concentration contours for both the averaging periods result in substantial reduction in spatial extent of elevated NO₂ under the mitigation scenario.

Table L.5: Predicted Maximum NO₂ Concentrations from Proposed Project under Unmitigated and Mitigated Scenarios (in µg/m³)

Air Contaminant	Averaging Period	Current MV AAQO/ CAAQS 2025	Background	T2 Unmitigated (w/o BG) ^[2]	T2 Mitigated (w/o BG) ^[3]	% Change in Project-Only Concentration with the Implementation of Mitigation
NO ₂ (OLM)	1-hour ^[1]	79	54.96 (98 th perc.) 40.87 (90 th perc.) 29.54 (70 th perc.)	38.9	6.6	83% reduction
	Annual	22.6	17.23 (50 th perc.)	0.8	0.11	88% reduction

Notes:

¹ Based on 3-year average of 98th percentile of the D1HM predictions in one year.

² Including emissions from T2_HOH, T2_TO and T2_TEGF.

³ Including emissions from T2_FGD and T2_TEGF.

Model results also indicate that the mitigated proposed Project has minimal effect on existing ambient NO₂ concentrations. The original Application (Section 7.2, Table 7.2-10) defined a "Negligibility Criteria" as follows:

"Negligibility Criteria: Increase from Base Case concentrations resulting from the proposed Project is less than 5% of the MV AAQO or CAAQS 2025."

Based on the current MV AAQO and CAAQS 2025, the negligibility thresholds are 3.95 µg/m³ for the 1-hour and 1.13 µg/m³ for the annual averaging periods.

Table L.6 presents the increase in NO₂ concentrations relative to the Base Case, resulting from the mitigated proposed Project. For context and comparison, the table also includes MV AAQO, background concentrations, concentrations from existing T1A sources, Base Case concentrations and Base Case + Mitigated proposed Project concentrations. Additionally, Table L.6 provides the number of receptors and the maximum distance from the fenceline where the negligibility criterion is exceeded for each averaging period.

Based on model results, the application of mitigation measures ensures the negligibility criteria are met throughout the modelling domain, with the exception of a few receptors on and in the immediate vicinity of the southwest fenceline of the proposed Project.

Figure L. 3 and Figure L. 4 illustrate isopleths showing the increase in NO₂ concentrations above the Base Case concentrations resulting from the Conceptual Mitigated proposed Project. These figures correspond to the 1-hour and annual averaging periods, respectively.

Table L.6 : Effect of the Conceptual Mitigated Project on Existing Ambient NO₂ Concentrations
(in µg/m³)¹

Averaging Period	MV AAQO and CAAQS 2025	Background ²	T1A	Base Case (incl. BG) ³	Base Case + Mitigated proposed Project (Incl. BG) ⁴	Maximum Increase to Base Case Resulting from Mitigated Project	# of receptors where the negligibility criteria are not met
1-hour	79	54.96 (98 th perc.)	32.4	87.3	88.1	17.3	19 on SW fenceline & 7 within 50 m of the SW fenceline
		40.87 (90 th perc.)		61.9	74.1		
		29.54 (70 th perc.)		73.2	62.7		
Annual	22.6	17.23 (50 th perc.)	1.7	18.9	20.3	2.1	5 on SW fenceline & one within 30 m of the SW fenceline

Notes:

- [1] Per Table 7.2-10 of the original Application, negligible effect is defined as “Increase from Base Case concentrations resulting from the Project is less than 5% of the MV AAQO or CAAQS 2025, which are 3.95 µg/m³ and 1.13 µg/m³ for the 1-hour and annual averaging periods, respectively.
- [2] Calculated values based on 2022 to 2024 data from MV air monitoring stations (T13, T17, T31 and T18) based on new MV guidance as discussed in Section L.2.3.
- [3] Calculated considering recent background values shown in this table. For Base Case concentrations using originally calculated background values (based on 2019-2022 data and previous background metrics) refer to table 5-1 of TDR.
- [4] Calculated considering recent background values shown in this table.

C.3.1.2 SO₂

Predicted SO₂ concentrations from the proposed Project sources alone under both unmitigated and mitigated scenarios are presented in Table L.7. The unmitigated proposed Project sources include the T2_HOH, T2_TO and T2_TEGF while the mitigated proposed Project sources include the T2_FGD and T2_TEGF. For comparison background concentrations, current MV AAQO and CAAQS 2025 are also provided.

Based on the model results, the conceptual mitigation measures will reduce maximum predicted proposed Project-only SO₂ concentration by over 70% for the 1-hour (both MV and CAAQS metrics) and annual averaging periods.

Concentration contours from the proposed Project only are compared for unmitigated and mitigated scenarios in Figure L. 5, Figure L. 6 and Figure L. 7 for the 1-hour MV AAQO, 1-hour CAAQS, and annual averaging periods, respectively. Based on model predictions, concentration contours for both the averaging periods result in substantial reduction in spatial extent of elevated SO₂ under the mitigated scenario.

Table L.8 presents the increase to Base Case SO₂ concentrations resulting from the mitigated proposed Project. MV AAQO, background concentrations, concentrations from existing T1A sources, Base Case concentrations and Base Case + Mitigated Project concentrations are also provided for context and comparison.

Table L.7: Predicted Maximum SO₂ Concentrations from Proposed Project only, under the Unmitigated and Mitigated Scenarios

Air Contaminant	Averaging Period	Objective	Background ^[3]	T2 Unmitigated (w/o BG) ^[4]	T2 Mitigated (w/o BG) ^[5]	% Change in Project-Only Concentration with the Implementation of Mitigation
SO ₂	1-hour MV AAQO ^[1]	183	3.14	150.8	40.5	73% Reduction
	1-hour CAAQS 2025 ^[2]	170		81.1	19.7	76% Reduction
	Annual (MV AAQO & CAAQS 2025)	10.5	0.59	1.1	0.22	80% Reduction

Note:

[1] Based on 100th percentile of the hourly predictions in each year, averaged over 2013-2015.

[2] Based on 99th percentile of the D1HM predictions in each year, averaged over 2013-2015.

[3] Calculated values based on 2022 to 2024 data from MV air monitoring stations (T13, T17, T31 and T18) as discussed in Section L.2.3.

[4] Proposed Project sources include T2_HOH, T2_TO and T2_TEGF.

[5] Proposed Project sources include T2_FGD and T2_TEGF.

Table L.8: Effect of the Conceptual Mitigated Proposed Project on Existing Ambient SO₂ Concentration

Averaging Period	Objective	Background ³	T1A	Base Case (incl. BG) ⁴	Base Case + Mitigated Project (Incl. BG) ⁵	Maximum Increase to Base Case Resulting from Mitigated Project
1-hour MV AAQO ^[1]	183	3.14	87.5	90.6	95.1	40.31
1-hour CAAQS 2025 ^[2]	170		56.9	60.00	75.9	42.28
Annual (MV AAQO & CAAQS 2025)	10.5	0.59	1.4	1.98	5.7	4.09

Notes:

[1] Based on 100th percentile of the hourly predictions in each year, averaged over 2013-2015.

[2] Based on 99th percentile of the D1HM predictions in each year, averaged over 2013-2015.

[3] Recently calculated values based on 2022 to 2024 data from MV air monitoring stations (T13, T17, T31 and T18)

[4] Calculated considering recent background values shown in this table. For Base Case concentrations using originally calculated background values (based on 2019-2022 data) refer to table 5-1 of TDR.

[5] Calculated considering recent background values shown in this table.

L.3.2 Mitigated Cumulative Case

The cumulative case accounts for emissions from the proposed mitigated Project during normal operation, continuous sources from the T1A and T1B projects, and emissions associated with the TMJ project. For the TMJ project, the representative emission rates for hourly, 8-hour, 24-hour and annual averages are detailed in Table 3-12 and AQ-Appendix F – *Tilbury Marine Jetty* of the TDR. Information on T1A and T1B sources are provided in Table 3-10 of the air quality TDR.

Overall maximum predicted concentrations over the RAA are tabulated in Table L.9. Contour plots are provided in Figures L.8 through L.17. Additional detailed results tables are provided in Tables LR.1 through LR.12.

Table L.9: Maximum Predicted Concentrations with Background for Base, Application (Baes + Proposed Project), and Cumulative Cases - Conceptual Mitigated Scenario ¹

Air Contaminant	Averaging period	Conceptual Mitigated Scenario - Maximum over RAA ⁵				Objective or Standard		Background ⁶
		Base Case	Project Only (no BG)	Base Case + Proposed Project	Cumulative Case	Value	Name	
NO ₂ (Total Conversion Method)	1-hour ²	91.4	7.8	99.7	415	79	Current MV AAQO CAAQS 2025	54.96 ⁷
		77.3		85.7	401			40.87 ⁸
		66.0		74.3	390			29.54 ⁹
	Annual	19.1	0.12	21.1	23.8	22.6		17.23
NO ₂ (OLM)	1-hour ²	87.3	6.6	88.2	161	79	Current MV AAQO CAAQS 2025	54.96 ⁷
		73.2		74.1	147			40.87 ⁸
		61.9		62.7	136			29.54 ⁹
	Annual	18.9	0.11	20.3	22.7	22.6		17.23
SO ₂	1-hour ³	90.6	40.5	95.1	120	183	Current MV AAQO	3.14
	1-hour ⁴	60.0	19.7	75.9	81.4	170	CAAQS 2025	
	Annual	2.0	0.22	5.7	6.0	10.5	Current MV AAQO and CAAQS 2025	0.59

Notes:

[1] Effects are compared with the MV AAQO and CAAQS 2025, each with their respective metrics. Exceedances are highlighted in **bold**.

[2] Based on 98th percentile of the D1HM predictions in one year, averaged over 2013-2015.

[3] Based on 100th percentile of the 1-hour predictions, in one year, averaged over 2013-2015.

[4] Based on 99th percentile of the D1HM predictions in one year, averaged over 2013-2015.

[5] Calculated considering recent background values shown in this table.

[6] Updated background concentrations using 2022–2024 data and MV's latest guidance.

[7] Background concentration based on 98th percentile.

[8] Background concentration based on 90th percentile.

[9] Background concentration based on 75th percentile.

Cumulative Effects for NO₂ with Mitigation:

For the Mitigated Cumulative Case, exceedances of the MV AAQO were predicted considering all background metrics specified by MV. However, the spatial extent of elevated concentrations is significantly reduced with the application of mitigation measures.

As observed in the unmitigated scenario (Section 5.4), the cumulative effects assessment for NO₂ continues to be primarily influenced by emissions from the TMJ project, resulting in predicted 1-hour concentrations that exceed the MV AAQO. This outcome remains unchanged under the mitigated scenario. TMJ emissions were initially estimated using conservative assumptions based on a preliminary understanding of the project's design and operations as outlined in its environmental certificate application (submitted 2019). Since then, the TMJ design and operational factors have evolved substantially with a reduced facility footprint and lower anticipated emissions from LNG vessels. These refinements are predicted to substantially lower TMJ's contribution to ambient NO₂ concentrations compared to levels reflected in both the original and revised air quality modelling assessments.

The maximum 1-hour NO₂ concentration isopleths for the mitigated cumulative case, assessed with the inclusion of the 98th, 90th, and 75th percentile background are shown in Figure L. 9, and Figure L. 10, respectively. Figures L.11 through L.13 present the predicted number of exceedances (per year) of the MV AAQO under each background concentration metric.

While the reduction in the absolute predicted maximum NO₂ concentration is modest, approximately 2.5% compared to the unmitigated cumulative scenario, the spatial extent of elevated concentrations is considerably reduced with mitigation. Notably, areas south of River Road exhibit little to no exceedance of the MV 1-hour objective. The exceedance footprint remains concentrated near the TMJ project, consistent with the unmitigated scenario; however, it is more spatially confined, thereby limiting the number of potentially affected off-site receptors.

On an annual basis, cumulative NO₂ concentrations slightly exceed the current MV AAQO's by approximately 0.1 µg/m³ at a limited number of receptors near the TMJ project (Figure L. 14

Cumulative Effects SO₂ with Mitigation:

The predicted cumulative SO₂ concentrations demonstrate compliance with MV AAQO and CAAQS criteria across all averaging periods. A comparison of the mitigated and unmitigated cumulative scenarios (Table 5.3 of the TDR) shows a noticeable reduction in the predicted 1-hour SO₂ concentrations with mitigation measures, while the reduction in annual concentrations is more modest.

Overall, predicted cumulative SO₂ concentration are below applicable AAQO and CAAQS, and the mitigation measures contribute to a more compact spatial footprint of the proposed Project's SO₂ emissions.

L.4 REFERENCES

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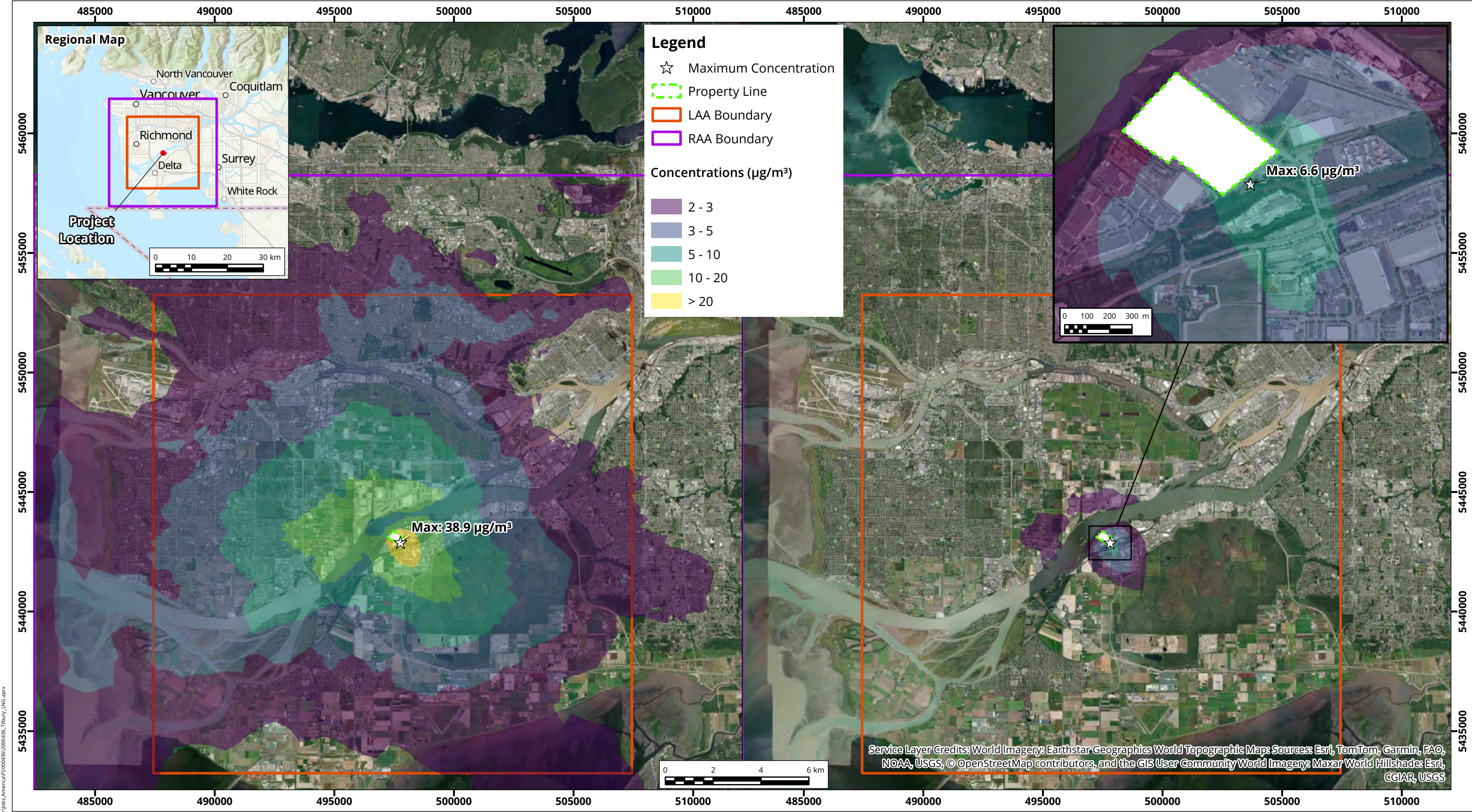
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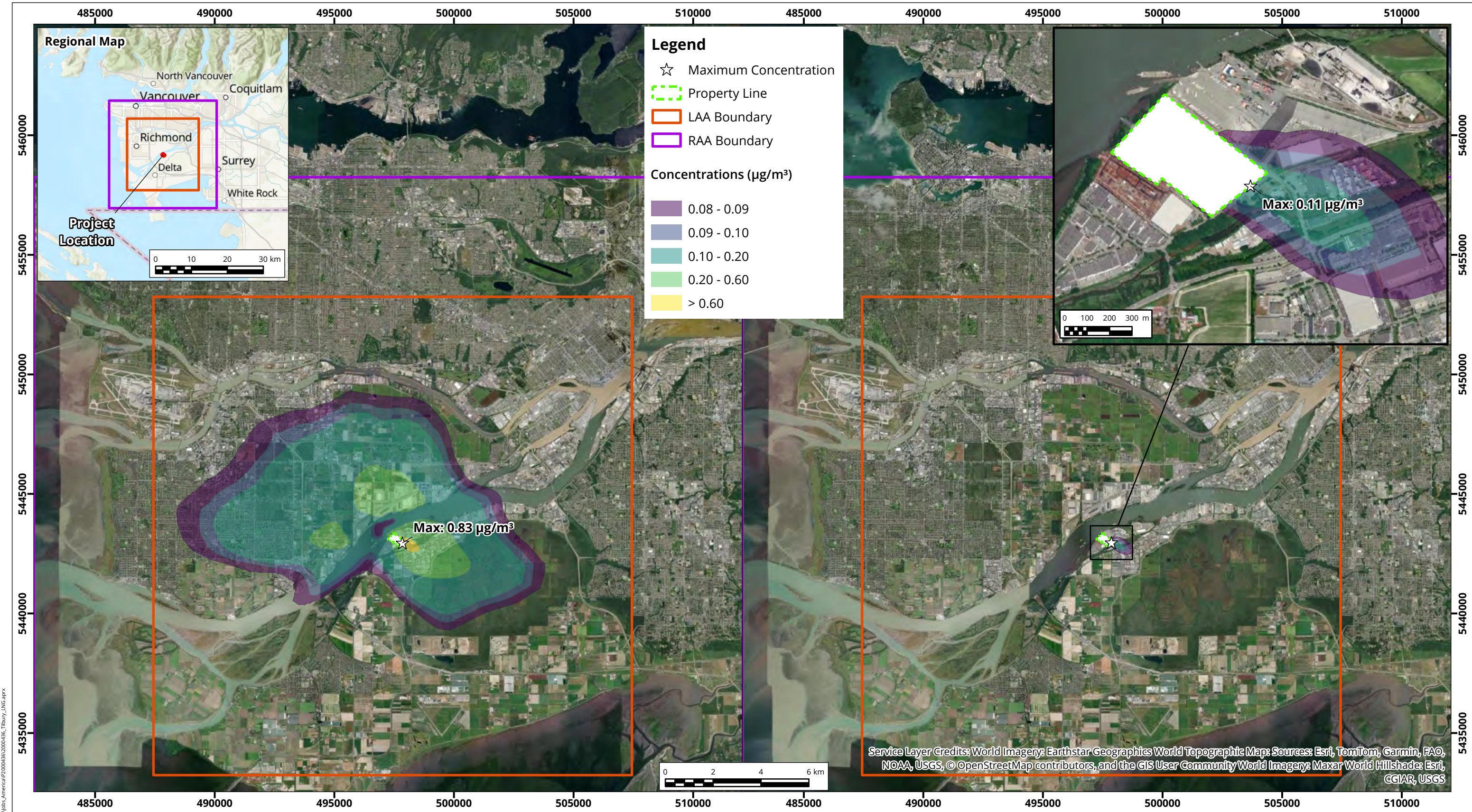
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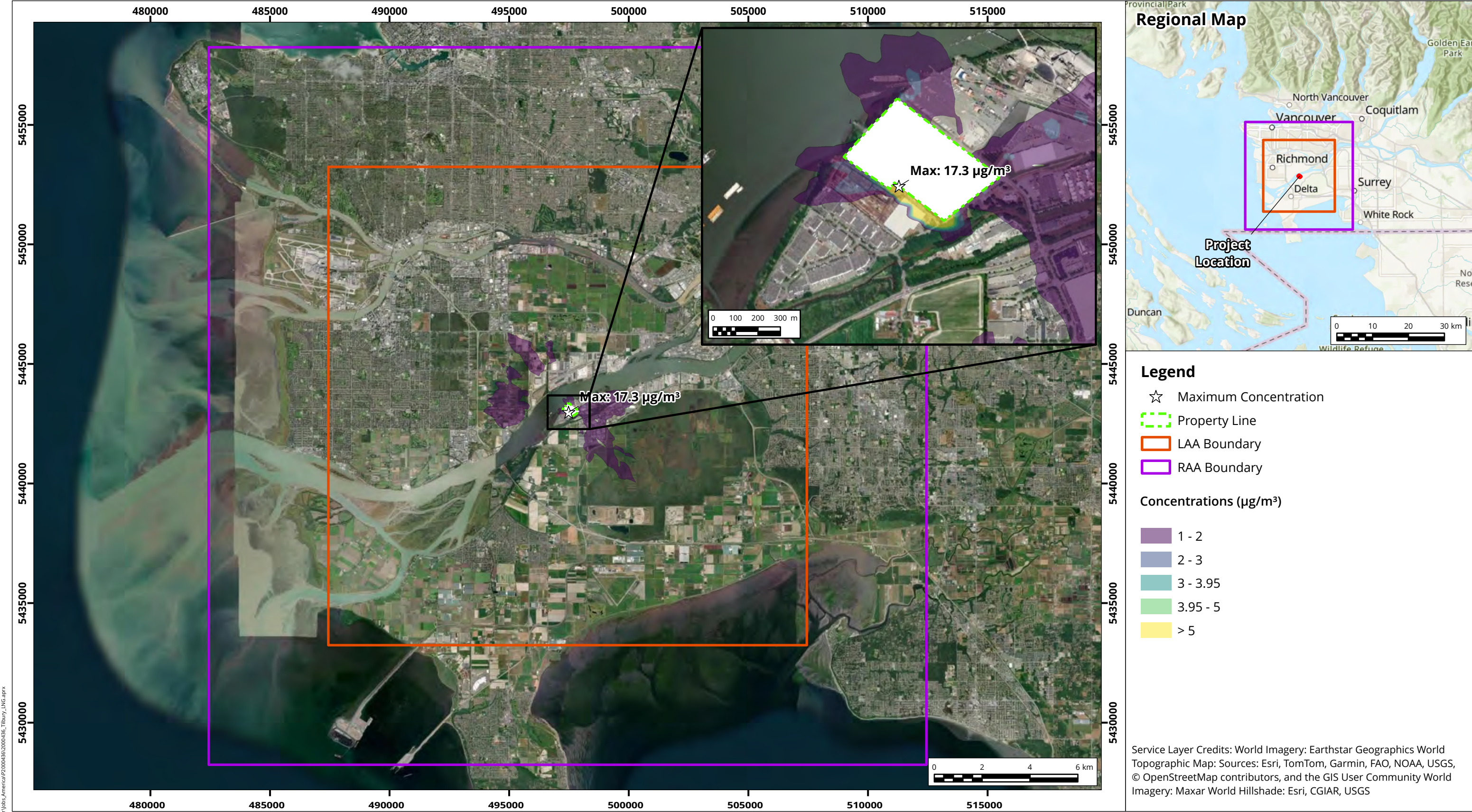
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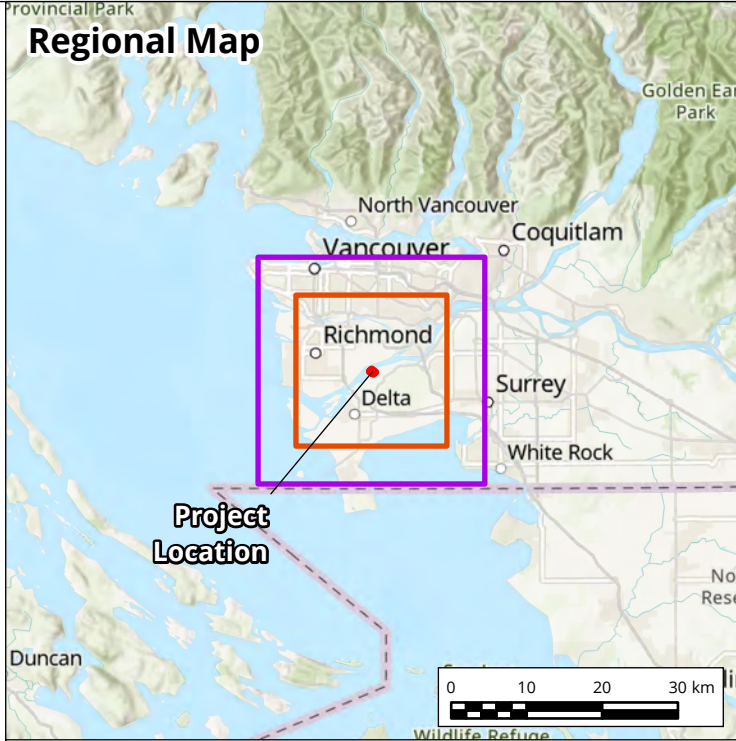
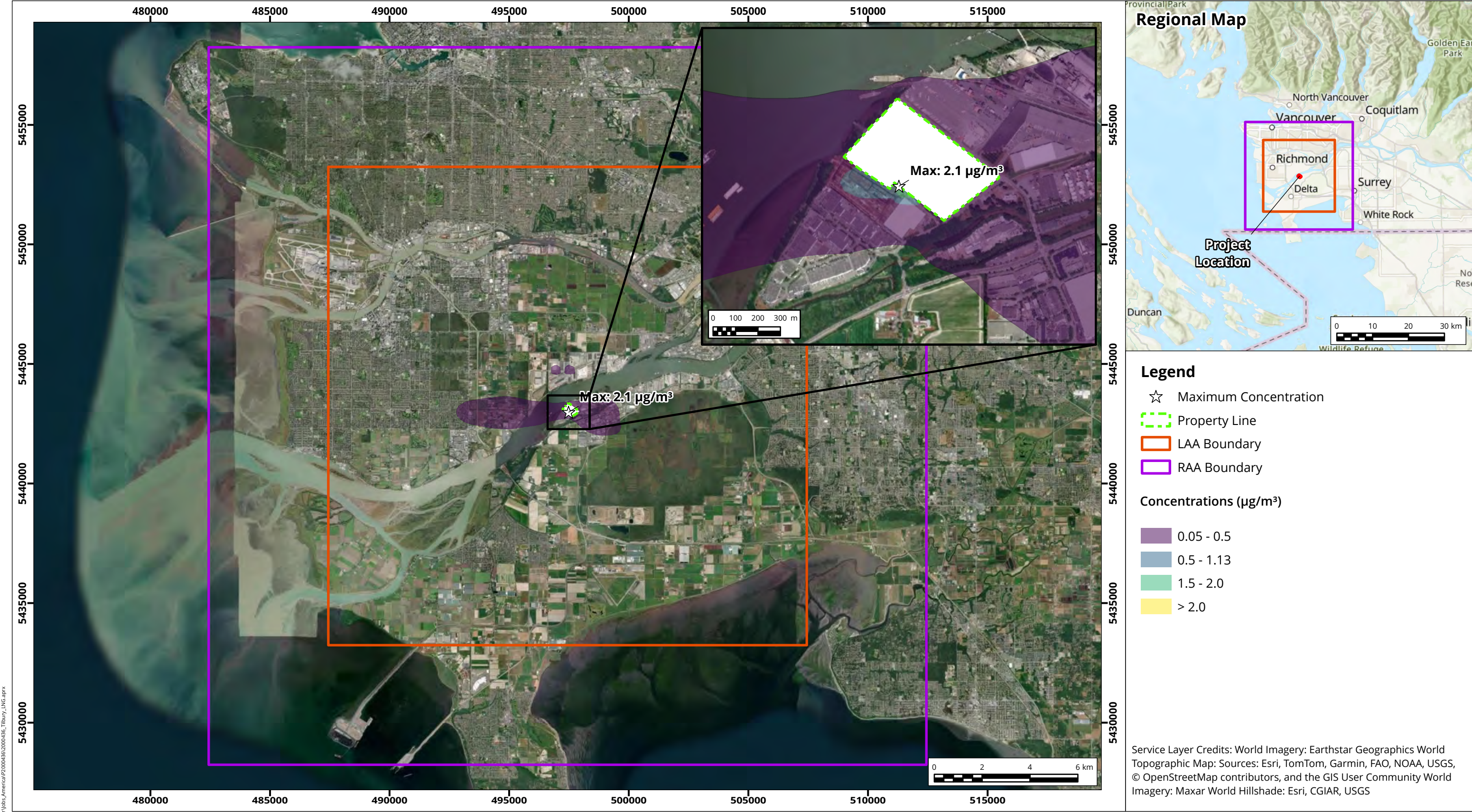
List of contour plots:

Figure No.	Title
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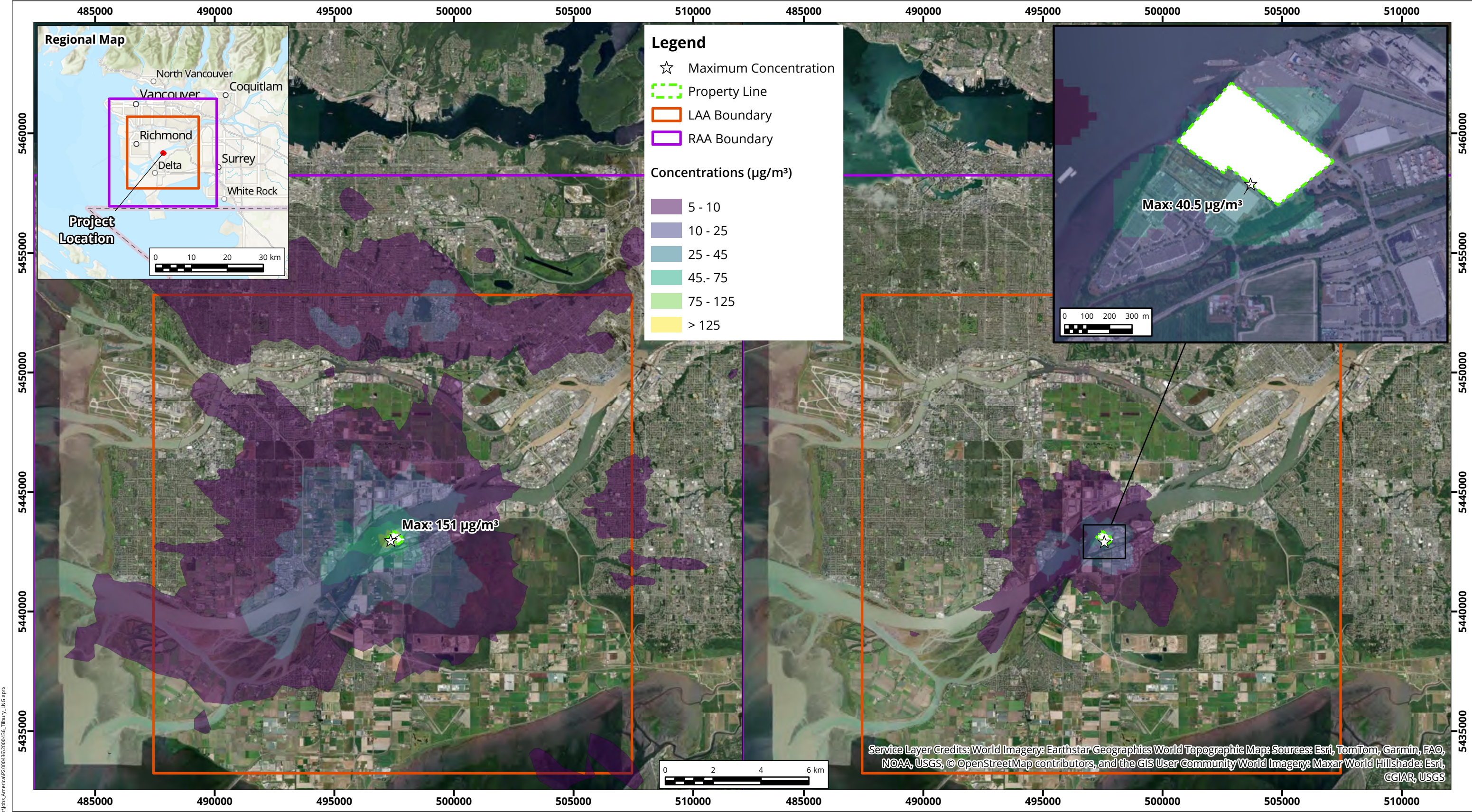
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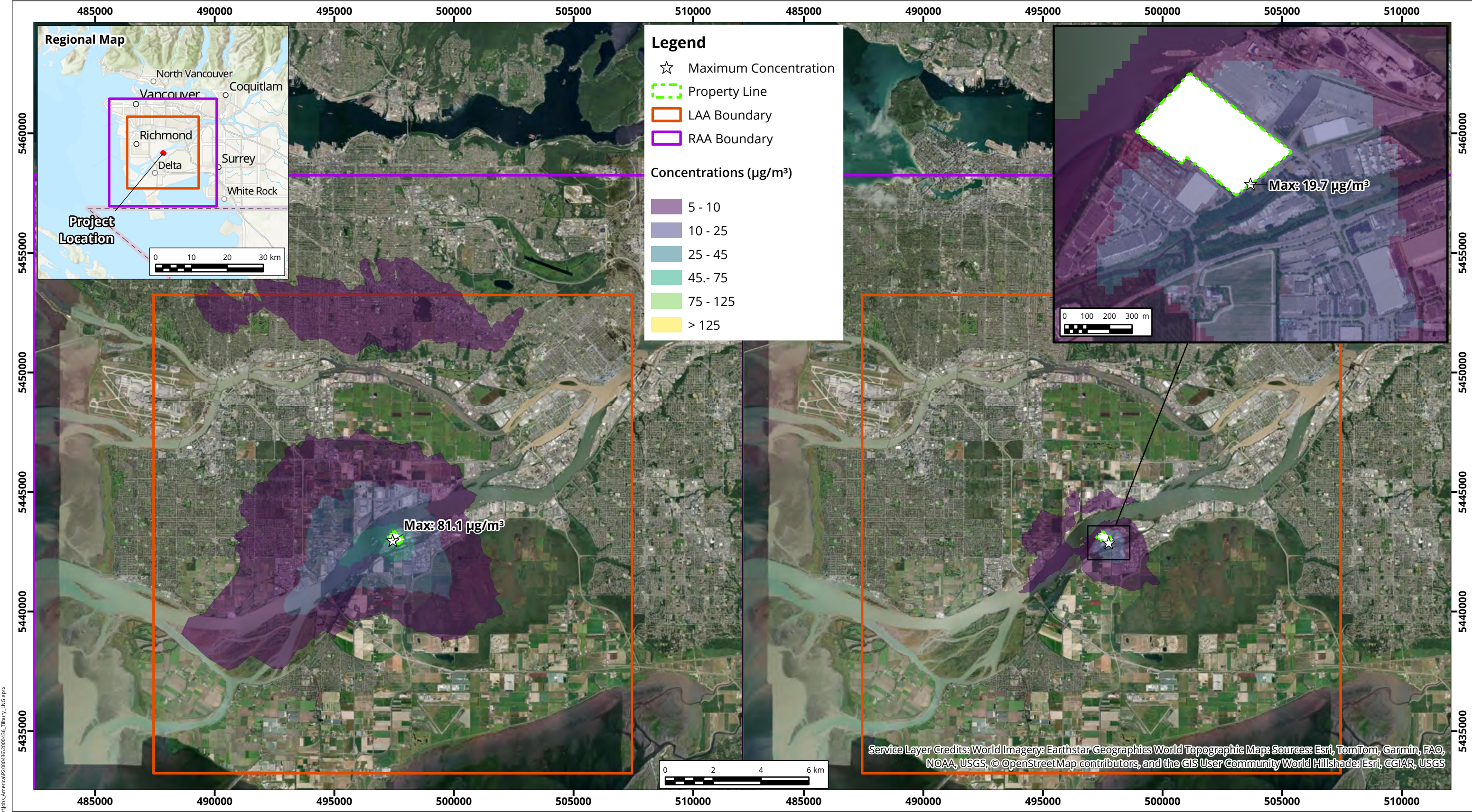
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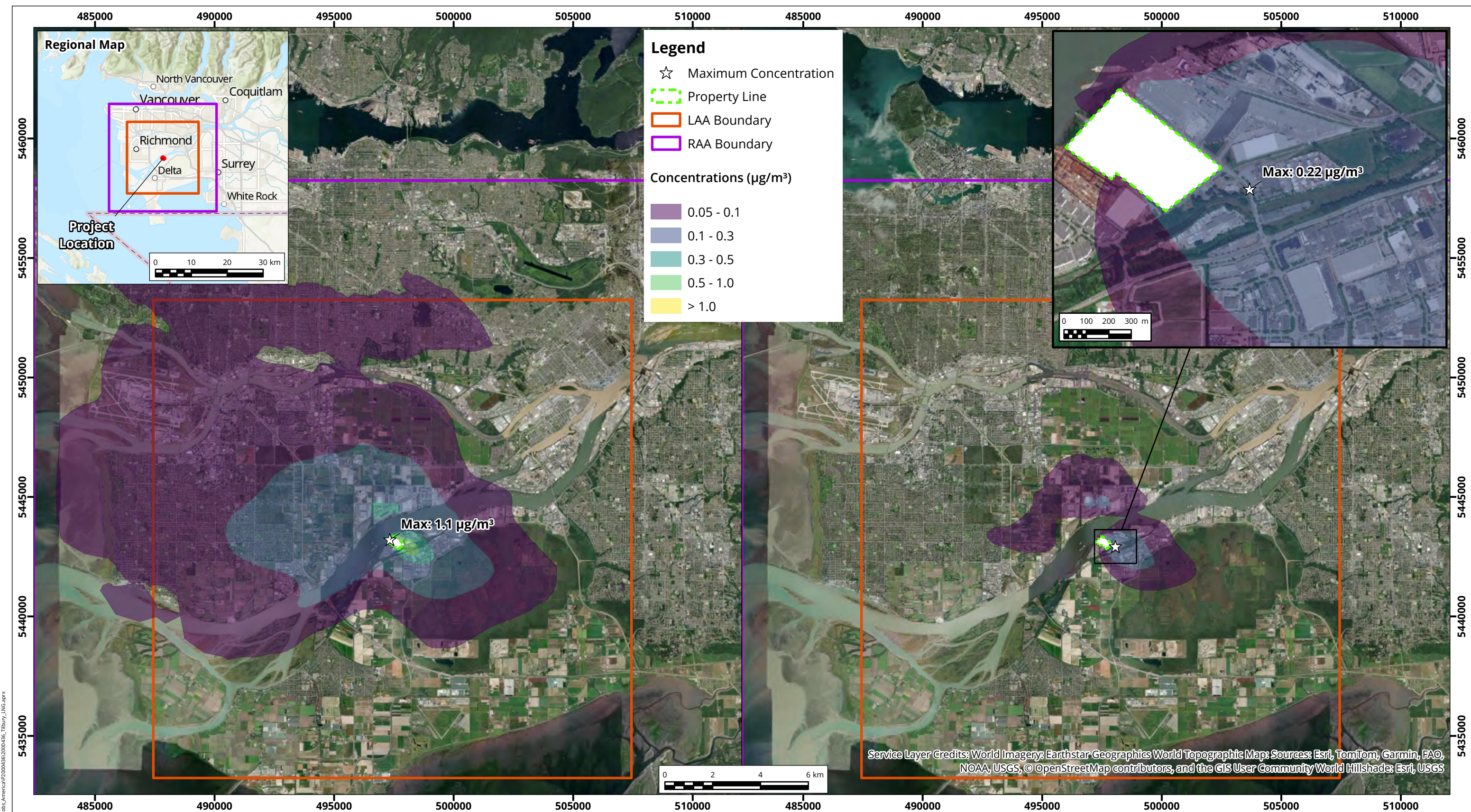
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- 1.5 - 2.0
- > 2.0

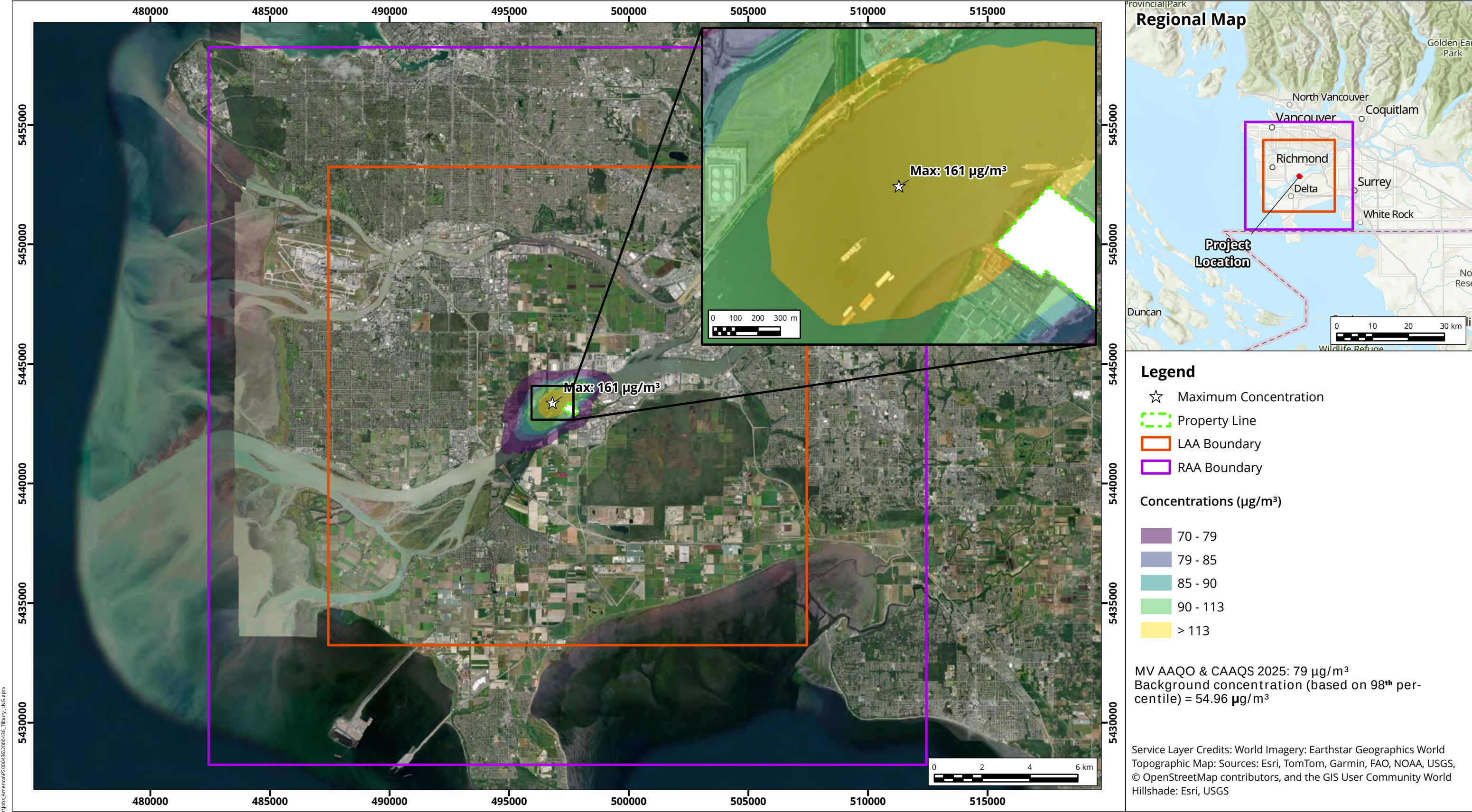
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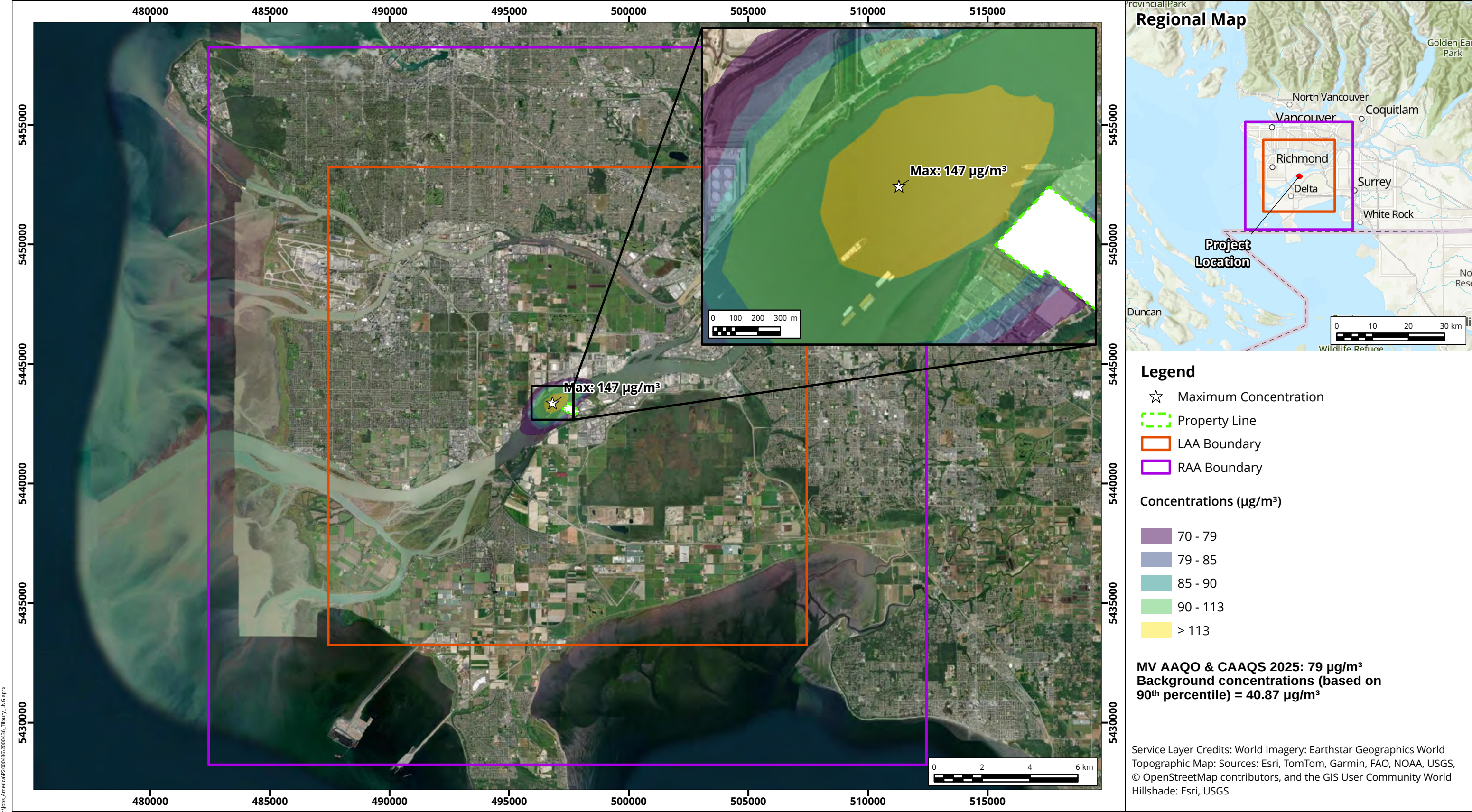


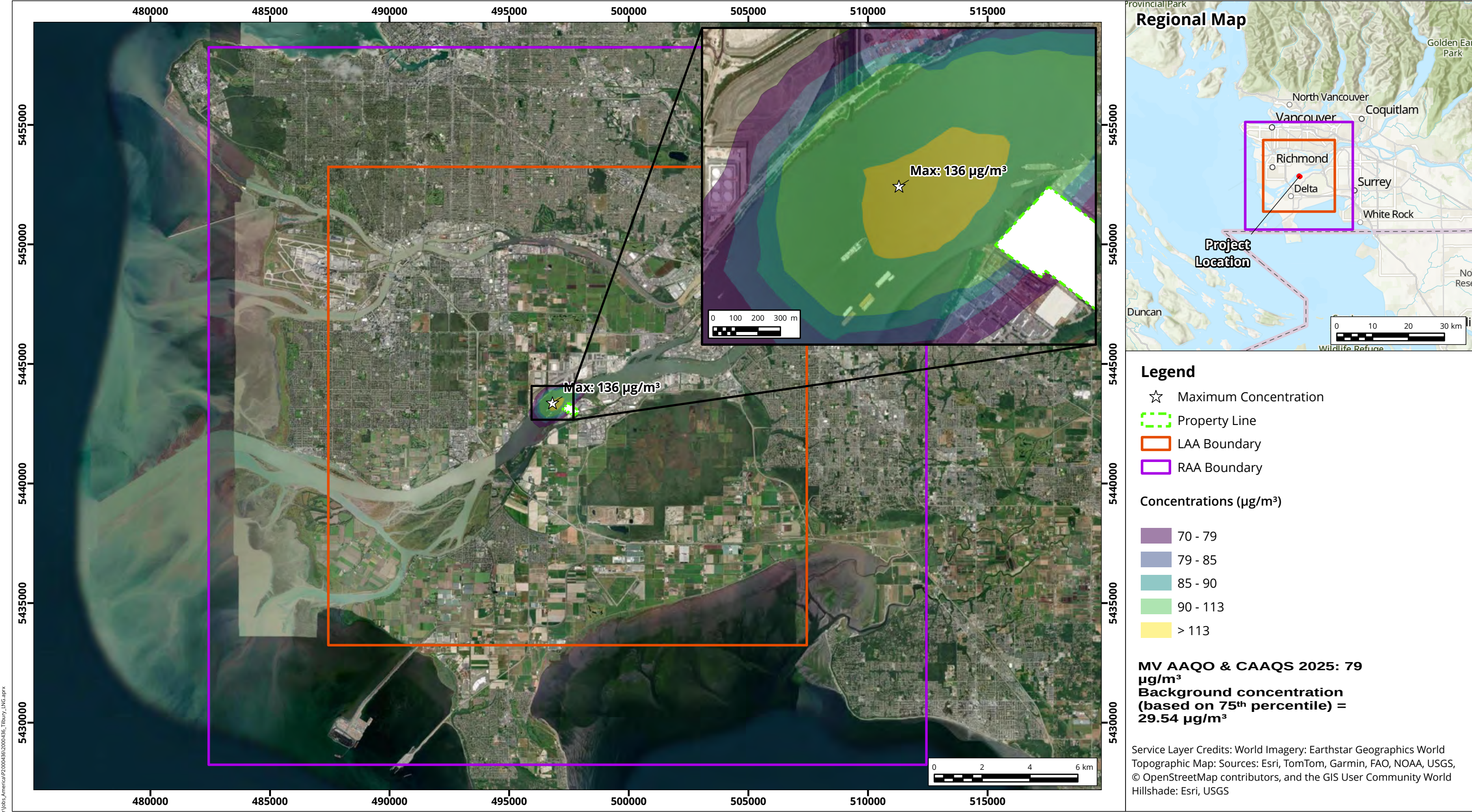


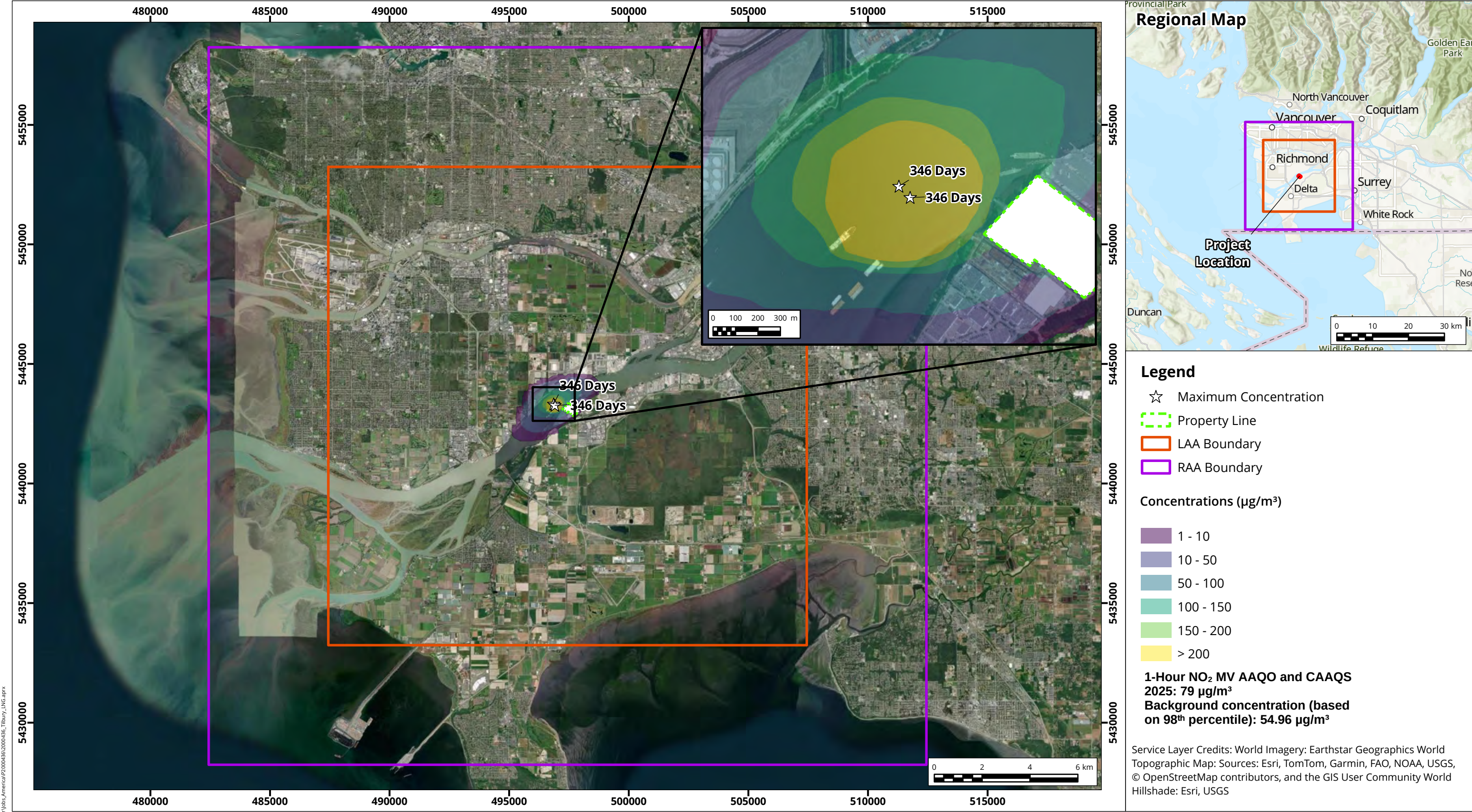


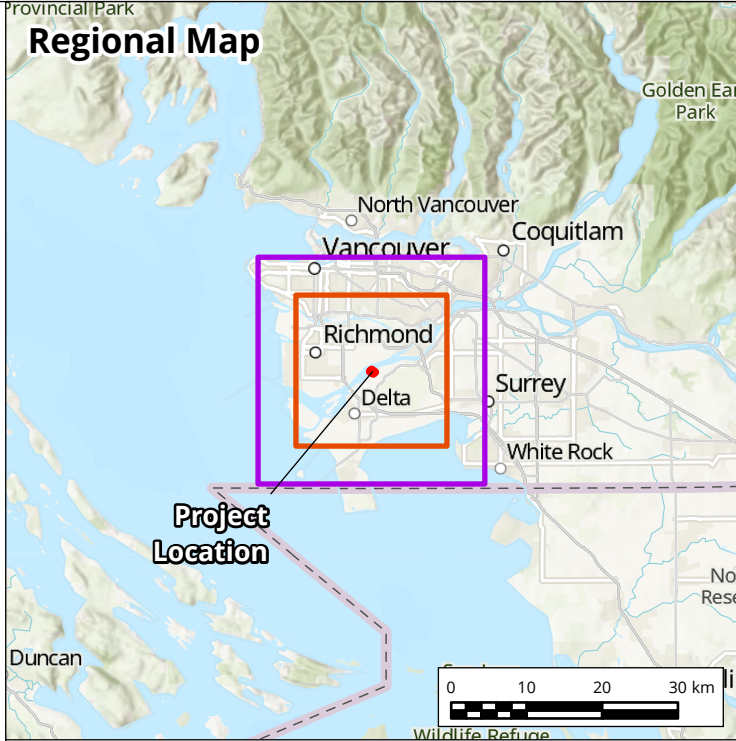
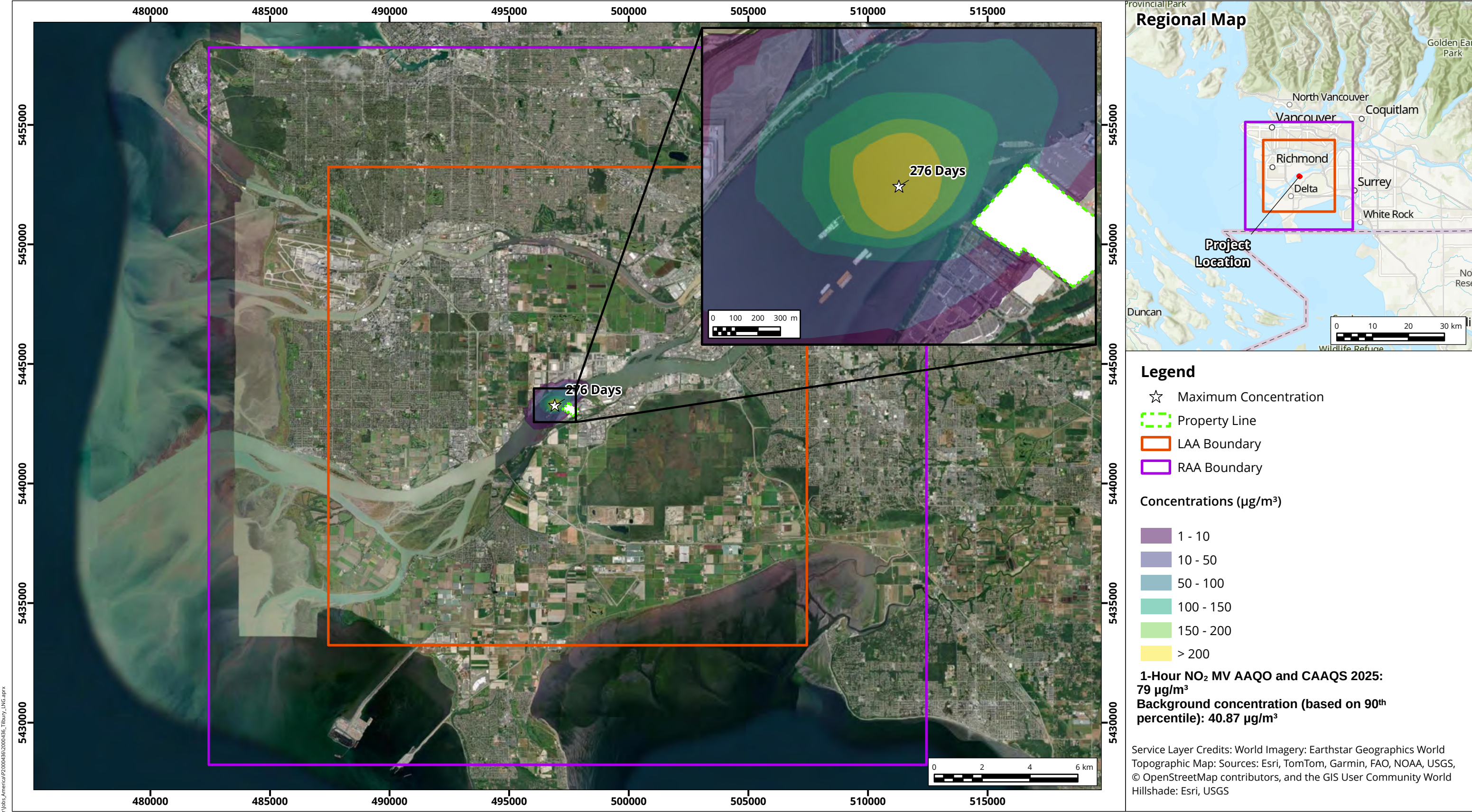
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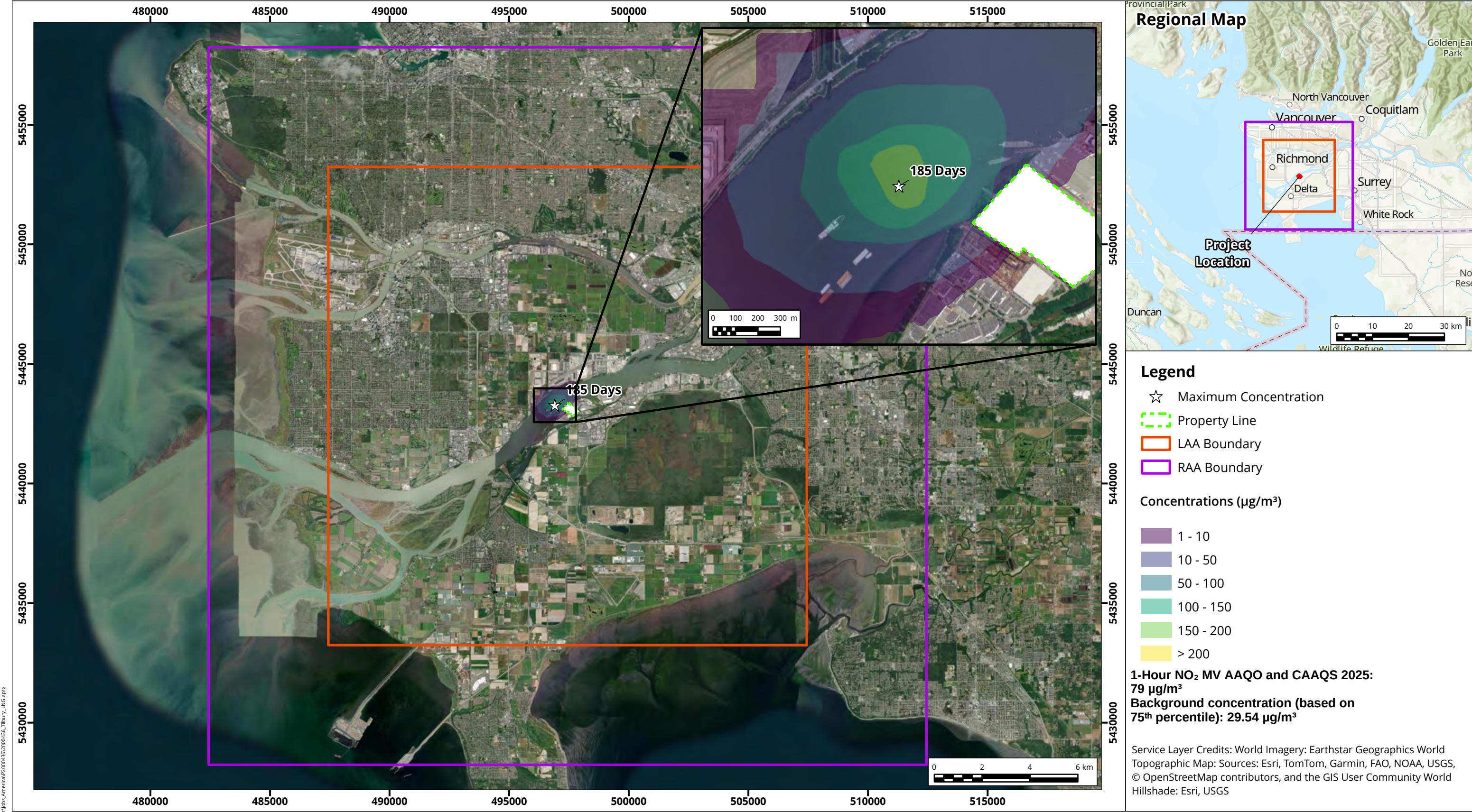
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- ▭ RAA Boundary

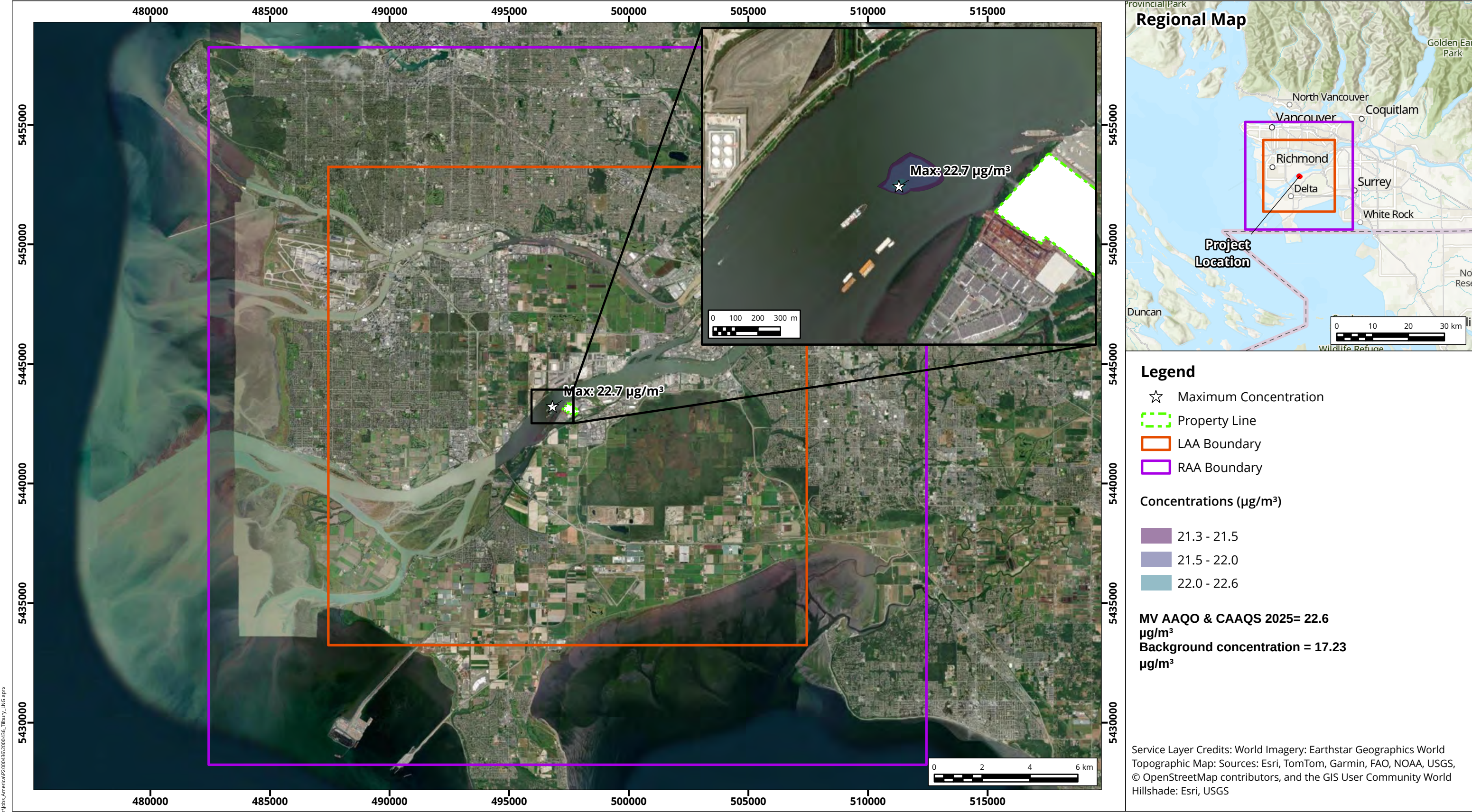
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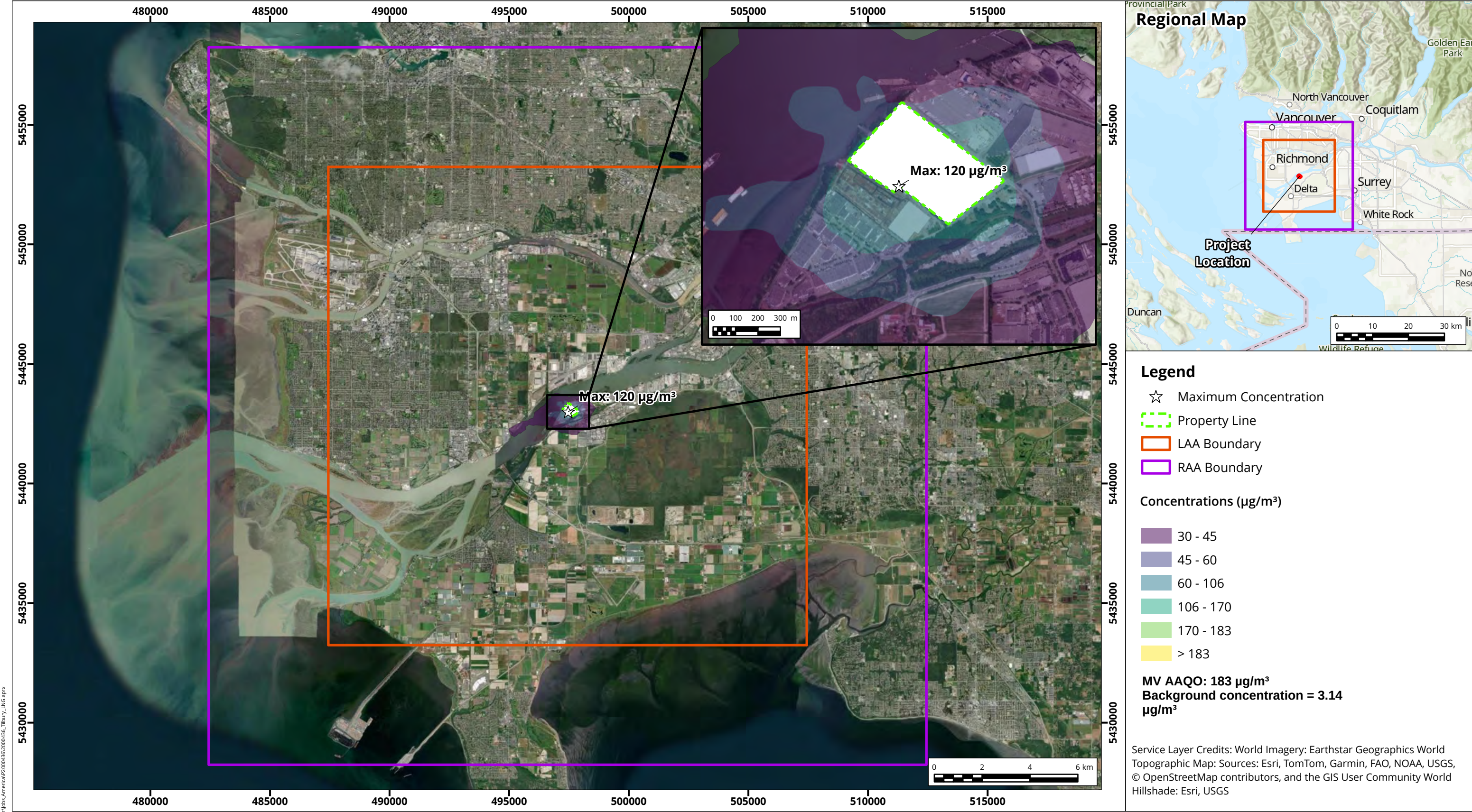
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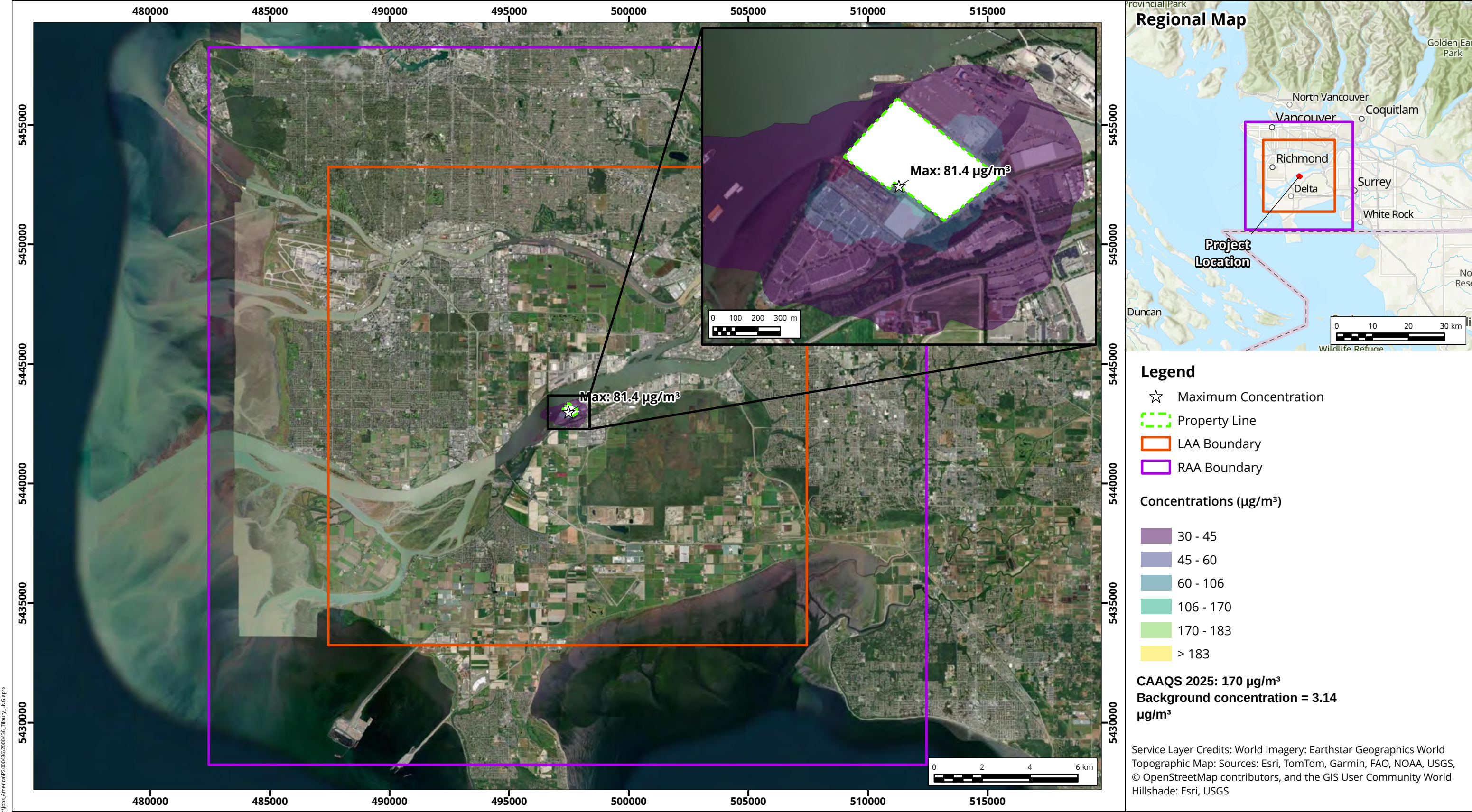
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Background concentration (based on 90th percentile): 40.87 µg/m³

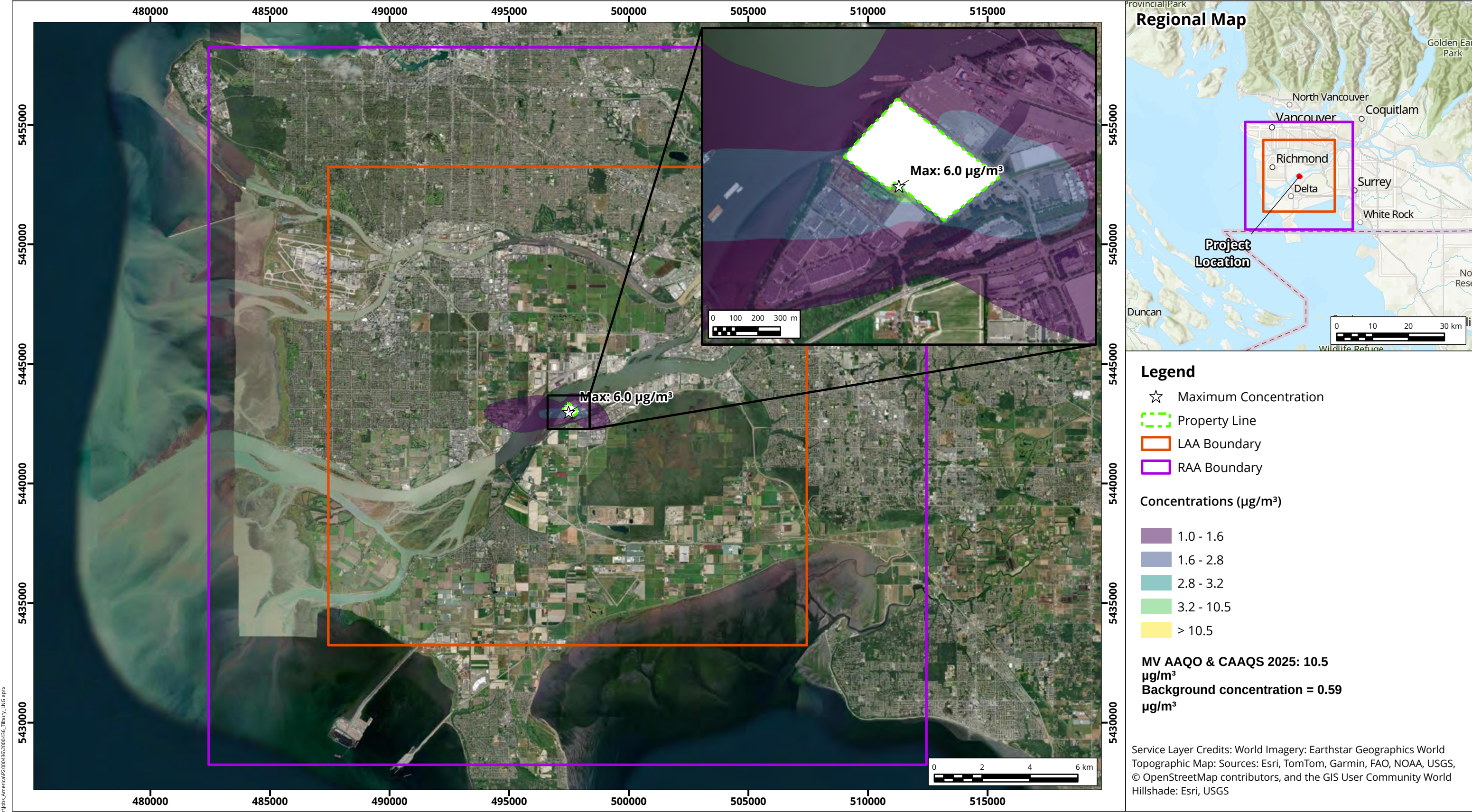
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Table LR.1: Maximum Predicted Concentrations without Background at Each Sensitive Receptor Category - Averaged over 2013-2015 – Conceptual Mitigated Scenario ^[1,2]

Air Contaminant	Averaging Period	Maximum over RAA			Residence			Childcare			School			Senior's Facility			Business			Historic Indigenous Village Site			Objective or Standard	
		Base.	T2+Base.	Cuml.	Base.	T2+Base.	Cuml.	Base.	T2+Base.	Cuml.	Base.	T2+Base.	Cuml.	Base.	T2+Base.	Cuml.	Base.	T2+Base.	Cuml.	Base.	T2+Base.	Cuml.	Value	Name
NO ₂ (total conversion)	1-hour ^[3]	36.4	45	360	9.9	9.4	45.4	4.6	5.1	34.4	1.9	2.6	10.6	2.2	2.6	10.2	23.4	40.1	181.5	4.0	4.5	99.5	79	Current MV AAQO
	Annual	1.9	4	7	0.2	0.3	2.6	0.1	0.2	2.0	0.1	0.1	1.0	0.1	0.1	1.0	1.3	2.6	3.7	0.1	0.1	1.5	22.6	
NO ₂ (OLM)	1-hour ^[3]	32.3	33	106	8.7	8.3	30.7	3.9	4.6	25.3	1.7	2.3	9.5	1.9	2.3	8.6	20.6	30.8	68.8	3.5	3.9	62.0	79	
	Annual	1.7	3	6	0.2	0.2	2.2	0.1	0.2	1.7	0.1	0.1	0.9	0.1	0.1	0.8	1.2	2.1	2.9	0.1	0.1	1.3	22.6	
SO ₂	1-hour ^[4]	87.5	92	117	24.0	28.3	39.5	12.0	18.8	29.6	5.5	5.7	9.5	4.8	7.1	10.1	57.9	74.8	94.3	13.1	12.2	19.2	183	MV AAQO
	1-hour ^[5]	56.9	73	78.3	17.9	21.2	29.3	7.8	10.2	15.8	3.3	5.0	7.4	3.9	5.1	6.8	34.7	64.8	66.0	7.8	8.9	14.7	170	CAAQS 2025
	Annual	1.4	5.1	5.4	0.2	0.4	0.7	0.2	0.3	0.5	0.1	0.2	0.3	0.1	0.2	0.2	1.2	3.5	3.7	0.1	0.2	0.4	10.5	Current MV AAQO and CAAQS 2025

- Notes:**
- 1. All values in the table are in µg/m³.
 - 2. This table presents the results for Conceptual Mitigated Scenario. Predicted concentrations for unmitigated scenario can be found in Table J.1 of Appendix- J.
 - 3. Based on 98th percentile of the daily maximum 1-hour predictions.
 - 4. Based on 100th percentile of the 1-hour predictions.
 - 5. Based on 99th percentile of the daily maximum 1-hour predictions.



Table LR.2: Maximum Predicted Concentrations with Background at Each Sensitive Receptor Category - Averaged over 2013-2015 – Conceptual Mitigation Scenario^[1,2]

Air Contaminant	Averaging Period	Background	Maximum over RAA-Mitigated			Residence			Childcare			School			Senior's Facility			Business			Historic Indigenous Village Site			Objective or Standard	
			Base.	T2+Base.	Cuml.	Base.	T2+Base.	Cuml.	Base.	T2+Base.	Cuml.	Base.	T2+Base.	Cuml.	Base.	T2+Base.	Cuml.	Base.	T2+Base.	Cuml.	Base.	T2+Base.	Cuml.	Value	Name
NO ₂ (total conversion)	1-hour ^[3]	54.96 ^[4]	91.4	100	415	64.9	64.4	100.3	59.5	60.1	89.3	56.8	57.6	65.6	57.1	57.5	65.1	78.3	95.1	236.5	59.0	59.5	154.5	79.0	Current MV AAQO and CAAQS 2025
		40.87 ^[5]	77.3	86	401	50.8	50.3	86.2	45.4	46.0	75.2	42.7	43.5	51.5	43.0	43.5	51.0	64.3	81.0	222.4	44.9	45.4	140.4	79.0	
		29.54 ^[6]	66.0	74	390	39.5	39.0	74.9	34.1	34.7	63.9	31.4	32.2	40.2	31.7	32.1	39.7	52.9	69.7	211.1	33.6	34.0	129.0	79.0	
	Annual	17.23	19.1	21	24	17.4	17.5	19.8	17.4	17.5	19.2	17.3	17.4	18.2	17.3	17.3	18.2	18.6	19.9	20.9	17.3	17.4	18.7	22.6	
NO ₂ (OLM)	1-hour ^[3]	54.96 ^[4]	87.3	88	161	63.7	63.3	85.6	58.9	59.5	80.2	56.6	57.3	64.4	56.9	57.3	63.6	75.6	85.7	123.8	58.5	58.9	117.0	79.0	
		40.87 ^[5]	73.2	74	147	49.6	49.2	71.5	44.8	45.4	66.2	42.6	43.2	50.3	42.8	43.2	49.5	61.5	71.6	109.7	44.4	44.8	102.9	79.0	
		29.54 ^[6]	61.9	63	136	38.3	37.8	60.2	33.4	34.1	54.8	31.2	31.8	39.0	31.5	31.8	38.2	50.2	60.3	98.3	33.1	33.5	91.5	79.0	
	Annual	17.23	18.9	20	23	17.4	17.5	19.4	17.4	17.4	18.9	17.3	17.4	18.1	17.3	17.3	18.1	18.4	19.3	20.2	17.3	17.4	18.6	22.6	
SO ₂	1-hour ^[7]	3.14	90.6	95	120	27.1	31.5	42.7	15.2	22.0	32.8	8.6	8.8	12.6	7.9	10.2	13.3	61.0	77.9	97.4	16.3	15.3	22.3	183.0	MV AAQO
	1-hour ^[8]	3.14	60.0	76	81.4	21.0	24.4	32.5	10.9	13.4	19.0	6.4	8.1	10.5	7.0	8.2	9.9	37.8	67.9	69.2	10.9	12.0	17.8	170	CAAQS 2025
	Annual	0.59	2.0	5.7	6.0	0.8	1.0	1.3	0.8	0.9	1.1	0.7	0.8	0.9	0.7	0.8	0.8	1.7	4.0	4.3	0.7	0.8	1.0	10.5	Current MV AAQO and CAAQS 2025

- Notes:**
- 1. All values in the table are in µg/m³.
 - 2. This table presents the results for Conceptual Mitigated Scenario, using recently calculated background values. Predicted concentrations for unmitigated scenario using previously calculated background values, can be found in Table J.2 of Appendix- J.
 - 3. Based on 98th percentile of the daily maximum 1-hour predictions.
 - 4. Background concentration based on 98th percentile.
 - 5. Background concentration based on 90th percentile.
 - 6. Background concentration based on 75th percentile.
 - 7. Based on 100th percentile of the 1-hour predictions.
 - 8. Based on 99th percentile of the daily maximum 1-hour predictions.



Table LR.3: 98th Percentile Background - Maximum Predicted 1-hr Concentrations of NO₂ over the RAA and at Each Sensitive Receptor Category for Each Modelled Year – Mitigated Project + Base Case - Conceptual Mitigated Scenario ^[1,2]

Pollutant	Averaging Period	Background (BG) 98 th Percentile	over RAA	over RAA + BG	Residence	Residence + BG	Childcare	Childcare + BG	School	School + BG	Seniors' Facility	Seniors' Facility + BG	Business	Business + BG	Historic Indigenous Village Site	Historic Indigenous Village Site + BG	Objective or Standard	
																	Value	Name
Year 1																		
NO ₂ (Total Conversion)	1-hr ^[3]	54.96	45	100	8.2	63.2	4.9	59.9	2.7	57.7	2.5	57.4	41	96	4.4	59	79	Current MV AAQO and CAAQS 2025
NO ₂ (OLM)		54.96	33	88	7.4	62.4	4.3	59.3	2.3	57.2	2.2	57.2	30.5	85	4.0	59	79	
Year 2																		
NO ₂ (Total Conversion)	1-hr ^[3]	54.96	43	98	10	65	5.2	60	2.7	57.7	2.5	57.5	40	95	5	60	79	Current MV AAQO and CAAQS 2025
NO ₂ (OLM)		54.96	34	89	9.1	64.0	4.7	59.6	2.4	57.4	2.3	57.2	30.3	85	4	59	79	
Year 3																		
NO ₂ (Total Conversion)	1-hr ^[3]	54.96	46	101	9.9	65	5.3	60	2.6	57.5	2.8	57.7	42	97	4.3	59	79	Current MV AAQO and CAAQS 2025
NO ₂ (OLM)		54.96	35	90	8.4	63.4	4.7	59.7	2.3	57.3	2.4	57.4	31.5	86	3.9	59	79	

Notes:
[1] All values in the table are in µg/m³.
[2] This table presents the results for Conceptual Mitigated Scenario, using recently calculated background values. Predicted concentrations for unmitigated scenario using previously calculated background values, can be found in Table J.9 of Appendix-J.
[3] Based on 98th percentile of the daily maximum 1-hour predictions.

Table LR.4: 90th Percentile Background - Maximum Predicted 1-hr Concentrations of NO₂ over the RAA and at Each Sensitive Receptor Category for Each Modelled Year – Mitigated Project + Base Case - Conceptual Mitigated Scenario ^[1,2]

Pollutant	Averaging Period	Background (BG) 90 th Percentile	over RAA	over RAA + BG	Residence	Residence + BG	Childcare	Childcare + BG	School	School + BG	Seniors' Facility	Seniors' Facility + BG	Business	Business + BG	Historic Indigenous Village Site	Historic Indigenous Village Site + BG	Objective or Standard	
																	Value	Name
Year 1																		
NO ₂ (Total Conversion)	1-hr ^[3]	40.87	45	86	8.2	49.1	4.9	45.8	2.7	43.6	2.5	43.3	41	82	4.4	45	79	Current MV AAQO and CAAQS 2025
NO ₂ (OLM)		40.87	33	74	7.4	48.3	4.3	45.2	2.3	43.1	2.2	43.1	30.5	71	4.0	45	79	
Year 2																		
NO ₂ (Total Conversion)	1-hr ^[3]	40.87	43	84	10	51	5.2	46	2.7	43.6	2.5	43.4	40	81	5	46	79	Current MV AAQO and CAAQS 2025
NO ₂ (OLM)		40.87	34	75	9.1	49.9	4.7	45.6	2.4	43.3	2.3	43.1	30.3	71	4	45	79	
Year 3																		
NO ₂ (Total Conversion)	1-hr ^[3]	40.87	46	87	9.9	51	5.3	46	2.6	43.4	2.8	43.6	42	83	4.3	45	79	Current MV AAQO and CAAQS 2025
NO ₂ (OLM)		40.87	35	76	8.4	49.3	4.7	45.6	2.3	43.2	2.4	43.3	31.5	72	3.9	45	79	

Notes:
[1] All values in the table are in µg/m³.
[2] This table presents the results for Conceptual Mitigated Scenario, using recently calculated background values. Predicted concentrations for unmitigated scenario using previously calculated background values, can be found in Table J.9 of Appendix-J.
[3] Based on 98th percentile of the daily maximum 1-hour predictions.



Table LR.5: 75th Percentile Background - Maximum Predicted 1-hr Concentrations of NO₂ over the RAA and at Each Sensitive Receptor Category for Each Modelled Year – Mitigated Project + Base Case - Conceptual Mitigated Scenario ^[1,2]

Pollutant	Averaging Period	Background (BG) 75 th Percentile	over RAA	over RAA + BG	Residence	Residence + BG	Childcare	Childcare + BG	School	School + BG	Seniors' Facility	Seniors' Facility + BG	Business	Business + BG	Historic Indigenous Village Site	Historic Indigenous Village Site + BG	Objective or Standard	
																	Value	Name
Year 1																		
NO ₂ (Total Conversion)	1-hr ^[3]	29.54	45	75	8.2	37.8	4.9	34.4	2.7	32.3	2.5	32.0	41	70	4.4	34	79	Current MV AAQO and CAAQS 2025
NO ₂ (OLM)		29.54	33	63	7.4	36.9	4.3	33.9	2.3	31.8	2.2	31.7	30.5	60	4.0	34	79	
Year 2																		
NO ₂ (Total Conversion)	1-hr ^[3]	29.54	43	72	10	40	5.2	35	2.7	32.2	2.5	32.0	40	69	5	34	79	Current MV AAQO and CAAQS 2025
NO ₂ (OLM)		29.54	34	63	9.1	38.6	4.7	34.2	2.4	32.0	2.3	31.8	30.3	60	4	33	79	
Year 3																		
NO ₂ (Total Conversion)	1-hr ^[3]	29.54	46	76	9.9	39	5.3	35	2.6	32.1	2.8	32.3	42	72	4.3	34	79	Current MV AAQO and CAAQS 2025
NO ₂ (OLM)		29.54	35	64	8.4	37.9	4.7	34.2	2.3	31.8	2.4	32.0	31.5	61	3.9	33	79	

Notes:
[1] All values in the table are in µg/m³.
[2] This table presents the results for Conceptual Mitigated Scenario, using recently calculated background values. Predicted concentrations for unmitigated scenario using previously calculated background values, can be found in Table J.9 of Appendix-J.
[3] Based on 98th percentile of the daily maximum 1-hour predictions.

Table LR.6: 50th Percentile Background - Maximum Predicted Annual Average Concentrations of NO₂ over the RAA and at Each Sensitive Receptor Category for Each Modelled Year – Mitigated Project + Base Case - Conceptual Mitigated Scenario ^[1,2]

Pollutant	Averaging Period	Background (BG) 50 th Percentile	over RAA	over RAA + BG	Residence	Residence + BG	Childcare	Childcare + BG	School	School + BG	Seniors' Facility	Seniors' Facility + BG	Business	Business + BG	Historic Indigenous Village Site	Historic Indigenous Village Site + BG	Objective or Standard	
																	Value	Name
Year 1																		
NO ₂ (Total Conversion)	Annual	17.23	4	21	0.3	17.5	0.2	17.5	0.1	17.4	0.1	17.4	3	20	0.1	17	22.6	Current MV AAQO and CAAQS 2025
NO ₂ (OLM)		17.23	3	20	0.2	17.5	0.2	17.4	0.1	17.4	0.1	17.3	2.2	19	0.1	17	22.6	
Year 2																		
NO ₂ (Total Conversion)	Annual	17.23	4	21	0	17	0.2	17	0.1	17.4	0.1	17.3	2	20	0	17	22.6	Current MV AAQO and CAAQS 2025
NO ₂ (OLM)		17.23	3	20	0.2	17.5	0.2	17.4	0.1	17.4	0.1	17.3	2.0	19	0	17	22.6	
Year 3																		
NO ₂ (Total Conversion)	Annual	17.23	4	21	0.2	17	0.2	17	0.1	17.4	0.1	17.3	2	20	0.1	17	22.6	Current MV AAQO and CAAQS 2025
NO ₂ (OLM)		17.23	3	20	0.2	17.5	0.2	17.4	0.1	17.3	0.1	17.3	2.0	19	0.1	17	22.6	

Notes:
[1] All values in the table are in µg/m³.
[2] This table presents the results for Conceptual Mitigated Scenario, using recently calculated background values. Predicted concentrations for unmitigated scenario using previously calculated background values, can be found in Table J.9 of Appendix-J.



Table LR.7: Maximum Predicted Concentrations of SO₂ over the RAA and at Each Sensitive Receptor Category for Each Modelled Year – Mitigated Project + Base Case - Conceptual Mitigated Scenario^[1,2]

Pollutant	Averaging Period	Background (BG)	over RAA	over RAA + BG	Residence	Residence + BG	Childcare	Childcare + BG	School	School + BG	Seniors' Facility	Seniors' Facility + BG	Business	Business + BG	Historic Indigenous Village Site	Historic Indigenous Village Site + BG	Objective or Standard	
																	Value	Name
Year 1																		
SO ₂	1-hr ^[3]	3.14	95	98	29.6	32.8	29.6	32.8	7.3	10.5	6.6	9.8	79	82	13.4	16.6	183	MV AAQO
SO ₂	1-hr ^[4]	3.14	73	76	18.7	21.8	9.7	12.8	4.8	7.9	5.5	8.6	63.7	67	10.0	13.2	170	CAAQS 2025
SO ₂	Annual	0.59	5.46	6.05	0.38	0.98	0.33	0.93	0.21	0.80	0.18	0.77	3.86	4.45	0.18	0.78	10.5	Current MV AQQO and CAAQS 2025
Year 2																		
SO ₂	1-hr ^[3]	3.14	91	95	29.7	32.8	13.8	17.0	7.5	10.6	8.7	11.9	73	76	13.3	16.5	183	MV AAQO
SO ₂	1-hr ^[4]	3.14	74	77	22.8	26.0	11.3	14.4	5.3	8.5	4.7	7.9	66	69	8.6	11.7	170	CAAQS 2025
SO ₂	Annual	0.59	5.15	5.75	0.38	0.97	0.31	0.91	0.21	0.81	0.15	0.75	3.25	3.84	0.16	0.76	10.5	Current MV AQQO and CAAQS 2025
Year 3																		
SO ₂	1-hr ^[3]	3.14	90.72	93.86	27.3	30.4	15.5	18.6	6.0	9.2	5.9	9.0	81	84	9.8	13.0	183	MV AAQO
SO ₂	1-hr ^[4]	3.14	78	81	22.1	25.3	9.8	12.9	4.8	7.9	5.0	8.1	68	71	8.1	11.2	170	CAAQS 2025
SO ₂	Annual	0.59	4.75	5.34	0.36	0.95	0.31	0.90	0.18	0.77	0.15	0.74	3.25	3.84	0.15	0.74	10.5	Current MV AQQO and CAAQS 2025

Notes:
[1] All values in the table are in µg/m³.
[2] This table presents the results for Conceptual Mitigated Scenario, using recently calculated background values. Predicted concentrations for unmitigated scenario using previously calculated background values, can be found in Table J.10 of Appendix-J.
[3] Based on 100th percentile of the 1-hour predictions.
[4] Based on 99th percentile of the daily maximum 1-hour predictions.



Table LR.8: 98th Percentile Background - Maximum Predicted 1-hr Concentrations of NO₂ over the RAA and at Each Sensitive Receptor Category for Each Modelled Year – Mitigated Cumulative Case – Conceptual Mitigated Scenario ^[1,2]

Pollutant	Averaging Period	Background (BG) 98 th Percentile	over RAA	over RAA + BG	Residence	Residence + BG	Childcare	Childcare + BG	School	School + BG	Seniors' Facility	Seniors' Facility + BG	Business	Business + BG	Historic Indigenous Village Site	Historic Indigenous Village Site + BG	Objective or Standard	
																	Value	Name
Year 1																		
NO ₂ (Total Conversion)	1-hr ^[3]	54.96	350	405	34.2	89.2	27.7	82.6	9.7	64.6	9.3	64.3	177	232	98.7	154	79	Current MV AAQO and CAAQS 2025
NO ₂ (OLM)		54.96	100	155	26.8	81.8	21.9	76.8	8.7	63.7	7.1	62.1	66.3	121	61.0	116	79	
Year 2																		
NO ₂ (Total Conversion)	1-hr ^[3]	54.96	371	426	54	109	38.4	93	11.3	66.3	10.6	65.5	171	226	104	159	79	Current MV AAQO and CAAQS 2025
NO ₂ (OLM)		54.96	95	150	33.7	88.6	27.4	82.4	10.2	65.1	9.2	64.2	70.0	125	62	117	79	
Year 3																		
NO ₂ (Total Conversion)	1-hr ^[3]	54.96	380	435	48.4	103	37.0	92	10.9	65.9	10.6	65.6	196	251	95.8	151	79	Current MV AAQO and CAAQS 2025
NO ₂ (OLM)		54.96	127	182	31.8	86.8	26.5	81.5	9.5	64.5	9.5	64.5	70.9	126	62.9	118	79	

Notes:
[1] All values in the table are in µg/m³.
[2] This table presents the results for Conceptual Mitigated Scenario, using recently calculated background values. Predicted concentrations for unmitigated scenario using previously calculated background values, can be found in Table J.15 of Appendix-J.
[3] Based on 98th percentile of the daily maximum 1-hour predictions.



Table LR.9: 90th Percentile Background - Maximum Predicted 1-hr Concentrations of NO₂ over the RAA and at Each Sensitive Receptor Category for Each Modelled Year – Mitigated Cumulative Case - Conceptual Mitigated Scenario ^[1,2]

Pollutant	Averaging Period	Background (BG) 90 th Percentile	over RAA	over RAA + BG	Residence	Residence + BG	Childcare	Childcare + BG	School	School + BG	Seniors' Facility	Seniors' Facility + BG	Business	Business + BG	Historic Indigenous Village Site	Historic Indigenous Village Site + BG	Objective or Standard	
																	Value	Name
Year 1																		
NO ₂ (Total Conversion)	1-hr ^[3]	40.87	350	391	34.2	75.1	27.7	68.5	9.7	50.5	9.3	50.2	177	218	98.7	140	79	Current MV AAQO and CAAQS 2025
NO ₂ (OLM)		40.87	100	141	26.8	67.7	21.9	62.8	8.7	49.6	7.1	48.0	66.3	107	61.0	102	79	
Year 2																		
NO ₂ (Total Conversion)	1-hr ^[3]	40.87	371	412	54	95	38.4	79	11.3	52.2	10.6	51.4	171	212	104	145	79	Current MV AAQO and CAAQS 2025
NO ₂ (OLM)		40.87	95	136	33.7	74.5	27.4	68.3	10.2	51.0	9.2	50.1	70.0	111	62	103	79	
Year 3																		
NO ₂ (Total Conversion)	1-hr ^[3]	40.87	380	421	48.4	89	37.0	78	10.9	51.8	10.6	51.5	196	237	95.8	137	79	Current MV AAQO and CAAQS 2025
NO ₂ (OLM)		40.87	127	168	31.8	72.7	26.5	67.4	9.5	50.4	9.5	50.4	70.9	112	62.9	104	79	

Notes:
[1] All values in the table are in µg/m³.
[2] This table presents the results for Conceptual Mitigated Scenario, using recently calculated background values. Predicted concentrations for unmitigated scenario using previously calculated background values, can be found in Table J.15 of Appendix-J.
[3] Based on 98th percentile of the daily maximum 1-hour predictions.

Table LR.10: 75th Percentile Background - Maximum Predicted 1-hr Concentrations of NO₂ over the RAA and at Each Sensitive Receptor Category for Each Modelled Year – Mitigated Cumulative Case - Conceptual Mitigated Scenario ^[1,2]

Pollutant	Averaging Period	Background (BG) 90th Percentile	over RAA	over RAA + BG	Residence	Residence + BG	Childcare	Childcare + BG	School	School + BG	Seniors' Facility	Seniors' Facility + BG	Business	Business + BG	Historic Indigenous Village Site	Historic Indigenous Village Site + BG	Objective or Standard	
																	Value	Name
Year 1																		
NO ₂ (Total Conversion)	1-hr ^[3]	29.54	350	380	34.2	63.8	27.7	57.2	9.7	39.2	9.3	38.8	177	206	98.7	128	79	Current MV AAQO and CAAQS 2025
NO ₂ (OLM)		29.54	100	130	26.8	56.3	21.9	51.4	8.7	38.2	7.1	36.7	66.3	96	61.0	90	79	
Year 2																		
NO ₂ (Total Conversion)	1-hr ^[3]	29.54	371	400	54	84	38.4	68	11.3	40.8	10.6	40.1	171	201	104	134	79	Current MV AAQO and CAAQS 2025
NO ₂ (OLM)		29.54	95	124	33.7	63.2	27.4	56.9	10.2	39.7	9.2	38.7	70.0	100	62	92	79	
Year 3																		
NO ₂ (Total Conversion)	1-hr ^[3]	29.54	380	410	48.4	78	37.0	67	10.9	40.5	10.6	40.1	196	226	95.8	125	79	Current MV AAQO and CAAQS 2025
NO ₂ (OLM)		29.54	127	157	31.8	61.3	26.5	56.1	9.5	39.1	9.5	39.1	70.9	100	62.9	92	79	

Notes:
[1] All values in the table are in µg/m³.
[2] This table presents the results for Conceptual Mitigated Scenario, using recently calculated background values. Predicted concentrations for unmitigated scenario using previously calculated background values, can be found in Table J.15 of Appendix-J.
[3] Based on 98th percentile of the daily maximum 1-hour predictions.



Table LR.11: 50th Percentile Background - Maximum Predicted Annual Average Concentrations of NO₂ over the RAA and at Each Sensitive Receptor Category for Each Modelled Year – Mitigated Cumulative Case – Conceptual Mitigated Scenario ^[1,2]

Pollutant	Averaging Period	Background (BG) 90th Percentile	over RAA	over RAA + BG	Residence	Residence + BG	Childcare	Childcare + BG	School	School + BG	Seniors' Facility	Seniors' Facility + BG	Business	Business + BG	Historic Indigenous Village Site	Historic Indigenous Village Site + BG	Objective or Standard	
																	Value	Name
Year 1																		
NO ₂ (Total Conversion)	Annual	17.23	7	24	2.6	19.8	2.0	19.2	1.0	18.2	1.0	18.2	4	21	1.6	19	22.6	Current MV AAQO and CAAQS 2025
NO ₂ (OLM)		17.23	5	23	2.1	19.4	1.7	18.9	0.9	18.1	0.9	18.1	3.0	20	1.3	19	22.6	
Year 2																		
NO ₂ (Total Conversion)	Annual	17.23	7	24	3	20	2.0	19	1.0	18.3	1.0	18.2	3	21	2	19	22.6	Current MV AAQO and CAAQS 2025
NO ₂ (OLM)		17.23	6	23	2.2	19.5	1.7	18.9	0.9	18.2	0.9	18.1	2.8	20	1	19	22.6	
Year 3																		
NO ₂ (Total Conversion)	Annual	17.23	6	24	2.6	20	1.9	19	0.9	18.2	0.9	18.2	4	21	1.5	19	22.6	Current MV AAQO and CAAQS 2025
NO ₂ (OLM)		17.23	5	23	2.2	19.4	1.6	18.9	0.8	18.1	0.8	18.0	3.0	20	1.3	19	22.6	

Notes:
[1] All values in the table are in µg/m³.
[2] This table presents the results for Conceptual Mitigated Scenario, using recently calculated background values. Predicted concentrations for unmitigated scenario using previously calculated background values, can be found in Table J.15 of Appendix-J.

Table LR.12: Maximum Predicted Concentrations of SO₂ over the RAA and at Each Sensitive Receptor Category for Each Modelled Year – Mitigated Cumulative Case - Conceptual Mitigated Scenario ^[1,2]

Pollutant	Background (BG)	Averaging Period	over RAA	over RAA + BG	Residence	Residence + BG	Childcare	Childcare + BG	School	School + BG	Seniors' Facility	Seniors' Facility + BG	Business	Business + BG	Historic Indigenous Village Site	Historic Indigenous Village Site + BG	Objective or Standard	
																	Value	Name
Year 1																		
SO ₂	3.14	1-hr ^[3]	123	126	38.7	41.8	36.5	39.6	11.2	14.3	9.1	12.2	121	124	18.3	21.4	183	MV AAQO
SO ₂	3.14	1-hr ^[4]	77	80	24.2	27.3	13.9	17.1	7.1	10.2	7.2	10.3	68.5	72	15.3	18.5	170	CAAQS 2025
SO ₂	0.59	Annual	5.70	6.29	0.67	1.26	0.55	1.14	0.35	0.94	0.27	0.87	4.06	4.66	0.42	1.01	10.5	Current MV AQQO and CAAQS 2025
Year 2																		
SO ₂	3.14	1-hr ^[3]	153	156	39.0	42.1	19.7	22.9	9.1	12.3	12.5	15.6	121	124	17.8	20.9	183	MV AAQO
SO ₂	3.14	1-hr ^[4]	80	83	30.9	34.1	16.6	19.7	7.7	10.8	6.7	9.8	66	69	14.3	17.4	170	CAAQS 2025
SO ₂	0.59	Annual	5.41	6.00	0.77	1.36	0.54	1.13	0.36	0.95	0.23	0.82	3.47	4.07	0.41	1.00	10.5	Current MV AQQO and CAAQS 2025
Year 3																		
SO ₂	3.14	1-hr ^[3]	108	111	41.0	44.1	32.7	35.9	8.2	11.3	8.9	12.0	83	86	21.4	24.6	183	MV AAQO
SO ₂	3.14	1-hr ^[4]	78	81	33.5	36.6	17.0	20.1	7.3	10.5	6.5	9.6	68	71	14.5	17.6	170	CAAQS 2025
SO ₂	0.59	Annual	5.00	5.59	0.63	1.22	0.48	1.07	0.31	0.90	0.22	0.81	3.48	4.07	0.36	0.96	10.5	Current MV AQQO and CAAQS 2025

Notes:
[1] All values in the table are in µg/m³.
[2] This table presents the results for Conceptual Mitigated Scenario, using recently calculated background values. Predicted concentrations for unmitigated scenario using previously calculated background values, can be found in Table J.16 of Appendix-J.
[3] Based on 100th percentile of the 1-hour predictions.
[4] Based on 99th percentile of the daily maximum 1-hour predictions.