GWP 4059-17-00

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Air Quality Assessment Report – Highway 401 Nagle Road Interchange Study (GWP 4059-17-00)

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Sign-off page

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Michael C. Murphy, Ph.D., P.Eng.

Executive Summary

The Ontario Ministry of Transportation (MTO) and the Town of Cobourg have retained Stantec Consulting Ltd. to undertake a Planning, Preliminary Design, and Class Environmental Assessment (Class EA) Study for a new interchange at Nagle Road and Highway 401 in the Town of Cobourg and the Township of Hamilton. The purpose of the study is to identify a Recommended Plan that addresses potential environmental impacts associated with future transportation and planning needs in the Study Area. The interchange study is the Town of Cobourg's initiative.

As part of the interchange study, the existing Nagle Road bridge is also being assessed. The Nagle Road bridge was constructed in 1959. It is a concrete structure and carries two lanes of traffic over Highway 401. Due to its age, the bridge is approaching the end of its planned service life and will need to be rehabilitated or replaced. Ultimately, the bridge will need to accommodate the future 8 lane footprint of Highway 401.

The objective of this study was to characterize existing air pollutant emissions (2016) and predict air quality effects within the Study Area, at Highway 401 and Nagle Road, after implementation of the Project in the future build (2041) scenarios using background air quality and traffic data. The horizon 2041 has been selected only for the analysis purpose and does not represent the actual timing of highway modifications. Predicted future emissions and effects with Project implementation are also compared to predicted future emissions and effects without implementation of the Project for a total of 3 assessment scenarios. Greenhouse gas (GHG) emissions are also evaluated in this study. This study has been conducted following guidance from the "Ministry of Transportation Environmental Guide for Assessing and Mitigating the Air Quality Impacts and Greenhouse Gas Emissions of Provincial Transportation Projects" (MTO Guide).

The contaminants of potential concern (CoPCs) selected for this study are based on the most relevant transportation-related contaminants as listed in the MTO Guide and include nitrogen dioxide (NO_2), carbon monoxide (CO), particulate matter with diameter less than 10 micrometres (PM_{10}), particulate matter with diameter less than 2.5 micrometres ($PM_{2.5}$), acrolein, benzene, 1,3-butadiene, benzo(a)pyrene (B(a)P), acetaldehyde and formaldehyde. Greenhouse gas (GHG) emissions in the form of CO_2e were also quantified.

Baseline ambient air quality conditions were characterized by using historical data obtained from the National Air Pollution Surveillance Network and the Ministry of the Environment, Conservation and Parks for stations located near the Study Area.

The latest version of the US EPA's Motor Vehicle Emission Simulator (MOVES3) model was used to estimate current and future emission rates from motor vehicle traffic. The US EPA dispersion model, CAL3QHCR was used to predict the maximum 1-hour, 8-hour, 24-hour and annual average ground level concentrations at special receptors for the following three scenarios:

- 2016 – Existing conditions, Highway 401 (6 lanes)
- 2041 – Future No Build, Highway 401 (8-lanes), replacement overpass at Nagle Road
- 2041 – Future Build, Highway 401 (8 lanes), replacement interchange at Nagle Road

The predicted ambient air quality results for each scenario were compared against relevant provincial Ambient Air Quality Criteria (AAQC) and Canadian Ambient Air Quality Standards (CAAQS) while the GHG emissions are compared to National and Provincial totals for 2020 and 2030 emissions targets. The following conclusions were made from the air quality and greenhouse gas impact assessment:

Operation Phase – Project Alone

- Maximum predicted Project alone ground level concentrations (GLCs) of all CoPCs are below their relevant AAQC and/or CAAQS at all special receptors for the future build and future no build scenarios.

Operation Phase – Cumulative (Project Plus Background Levels)

- Maximum predicted cumulative GLCs of CoPCs other than NO_2 and B(a)P are below their relevant AAQC and/or CAAQS at all special receptors for all release scenarios.
- Predicted cumulative concentrations of NO_2 exceed the 2025 1-hour CAAQS at two sensitive receptors for the future build scenario but remain well below the provincial AAQC. Predictions for NO_2 are presented as maximum modelled concentrations and are used for comparison to the applicable CAAQS, as CAL3QHCR does not provide outputs that are the appropriate statistical measure required for direct comparison to the standards. Therefore, the results for NO_2 presented in comparison to the CAAQS are conservatively high.
- Maximum predicted cumulative concentrations of B(a)P exceed the 24-hour and annual average AAQCs at all special receptor locations for all scenarios, with the background concentrations alone exceeding the 24-hour and annual average AAQCs. The maximum predicted 24-hour and annual average cumulative B(a)P concentrations for the future build scenario are 5% and 3% higher than the future no build scenario, respectively. The maximum cumulative B(a)P concentrations are predicted to decrease in the future build and future no build scenarios relative to the existing scenario due to expected future reductions in vehicle emissions.

Construction Phase

- During Project construction, best management practices should be followed to minimize emissions. With implementation of proper mitigation measures, emissions from the construction phase and resulting adverse changes in local air quality can be mitigated.

Greenhouse Gas

- Releases of GHGs from the Project are expected to be insignificant (less than 0.1%) in comparison to the 2020 Canada and Ontario totals and the 2030 emissions targets.

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Acronyms / Abbreviations

AADT	Annual Average Daily Traffic
AAQC	Ambient Air Quality Criteria
ADMGO	Air Dispersion Modelling Guideline for Ontario
AP-42	U.S. Environmental Protection Agency Compilation of Air Pollution Emission Estimation Factors Document
CAAQS	Canadian Ambient Air Quality Standards
CAC	Criteria Air Contaminants
CAS	Chemical Abstracts Service
CCME	Canadian Council of Ministers of the Environment
CoPCs	Contaminants of Potential Concern
ECCC	Environment and Climate Change Canada
EA	Environmental Assessment
EPA	*Environmental Protection Act*
GHG	Greenhouse gas
GLC	Ground Level Concentrations
GWP	Global Warming Potential
Max	Maximum
MECP	Ontario Ministry of the Environment, Conservation and Parks
MTO	Ministry of Transportation
N/A	Not Applicable
NAPS	National Air Pollution Surveillance
O. Reg.	Ontario Regulation
Stantec	Stantec Consulting Ltd.
US EPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator
VMT	Vehicle Mile Travelled

Units of Measurement

cm	centimetre
km	kilometre
m	metre
mm	millimetre

Mass/Weight

Re. Orders of Magnitude: x 10^2 = x 100, x10^3 = x 1000, etc.

g	gram	
mg	milligrams	1 x 10^{-3} grams
µg	microgram	1 x 10^{-6} grams
kg	kilogram	1 x 10^3 g
Mg	Megagram	1 x 10^6 g
t	metric tonne	1 x 10^3 kg
lb	pound	1 lb = 453.592 grams

Concentration

ppm	parts per million
µg/m^3	micrograms per cubic metre

Temperature

°C	degrees Celsius

Speed

km/h	kilometres per hour

Time

s	second
hr	hour
y	year

Compounds

B(a)P	Benzo(a)pyrene
CH_4	Methane
CO	Carbon Monoxide
CO_2e	Carbon Dioxide Equivalent
THC	Total Hydrocarbons
TSP	Total Suspended Particulate
N_2O	Nitrous Oxide
NO_x	Nitrogen Oxides
NO_2	Nitrogen Dioxide
NO	Nitric Oxide
O_3	Ozone
PAH	Polycyclic Aromatic Hydrocarbon
PM	Particulate Matter (also referred to as TSP)
PM_{10}	Particulate Matter smaller than 10 microns
$PM_{2.5}$	Particulate Matter smaller than 2.5 microns
VOC	Volatile Organic Compounds

Glossary

Term	Description
Air Contaminant Emissions	For stationary sources, the release or discharge of a pollutant from a facility or operation into the ambient air either by means of a stack, vent or as a fugitive dust, mist or vapour.
Canadian Council of Ministers of the Environment (CCME)	A council made up of environmental ministers from provincial and federal levels of government that proposes nationally consistent environmental standards and objectives to achieve high levels of environmental quality for waste management, air pollution, and toxic chemicals across Canada.
Carbon Monoxide (CO)	A colourless, odourless gas produced by incomplete fossil fuel combustion.
Combustion Product	Substance produced during the burning or oxidation of a material.
Combustion	1. Burning, or rapid oxidation, accompanied by the release of energy in the form of heat and light. 2. Refers to controlled burning of waste, in which heat chemically alters organic compounds, converting into stable compounds such as carbon dioxide and water.
Concentration	In air quality, concentration is defined as the abundance (mass or volume) of a substance suspended in a unit volume of ambient air.
Dust	A term used to describe particles of a solid or liquid that are suspended in air. Also referred to as particulate or suspended particulate.
Mitigation	Measures taken to reduce adverse effects on the environment.

Term	Description
Monitoring	Periodic or continuous surveillance or testing to determine the characteristics of a substance or the level of compliance with statutory requirements and/or pollutant levels in various media or in humans, plants, and animals.
Particulate	A particle of a solid or liquid that is suspended in air.
Particulate Matter	A particle in solid or liquid phase that is suspended in air.
Pollutant	Generally, any substance introduced into the environment that can adversely affect the usefulness of a resource or the health of humans, animals, or ecosystems.
Pollution	Generally, the presence of a substance in the environment that because of its chemical composition or quantity can prevent the functioning of natural processes and produce undesirable environmental and health effects
Receptor	A person, plant or wildlife species that may be affected due to exposure to a contaminant.
United States Environmental Protection Agency AP-42 (US EPA AP-42)	US EPA document Compilation of Air Emission Factors, Volume 1: Stationary Point and Area Sources.

1.0 Introduction

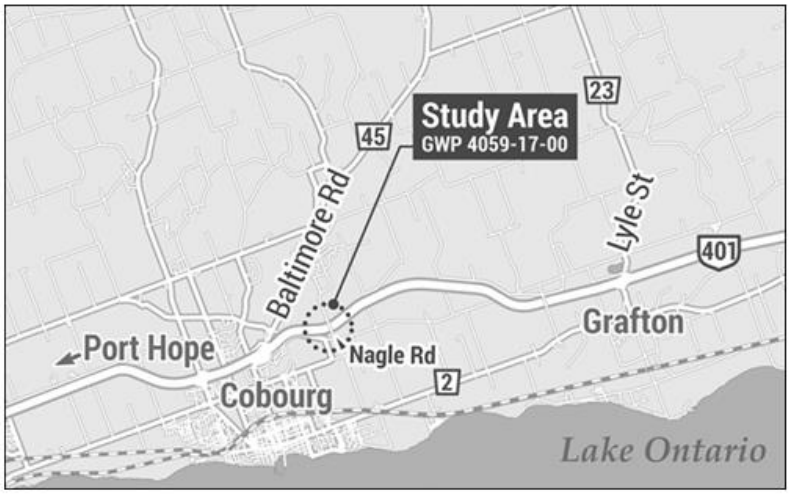
The Ontario Ministry of Transportation (MTO) and the Town of Cobourg have retained Stantec Consulting Ltd. to undertake a Planning, Preliminary Design, and Class Environmental Assessment (Class EA) Study or a new interchange at Nagle Road and Highway 401 in the Town of Cobourg and the Township of Hamilton. The purpose of the study is to identify a Recommended Plan that addresses potential environmental impacts associated with future transportation and planning needs in the study area. The interchange study is the Town of Cobourg's initiative.

As part of this study, the existing Nagle Road bridge is also being assessed. The Nagle Road bridge was constructed in 1959. It is a concrete structure and carries two lanes of traffic over Highway 401. Due to its age, the bridge is approaching the end of its planned service life and will need to be rehabilitated or replaced. Ultimately, the bridge will need to accommodate the future 8 lane footprint of Highway 401 (the Project).

1.1 Study Area

The Study Area used for assessing potential air contaminant emissions includes the immediate vicinity of the Project at Highway 401 and Nagle Road (GWP 4059-17-00). A map of the Study Area is presented in Figure 1.

Figure 1: Study Area



1.2 Study Objectives

The objective of this study is to characterize existing (2016) air pollutant emissions and predict air quality effects within the Study Area after implementation of the Project in the future build (2041) scenario using background air quality and traffic data. Predicted future emissions and effects with Project implementation are also compared to predicted future emissions and effects without implementation (future no build) of the Project for a total of three assessment scenarios. Greenhouse gas (GHG) emissions are also evaluated in this study. This study has been completed following guidance from the "Ministry of Transportation Environmental Guide for Assessing and Mitigating the Air Quality Impacts and Greenhouse Gas Emissions of Provincial Transportation Projects" (MTO, 2020).

1.3 Project Description

For the purposes of this study, air quality and GHG impacts are evaluated in the existing (2016) and the ultimate build timeframe (2041). Traffic volumes for 2016 were used to project future volumes in 2041 (Stantec 2020a and CIMA+ 2020) and is therefore selected as the existing year. The year 2041 has been selected for analysis purposes only and does not represent the actual timing of highway improvements, or the conversion of the Nagle Road overpass to an interchange. The Preferred Design Plan for the Project is provided in Appendix A.

1.3.1 Highway 401

The existing portion of Highway 401 at Nagle Road currently has a total of six travelled lanes (three in each travel direction). The Project will include highway modifications from six travel lanes to eight lanes (four lanes in each travel direction).

1.3.2 Nagle Road Overpass Reconfiguration

Nagle Road is a two-lane overpass (one lane in each travel direction) that serves traffic northbound and southbound over Highway 401. There is currently no access to Highway 401 from Nagle Road. The Project will include an ultimate reconfiguration of the Nagle Road overpass to an interchange which will include a replacement bridge (consisting of 4 lanes, 2 in each travel direction), two off ramps, and two on-ramps. Traffic travelling on the highway off-ramps will approach signalized intersections on Nagle Road. Both Highway 401 west and Highway 401 east on ramps will be accessible to vehicles travelling either northbound or southbound on Nagle Road.

2.0 Methodology

2.1 Overview

The assessment of the Project's effect on air quality was performed by conducting dispersion modelling to predict the downwind concentrations of the most relevant transportation-related air contaminants and comparing these predictions to regulatory criteria and standards.

The assessment of air quality effects related to the Project consists of the following elements:

- Review the air contaminants of interest for consistency with the MTO Guideline.
- Estimate current background concentrations for each relevant transportation-related contaminant using representative historical monitoring data from the nearest Ministry of the Environment, Conservation and Parks (MECP) or National Air Pollution Surveillance (NAPS) station.
- Establish current background emission levels using published provincial and national greenhouse gas (GHG) emissions data.
- Predict tailpipe emissions using the most recent US EPA Motor Vehicle Emission Simulator (MOVES3) and estimate road dust emissions using the US EPA AP-42 calculation methodology for Project related traffic.
- Identify critical and representative sensitive receptor locations along the modelled highway segment.
- Predict maximum contaminant concentrations using the US EPA CAL3QHCR atmospheric dispersion model at the critical and sensitive receptors around the modelled interchange and highway segment due to emissions from Project-related traffic for all three scenarios.
- Estimate cumulative air quality concentrations by combining the maximum predicted concentrations with background air quality concentrations and compare the results relative to the applicable current and future ambient air quality criteria and standards.
- For receptors where the maximum combined concentration of relevant air contaminants exceeds a criterion, assess the potential frequency of exceeding the air quality criteria and standards through a more detailed assessment of the combined effect of the Project-related and background concentrations.

- Estimate GHG emissions for each scenario and compare to the provincial and national GHG emissions levels and targets.
- Qualitatively assess the potential air quality impacts during construction and provide recommendations on construction mitigation measures.

2.2 Contaminants of Potential Concern

The air contaminant emission sources expected from the Project are mobile sources that emit combustion gases from burning fossil fuels (e.g., gasoline and diesel) and fugitive dust. Combustion emissions depend on the combustion device type (engine type), the fuel composition, the fuel consumption rate and operating time. Fugitive dust emissions are generated by road traffic during the movement of mobile sources (e.g., cars and trucks). The contaminants of potential concern (CoPCs) selected for this study are based on the most relevant transportation-related contaminants as listed in the MTO Guide (MTO, 2020).

2.3 Air Quality Contaminants

The expected CoPCs that would likely be emitted during the Project construction and operation are primarily criteria air contaminants (CACs), volatile organic compounds (VOCs) and polycyclic aromatic hydrocarbons (PAHs). The CACs include nitrogen oxides (NO_X), carbon monoxide (CO), total suspended particulate matter (TSP), particulate matter less than 10 µm in diameter (PM_{10}) and particulate matter less than 2.5 µm in diameter ($PM_{2.5}$).

NO_x is produced in most combustion processes, consisting of nitric oxide (NO) and nitrogen dioxide (NO_2). NO is a colourless gas with no direct effects on health or vegetation at ambient levels and with no regulatory criteria. NO_2 is the regulated form of NO_x. TSP refers to air borne particles with an aerodynamic diameter of less than 44 µm. Particulate effects on human health are primarily associated with PM_{10} and $PM_{2.5}$ as particles of these sizes can become trapped by the upper airways or in the case of $PM_{2.5}$, can make their way deep into the lungs.

Total hydrocarbons (THC) and volatile organic compounds (VOCs) constitute two other groupings of CoPCs for the Project. Key VOCs from fuel combustion processes which are included in the study include benzene, 1,3-butadiene, formaldehyde, acetaldehyde, and acrolein. The compliance status of these speciated VOCs can be used as representatives for determination of compliance of other VOCs.

Polycyclic aromatic hydrocarbons (PAHs) are a subset of total hydrocarbons, of which the key representative substance is benzo(a)pyrene (B(a)P) which can be considered as a surrogate of total PAHs.

A summary of the applicable Ontario Ambient Air Quality Criteria (AAQC) and Canadian Ambient Air Quality Standards (CAAQS) used in this study are presented in Table 1.

Table 1: Summary of Applicable Air Quality Criteria and Standards

CoPC	CAS	Averaging Period (hours)	Air Quality Criteria/Standard (µg/m^3)	Regulatory Framework
CO	630-08-0	1	36,200	AAQC
		8	15,700	
NO_2	10102-44-0	1	400	AAQC
			119[A, B]	2020 CAAQS
			83[A, B]	2025 CAAQS
		24	200	AAQC
		Annual	34[A, C]	2020 CAAQS
			24[A, C]	2025 CAAQS
PM_{10}	N/A	24	50[D]	AAQC
$PM_{2.5}$	N/A	24	28[E]	2015 CAAQS
			27[E]	2020 CAAQS
		Annual	10[F]	2015 CAAQS
			8.8[F]	2020 CAAQS
Benzene	71-43-2	24	2.3	AAQC
		Annual	0.45	AAQC
Benzo(a)pyrene[G]	50-32-8	24	0.00005	AAQC
		Annual	0.00001	AAQC
1,3-Butadiene	106-99-0	24	10	AAQC
		Annual	2	AAQC
Formaldehyde	50-00-0	24	65	AAQC
Acetaldehyde	75-07-0	0.5	500	AAQC
		24	500	AAQC
Acrolein	107-02-8	1	4.5	AAQC
		24	0.4	AAQC

Notes:

[A] Converted to µg/m^3 assuming 10°C and 760 mmHg, consistent with the approach for converting AAQCs (MTO, 2020).

[B] The 3-year average of the annual 98th percentile daily maximum 1-hour average concentrations.

[C] The average over a single calendar year of all the 1-hour average concentrations.

[D] AAQC for PM_{10} is an interim AAQC provided as a guide for decision-making.

[E] The 3-year average of the annual 98th percentile of the daily 24-hour average concentrations.

[F] The 3-year average of the annual average concentrations.

[G] As a surrogate of total polycyclic aromatic hydrocarbons (PAHs).

2.4 Greenhouse Gases

A greenhouse gas (GHG) is any gas that contributes to potential climate change by trapping heat in the atmosphere. GHGs are known to contribute to warming of the climate, leading to many other changes around the world: in the atmosphere; on land; and in the oceans.

Common GHGs include carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Other GHGs include hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6), and nitrogen trifluoride (NF_3). HFCs and PFCs are used mainly as refrigerants, SF_6 is commonly found in electrical equipment, and NF_3 is used in the plasma etching of silicon wafers. The Project is expected to emit CO_2, CH_4, and N_2O from the combustion of fuels in vehicles and all three of these GHGs are assessed in this study. Other GHGs, such as HFCs, PFCs, SF_6 and NF_3, are not expected to occur in notable quantities related to the Project therefore these gases are not included in the analysis.

GHGs absorb heat radiated by the earth and subsequently warm the atmosphere, leading to what is commonly known as the greenhouse effect. The relative measure of how much heat a GHG absorbs in the atmosphere is characterized as the global warming potential (GWP), relative to CO_2. For this assessment, the GWPs of CO_2, CH_4 and N_2O are 1, 25, and 298, respectively, based on Canada's National Inventory Report 1990-2020 (Environment and Climate Change Canada (ECCC, 2022)). Because different GHGs contribute by different extents to the greenhouse effect, the unit of kilotonnes of carbon dioxide equivalent (kt CO_2e) is used to express the total quantity of GHGs. This unit is calculated by multiplying the tonnage emission of each GHG by its global warming potential, then summing the contributions from all relevant GHGs.

As identified in guidance provided on assessing climate change in environmental assessments, "the contribution of an individual project to climate change cannot be measured" (Federal-Provincial-Territorial Committee on Climate Change and Environmental Assessment 2003). Therefore, evaluation of Project effects will focus on estimation of GHG releases and evaluation of Project GHG releases in relation to provincial (Ontario) and national (Canada) GHG totals.

3.0 Existing Conditions

Ambient air quality in the Study Area is influenced by emissions from vehicular traffic. Meteorology and climatology play an important role in contaminant formation, dispersion, and transport. The local meteorology and ambient air quality data are discussed in this section.

3.1 Climate

The following sections describe the general climatology of the Study Area. The climatology is based on 30-year (1981 to 2010) Canadian Climate Normal data obtained from Environment and Climate Change Canada (ECCC) for the Cobourg STP meteorological station and the Trenton Airport Station which are the closest stations to the centre of the Study Area that contain complete climate normal data.

3.1.1 Temperature

A summary of the daily average, daily maximum and daily minimum temperatures on a monthly basis over the period 1981 to 2010 is presented in Table 2. The daily average temperature for the area varies from -5.6°C to 19.9°C with an annual average temperature of 7.5°C.

Table 2: Summary of Average Temperature Data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Daily Average (°C)	-5.6	-4.3	-0.5	5.9	11.7	16.9	19.9	19.4	15.4	9	3.7	-2	7.5
Daily Maximum (°C)	-1.4	0	3.7	10.3	16.4	21.6	24.6	24	19.9	13.1	7.3	1.9	11.8
Daily Minimum (°C)	-9.7	-8.5	-4.6	1.5	6.9	12.1	15.2	14.9	10.8	4.8	0.1	-5.8	3.1

SOURCE: Environment and Climate Change Canada Canadian Climate Normal – Cobourg STP meteorological station

3.1.2 Precipitation

A summary of the monthly average rainfall, snowfall, total precipitation (as equivalent rainfall based on a conversion factor for snowfall to equivalent rainfall of 0.1) and average snow depth on a monthly basis over the period 1981 to 2010 is presented in Table 3. The annual average total precipitation for the area is about 890.4 millimetres (mm).

Table 3: Summary of Average Precipitation Data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Rainfall [(1)] (mm)	34	32.9	42.7	74.3	81.2	80.5	64.8	71.7	93.2	76.3	89.2	53.1	793.9
Snowfall [(1)] (cm)	32.7	21.2	14.2	1.8	0	0	0	0	0	0	4	22.7	96.5
Precipitation [(1)] (mm)	66.7	54.1	56.8	76.2	81.2	80.5	64.8	71.7	93.2	76.3	93.2	75.8	890.4
Average Snow Depth [(2)] (cm)	8	9	4	0	0	0	0	0	0	0	0	4	2

Notes:

[1] SOURCE: Environment and Climate Change Canada Canadian Climate Normal – Cobourg STP meteorological station

[2] SOURCE: Environment and Climate Change Canada Canadian Climate Normal – Trenton Airport meteorological station

3.1.3 Humidity

A summary of the average morning and afternoon relative humidity on a monthly basis over the period 1981 to 2010 is presented in Table 4. The annual average relative humidity in the morning is 83.3% and in the afternoon is 63.7%.

Table 4: Summary of Average Relative Humidity Data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Relative Humidity – 0600LST (%)	79.1	79	78.6	78.8	81.6	84.4	85.9	90	90.8	86.9	83.3	81.5	83.3
Average Relative Humidity – 1500LST (%)	71.6	68.7	63	56.8	57	59.6	59.1	60.5	63	63.9	69.1	72.6	63.7

SOURCE: Environment and Climate Change Canada Canadian Climate Normal – Trenton Airport meteorological station

3.1.4 Wind Speed and Direction

The climate normal data with respect to wind speed and directionality are presented in Table 5. The annual average wind speed for the area is 13.1 km/h and the most frequent wind direction, on an annual basis, is wind blowing from the southwest.

Table 5: Summary of Wind Data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Speed (km/h)	15.2	14.3	14.4	15	13	11.7	11.4	10.3	11.1	12.5	13.9	14.6	13.1
Most Frequent Direction (1)	W	W	W	SW	SW	SW	SW	SW	SW	SW	W	W	SW
Max Hourly Speed (km/h)	89	74	105	76	64	72	64	63	64	74	80	69	105
Max Gust Speed (km/h)	153	113	145	128	106	119	127	103	116	106	145	154	154
Direction of Max Gust 1	NW	W	W	W	W	W	SW	W	SW	N	W	W	W

SOURCE: Environment and Climate Change Canada Canadian Climate Normal – Trenton Airport meteorological station

Note: [1] denotes the direction *from which* the wind is blowing most frequently

3.2 Special Receptors

Special receptors are placed to assess data at points where human activity more regularly takes place. The MTO Guide recommends that the local air quality impacts be studied within a distance of 500 m from a Project at both sensitive (residences) and critical receptors (hospitals, retirement homes, childcare centres). The special receptors in the Study Area include existing residences and potential future residences to be located south of Danforth Road and west of Greer Road. It is noted that there is an elementary school (Northumberland Christian) located approximately 1.3 km west of the existing Highway 401 and Nagle Road overpass.

Thirty-four (34) receptors were identified to be close to the Study Area, thirty-three of which are considered to be representative of residences in the area. These receptors, along with the elementary school were considered in the assessment.

The receptors considered are the nearest to the Project in each direction and are identified in Table 6. The table also presents the UTM coordinates (NAD 83) for each receptor. Five property acquisitions are expected be required for the ultimate build of the Project. These receptors are identified in the table and were not considered for the future build scenario. The locations of the receptors are shown in a receptor map in Appendix B.

Table 6: Location of Special Receptors

Sensitive Receptor ID	Receptor Description	UTM Coordinates		
		Zone	Easting (m)	Northing (m)
R001	Northumberland Christian School	17	727717	4874789
R002	Proposed future residential development south of Danforth Rd. and west of Nagle Rd	17	728199	4874710
R003	Proposed future residential development south of Danforth Rd. and west of Nagle Rd	17	728312	4874688
R004	Proposed future residential development south of Danforth Rd. and west of Nagle Rd	17	728377	4874784
R005	Proposed future residential development south of Danforth Rd. and west of Nagle Rd	17	728516	4874757
R006	Proposed future residential development south of Danforth Rd. and west of Nagle Rd	17	728649	4874737
R007	Proposed future residential development south of Danforth Rd. and west of Nagle Rd	17	728771	4874716
R008	Residence on Danforth Rd and west of Nagle Rd	17	728748	4874788
R009	Residence on Danforth Rd and west of Nagle Rd	17	728826	4874761

Sensitive Receptor ID	Receptor Description	UTM Coordinates		
		Zone	Easting (m)	Northing (m)
R010	Residence on Danforth Rd and west of Nagle Rd	17	728865	4874753
R011	Residence on Danforth Rd and west of Nagle Rd	17	728894	4874748
R012	Residence on Danforth Rd and west of Nagle Rd	17	728927	4874748
R013	Residence on Danforth Rd and west of Nagle Rd	17	728968	4874749
R014	Residence on Danforth Rd and west of Nagle Rd	17	729003	4874749
R015	Residence on Danforth Rd and west of Nagle Rd	17	729034	4874756
R016*	Residence on west side of Nagle Rd, property acquisition	17	729063	4874777
R017*	Residence on west side of Nagle Rd, property acquisition	17	729035	4874827
R018*	Residence on west side of Nagle Rd, property acquisition	17	729021	4874861
R019*	Residence on west side of Nagle Rd, property acquisition	17	728992	4874919
R020	Residence on Danforth Rd and east of Nagle Rd	17	729120	4874804
R021	Residence on Danforth Rd and east of Nagle Rd	17	729180	4874823
R022	Residence on Danforth Rd and east of Nagle Rd	17	729222	4874871
R023	Residence on the west side of Nagle Rd	17	728729	4875511
R024	Residence on the east side of Nagle Rd	17	728869	4875525
R025*	Residence on east side of Nagle Rd, property acquisition	17	728992	4875319
R026	Residence on Danforth Rd and east of Nagle Rd	17	729632	4874873
R027	Residence on Danforth Rd and east of Nagle Rd	17	729834	4874961
R028	Residence on Danforth Rd and east of Nagle Rd	17	729750	4875146
R029	Residence on Danforth Rd and east of Nagle Rd	17	730143	4875083
R030	Residence on Cunningham Rd	17	730150	4875569
R031	Residence on Cunningham Rd	17	730160	4875772
R032	Residence on the west side of Van Luven Rd	17	729952	4876230
R033	Residence on the west side of Van Luven Rd	17	730001	4876135
R034	Residence on the east side of Van Luven Rd	17	730132	4876080

Note:

* Indicates a property acquisition for the future build scenario.

3.3 Local Air Quality

3.3.1 Available Published Ambient Air Monitoring Data

Ambient air quality monitoring has been conducted by the National Air Pollution Surveillance Program (NAPS) operated by ECCC in populated regions of Canada. NAPS was established in 1969 with the goal of the program to provide accurate and long-term air quality data of a uniform standard across Canada. The NAPS program continuously measures NO_2, CO, O_3, and $PM_{2.5}$. The NAPS network data between 2014-2018 at the nearest monitoring stations to the Project were reviewed to determine background air quality concentrations. Monitoring station data was reviewed based on proximity to the Study Area, data completeness, proximity of monitoring station to an existing major roadway, having a similar land use to the Study Area, and/or similar population size. The Study Area is characterized as a rural location. The population size of Cobourg is 19,440 and the population of Colborne is 1,577 (Statistics Canada 2017a, b). These features were considered in the selection of the appropriate monitoring station to represent background concentrations in the Study Area. The NAPS stations that were considered for this study are presented in Table 7.

Table 7: NAPS Locations Assessed in the Study

NAPS ID	Location	Station Name	CoPC [A]	Availability of Data
60104	Rideau & Wurtemburg	Ottawa	CO	2014-2018
60204	467 University Avenue West	Windsor	CO	2014-2018
60430	125 Resources Road	Toronto	CO	2014-2018
60512	Elgin & Kelly	Hamilton	CO	2014-2018
61104	10 Hospital Drive	Peterborough	NO_2, $PM_{2.5}$	2014-2018
61702	2200 Simcoe Street North	Oshawa	NO_2, $PM_{2.5}$	2014-2018
65401	2 Sidney Street	Belleville	NO_2, $PM_{2.5}$	2014-2018
62601	Experimental Farm	Simcoe	BaP	2016-2018[C]
			acetaldehyde, acrolein, formaldehyde	2014-2018
			benzene, 1,3-butadiene	2014-2015, 2017-2018[D]
60211	College & South Street / 928 South Street	Windsor West	benzene, 1,3-butadiene	2013-2017[E]
65101	Eagle Street & McCaffrey Road	Newmarket	benzene, 1,3-butadiene	2014-2017[E]

NAPS ID	Location	Station Name	CoPC [A]	Availability of Data
61502	West Avenue & Homewood	Kitchener	benzene, 1,3-butadiene	2014-2018

Notes:

[A] Only contaminants pertinent to this study are listed.

[B] Grey shaded locations were selected for the study.

[C] Data availability is less than 75% for 2014 and 2015.

[D] Data for 2014 and 2015 are available for a 24-hour sampling period. Data availability is less than 75% for 2016. Data for 2017 and 2018 are available for a 4-hour sampling period.

[E] Data availability is less than 75% for 2018.

3.3.2 Background Concentration Levels

Background concentrations are used in dispersion modelling to represent the cumulative effect of other emissions sources (i.e., both anthropogenic and biogenic) in addition to the sources being included in the dispersion modelling. The MTO Environmental Guideline for Air Quality (MTO, 2020) recommends that the background pollutant concentration levels to be used in this analysis are the 90th percentile of the most recently measured and complete concentration data from the nearest MECP or ECCC monitoring stations. The use of 90th percentile levels is to account for spatial and temporal variations between the monitoring location(s) and the Study Area, while still providing a conservative assessment. The background levels used in this study were therefore the 90th percentile values for short-term averages. For annual averages, an annual average value was used as the background level.

Background concentrations of the CoPCs were determined from the NAPS station data. The maximum (over all stations) of the 90th percentile concentration over all available years with complete data was considered to be the representative background value for the Project. The maximum, minimum, average and 90th percentile concentrations for applicable time periods for each CoPC are presented in Table 8. The following observations were made from the ambient monitoring data:

- The measured maximum 1-hour and 8-hour average CO concentrations at the Ottawa station were well below the applicable 1-hour and 8-hour AAQC of 36,200 µg/m^3 and 15,700 µg/m^3, respectively.
- The measured maximum 1-hour and 24-hour average NO_2 concentrations at the Peterborough station were below the applicable 1-hour and 24-hour AAQC of 400 µg/m^3 and 200 µg/m^3, respectively. The annual average NO_2 concentration is below the current (34 µg/m^3) and future (24 µg/m^3) CAAQS.

- Ambient PM_{10} concentrations were estimated based on $PM_{2.5}$ measurements at the Peterborough station using a ratio of $PM_{2.5}$ / PM_{10} = 0.54 (Lall *et al*, 2004). Based on this estimation methodology, PM_{10} background concentrations are above the 24-hour interim AAQC of 50 µg/m^3 in three of the five years.
- The maximum measured 24-hour average $PM_{2.5}$ concentration is above the 2015 CAAQS of 28 µg/m^3 and the 2020 CAAQS of 27 µg/m^3 in three of the five years.
- An exceedance of the 24-hour AAQC for benzene (2.4 µg/m^3) was measured in one of four years at the Newmarket station. The maximum measured annual average concentrations of benzene did not exceed the annual average AAQC of 0.45 µg/m^3.
- The maximum measured 24-hour and annual average concentrations of BaP at the Simcoe station are above the AAQC in all three years of data.
- The maximum measured 24-hour and annual average 1,3-butadiene concentrations at the Newmarket station were well below the applicable 24-hour and annual average AAQC of 10 µg/m^3 and 2 µg/m^3, respectively.
- The maximum measured 24-hour average formaldehyde concentration at the Simcoe station was well below the applicable 24-hour AAQC of 65 µg/m^3.
- The maximum measured 24-hour average acetaldehyde concentration at the Simcoe station was well below the 24-hour AAQC of 500 µg/m^3. Since acetaldehyde is not measured for shorter averaging periods, the 24-hour average concentration was converted to a half-hour concentration using the MECP averaging period conversion factor equation (MECP, 2017) and compared to the ½-hour AAQC.
- The maximum measured 24-hour average acrolein concentration at the Simcoe station was well below the applicable 24-hour AAQC of 0.4 µg/m^3, respectively. Since acrolein is not measured for shorter averaging periods, the 24-hour average concentration was converted to a 1-hour concentration using the MECP averaging period conversion factor equation (MECP, 2017) and is well below the 1-hour AAQC of 4.5 µg/m^3.

Table 8: Summary of CoPC Background Concentrations

CoPC	CAS	Averaging Period	Background Concentration (µg/m³)				Air Quality Criteria	Source	% of Criteria
		(hours)	Maximum	Minimum	Mean	90th Percentile	(µg/m³)		
CO	630-08-0	1	1194 [A]	0 [A]	238 [A]	362 [A]	36,200	AAQC	1%
		8	844 [A]	0 [A]	238 [A]	362 [A]	15,700		2%
NO_2	10102-44-0	1	114 [A]	-1 [A]	9.4 [A]	21.8 [A]	400	AAQC	5%
							119	2020 CAAQS	-[B]
							83	2025 CAAQS	-[B]
		24	59 [A]	1 [A]	9.3 [A]	21.2 [A]	200	AAQC	11%
		Annual	-	-	9.4[A]	-	34	2020 CAAQS	28%
							24	2025 CAAQS	39%
PM_{10}	N/A	24	59 [D]	0 [D]	11.9 [D]	24.1 [D]	50	AAQC	48%
$PM_{2.5}$	N/A	24	32	0	6.4	13.0	28	2015 CAAQS	-[C]
							27	2020 CAAQS	-[C]
		Annual	-	-	6.4	-	10	2015 CAAQS	-[C]
							8.8	2020 CAAQS	-[C]

CoPC	CAS	Averaging Period	Background Concentration (µg/m^3)				Air Quality Criteria	Source	% of Criteria
		(hours)	Maximum	Minimum	Mean	90th Percentile	(µg/m^3)		
Benzene	71-43-2	24	2.5	0.091	0.39	0.70	2.3	AAQC	30%
		Annual	-	-	0.39	-	0.45	AAQC	88%
Benzo(a)pyrene	50-32-8	24	0.00043	0	0.000023	0.000053	0.00005	AAQC	106%
		Annual	-	-	0.000023	-	0.00001	AAQC	230%
1,3-Butadiene	106-99-0	24	0.11	0.0030	0.023	0.063	10	AAQC	1%
		Annual	-	-	0.023	-	2	AAQC	1%
Formaldehyde	50-00-0	24	3.7	0.0036	0.69	2.2	65	AAQC	3%
Acetaldehyde	75-07-0	0.5	-	-	-	3.52[E]	500	AAQC	1%
		24	2.0	0	0.46	1.19	500	AAQC	0%
Acrolein	107-02-8	1	-	-	-	0.073[E]	4.5	AAQC	2%
		24	0.072	0	0.0080	0.030	0.4	AAQC	7%

Notes:

[A] The monitoring data was converted to µg/m^3 based on a standard temperature of 10°C and pressure of 1 atm.

[B] The background hourly NO_2 concentration is not explicitly compared with the CAAQS as the 1-hour CAAQS for NO_2 is referenced to the three-year average of the annual 98th percentile of the daily maximum one-hour average concentrations while the background concentration is the 90th percentile of hourly values, and therefore the calculation basis for these two parameters are inconsistent.

[C] Background concentrations of $PM_{2.5}$ are not explicitly compared with the CAAQS as the 24-hour and annual standards are referenced to the 98th percentile daily average concentration averaged over 3 consecutive years, and 3-year average of the annual average concentrations, respectively. The background concentrations are 90th percentile of hourly values and single year annual averages and therefore the calculation basis for these parameters is different.

[D] Background concentrations of PM_{10} are estimated based on a ratio of $PM_{2.5}/PM_{10}$ = 0.54 (Lall *et al,* 2004).

[E] Monitoring data are based on 24-hour measurements. The 24-hour background concentration is converted to the appropriate averaging period following guidance in the Air Dispersion Modelling Guideline for Ontario (ADMGO) (MECP, 2017).

3.4 Existing Greenhouse Gas Emissions

Existing national and provincial GHG emission totals were obtained from Canada's 2020 National Inventory Report and are provided in Table 9. The table also shows the national (ECCC, 2022) and provincial (MECP, 2018a) GHG emission reduction targets for 2030.

Table 9: National and Provincial GHG Emissions

Year	GHG Emissions (kt CO_2e)	
	Canada	**Ontario**
2015	733,000	164,000
2016	715,000	162,000
2017	725,000	159,000
2018	740,000	167,000
2019	738,000	166,000
2020	672,000	150,000
2030 Target	443,000	143,000

4.0 Emission Inventory

The methods and results of the air and GHG emissions estimations are provided in this section for the existing and future assessment years.

4.1 Vehicle Emissions

The U.S. EPA Motor Vehicle Emission Simulator (MOVES3) was used to estimate existing and future emissions rates from motor vehicle traffic on local roads (US EPA, 2020). MOVES3 is the latest U.S. EPA tool for estimating vehicle emissions due to the combustion of fuel, brake and tire wear, fuel evaporation, permeation and refueling leaks. MOVES3 was used to estimate vehicle emissions based on vehicle type, fuel type, road type, model year, and vehicle speed. Vehicle types, distribution and average travel speed were provided by the project design team (Stantec, 2022). A summary of the MOVES3 input parameters is provided in Table 10.

Table 10: Summary of MOVES Inputs

Parameter	Input
Scale	Project Domain
Years	2016, 2041
Months	January and July
Meteorology	Temperature – Climate Normals from Cobourg STP meteorological station Relative Humidity – Climate Normals from Trenton Airport meteorological station
Source Use Types	Passenger Car Single Unit Short-haul Truck Combination Short-haul Truck
Vehicle Distribution	76% passenger cars, 19% heavy truck, 5% medium truck 78% passenger cars, 12% heavy truck, 10% medium truck
Fuels	Diesel / Gasoline
Age Distribution	MOVES defaults based on modelling year
Pollutants	CO, NO_2, PM_{10}, $PM_{2.5}$, Benzene, Benzo(a)pyrene, 1,3-Butadiene, Formaldehyde, Acetaldehyde, Acrolein, CO_2e
Road Type	Rural Restricted Access, Rural Unrestricted Access
Average Speed	30 km/hr, 60 km/hr, 100 km/hr

Emission factors in grams of pollutant emitted per vehicle mile travelled (g/VMT) for the above listed vehicle speeds and two vehicle distributions were obtained from MOVES3 and applied to appropriate links in the dispersion model. Appendix C summarizes the emission factors obtained from MOVES.

Annual average daily traffic (AADT) volumes for the existing (2016) and future (2041) scenarios were provided by the project design team (Stantec, 2022). Peak hour (AM and PM) traffic volumes for the ultimate build scenario (2041) were provided by CIMA+ (CIMA+, 2020). Peak hour traffic volumes for the existing and future no build scenarios were estimated using the peak hour to AADT ratio for the future build scenario. The diurnal variation in traffic levels was provided by the project design team and is based on 2016 traffic counts on Highway 401 taken approximately 7.9 km west of the Lyle Street Interchange (Stantec, 2020a). Both AADT and peak hour traffic data were used as inputs to the dispersion model and are provided in Appendix D. The hourly diurnal traffic pattern is also provided in Appendix D.

4.2 Road Dust Emissions

In addition to emissions from exhaust, tire wear, brake and evaporative releases, the re-entrainment of road dust from vehicles travelling over paved roads is considered a source of PM_{10} and $PM_{2.5}$. Emissions resulting from travel on paved roads were quantified using the US EPA AP-42 Chapter 13.2.1 calculation methodology.

The quantity of particulate emissions from resuspension of loose material on the road surface due to vehicles travelling on the Project roadways were calculated using the equation suggested in AP-42, Section 13.2 (US EPA, 2011):

$$E = K \times (SL)^{0.91} \times (w)^{1.02}$$

Where:

E= particulate emission factor (g/VMT)

sL = road surface silt loading (g/m^2):

AADT < 500: 0.6 g/m^2
AADT between 500 – 5,000: 0.2 g/m^2
AADT between 5,000 – 10,000: 0.06 g/m^2
AADT > 10,000: 0.03 g/m^2 and 0.015 g/m^2 on limited access roads

W = average weight (tons) of the vehicles traveling the road:
Passenger cars: 1.8 tons
Heavy Trucks: 20 tons
Medium Trucks: 9 tons

K = particle size multiplier of 0.25 (g/VMT) for $PM_{2.5}$ and 1 (g/VMT) for PM_{10}.

The particulate resuspension emission factors were calculated from the above equation and aggregated with the emission factors generated from MOVES3 for $PM_{2.5}$ and PM_{10}.

The MOVES output emission factors and detailed road dust emissions calculations are presented in Appendix C.

4.3 Greenhouse Gas Emissions

The estimation of GHG emissions for the Project follows the same methodology described for air contaminant emissions, using MOVES3 to predict CO_2e emission factors with the same model inputs for the existing and future no build and build scenarios. These emission factors were then used to calculate total emissions both with and without implementation of the Project. The total emissions for each case were based on each link's emission factor (g/VMT) and the predicted annual vehicle miles travelled (based on the length and AADT of each link). The detailed GHG emissions calculations are provided in Appendix E and are summarized in Table 11.

Table 11: Project GHG Emissions – Annual GHG Emissions (t CO_2e / year)

Existing	Future No Build	Future Build
22,035	28,747	35,005

The future build scenario represents an increase in GHG emissions of approximately 59% compared to the existing scenario and 22% compared to the future no build scenario. Due to expected improvements in engine technology and cleaner fuels, overall CO_2e emissions per vehicle mile travelled are lower in the future but are offset by the expected corresponding increase in vehicle traffic. It is noted that the annual GHG emissions do not account for the current trend/goals for electric vehicle usage.

5.0 Air Dispersion Modelling Methodology

Dispersion modelling of CoPCs from vehicle traffic travel on local roads was performed for the following assessment scenarios:

- 2016 – Existing conditions, Highway 401 (6-lanes), Nagle Road overpass;
- 2041 – Future No Build, Highway 401 (8-lanes), Nagle Road replacement – overpass; and
- 2041 – Future Build, Highway 401 (8 lanes), Nagle Road replacement – interchange.

5.1 Dispersion Model Used

The US EPA CAL3QHCR model (US EPA 2013) was used to predict air quality concentrations at the special receptor locations for all emission scenarios. The model can predict pollutant ground level concentrations (GLCs) from motor vehicles near highways and arterial streets. CAL3QHCR requires inputs such as roadway geometries, receptor locations, meteorological conditions, and vehicular emission factors.

A total of 25 links (road segments) were input into the model for the existing and future no build scenarios and 38 links for the future build scenario. Detailed link data for each scenario is included in Appendix F. The links were determined based on the preferred design plan presented in Appendix A and available traffic volumes and hourly distribution data provided by the project design team and CIMA+ (Stantec, 2020a) presented in Appendix D. Emission factors from MOVES3 in g/VMT were assigned to each link depending on the predicted vehicle distribution and average travel speed. Table 12 summarizes key CAL3QHCR inputs used in the model runs.

Table 12: Key CAL3QHCR Model Input Parameters

Parameter	Input
Traffic Data	• Peak hourly traffic volumes • AADT volumes coupled with local traffic distribution (see Section 4.1)
Deposition Velocity	• Deposition velocities selected as per the MTO Guide • $PM_{2.5}$: 0.1 cm/s • PM_{10}: 0.5 cm/s • CO, NO_2, BAP and VOCs: 0 cm/s
Settling Velocity	• Settling velocities selected as per MTO Guide • $PM_{2.5}$: 0.02 cm/s • PM_{10}: 0.3 cm/s • CO, NO_2, BAP and VOCs: 0 cm/s

Parameter	Input
Surface Roughness Length	• The Study Area is dominated by a mixture of forest and crop land (Stantec 2020b) and, therefore, 50 cm for mixed far fields and forest clumps, orchards, scattered buildings were selected
Emission Factor	• Emission Factors from MOVES3 were applied to the appropriate links depending on assigned average vehicle speed and vehicle distribution

5.2 Meteorological Data Sources

The local meteorology of the region must be characterized to evaluate the short-term atmospheric dispersion and transport of emissions released by the Project. A five-year (2014-2018) site specific meteorological dataset that was preprocessed by the MECP was used as an input to the dispersion model with upper air data from Buffalo NY and surface data from Oshawa Airport. Since CAL3QHCR can only process one year of meteorological data for each run, each of the five years' met data were processed individually and the highest ambient concentrations predicted over the 5-year period were used in the assessment.

5.3 Wind Speed and Direction

The frequency distribution of wind speeds from the site-specific meteorological data set is shown in Figure 2. High wind speeds greater than 8.8 m/s occur infrequently, while wind speeds between 3.6 – 5.7 m/s occur the most frequently. A wind rose plot is presented in Figure 3. Wind roses are an efficient and convenient means of presenting wind data. The length of the radial barbs gives the total percent frequency of winds from the indicated direction, while portions of the barbs of different widths indicate the frequency associated with each wind speed category. Winds blow most frequently from westerly and south-southeasterly directions.

Figure 2: Wind Class Frequency Distribution for Oshawa Airport (2014-2018)

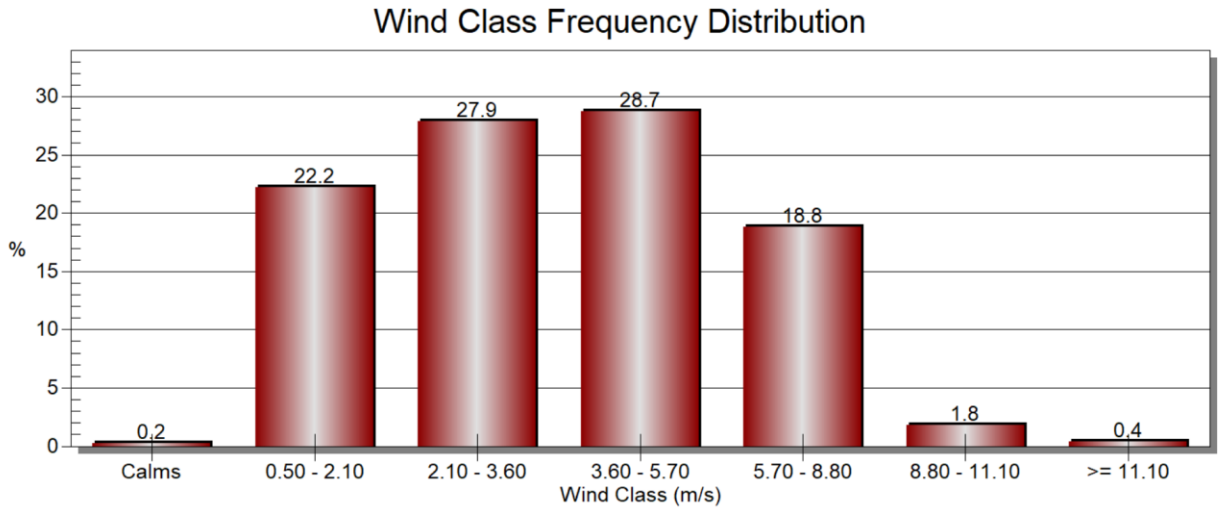
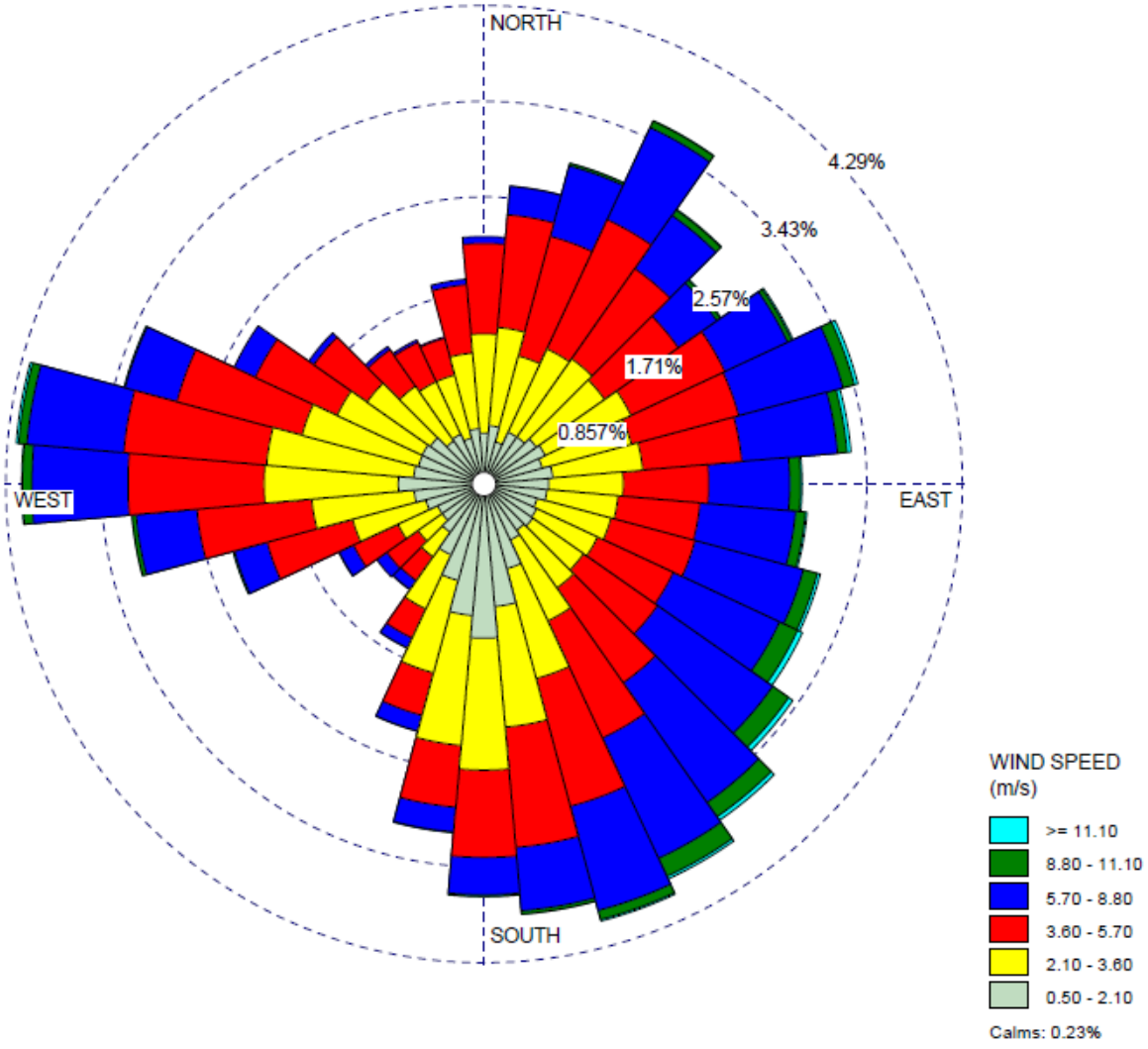


Figure 3: Wind Rose Plot for Oshawa Airport (2014-2018)



5.4 Averaging Periods

The CAL3QHCR dispersion model is capable of predicting concentrations for a variety of averaging times greater than 1-hour. For this Project, the model was run for 1-hour, 8-hour, 24-hour and annual averaging times.

5.5 Receptors

The MTO Guide recommends that the local air quality impacts be studied within a distance of 500 m from the transportation facility, in each direction and at both sensitive (residences) and critical receptors (hospitals, retirement homes, childcare centres). The choice of a 500 m limit is based on empirical evidence for heavily travelled, large highways, which clearly indicates that the concentrations of road-related pollutants drop to within 10% of their background levels over this distance (MTO, 2020).

It is noted that there is one critical receptor located just beyond the 500 m study area to the west of the existing Highway 401 and Nagle Rd overpass and is included in the assessment. The locations of the representative sensitive (residence) and critical receptors used to assess compliance with the air quality criteria are shown in Appendix B and identified in Table 6.

6.0 Air Dispersion Modelling Results (Project Alone)

In this section, the results of the dispersion modelling analysis are presented for the existing and future scenarios for the Project build and no build configurations at the special receptor locations discussed in Section 3.2. A comparison of the maximum predicted values with the applicable AAQC and/or CAAQS is presented in Table 13. Dispersion model predictions at the individual special receptors are included in Appendix G. Predictions for $PM_{2.5}$ and NO_2 are presented as maximum modelled concentrations, and these are used for comparison to the applicable CAAQS. It is noted that the CAL3QHCR model does not provide outputs that are the appropriate statistical measure[1] required for direct comparison to the standards. Therefore, results for $PM_{2.5}$ and NO_2 presented and discussed in comparison to the CAAQS are conservatively high.

The maximum predicted GLCs for all CoPCs are below their relevant AAQC and/or CAAQS except for B(a)P in the existing (2016) scenario. The general trend is a decrease in predicted maximum concentrations over time due to advances in cleaner fuels and emissions control technology, which are anticipated to lower all vehicle contaminant tailpipe emissions in the future.

CACs

Predicted maximum concentrations of CO, NO_2, PM_{10} and $PM_{2.5}$ are below the relevant AAQC and/or CAAQS for all three scenarios and show a general decrease in the future no build scenario in comparison to existing conditions. The following incremental increases in the maximum concentrations for the future build versus the future no build scenario are predicted due to increases in traffic volume:

- CO – 67%

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[1] For NO_2, the 3-year average of the annual 98th percentile of the daily maximum one-hour average concentration are to be used for comparison to the 1-hour CAAQS. The average over a single calendar year of all 1-hour average concentrations are to be used for comparison to the annual CAAQS.
For $PM_{2.5}$, the 3-year average of the annual 98th percentile of the daily 24-hour average concentrations are to be used for comparison to the 24-hour CAAQS. The 3-year average of the annual average of the daily 24-hour average concentrations are to be used for comparison to the annual CAAQS.

- NO_2 – 67%
- PM_{10} – 174%
- $PM_{2.5}$ – 149%

Volatile Organic Compounds

Predicted maximum concentrations of benzene, 1,3-butadiene, formaldehyde, acetaldehyde and acrolein show a general decrease in maximum predicted GLCs for the future scenarios compared to the existing scenario. The maximum predicted concentrations for the future build scenario are less than 1% of their relevant AAQC for all VOCs.

Benzo(a)pyrene

The maximum predicted 24-hour and annual average B(a)P concentrations for the existing scenario are 73% and 79% higher than their AAQCs, respectively. For the existing scenario, exceedances of the 24-hour average AAQC are predicted at eight sensitive and one critical receptors and exceedances of the annual average AAQC are predicted at nine sensitive and one critical receptors, as shown in Appendix G. The maximum predicted B(a)P concentrations decrease for both the future build and no-build scenarios relative to existing conditions, with the maximum predicted 24-hour and annual average concentrations being below their AAQCs for both future scenarios. I maximum predicted B(a)P GLCs for the future build scenario are predicted to be higher than the future no build scenario due to increased traffic volumes. B(a)P concentration contour plots are presented in Appendix H.

Table 13: Maximum Predicted Ground Level Concentrations – Project Alone

CoPC	CAS	Averaging Period (hours)	Maximum Predicted Concentration [A] (µg/m³)			Air Quality Objectives/Criteria (µg/m³)	Regulatory Framework	Percentage of Reference Criteria (%)		
			Existing	Future No Build	Future Build			Existing	Future No Build	Future Build
CO	630-08-0	1	695.9	279.7	364.6	36,200	AAQC	2%	<1%	1%
		8	434.0	180.8	301.4	15,700	AAQC	3%	1%	2%
NO_2	10102-44-0	1	52.7	48.5	80.8	400	AAQC	13%	12%	20%
		1	52.7	48.5	80.8	119	2020 CAAQS	44%	41%	68%
		1	52.7	48.5	80.8	83	2025 CAAQS	64%	58%	97%
		24	4.2	3.9	11.9	200	AAQC	2%	2%	6%
		Annual	3.3	3.1	9.0	34	2020 CAAQS	10%	9%	26%
		Annual	3.3	3.1	9.0	24	2025 CAAQS	14%	13%	37%
PM_{10}	N/A	24	3.6	3.6	10.0	50	AAQC	7%	7%	20%
$PM_{2.5}$	N/A	24	2.2	1.0	2.4	28	2015 CAAQS	8%	4%	9%
		24	2.2	1.0	2.4	27	2020 CAAQS	8%	4%	9%
		Annual	0.5	0.2	0.6	10	2015 CAAQS	5%	2%	6%
		Annual	0.5	0.2	0.6	8.8	2020 CAAQS	5%	3%	7%
Benzo(a)pyrene	50-32-8	24	8.65E-05	3.30E-06	6.16E-06	5.00E-05	AAQC	173%	7%	12%
		Annual	1.79E-05	6.90E-07	1.48E-06	1.00E-05	AAQC	179%	7%	15%
Benzene	71-43-2	24	0.0375	0.0034	0.0078	2.3	AAQC	2%	<1%	<1%
		Annual	0.0078	0.0007	0.0019	0.45	AAQC	2%	<1%	<1%
1,3-Butadiene	106-99-0	24	8.60E-03	3.30E-06	6.54E-06	10	AAQC	<1%	<1%	<1%
		Annual	1.80E-03	6.90E-07	1.55E-06	2	AAQC	<1%	<1%	<1%
Formaldehyde	50-00-0	24	0.17	0.01	0.02	65	AAQC	<1%	<1%	<1%
Acetaldehyde	75-07-0	0.5	1.2	0.2	0.2	500	AAQC	<1%	<1%	<1%
		24	0.08	0.01	0.02	500	AAQC	<1%	<1%	<1%
Acrolein	107-02-8	1	0.162	0.012	0.015	4.5	AAQC	4%	<1%	<1%
		24	0.013	0.001	0.002	0.4	AAQC	3%	<1%	<1%

Note:
[A] Maximum predicted concentration over all special receptors.

7.0 Cumulative Effects Assessment

This section discusses the assessment of background air quality and GHG emissions in order to evaluate the Project's emissions cumulatively and in relation to other existing sources of emissions in the Study Area.

7.1 Air Quality

The maximum predicted GLCs from the air quality dispersion modelling presented in Section 6.0 were added to the background concentrations presented in Section3.3.2 in order to assess the cumulative effects of the Project with existing air quality levels in the Study Area. A summary of the maximum modelled predictions including background concentrations in comparison to the applicable AAQC and/or CAAQS is presented in Table 14. Cumulative predictions for $PM_{2.5}$ and NO_2 are maximum modelled concentrations and are used for a conservative comparison to the applicable CAAQS as CAL3QHCR does not provide predictions in the appropriate statistical measure required for direct comparison to these standards. The model predictions for $PM_{2.5}$ and NO_2 in Table 14 therefore provide conservatively high comparisons relative to the CAAQS.

The maximum predicted cumulative GLCs for all CoPCs are below their relevant AAQC and/or CAAQS except for NO_2 for the future build scenario and B(a)P for all three scenarios.

CACs

The maximum predicted cumulative NO_2 GLCs are 90%, 85% and 124% of the 1-hour 2025 CAAQS for the existing, future no build and future build scenarios, respectively, but remain below the 1-hour AAQC. The AAQC is currently used by the MECP and the NO_2 CAAQS have not been adopted as an AAQC in Ontario and are intended for regional air quality planning rather than assessing the local impacts of individual projects. Exceedances of the 2025 NO_2 CAAQS are predicted at two sensitive receptors. Maximum predicted cumulative GLCs of CO, PM_{10} and $PM_{2.5}$ are below their relevant AAQC and/or CAAQS for all three scenarios.

Volatile Organic Compounds

Predicted cumulative concentrations of 1,3-butadiene, formaldehyde, acetaldehyde and acrolein are all well below their relevant AAQCs even with the addition of background concentrations. The maximum annual average benzene concentrations are predicted to be 88% of the AAQC for the future build and no build scenarios. The major contributor

to these concentrations (99%) is the existing background concentration, with the Project adding less than 1% to this level.

Ambient air quality monitoring data suggests a decreasing trend in benzene concentrations in Ontario over the past decade (MECP, 2019). Based on this trend, it is likely that background benzene levels will continue to improve in the future and therefore the background concentrations used in the assessment are likely to be conservative on the high side.

Benzo(a)pyrene

The maximum predicted cumulative concentrations of B(a)P exceed the 24-hour and annual average AAQCs at all special receptor locations for all scenarios, with the background concentrations alone exceeding the 24-hour and annual average AAQCs. The maximum predicted 24-hour and annual average cumulative B(a)P concentrations for the future build scenario are 5% and 3% higher than the future no build scenario, respectively. The maximum cumulative B(a)P concentrations are predicted to decrease in the future build and future no build scenarios relative to the existing scenario due to expected future reductions in vehicle emissions.

Table 14: Maximum Predicted Ground Level Concentrations – Cumulative

CoPC	CAS	Averaging Period (hours)	Background Concentrations (µg/m³)	Maximum Predicted Cumulative Concentration [A] (µg/m³)			Air Quality Objectives/Criteria (µg/m³)	Regulatory Framework	Percentage of Reference Criteria (%)		
				Existing	Future No Build	Future Build			Existing	Future No Build	Future Build
CO	630-08-0	1	361.7	1057.5	641.4	726.2	36,200	AAQC	3%	2%	2%
		8	361.7	795.7	542.5	663.1	15,700	AAQC	5%	3%	4%
NO_2	10102-44-0	1	21.8	74.5	70.3	102.6	400	AAQC	19%	18%	26%
		1	21.8	74.5	70.3	102.6	119	2020 CAAQS	63%	59%	86%
		1	21.8	74.5	70.3	102.6	83	2025 CAAQS	90%	85%	124%
		24	21.2	25.4	25.1	33.1	200	AAQC	13%	13%	17%
		Annual	9.4	12.7	12.5	18.3	34	2020 CAAQS	37%	37%	54%
		Annual	9.4	12.7	12.5	18.3	24	2025 CAAQS	53%	52%	76%
PM_{10}	N/A	24	24.1	27.6	27.7	34.0	50	AAQC	55%	55%	68%
$PM_{2.5}$	N/A	24	13.0	15.2	14.0	15.4	28	2015 CAAQS	54%	50%	55%
		24	13.0	15.2	14.0	15.4	27	2020 CAAQS	56%	52%	57%
		Annual	6.4	6.9	6.6	7.0	10	2015 CAAQS	69%	66%	70%
		Annual	6.4	6.9	6.6	7.0	8.8	2020 CAAQS	78%	75%	79%
Benzo(a)pyrene	50-32-8	24	5.28E-05	1.39E-04	5.61E-05	5.90E-05	5.00E-05	AAQC	279%	112%	118%
		Annual	2.30E-05	4.09E-05	2.37E-05	2.45E-05	1.00E-05	AAQC	409%	237%	245%
Benzene	71-43-2	24	0.6998	0.7373	0.7032	0.7076	2.3	AAQC	32%	31%	31%
		Annual	0.3946	0.4024	0.3953	0.3965	0.45	AAQC	89%	88%	88%
1,3-Butadiene	106-99-0	24	0.0627	7.13E-02	6.27E-02	6.27E-02	10	AAQC	<1%	<1%	<1%
		Annual	0.0230	2.48E-02	2.30E-02	2.30E-02	2	AAQC	1%	1%	1%
Formaldehyde	50-00-0	24	2.24	2.40	2.25	2.26	65	AAQC	4%	3%	3%
Acetaldehyde	75-07-0	0.5	3.52	4.7	3.7	3.7	500	AAQC	<1%	<1%	<1%
		24	1.19	1.27	1.20	1.21	500	AAQC	<1%	<1%	<1%
Acrolein	107-02-8	1	0.073	0.235	0.085	0.088	4.5	AAQC	5%	2%	2%
		24	0.030	0.043	0.031	0.032	0.4	AAQC	11%	8%	8%

Note:

[A] Maximum predicted concentrations over all special receptors.

7.2 Greenhouse Gases

To evaluate the potential cumulative effects of GHG emissions due to the Project, estimated emissions with and without implementation of the Project are compared to the existing baseline emissions in Canada and Ontario. Table 15 presents the GHG emissions estimates for each of the three scenarios compared to Canada and Ontario 2020 totals and the 2030 emissions targets. The estimated GHG emissions from the future build scenario represents 0.023% of Ontario's total emissions for 2020, and 0.005% of Canada's total emissions for 2020. Furthermore, this represents 0.024% of Ontario's and 0.008% of Canada's 2030 targets, respectively.

The incremental increase in GHG emissions due to the future build scenario, in relation to the future no build scenario is 6.3 kt CO_2e per year. This is an incremental increase in the GHG emissions in Ontario of 0.0000042% and in Canada of 0.0000009% compared to 2020 totals and in Ontario of 0.000044% and in Canada of 0.0000014% compared to 2030 targets. These potential changes are considered insignificant in relation to the 2020 Canada and Ontario GHG emissions totals and the 2030 emissions targets.

Table 15: GHG Emissions Estimates Compared to Canada and Ontario Totals

Scenario	Project ($kt CO_2e$)	Canada				Ontario			
		2020 Total ($kt CO_2e$)	% 2020 Total	2030 Target ($kt CO_2e$)	% of 2030 Target	2020 Total ($kt CO_2e$)	% of 2020 Total	2030 Target ($kt CO_2e$)	% of 2030 Target
Existing	22.0	672,000	0.003%	443,000	0.005%	150,000	0.015%	143,000	0.015%
Future No Build	28.7		0.004%		0.006%		0.019%		0.020%
Future Build	35.0		0.005%		0.008%		0.023%		0.024%

8.0 Potential Impacts and Mitigation During Construction and Operation

8.1 Potential Impacts and Mitigation During Construction

During construction of the Project, particulate matter (dust) will be the primary CoPC. Other CoPCs such as NO_2 and VOCs will also be emitted from equipment used during construction. As the construction activities will be short-term and intermittent, emissions are expected to be minor provided adequate mitigation measures are implemented. The ECCC guideline “Best Practices for the Reduction of Air Emissions from Construction and Demolition Activities” provides recommendations for mitigation measures to reduce construction emissions. These measures include material wetting or use of chemical suppressants to reduce dust, the use of wind barriers to limit exposed areas which may be a source of dust, and equipment washing. It is recommended that these best management practices be followed during Project construction. With implementation of proper mitigation measures, the emissions from the construction phase and resulting changes in local air quality can be controlled and reduced.

8.2 Potential Impacts and Mitigation During Operation

The air quality assessment has identified that exceedances of the 1-hour average 2025 CAAQS for cumulative NO_2 may occur when background air quality levels are added to Project alone predictions.

Exceedances of B(a)P are predicted to occur for both the future no-build scenario as well as the future build scenario, with background levels being the major contributor to the cumulative exceedances. However, cumulative B(a)P concentrations are predicted to be lower for the future build and no build scenarios relative to existing levels.

While the Project contributions to exceedances are expected to be small, it is expected that with ongoing advancements in on-road vehicles to newer, lower emissions or electric vehicles, the quantities of air contaminants released to the atmosphere from transportation sources will be lower in the future. Implementation of the Project is expected to improve the future traffic flow on the local road network with less congestion than the future no build scenario, which will, thereby minimize changes in air quality.

Other measures to minimize impacts of particulate matter and NOx emissions that could be considered include incorporating vegetative barriers in the landscaping design of the Project. The effectiveness of trees and plants as physical barriers for particulate matter (dust) or gaseous contaminants control depends on the density and height of the vegetation. In general, a vegetation barrier should be thick (approximately 6-metres or more) and have full leaf and branch coverage from the ground to the top of the canopy with no gaps in-between or underneath the vegetation. Typically, evergreen species are more effective than deciduous for this objective and the barrier should be located close to the emissions sources (US EPA, 2015).

9.0 Conclusions

The following are the main findings from the air quality and greenhouse gas impact assessment:

- For the Project alone case, the maximum predicted GLCs of all CoPCs are below their relevant AAQC and/or CAAQS at all special receptors for the future build and future no build scenarios.
- Maximum predicted cumulative GLCs (i.e., with background values added) of CoPCs other than NO_2 and B(a)P are below their relevant AAQC and/or CAAQS at all special receptors for all release scenarios.
- Predicted cumulative concentrations of NO_2 exceed the 2025 1-hour CAAQS at two sensitive receptors for the future build scenario but remain well below the provincial AAQC. Predictions for NO_2 are presented as maximum modelled concentrations and are used for comparison to the applicable CAAQS, as CAL3QHCR does not provide outputs that are the appropriate statistical measure required for direct comparison to the standards. Therefore, the results for NO_2 presented and discussed in comparison to the CAAQS are conservatively high.
- Maximum predicted cumulative concentrations of B(a)P exceed the 24-hour and annual average AAQCs at all special receptor locations for all scenarios, with the background concentrations alone exceeding the 24-hour and annual average AAQCs. The maximum predicted 24-hour and annual average cumulative B(a)P concentrations for the future build scenario are 5% and 3% higher than the future no build scenario, respectively. The maximum cumulative B(a)P concentrations are predicted to decrease in the future build and future no build scenarios relative to the existing scenario due to expected future reductions in vehicle emissions.
- During Project construction, best management practices should be followed to minimize emissions. With implementation of proper mitigation measures, emissions from the construction phase and resulting adverse changes in local air quality can be mitigated.
- Releases of GHGs from the Project are expected to be insignificant (less than 0.1%) in comparison to the 2020 Canada and Ontario totals and the 2030 emissions targets.

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February 16, 2023

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Appendix A
Preferred Design Plan

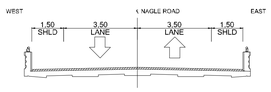
Nagle Road - Preferred Plan

GWP 4059-17-00

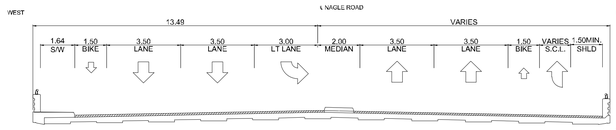
LEGEND

- NEW ROADWAY
- NEW BIKE LANE
- NEW SIDEWALK
- FUTURE ROADWAY
- PROPERTY REQUIRED - Phase 1
- PROPERTY REQUIRED - Phase 2
- PROPERTY REQUIRED - Phase 3
- POSSIBLE ROAD CONNECTION BY THE TOWN OF COBOURG
- PROPERTY ACQUISITION - Phase 2

Nagle Road Bridge Cross Section (Phase 1)



Nagle Road Bridge Cross Section (Phase 2)



Construction Phasing

The Preferred Plan will be constructed in several phases to accommodate structural needs and development growth.
The following construction phases are anticipated at this time; however, the timing of each phase will be dependent on the bridge condition and the actual timing of development.

Phase	Construction
1) Bridge Replacement Phase	Replace bridge only with minor profile adjustments to connect new bridge to existing Nagle Road. Bridge may be constructed as 2-lane bridge only, with provision for future widening
2) Cobourg East Development Phase	Widen bridge, widen Nagle Road, construct interchange ramps (Parclo A2 on north side, Diamond on south side)
3) Possible Future Construction Phase	Construct Ramp N-W and Ramp N-E (Parclo A4), modify Ramp N/S-E and Ramp N/S-W to single movements (S-E and S-W)

Realignment of Danforth Road and Nagle Road Extension to be at least 400 m from interchange south ramp terminal intersection. The final alignments and intersection type (i.e. signalized or roundabout) will be confirmed during the municipal development planning process

Nagle Road Profile

100
1: 2000

Ontario

Stantec

highway401cobourgcolborne.ca

Appendix B
Receptor Map

Stantec

Legend

- Air Receptor
- Preferred Plan
- Parcel Boundary

0 200 400 Meters

1:10,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018.
3. Orthoimagery obtained from Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community,

Project Location
County of Northumberland

165001106 REVA
Prepared by JWH on 2022-09-22
Technical Review by ABC on yyyy-mm-dd
Independent Review by ABC on yyyy-mm-dd

Client/Project
MINISTRY OF TRANSPORTATION
NAGLE ROAD INTERCHANGE STUDY
(GWP 4059-17-00)

Tile No.
B-1

Title
Air Quality and Greenhouse Gas Assessment - Receptor Map

Appendix C
Emission Factors

Summary of g/VMT emission factors by contaminant/ link - 2016 (Including paved road resuspension)																					
Group Link ID	Link ID	Description	2016 AADT	Peak Vehicle Volume (veh/hour)	Assigned Average Speed km/hr	Assigned Average Speed (mph)	Vehicle Distribution	MOVES Generic Link ID	Pollutant Name and ID												
									Carbon Monoxide	Oxides of Nitrogen (Nox)	Benzene	1,3-Butadiene	Formaldehyde	Acetaldehyde	Acrolein	Nitrogen Dioxide (NO2)	Benzo(a)pyrene	PM	PM10	PM2.5	CO2 Equivalent
									2	3	20	24	25	26	27	33	Benzo(a)pyrene	PM	PM10	PM2.5	CO2 Equivalent
EB1	1	West of Nagle	23,223	2,556	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	3.6186645	3.7647262	0.002572556	0.000560707	0.011472655	0.00561727	0.000944796	0.29235571	6.41692E-06	0.81	0.28	0.16	567.984
EB1	2	West of Nagle	23,223	2,556	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	3.6186645	3.7647262	0.002572556	0.000560707	0.011472655	0.00561727	0.000944796	0.29235571	6.41692E-06	0.81	0.28	0.16	567.984
EB1	3	West of Nagle	23,223	2,556	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	3.6186645	3.7647262	0.002572556	0.000560707	0.011472655	0.00561727	0.000944796	0.29235571	6.41692E-06	0.81	0.28	0.16	567.984
EB1	4	West of Nagle	23,223	2,556	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	3.6186645	3.7647262	0.002572556	0.000560707	0.011472655	0.00561727	0.000944796	0.29235571	6.41692E-06	0.81	0.28	0.16	567.984
EB1	5	West of Nagle	23,223	2,556	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	3.6186645	3.7647262	0.002572556	0.000560707	0.011472655	0.00561727	0.000944796	0.29235571	6.41692E-06	0.81	0.28	0.16	567.984
EB1	6	West of Nagle	23,223	2,556	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	3.6186645	3.7647262	0.002572556	0.000560707	0.011472655	0.00561727	0.000944796	0.29235571	6.41692E-06	0.81	0.28	0.16	567.984
WB1	7	West of Nagle	20,277	2,232	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	3.6186645	3.7647262	0.002572556	0.000560707	0.011472655	0.00561727	0.000944796	0.29235571	6.41692E-06	0.81	0.28	0.16	567.984
WB1	8	West of Nagle	20,277	2,232	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	3.6186645	3.7647262	0.002572556	0.000560707	0.011472655	0.00561727	0.000944796	0.29235571	6.41692E-06	0.81	0.28	0.16	567.984
WB1	9	West of Nagle	20,277	2,232	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	3.6186645	3.7647262	0.002572556	0.000560707	0.011472655	0.00561727	0.000944796	0.29235571	6.41692E-06	0.81	0.28	0.16	567.984
WB1	10	West of Nagle	20,277	2,232	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	3.6186645	3.7647262	0.002572556	0.000560707	0.011472655	0.00561727	0.000944796	0.29235571	6.41692E-06	0.81	0.28	0.16	567.984
WB1	11	West of Nagle	20,277	2,232	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	3.6186645	3.7647262	0.002572556	0.000560707	0.011472655	0.00561727	0.000944796	0.29235571	6.41692E-06	0.81	0.28	0.16	567.984
WB1	12	West of Nagle	20,277	2,232	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	3.6186645	3.7647262	0.002572556	0.000560707	0.011472655	0.00561727	0.000944796	0.29235571	6.41692E-06	0.81	0.28	0.16	567.984
EB2	13	East of Nagle	22,774	2,517	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	3.6186645	3.7647262	0.002572556	0.000560707	0.011472655	0.00561727	0.000944796	0.29235571	6.41692E-06	0.81	0.28	0.16	567.984
EB2	14	East of Nagle	22,774	2,517	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	3.6186645	3.7647262	0.002572556	0.000560707	0.011472655	0.00561727	0.000944796	0.29235571	6.41692E-06	0.81	0.28	0.16	567.984
EB2	15	East of Nagle	22,774	2,517	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	3.6186645	3.7647262	0.002572556	0.000560707	0.011472655	0.00561727	0.000944796	0.29235571	6.41692E-06	0.81	0.28	0.16	567.984
EB2	16	East of Nagle	22,774	2,517	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	3.6186645	3.7647262	0.002572556	0.000560707	0.011472655	0.00561727	0.000944796	0.29235571	6.41692E-06	0.81	0.28	0.16	567.984
WB2	17	East of Nagle	19,726	2,180	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	3.6186645	3.7647262	0.002572556	0.000560707	0.011472655	0.00561727	0.000944796	0.29235571	6.41692E-06	0.81	0.28	0.16	567.984
WB2	18	East of Nagle	19,726	2,180	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	3.6186645	3.7647262	0.002572556	0.000560707	0.011472655	0.00561727	0.000944796	0.29235571	6.41692E-06	0.81	0.28	0.16	567.984
WB2	19	East of Nagle	19,726	2,180	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	3.6186645	3.7647262	0.002572556	0.000560707	0.011472655	0.00561727	0.000944796	0.29235571	6.41692E-06	0.81	0.28	0.16	567.984
WB2	20	East of Nagle	19,726	2,180	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	3.6186645	3.7647262	0.002572556	0.000560707	0.011472655	0.00561727	0.000944796	0.29235571	6.41692E-06	0.81	0.28	0.16	567.984
IC1	21	North of Hwy 401	493	54	60	37.3	78% Car and 12% Heavy Truck 10% Medium Truck	2	4.786419	3.15833751	0.003531977	0.000712983	0.01345789	0.006719364	0.001100549	0.27072159	7.49126E-06	16.01	3.23	0.90	560.374
IC1	22	North of Hwy 401	493	54	60	37.3	78% Car and 12% Heavy Truck 10% Medium Truck	2	4.786419	3.15833751	0.003531977	0.000712983	0.01345789	0.006719364	0.001100549	0.27072159	7.49126E-06	16.01	3.23	0.90	560.374
IC1	23	North of Hwy 401	493	54	60	37.3	78% Car and 12% Heavy Truck 10% Medium Truck	2	4.786419	3.15833751	0.003531977	0.000712983	0.01345789	0.006719364	0.001100549	0.27072159	7.49126E-06	16.01	3.23	0.90	560.374
IC2	24	South of Hwy 401	493	54	60	37.3	78% Car and 12% Heavy Truck 10% Medium Truck	2	4.786419	3.15833751	0.003531977	0.000712983	0.01345789	0.006719364	0.001100549	0.27072159	7.49126E-06	16.01	3.23	0.90	560.374
IC2	25	South of Hwy 401	493	54	60	37.3	78% Car and 12% Heavy Truck 10% Medium Truck	2	4.786419	3.15833751	0.003531977	0.000712983	0.01345789	0.006719364	0.001100549	0.27072159	7.49126E-06	16.01	3.23	0.90	560.374

Summary of g/VMT emission factors by contaminant/ link - 2041 (Including paved road resuspension)																					
Group Link ID	Link ID	Description	2041 AADT	Peak Vehicle Volume (veh/hour)	Assigned Average Speed km/hr	Assigned Average Speed (mph)	Vehicle Distribution	MOVES Generic Link ID	Pollutant Name and ID												
									Carbon Monoxide	Oxides of Nitrogen (Nox)	Benzene	1,3-Butadiene	Formaldehyde	Acetaldehyde	Acrolein	Nitrogen Dioxide (NO2)	Benzo(a)pyrene	PM	PM10	PM2.5	CO2 Equivalent
									2	3	20	24	25	26	27	33	Benzo(a)pyrene	PM	PM10	PM2.5	CO2 Equivalent
EB1	1	West of Nagle	42,708	4,701	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
EB1	2	West of Nagle	42,708	4,701	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
EB1	3	West of Nagle	42,708	4,701	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
EB1	4	West of Nagle	42,708	4,701	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
EB1	5	West of Nagle	42,708	4,701	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
EB1	6	West of Nagle	42,708	4,701	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
WB1	7	West of Nagle	37,292	4,105	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
WB1	8	West of Nagle	37,292	4,105	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
WB1	9	West of Nagle	37,292	4,105	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
WB1	10	West of Nagle	37,292	4,105	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
WB1	11	West of Nagle	37,292	4,105	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
WB1	12	West of Nagle	37,292	4,105	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
EB2	13	East of Nagle	42,869	4,737	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
EB2	14	East of Nagle	42,869	4,737	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
EB2	15	East of Nagle	42,869	4,737	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
EB2	16	East of Nagle	42,869	4,737	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
WB2	17	East of Nagle	37,131	4,103	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
WB2	18	East of Nagle	37,131	4,103	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
WB2	19	East of Nagle	37,131	4,103	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
WB2	20	East of Nagle	37,131	4,103	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
IC1	21	North of Hwy 401	850	94	60	37.3	78% Car and 12% Heavy Truck 10% Medium Truck	2	1.02268319	0.52526234	0.000176117	1.18247E-07	0.000332265	0.000448822	3.87431E-05	0.20832799	1.38894E-07	5.88	1.18	0.29	383.15
IC1	22	North of Hwy 401	850	94	60	37.3	78% Car and 12% Heavy Truck 10% Medium Truck	2	1.02268319	0.52526234	0.000176117	1.18247E-07	0.000332265	0.000448822	3.87431E-05	0.20832799	1.38894E-07	5.88	1.18	0.29	383.15
IC1	23	North of Hwy 401	850	94	60	37.3	78% Car and 12% Heavy Truck 10% Medium Truck	2	1.02268319	0.52526234	0.000176117	1.18247E-07	0.000332265	0.000448822	3.87431E-05	0.20832799	1.38894E-07	5.88	1.18	0.29	383.15
IC2	24	South of Hwy 401	850	94	60	37.3	78% Car and 12% Heavy Truck 10% Medium Truck	2	1.02268319	0.52526234	0.000176117	1.18247E-07	0.000332265	0.000448822	3.87431E-05	0.20832799	1.38894E-07	5.88	1.18	0.29	383.15
IC2	25	South of Hwy 401	850	94	60	37.3	78% Car and 12% Heavy Truck 10% Medium Truck	2	1.02268319	0.52526234	0.000176117	1.18247E-07	0.000332265	0.000448822	3.87431E-05	0.20832799	1.38894E-07	5.88	1.18	0.29	383.15

Note: MOVES3 emission factors are from the model year 2041 except for 1,3-butadiene which are from 2039.

Summary of g/VMT emission factors by contaminant/ link - 2041 (Including paved road resuspension)																					
Group Link ID	Link ID	Description	2041 AADT	Peak Vehicle Volume (veh/hour)	Assigned Average Speed km/hr	Assigned Average Speed (mph)	Vehicle Distribution	MOVES Generic Link ID	Pollutant Name and ID												
									Carbon Monoxide	Oxides of Nitrogen (Nox)	Benzene	1,3-Butadiene	Formaldehyde	Acetaldehyde	Acrolein	Nitrogen Dioxide (NO2)	Benzo(a)pyrene	PM	PM10	PM2.5	CO2 Equivalent
									2	3	20	24	25	26	27	33	Benzo(a)pyrene	PM	PM10	PM2.5	CO2 Equivalent
EB1	1	West of Nagle	45,911	5,054	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
EB1	2	West of Nagle	45,911	5,054	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
EB1	3	West of Nagle	45,911	5,054	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
EB1	4	West of Nagle	45,911	5,054	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
EB1	5	West of Nagle	45,911	5,054	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
EB1	6	West of Nagle	45,911	5,054	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
WB1	7	West of Nagle	40,089	4,413	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
WB1	8	West of Nagle	40,089	4,413	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
WB1	9	West of Nagle	40,089	4,413	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
WB1	10	West of Nagle	40,089	4,413	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
WB1	11	West of Nagle	40,089	4,413	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
WB1	12	West of Nagle	40,089	4,413	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
EB2	13	East of Nagle	42,869	4,737	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
EB2	14	East of Nagle	42,869	4,737	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
EB2	15	East of Nagle	42,869	4,737	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
EB2	16	East of Nagle	42,869	4,737	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
WB2	17	East of Nagle	37,131	4,103	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
WB2	18	East of Nagle	37,131	4,103	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
WB2	19	East of Nagle	37,131	4,103	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
WB2	20	East of Nagle	37,131	4,103	100	62.1	76% Car and 19% Heavy Truck 5% Medium Truck	1	0.77345576	0.3606246	0.000124026	1.14998E-07	0.000298627	0.00041816	3.60975E-05	0.14280898	1.18362E-07	0.69	0.15	0.04	398.108
IC1	21	North of Hwy 401	11,700	1,291	30	18.6	78% Car and 12% Heavy Truck 10% Medium Truck	3	1.72847629	1.0587727	0.000268134	2.04782E-07	0.000584472	0.000805473	6.95309E-05	0.42053797	2.01673E-07	1.19	0.35	0.08	522.477
IC1	22	North of Hwy 401	11,700	1,291	30	18.6	78% Car and 12% Heavy Truck 10% Medium Truck	3	1.72847629	1.0587727	0.000268134	2.04782E-07	0.000584472	0.000805473	6.95309E-05	0.42053797	2.01673E-07	1.19	0.35	0.08	522.477
IC1	23	North of Hwy 401	11,700	1,291	30	18.6	78% Car and 12% Heavy Truck 10% Medium Truck	3	1.72847629	1.0587727	0.000268134	2.04782E-07	0.000584472	0.000805473	6.95309E-05	0.42053797	2.01673E-07	1.19	0.35	0.08	522.477
IC2	24	South of Hwy 401	32,600	3,591	30	18.6	78% Car and 12% Heavy Truck 10% Medium Truck	3	1.72847629	1.0587727	0.000268134	2.04782E-07	0.000584472	0.000805473	6.95309E-05	0.42053797	2.01673E-07	1.19	0.35	0.08	522.477
IC2	25	South of Hwy 401	32,600	3,591	30	18.6	78% Car and 12% Heavy Truck 10% Medium Truck	3	1.72847629	1.0587727	0.000268134	2.04782E-07	0.000584472	0.000805473	6.95309E-05	0.42053797	2.01673E-07	1.19	0.35	0.08	522.477
R1	26	EB to NB/SB	9,200	904	30	18.6	76% Car and 19% Heavy Truck 5% Medium Truck	4	1.86987461	1.3992809	0.000261259	3.08001E-07	0.000751755	0.001070557	9.24163E-05	0.55608192	1.96502E-07	2.52	0.62	0.14	588.832
R1	27	EB to NB/SB	9,200	904	30	18.6	76% Car and 19% Heavy Truck 5% Medium Truck	4	1.86987461	1.3992809	0.000261259	3.08001E-07	0.000751755	0.001070557	9.24163E-05	0.55608192	1.96502E-07	2.52	0.62	0.14	588.832
R1	28	EB to NB/SB	9,200	904	30	18.6	76% Car and 19% Heavy Truck 5% Medium Truck	4	1.86987461	1.3992809	0.000261259	3.08001E-07	0.000751755	0.001070557	9.24163E-05	0.55608192	1.96502E-07	2.52	0.62	0.14	588.832
R2	29	WB to NB/SB	3,700	400	30	18.6	76% Car and 19% Heavy Truck 5% Medium Truck	4	1.86987461	1.3992809	0.000261259	3.08001E-07	0.000751755	0.001070557	9.24163E-05	0.55608192	1.96502E-07	7.19	1.51	0.37	588.832
R2	30	WB to NB/SB	3,700	400	30	18.6	76% Car and 19% Heavy Truck 5% Medium Truck	4	1.86987461	1.3992809	0.000261259	3.08001E-07	0.000751755	0.001070557	9.24163E-05	0.55608192	1.96502E-07	7.19	1.51	0.37	588.832
R2	31	WB to NB/SB	3,700	400	30	18.6	76% Car and 19% Heavy Truck 5% Medium Truck	4	1.86987461	1.3992809	0.000261259	3.08001E-07	0.000751755	0.001070557	9.24163E-05	0.55608192	1.96502E-07	7.19	1.51	0.37	588.832
R3	32	NB/SB to EB	5,300	585	60	37.3	78% Car and 12% Heavy Truck 10% Medium Truck	2	1.02268319	0.52526234	0.000176117	1.18247E-07	0.000332265	0.000448822	3.87431E-05	0.20832799	1.38894E-07	2.01	0.44	0.11	383.15
R3	33	NB/SB to EB	5,300	585	60	37.3	78% Car and 12% Heavy Truck 10% Medium Truck	2	1.02268319	0.52526234	0.000176117	1.18247E-07	0.000332265	0.000448822	3.87431E-05	0.20832799	1.38894E-07	2.01	0.44	0.11	383.15
R3	34	NB/SB to EB	5,300	585	60	37.3	78% Car and 12% Heavy Truck 10% Medium Truck	2	1.02268319	0.52526234	0.000176117	1.18247E-07	0.000332265	0.000448822	3.87431E-05	0.20832799	1.38894E-07	2.01	0.44	0.11	383.15
R4	35	NB/SB to WB	9,600	719	30	18.6	78% Car and 12% Heavy Truck 10% Medium Truck	3	1.72847629	1.0587727	0.000268134	2.04782E-07	0.000584472	0.000805473	6.95309E-05	0.42053797	2.01673E-07	2.10	0.53	0.12	522.477
R4	36	NB/SB to WB	9,600	719	30	18.6	78% Car and 12% Heavy Truck 10% Medium Truck	3	1.72847629	1.0587727	0.000268134	2.04782E-07	0.000584472	0.000805473	6.95309E-05	0.42053797	2.01673E-07	2.10	0.53	0.12	522.477
R4	37	NB/SB to WB	9,600	719	30	18.6	78% Car and 12% Heavy Truck 10% Medium Truck	3	1.72847629	1.0587727	0.000268134	2.04782E-07	0.000584472	0.000805473	6.95309E-05	0.42053797	2.01673E-07	2.10	0.53	0.12	522.477
R4	38	NB/SB to WB	9,600	719	30	18.6	78% Car and 12% Heavy Truck 10% Medium Truck	3	1.72847629	1.0587727	0.000268134	2.04782E-07	0.000584472	0.000805473	6.95309E-05	0.42053797	2.01673E-07	2.10	0.53	0.12	522.477

Note: Emission factors for all contaminants are for the model year 2041 except for 1,3-butadiene which are from model year 2039.

Appendix D
Traffic Volumes and Hourly Distribution Data

								CAL3QHCR Group Link ID		2016 Existing Hwy 401 6-lanes Nagle Overpass 2-lanes			2041 No Build Hwy 401 8-lanes Nagle Replacement Overpass 2-lanes			2041 Build Hwy 401 8-lanes Nagle Replacement Interchange 4-lanes		
Grade Separation Site	**Road Segment**	**Travel Direction**	**Existing/Future No Build Posted Speed (km/h)**	**Assumed Average Future Build Traffic Speed (km/h)**	**% Passenger Cars**	**% Heavy Truck**	**% Medium Truck**	**Existing/ No Build**	**Build**	**AADT**	**AADT for Each Direction of Travel**	**PM Peak Hour Volume**	**AADT**	**AADT for Each Direction of Travel**	**PM Peak Hour Volume**	**AADT**	**AADT for Each Direction of Travel**	**PM Peak Hour Volume**
Highway 401	West of Nagle Road	EB	100	100	76%	19%	5%	EB1	EB1	43,500	23,223	2,556	80,000	42,708	4,701	86,000	45,911	5,054
	West of Nagle Road	WB	100	100	76%	19%	5%	WB1	WB1		20,277	2,232		37,292	4,105		40,089	4,413
	East of Nagle Road	EB	100	100	76%	19%	5%	EB2	EB2	42,500	22,774	2,517	80,000	42,869	4,737	80,000	42,869	4,737
	East of Nagle Road	WB	100	100	76%	19%	5%	WB2	WB2		19,726	2,180		37,131	4,103		37,131	4,103
Nagle Road Bridge	North of Hwy 401	NB/SB	60	30	78%	12%	10%	IC1	IC1	493	-	54	850	-	94	11,700	-	1,291
	South of Hwy 401	NB/SB	60	30	78%	12%	10%	IC2	IC2	493	-	54	850	-	94	32,600	-	3,591
Nagle Road Ramps	Exit Ramps	EB to NB/SB	-	30	76%	19%	5%	-	R1	-	-	-	-	-	-	9,200	9,200	904
		WB to NB/SB	-	30	76%	19%	5%	-	R2	-	-	-	-	-	-	3,700	3,700	400
	On Ramps	NB/SB to EB	-	60	78%	12%	10%	-	R3	-	-	-	-	-	-	5,300	5,300	585
		NB/SB to WB	-	30	78%	12%	10%	-	R4	-	-	-				9,600	9,600	719

		Traffic Distribution	1%	1%	1%	1%	1%	2%	3%	3%	4%	4%	6%	7%	7%	7%	7%	7%	7%	7%	6%	6%	5%	4%	3%	2%
			Existing (2016) Scenario Hourly Traffic Volumes																							
Group Link ID	**Link ID**	**2016 AADT**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
EB1	1	23,223	309	230	209	199	245	397	607	743	878	1,030	1,354	1,574	1,618	1,666	1,668	1,660	1,538	1,523	1,374	1,312	1,078	884	669	457
EB1	2	23,223	309	230	209	199	245	397	607	743	878	1,030	1,354	1,574	1,618	1,666	1,668	1,660	1,538	1,523	1,374	1,312	1,078	884	669	457
EB1	3	23,223	309	230	209	199	245	397	607	743	878	1,030	1,354	1,574	1,618	1,666	1,668	1,660	1,538	1,523	1,374	1,312	1,078	884	669	457
EB1	4	23,223	309	230	209	199	245	397	607	743	878	1,030	1,354	1,574	1,618	1,666	1,668	1,660	1,538	1,523	1,374	1,312	1,078	884	669	457
EB1	5	23,223	309	230	209	199	245	397	607	743	878	1,030	1,354	1,574	1,618	1,666	1,668	1,660	1,538	1,523	1,374	1,312	1,078	884	669	457
EB1	6	23,223	309	230	209	199	245	397	607	743	878	1,030	1,354	1,574	1,618	1,666	1,668	1,660	1,538	1,523	1,374	1,312	1,078	884	669	457
WB1	7	20,277	270	201	182	174	214	347	530	649	767	899	1,182	1,375	1,412	1,455	1,457	1,450	1,343	1,330	1,200	1,146	941	772	584	399
WB1	8	20,277	270	201	182	174	214	347	530	649	767	899	1,182	1,375	1,412	1,455	1,457	1,450	1,343	1,330	1,200	1,146	941	772	584	399
WB1	9	20,277	270	201	182	174	214	347	530	649	767	899	1,182	1,375	1,412	1,455	1,457	1,450	1,343	1,330	1,200	1,146	941	772	584	399
WB1	10	20,277	270	201	182	174	214	347	530	649	767	899	1,182	1,375	1,412	1,455	1,457	1,450	1,343	1,330	1,200	1,146	941	772	584	399
WB1	11	20,277	270	201	182	174	214	347	530	649	767	899	1,182	1,375	1,412	1,455	1,457	1,450	1,343	1,330	1,200	1,146	941	772	584	399
WB1	12	20,277	270	201	182	174	214	347	530	649	767	899	1,182	1,375	1,412	1,455	1,457	1,450	1,343	1,330	1,200	1,146	941	772	584	399
EB2	13	22,774	303	226	205	195	240	390	595	729	861	1,010	1,328	1,544	1,586	1,634	1,636	1,628	1,508	1,493	1,348	1,287	1,057	867	656	448
EB2	14	22,774	303	226	205	195	240	390	595	729	861	1,010	1,328	1,544	1,586	1,634	1,636	1,628	1,508	1,493	1,348	1,287	1,057	867	656	448
EB2	15	22,774	303	226	205	195	240	390	595	729	861	1,010	1,328	1,544	1,586	1,634	1,636	1,628	1,508	1,493	1,348	1,287	1,057	867	656	448
EB2	16	22,774	303	226	205	195	240	390	595	729	861	1,010	1,328	1,544	1,586	1,634	1,636	1,628	1,508	1,493	1,348	1,287	1,057	867	656	448
WB2	17	19,726	263	196	177	169	208	337	515	631	746	875	1,150	1,337	1,374	1,415	1,417	1,410	1,307	1,294	1,167	1,115	915	751	568	388
WB2	18	19,726	263	196	177	169	208	337	515	631	746	875	1,150	1,337	1,374	1,415	1,417	1,410	1,307	1,294	1,167	1,115	915	751	568	388
WB2	19	19,726	263	196	177	169	208	337	515	631	746	875	1,150	1,337	1,374	1,415	1,417	1,410	1,307	1,294	1,167	1,115	915	751	568	388
WB2	20	19,726	263	196	177	169	208	337	515	631	746	875	1,150	1,337	1,374	1,415	1,417	1,410	1,307	1,294	1,167	1,115	915	751	568	388
IC1	21	493	7	5	4	4	5	8	13	16	19	22	29	33	34	35	35	35	33	32	29	28	23	19	14	10
IC1	22	493	7	5	4	4	5	8	13	16	19	22	29	33	34	35	35	35	33	32	29	28	23	19	14	10
IC1	23	493	7	5	4	4	5	8	13	16	19	22	29	33	34	35	35	35	33	32	29	28	23	19	14	10
IC2	24	493	7	5	4	4	5	8	13	16	19	22	29	33	34	35	35	35	33	32	29	28	23	19	14	10
IC2	25	493	7	5	4	4	5	8	13	16	19	22	29	33	34	35	35	35	33	32	29	28	23	19	14	10

		Traffic Distribution	1%	1%	1%	1%	1%	2%	3%	3%	4%	4%	6%	7%	7%	7%	7%	7%	7%	7%	6%	6%	5%	4%	3%	2%
			Ultimate No Build (2041) Scenario Hourly Traffic Volumes																							
Group Link ID	**Link ID**	**2041 AADT**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
EB1	1	42,708	569	424	384	366	451	731	1,115	1,367	1,615	1,894	2,490	2,895	2,975	3,065	3,068	3,053	2,829	2,801	2,527	2,414	1,982	1,625	1,230	840
EB1	2	42,708	569	424	384	366	451	731	1,115	1,367	1,615	1,894	2,490	2,895	2,975	3,065	3,068	3,053	2,829	2,801	2,527	2,414	1,982	1,625	1,230	840
EB1	3	42,708	569	424	384	366	451	731	1,115	1,367	1,615	1,894	2,490	2,895	2,975	3,065	3,068	3,053	2,829	2,801	2,527	2,414	1,982	1,625	1,230	840
EB1	4	42,708	569	424	384	366	451	731	1,115	1,367	1,615	1,894	2,490	2,895	2,975	3,065	3,068	3,053	2,829	2,801	2,527	2,414	1,982	1,625	1,230	840
EB1	5	42,708	569	424	384	366	451	731	1,115	1,367	1,615	1,894	2,490	2,895	2,975	3,065	3,068	3,053	2,829	2,801	2,527	2,414	1,982	1,625	1,230	840
EB1	6	42,708	569	424	384	366	451	731	1,115	1,367	1,615	1,894	2,490	2,895	2,975	3,065	3,068	3,053	2,829	2,801	2,527	2,414	1,982	1,625	1,230	840
WB1	7	37,292	497	370	335	320	393	638	974	1,193	1,410	1,654	2,174	2,528	2,597	2,676	2,679	2,666	2,470	2,445	2,207	2,108	1,730	1,419	1,074	734
WB1	8	37,292	497	370	335	320	393	638	974	1,193	1,410	1,654	2,174	2,528	2,597	2,676	2,679	2,666	2,470	2,445	2,207	2,108	1,730	1,419	1,074	734
WB1	9	37,292	497	370	335	320	393	638	974	1,193	1,410	1,654	2,174	2,528	2,597	2,676	2,679	2,666	2,470	2,445	2,207	2,108	1,730	1,419	1,074	734
WB1	10	37,292	497	370	335	320	393	638	974	1,193	1,410	1,654	2,174	2,528	2,597	2,676	2,679	2,666	2,470	2,445	2,207	2,108	1,730	1,419	1,074	734
WB1	11	37,292	497	370	335	320	393	638	974	1,193	1,410	1,654	2,174	2,528	2,597	2,676	2,679	2,666	2,470	2,445	2,207	2,108	1,730	1,419	1,074	734
WB1	12	37,292	497	370	335	320	393	638	974	1,193	1,410	1,654	2,174	2,528	2,597	2,676	2,679	2,666	2,470	2,445	2,207	2,108	1,730	1,419	1,074	734
EB2	13	42,869	571	425	385	368	452	733	1,120	1,372	1,621	1,901	2,500	2,906	2,986	3,076	3,080	3,065	2,839	2,811	2,537	2,423	1,989	1,631	1,235	844
EB2	14	42,869	571	425	385	368	452	733	1,120	1,372	1,621	1,901	2,500	2,906	2,986	3,076	3,080	3,065	2,839	2,811	2,537	2,423	1,989	1,631	1,235	844
EB2	15	42,869	571	425	385	368	452	733	1,120	1,372	1,621	1,901	2,500	2,906	2,986	3,076	3,080	3,065	2,839	2,811	2,537	2,423	1,989	1,631	1,235	844
EB2	16	42,869	571	425	385	368	452	733	1,120	1,372	1,621	1,901	2,500	2,906	2,986	3,076	3,080	3,065	2,839	2,811	2,537	2,423	1,989	1,631	1,235	844
WB2	17	37,131	495	368	333	318	392	635	970	1,188	1,404	1,646	2,165	2,517	2,586	2,664	2,667	2,655	2,459	2,435	2,197	2,098	1,723	1,413	1,070	731
WB2	18	37,131	495	368	333	318	392	635	970	1,188	1,404	1,646	2,165	2,517	2,586	2,664	2,667	2,655	2,459	2,435	2,197	2,098	1,723	1,413	1,070	731
WB2	19	37,131	495	368	333	318	392	635	970	1,188	1,404	1,646	2,165	2,517	2,586	2,664	2,667	2,655	2,459	2,435	2,197	2,098	1,723	1,413	1,070	731
WB2	20	37,131	495	368	333	318	392	635	970	1,188	1,404	1,646	2,165	2,517	2,586	2,664	2,667	2,655	2,459	2,435	2,197	2,098	1,723	1,413	1,070	731
IC1	21	850	11	8	8	7	9	15	22	27	32	38	50	58	59	61	61	61	56	56	50	48	39	32	24	17
IC1	22	850	11	8	8	7	9	15	22	27	32	38	50	58	59	61	61	61	56	56	50	48	39	32	24	17
IC1	23	850	11	8	8	7	9	15	22	27	32	38	50	58	59	61	61	61	56	56	50	48	39	32	24	17
IC2	24	850	11	8	8	7	9	15	22	27	32	38	50	58	59	61	61	61	56	56	50	48	39	32	24	17
IC2	25	850	11	8	8	7	9	15	22	27	32	38	50	58	59	61	61	61	56	56	50	48	39	32	24	17

		Traffic Distribution	1%	1%	1%	1%	1%	2%	3%	3%	4%	4%	6%	7%	7%	7%	7%	7%	7%	7%	6%	6%	5%	4%	3%	2%
			Ultimate Build (2041) Scenario Hourly Traffic Volumes																							
Group Link ID	**Link ID**	**2041 AADT**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
EB1	1	45,911	612	455	412	394	484	785	1,199	1,469	1,736	2,036	2,677	3,113	3,198	3,294	3,298	3,282	3,041	3,011	2,717	2,595	2,130	1,747	1,322	903
EB1	2	45,911	612	455	412	394	484	785	1,199	1,469	1,736	2,036	2,677	3,113	3,198	3,294	3,298	3,282	3,041	3,011	2,717	2,595	2,130	1,747	1,322	903
EB1	3	45,911	612	455	412	394	484	785	1,199	1,469	1,736	2,036	2,677	3,113	3,198	3,294	3,298	3,282	3,041	3,011	2,717	2,595	2,130	1,747	1,322	903
EB1	4	45,911	612	455	412	394	484	785	1,199	1,469	1,736	2,036	2,677	3,113	3,198	3,294	3,298	3,282	3,041	3,011	2,717	2,595	2,130	1,747	1,322	903
EB1	5	45,911	612	455	412	394	484	785	1,199	1,469	1,736	2,036	2,677	3,113	3,198	3,294	3,298	3,282	3,041	3,011	2,717	2,595	2,130	1,747	1,322	903
EB1	6	45,911	612	455	412	394	484	785	1,199	1,469	1,736	2,036	2,677	3,113	3,198	3,294	3,298	3,282	3,041	3,011	2,717	2,595	2,130	1,747	1,322	903
WB1	7	40,089	534	398	360	344	423	686	1,047	1,283	1,516	1,778	2,337	2,718	2,792	2,877	2,880	2,866	2,655	2,629	2,372	2,266	1,860	1,526	1,155	789
WB1	8	40,089	534	398	360	344	423	686	1,047	1,283	1,516	1,778	2,337	2,718	2,792	2,877	2,880	2,866	2,655	2,629	2,372	2,266	1,860	1,526	1,155	789
WB1	9	40,089	534	398	360	344	423	686	1,047	1,283	1,516	1,778	2,337	2,718	2,792	2,877	2,880	2,866	2,655	2,629	2,372	2,266	1,860	1,526	1,155	789
WB1	10	40,089	534	398	360	344	423	686	1,047	1,283	1,516	1,778	2,337	2,718	2,792	2,877	2,880	2,866	2,655	2,629	2,372	2,266	1,860	1,526	1,155	789
WB1	11	40,089	534	398	360	344	423	686	1,047	1,283	1,516	1,778	2,337	2,718	2,792	2,877	2,880	2,866	2,655	2,629	2,372	2,266	1,860	1,526	1,155	789
WB1	12	40,089	534	398	360	344	423	686	1,047	1,283	1,516	1,778	2,337	2,718	2,792	2,877	2,880	2,866	2,655	2,629	2,372	2,266	1,860	1,526	1,155	789
EB2	13	42,869	571	425	385	368	452	733	1,120	1,372	1,621	1,901	2,500	2,906	2,986	3,076	3,080	3,065	2,839	2,811	2,537	2,423	1,989	1,631	1,235	844
EB2	14	42,869	571	425	385	368	452	733	1,120	1,372	1,621	1,901	2,500	2,906	2,986	3,076	3,080	3,065	2,839	2,811	2,537	2,423	1,989	1,631	1,235	844
EB2	15	42,869	571	425	385	368	452	733	1,120	1,372	1,621	1,901	2,500	2,906	2,986	3,076	3,080	3,065	2,839	2,811	2,537	2,423	1,989	1,631	1,235	844
EB2	16	42,869	571	425	385	368	452	733	1,120	1,372	1,621	1,901	2,500	2,906	2,986	3,076	3,080	3,065	2,839	2,811	2,537	2,423	1,989	1,631	1,235	844
WB2	17	37,131	495	368	333	318	392	635	970	1,188	1,404	1,646	2,165	2,517	2,586	2,664	2,667	2,655	2,459	2,435	2,197	2,098	1,723	1,413	1,070	731
WB2	18	37,131	495	368	333	318	392	635	970	1,188	1,404	1,646	2,165	2,517	2,586	2,664	2,667	2,655	2,459	2,435	2,197	2,098	1,723	1,413	1,070	731
WB2	19	37,131	495	368	333	318	392	635	970	1,188	1,404	1,646	2,165	2,517	2,586	2,664	2,667	2,655	2,459	2,435	2,197	2,098	1,723	1,413	1,070	731
WB2	20	37,131	495	368	333	318	392	635	970	1,188	1,404	1,646	2,165	2,517	2,586	2,664	2,667	2,655	2,459	2,435	2,197	2,098	1,723	1,413	1,070	731
IC1	21	11,700	156	116	105	100	123	200	306	374	442	519	682	793	815	840	840	836	775	767	692	661	543	445	337	230
IC1	22	11,700	156	116	105	100	123	200	306	374	442	519	682	793	815	840	840	836	775	767	692	661	543	445	337	230
IC1	23	11,700	156	116	105	100	123	200	306	374	442	519	682	793	815	840	840	836	775	767	692	661	543	445	337	230
IC2	24	32,600	434	323	293	280	344	558	851	1,043	1,233	1,445	1,901	2,210	2,271	2,339	2,342	2,331	2,159	2,138	1,929	1,842	1,513	1,241	939	641
IC2	25	32,600	434	323	293	280	344	558	851	1,043	1,233	1,445	1,901	2,210	2,271	2,339	2,342	2,331	2,159	2,138	1,929	1,842	1,513	1,241	939	641
R1	26	9,200	123	91	83	79	97	157	240	294	348	408	536	624	641	660	661	658	609	603	544	520	427	350	265	181
R1	27	9,200	123	91	83	79	97	157	240	294	348	408	536	624	641	660	661	658	609	603	544	520	427	350	265	181
R1	28	9,200	123	91	83	79	97	157	240	294	348	408	536	624	641	660	661	658	609	603	544	520	427	350	265	181
R2	29	3,700	49	37	33	32	39	63	97	118	140	164	216	251	258	265	266	265	245	243	219	209	172	141	107	73
R2	30	3,700	49	37	33	32	39	63	97	118	140	164	216	251	258	265	266	265	245	243	219	209	172	141	107	73
R2	31	3,700	49	37	33	32	39	63	97	118	140	164	216	251	258	265	266	265	245	243	219	209	172	141	107	73
R3	32	5,300	71	53	48	45	56	91	138	170	200	235	309	359	369	380	381	379	351	348	314	300	246	202	153	104
R3	33	5,300	71	53	48	45	56	91	138	170	200	235	309	359	369	380	381	379	351	348	314	300	246	202	153	104
R3	34	5,300	71	53	48	45	56	91	138	170	200	235	309	359	369	380	381	379	351	348	314	300	246	202	153	104
R4	35	9,600	128	95	86	82	101	164	251	307	363	426	560	651	669	689	690	686	636	630	568	543	445	365	277	189
R4	36	9,600	128	95	86	82	101	164	251	307	363	426	560	651	669	689	690	686	636	630	568	543	445	365	277	189
R4	37	9,600	128	95	86	82	101	164	251	307	363	426	560	651	669	689	690	686	636	630	568	543	445	365	277	189
R4	38	9,600	128	95	86	82	101	164	251	307	363	426	560	651	669	689	690	686	636	630	568	543	445	365	277	189

Appendix E
Greenhouse Gas Emissions

MTO 401 Nagle Rd EA - Greenhouse Gas Emissions Existing (2016) Scenario

Link [1]	Start of Link		End of Link		Length [2] (m)	Length (miles)	AADT [3]	Annual Miles travelled [4] (VMT/ year)	CO2 Equivalent Emission Factor [5] (g/VMT)	Annual CO2 Equivalent Emissions [6] (t CO2e/ year)
	Easting (m)	Northing (m)	Easting (m)	Northing (m)						
1	727259	4874601	727464	4874792	281	0.17	23,223	1,479,191	568	840
2	727464	4874792	727654	4874911	224	0.14	23,223	1,180,465	568	670
3	727654	4874911	727852	4874974	208	0.13	23,223	1,094,952	568	622
4	727852	4874974	728636	4875024	786	0.49	23,223	4,137,428	568	2,350
5	728636	4875024	728811	4875060	179	0.11	23,223	940,972	568	534
6	728811	4875060	728966	4875116	164	0.10	23,223	865,517	568	492
7	728961	4875129	728805	4875074	165	0.10	20,277	757,992	568	431
8	728805	4875074	728631	4875043	177	0.11	20,277	815,331	568	463
9	728631	4875043	727848	4874994	785	0.49	20,277	3,608,905	568	2,050
10	727848	4874994	727644	4874929	213	0.13	20,277	981,199	568	557
11	727644	4874929	727452	4874808	228	0.14	20,277	1,047,296	568	595
12	727452	4874808	727242	4874614	285	0.18	20,277	1,312,244	568	745
13	728966	4875116	729083	4875173	130	0.08	22,774	671,566	568	381
14	729083	4875173	729246	4875280	195	0.12	22,774	1,007,019	568	572
15	729246	4875280	729918	4875812	858	0.53	22,774	4,430,156	568	2,516
16	729918	4875812	730760	4876222	937	0.58	22,774	4,838,702	568	2,748
17	730753	4876238	729906	4875823	943	0.59	19,726	4,216,746	568	2,395
18	729906	4875823	729234	4875292	856	0.53	19,726	3,831,569	568	2,176
19	729234	4875292	729073	4875182	195	0.12	19,726	873,322	568	496
20	729073	4875182	728961	4875129	124	0.08	19,726	556,924	568	316
21	728632	4875990	728827	4875476	550	0.34	493	61,489	560	34
22	728827	4875476	728942	4875178	320	0.20	493	35,756	560	20
23	728942	4875178	728962	4875127	54	0.03	493	6,018	560	3
24	728962	4875127	728979	4875082	49	0.03	493	5,467	560	3
25	728979	4875082	729109	4874735	370	0.23	493	41,381	560	23
Total	-	-	-	-	-	-	-	-	-	22,035

Notes:

(1) Link ID and coordinates selected based on available road traffic data within study area.

(2) Calculated based on each link's starting and ending coordinates. Sample calculation:Length (m) = $SQRT((Y_2-Y_1)^2+(X_2-X_1)^2)$

(3) 2016 Existing AADT provided by project design team.

(4) Annual Vehicle miles travelled in one year (VMT/year) = AADT x Link Length (mil) x 365 day/year

(5) MOVES emission factor assigned to each link.

(6) Annual CO_2 Equivalent Emissions (kg CO_{2e}/ year) = Annual miles travelled per year (VMT/year) x Weighted CO_2 Emission Factor (g/VMT) / 1000 g / kg / 1000 kg/tonne

MTO 401 Nagle Rd EA - Greenhouse Gas Emissions Future (2041) Ultimate No Build Scenario

Link [1]	Start of Link		End of Link		Length [2] (m)	Length (miles)	AADT [3]	Annual Miles travelled [4] (VMT/ year)	CO2 Equivalent Emission Factor [5] (g/VMT)	Annual CO2 Equivalent Emissions [6] (t CO2e/ year)
	Easting (m)	Northing (m)	Easting (m)	Northing (m)						
1	727259	4874601	727464	4874792	281	0.17	42,708	2,720,290	398	1,083
2	727464	4874792	727654	4874911	224	0.14	42,708	2,170,921	398	864
3	727654	4874911	727852	4874974	208	0.13	42,708	2,013,660	398	802
4	727852	4874974	728636	4875024	786	0.49	42,708	7,608,891	398	3,029
5	728636	4875024	728811	4875060	179	0.11	42,708	1,730,483	398	689
6	728811	4875060	728966	4875116	164	0.10	42,708	1,591,719	398	634
7	728961	4875129	728805	4875074	165	0.10	37,292	1,394,044	398	555
8	728805	4875074	728631	4875043	177	0.11	37,292	1,499,498	398	597
9	728631	4875043	727848	4874994	785	0.49	37,292	6,637,239	398	2,642
10	727848	4874994	727644	4874929	213	0.13	37,292	1,804,550	398	718
11	727644	4874929	727452	4874808	228	0.14	37,292	1,926,111	398	767
12	727452	4874808	727242	4874614	285	0.18	37,292	2,413,384	398	961
13	728966	4875116	729083	4875173	130	0.08	42,869	1,264,132	398	503
14	729083	4875173	729246	4875280	195	0.12	42,869	1,895,579	398	755
15	729246	4875280	729918	4875812	858	0.53	42,869	8,339,175	398	3,320
16	729918	4875812	730760	4876222	937	0.58	42,869	9,108,207	398	3,626
17	730753	4876238	729906	4875823	943	0.59	37,131	7,937,342	398	3,160
18	729906	4875823	729234	4875292	856	0.53	37,131	7,212,307	398	2,871
19	729234	4875292	729073	4875182	195	0.12	37,131	1,643,887	398	654
20	729073	4875182	728961	4875129	124	0.08	37,131	1,048,318	398	417
21	728632	4875990	728827	4875476	550	0.34	850	106,016	383	41
22	728827	4875476	728942	4875178	320	0.20	850	61,648	383	24
23	728942	4875178	728962	4875127	54	0.03	850	10,377	383	4
24	728962	4875127	728979	4875082	49	0.03	850	9,425	383	4
25	728979	4875082	729109	4874735	370	0.23	850	71,347	383	27
Total	-	-	-	-	-	-		-	-	28,747

Notes:

(1) Link ID and coordinates selected based on available road traffic data within study area.

(2) Calculated based on each link's starting and ending coordinates. Sample calculation:Length (m) = SQRT((Y_2-Y_1)^2+(X_2-X_1)^2)

(3) 2041 no build AADT provided by project design team.

(4) Annual Vehicle miles travelled in one year (VMT/year) = AADT x Link Length (mil) x 365 day/year

(5) MOVES emission factor assigned to each link.

(6) Annual CO_2 Equivalent Emissions (kg CO_{2e}/ year) = Annual miles travelled per year (VMT/year) x Weighted CO_2 Emission Factor (g/VMT) / 1000 g / kg / 1000 kg/tonne

MTO 401 Nagle Rd EA - Greenhouse Gas Emissions Future (2041) Ultimate Build Scenario

Link [1]	Start of Link		End of Link		Length [2] (m)	Length (miles)	AADT [3]	Annual Miles travelled [4] (VMT/ year)	CO2 Equivalent Emission Factor [5] (g/VMT)	Annual CO2 Equivalent Emissions [6] (t CO2e/ year)
	Easting (m)	Northing (m)	Easting (m)	Northing (m)						
1	727259	4874601	727464	4874792	281	0.17	45,911	2,924,317	398	1,164
2	727464	4874792	727654	4874911	224	0.14	45,911	2,333,786	398	929
3	727654	4874911	727852	4874974	208	0.13	45,911	2,164,591	398	862
4	727852	4874974	728636	4875024	786	0.49	45,911	8,179,534	398	3,256
5	728636	4875024	728811	4875060	179	0.11	45,911	1,860,362	398	741
6	728811	4875060	728966	4875116	164	0.10	45,911	1,711,031	398	681
7	728961	4875129	728805	4875074	165	0.10	40,089	1,498,561	398	597
8	728805	4875074	728631	4875043	177	0.11	40,089	1,611,986	398	642
9	728631	4875043	727848	4874994	785	0.49	40,089	7,135,078	398	2,841
10	727848	4874994	727644	4874929	213	0.13	40,089	1,939,876	398	772
11	727644	4874929	727452	4874808	228	0.14	40,089	2,070,624	398	824
12	727452	4874808	727242	4874614	285	0.18	40,089	2,594,278	398	1,033
13	728966	4875116	729083	4875173	130	0.08	42,869	1,264,182	398	503
14	729083	4875173	729246	4875280	195	0.12	42,869	1,895,554	398	755
15	729246	4875280	729918	4875812	858	0.53	42,869	8,339,177	398	3,320
16	729918	4875812	730760	4876222	937	0.58	42,869	9,108,223	398	3,626
17	730753	4876238	729906	4875823	943	0.59	37,131	7,937,331	398	3,160
18	729906	4875823	729234	4875292	856	0.53	37,131	7,212,265	398	2,871
19	729234	4875292	729073	4875182	195	0.12	37,131	1,643,957	398	654
20	729073	4875182	728961	4875129	124	0.08	37,131	1,048,293	398	417
21	728632	4875990	728827	4875476	550	0.34	11,700	1,459,278	522	762
22	728827	4875476	728942	4875178	320	0.20	11,700	848,543	522	443
23	728942	4875178	728962	4875127	54	0.03	11,700	142,828	522	75
24	728962	4875127	728979	4875082	49	0.03	32,600	361,481	522	189
25	728979	4875082	729109	4874735	370	0.23	32,600	2,736,358	522	1,430
26	728394	4875006	728717	4875002	323	0.20	9,200	674,385	589	397
27	728717	4875002	728923	4874939	215	0.13	9,200	449,028	589	264
28	728923	4874939	729020	4874969	101	0.06	9,200	211,277	589	124
29	729673	4875648	729268	4875389	481	0.30	3,700	403,367	589	238
30	729268	4875389	729013	4875387	255	0.16	3,700	214,100	589	126
31	729013	4875387	728879	4875343	141	0.09	3,700	118,118	589	70
32	729021	4874970	729101	4875017	93	0.06	5,300	111,958	383	43
33	729101	4875017	729199	4875199	207	0.13	5,300	248,382	383	95
34	729199	4875199	729634	4875581	578	0.36	5,300	694,722	383	266
35	728955	4875146	728931	4875275	131	0.08	9,600	286,276	522	150
36	728931	4875275	729036	4875314	112	0.07	9,600	243,765	522	127
37	729036	4875314	729080	4875205	118	0.07	9,600	257,662	522	135
38	729080	4875205	728737	4875061	372	0.23	9,600	810,042	522	423
Total	-	-	-	-	-	-	-	-	-	35,005

Notes:

(1) Link ID and coordinates selected based on available road traffic data within study area.

(2) Calculated based on each link's starting and ending coordinates. Sample calculation:Length (m) = $SQRT((Y_{2}-Y_1)^2+(X_2-X_1)^2)$

(3) 2041 build AADT provided by project design team.

(4) Annual Vehicle miles travelled in one year (VMT/year) = AADT x Link Length (mil) x 365 day/year

(5) MOVES emission factor assigned to each link.

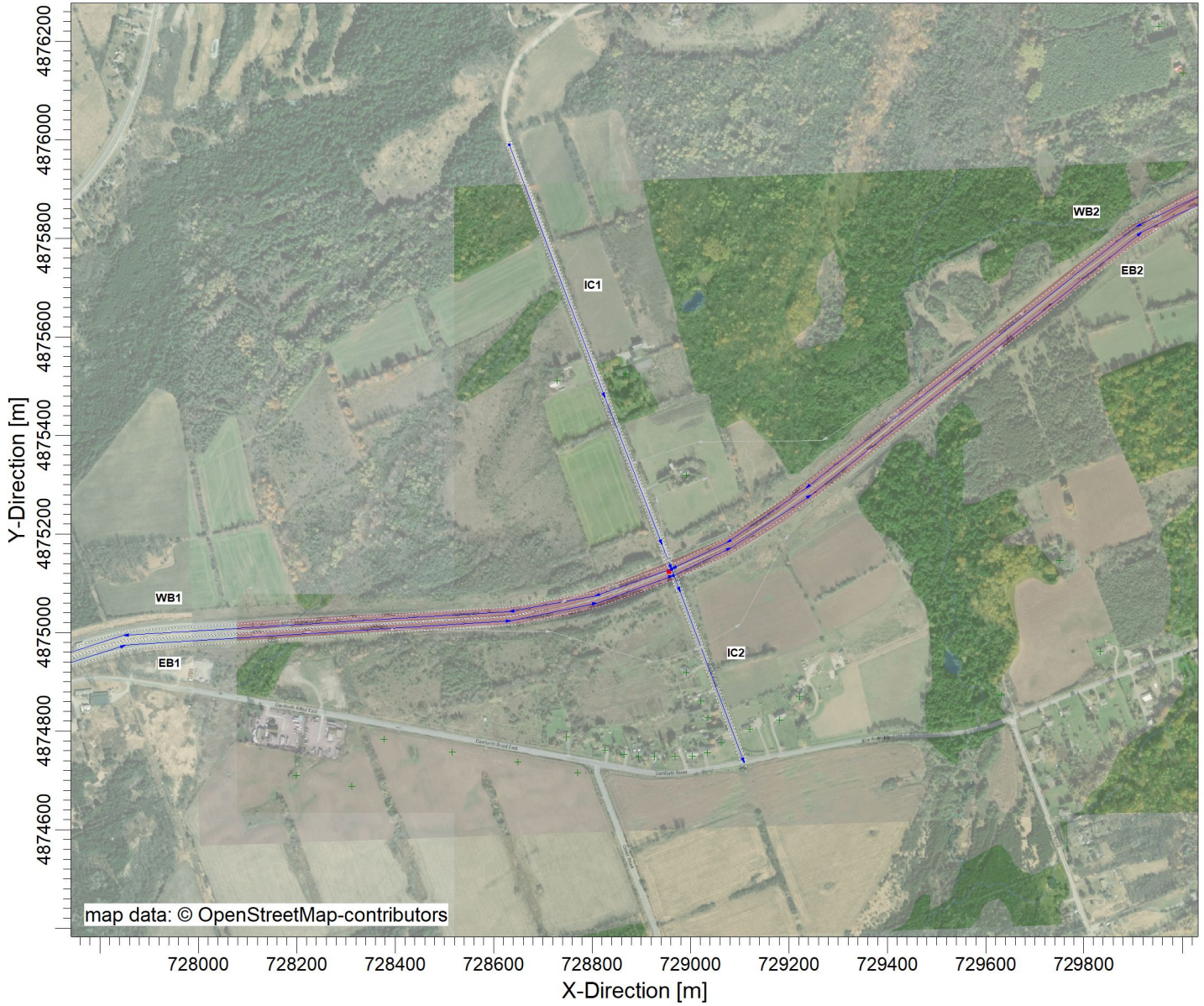
(6) Annual CO_2 Equivalent Emissions (kg CO_{2e}/ year) = Annual miles travelled per year (VMT/year) x Weighted CO_2 Emission Factor (g/VMT) / 1000 g / kg / 1000 kg/tonne

Appendix F
CAL3QHCR Links

PROJECT TITLE:

MTO Hwy 401 Nagle Rd EA

Figure F-1: Existing/Future No Build CAL3QHCR Links



COMMENTS:

MODEL:

CAL3QHCR

LINKS:

25

RECEPTORS:

34

COMPANY NAME:

Stantec Consulting Ltd.

DATE:

9/20/2022

SCALE: 1:12,908

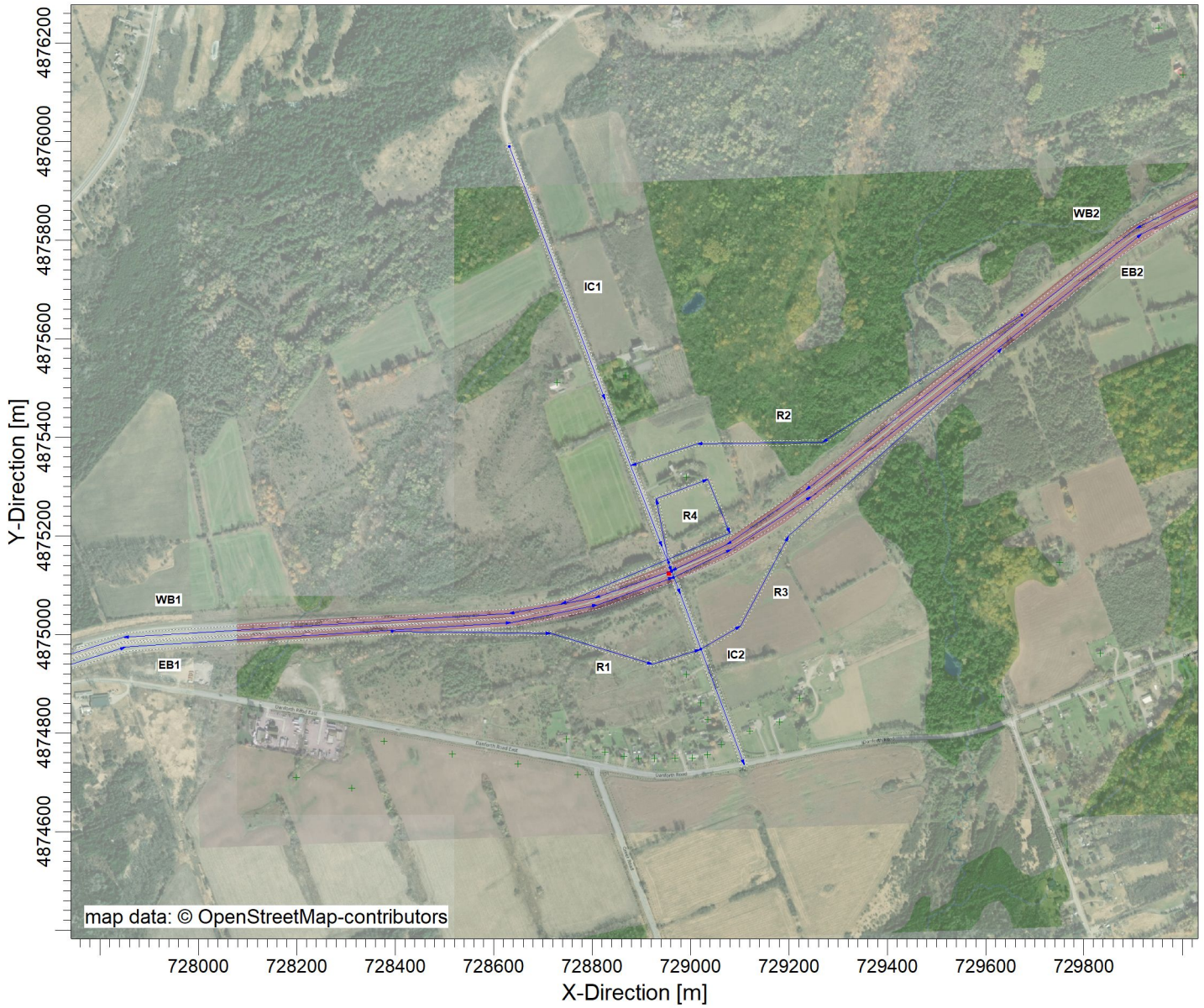
0 0.4 m

PROJECT / PLOT NO.:

PROJECT TITLE:

MTO Hwy 401 Nagle Rd EA

Figure F-2: Future Build CAL3QHCR Links



COMMENTS:

MODEL:

CAL3QHCR

LINKS:

38

RECEPTORS:

34

COMPANY NAME:

Stantec Consulting Ltd.

DATE:

9/20/2022

SCALE: 1:12,908

0 0.4 m

PROJECT / PLOT NO.:

EXISTING (2016) SCENARIO										
Link	Link Type [1]	Start of Link Easting (m)	Start of Link Northing (m)	End of Link Easting (m)	End of Link Northing (m)	Link Height [2] (m)	Mixing Zone Width [3] (m)	Link Length [4] (m)	Link Description	Traffic Volume ID
1	AG	727259	4874601	727464	4874792	0.35	17.1	281	West of Nagle	EB1
2	AG	727464	4874792	727654	4874911	0.35	17.1	224	West of Nagle	EB1
3	AG	727654	4874911	727852	4874974	0.35	17.1	208	West of Nagle	EB1
4	AG	727852	4874974	728636	4875024	0.35	17.1	786	West of Nagle	EB1
5	AG	728636	4875024	728811	4875060	0.35	17.1	179	West of Nagle	EB1
6	AG	728811	4875060	728966	4875116	0.35	17.1	164	West of Nagle	EB1
7	AG	728961	4875129	728805	4875074	0.35	17.1	165	West of Nagle	WB1
8	AG	728805	4875074	728631	4875043	0.35	17.1	177	West of Nagle	WB1
9	AG	728631	4875043	727848	4874994	0.35	17.1	785	West of Nagle	WB1
10	AG	727848	4874994	727644	4874929	0.35	17.1	213	West of Nagle	WB1
11	AG	727644	4874929	727452	4874808	0.35	17.1	228	West of Nagle	WB1
12	AG	727452	4874808	727242	4874614	0.35	17.1	285	West of Nagle	WB1
13	AG	728966	4875116	729083	4875173	0.35	17.1	130	East of Nagle	EB2
14	AG	729083	4875173	729246	4875280	0.35	17.1	195	East of Nagle	EB2
15	AG	729246	4875280	729918	4875812	0.35	17.1	858	East of Nagle	EB2
16	AG	729918	4875812	730760	4876222	0.35	17.1	937	East of Nagle	EB2
17	AG	730753	4876238	729906	4875823	0.35	17.1	943	East of Nagle	WB2
18	AG	729906	4875823	729234	4875292	0.35	17.1	856	East of Nagle	WB2
19	AG	729234	4875292	729073	4875182	0.35	17.1	195	East of Nagle	WB2
20	AG	729073	4875182	728961	4875129	0.35	17.1	124	East of Nagle	WB2
21	AG	728632	4875990	728827	4875476	0.34	13.0	550	North of Hwy 401	IC1
22	AG	728827	4875476	728942	4875178	0.34	13.0	320	North of Hwy 401	IC1
23	BR	728942	4875178	728962	4875127	6.34	13.0	54	North of Hwy 401	IC1
24	BR	728962	4875127	728979	4875082	6.34	13.0	49	South of Hwy 401	IC2
25	AG	728979	4875082	729109	4874735	0.34	13.0	370	South of Hwy 401	IC2

Notes:

(1) AG - at grade, BR - bridge

(2) Weighted average of assumed vehicle exhaust height is 0.34 m and 0.35 m. Bridge height is approximately 6 m.

(3) Mixing zone widths are based on lane width * # of lanes + 6m.

(4) Calculated based on each link's starting and ending coordinates. Sample calculation: Length (m) = $SQRT((Y2-Y1)^2+(X2-X1)^2)$

ULTIMATE NO BUILD (2041) SCENARIO										
Link	Link Type [1]	Start of Link Easting (m)	Start of Link Northing (m)	End of Link Easting (m)	End of Link Northing (m)	Link Height [2] (m)	Mixing Zone Width [3] (m)	Link Length [4] (m)	Link Description	Traffic Volume ID
1	AG	727259	4874601	727464	4874792	0.35	20.8	281	West of Nagle	EB1
2	AG	727464	4874792	727654	4874911	0.35	20.8	224	West of Nagle	EB1
3	AG	727654	4874911	727852	4874974	0.35	20.8	208	West of Nagle	EB1
4	AG	727852	4874974	728636	4875024	0.35	20.8	786	West of Nagle	EB1
5	AG	728636	4875024	728811	4875060	0.35	20.8	179	West of Nagle	EB1
6	AG	728811	4875060	728966	4875116	0.35	20.8	164	West of Nagle	EB1
7	AG	728961	4875129	728805	4875074	0.35	20.8	165	West of Nagle	WB1
8	AG	728805	4875074	728631	4875043	0.35	20.8	177	West of Nagle	WB1
9	AG	728631	4875043	727848	4874994	0.35	20.8	785	West of Nagle	WB1
10	AG	727848	4874994	727644	4874929	0.35	20.8	213	West of Nagle	WB1
11	AG	727644	4874929	727452	4874808	0.35	20.8	228	West of Nagle	WB1
12	AG	727452	4874808	727242	4874614	0.35	20.8	285	West of Nagle	WB1
13	AG	728966	4875116	729083	4875173	0.35	20.8	130	East of Nagle	EB2
14	AG	729083	4875173	729246	4875280	0.35	20.8	195	East of Nagle	EB2
15	AG	729246	4875280	729918	4875812	0.35	20.8	858	East of Nagle	EB2
16	AG	729918	4875812	730760	4876222	0.35	20.8	937	East of Nagle	EB2
17	AG	730753	4876238	729906	4875823	0.35	20.8	943	East of Nagle	WB2
18	AG	729906	4875823	729234	4875292	0.35	20.8	856	East of Nagle	WB2
19	AG	729234	4875292	729073	4875182	0.35	20.8	195	East of Nagle	WB2
20	AG	729073	4875182	728961	4875129	0.35	20.8	124	East of Nagle	WB2
21	AG	728632	4875990	728827	4875476	0.34	13.0	550	North of Hwy 401	IC1
22	AG	728827	4875476	728942	4875178	0.34	13.0	320	North of Hwy 401	IC1
23	BR	728942	4875178	728962	4875127	7.34	13.0	54	North of Hwy 401	IC1
24	BR	728962	4875127	728979	4875082	7.34	13.0	49	South of Hwy 401	IC2
25	AG	728979	4875082	729109	4874735	0.34	13.0	370	South of Hwy 401	IC2

Notes:

(1) AG - at grade, BR - bridge

(2) Weighted average of assumed vehicle exhaust height is 0.34 m and 0.35 m. Replacement bridge height is approximately 7 m.

(3) Mixing zone widths are based on lane width * # of lanes + 6m.

(4) Calculated based on each link's starting and ending coordinates. Sample calculation: Length (m) = $SQRT((Y2-Y1)^2+(X2-X1)^2)$

ULTIMATE BUILD (2041) SCENARIO										
Link	Link Type [1]	Start of Link Easting (m)	Start of Link Northing (m)	End of Link Easting (m)	End of Link Northing (m)	Link Height [2] (m)	Mixing Zone Width [3] (m)	Link Length [4] (m)	Link Description	Traffic Volume ID
1	AG	727259	4874601	727464	4874792	0.35	20.8	281	West of Nagle	EB1
2	AG	727464	4874792	727654	4874911	0.35	20.8	224	West of Nagle	EB1
3	AG	727654	4874911	727852	4874974	0.35	20.8	208	West of Nagle	EB1
4	AG	727852	4874974	728636	4875024	0.35	20.8	786	West of Nagle	EB1
5	AG	728636	4875024	728811	4875060	0.35	20.8	179	West of Nagle	EB1
6	AG	728811	4875060	728966	4875116	0.35	20.8	164	West of Nagle	EB1
7	AG	728961	4875129	728805	4875074	0.35	20.8	165	West of Nagle	WB1
8	AG	728805	4875074	728631	4875043	0.35	20.8	177	West of Nagle	WB1
9	AG	728631	4875043	727848	4874994	0.35	20.8	785	West of Nagle	WB1
10	AG	727848	4874994	727644	4874929	0.35	20.8	213	West of Nagle	WB1
11	AG	727644	4874929	727452	4874808	0.35	20.8	228	West of Nagle	WB1
12	AG	727452	4874808	727242	4874614	0.35	20.8	285	West of Nagle	WB1
13	AG	728966	4875116	729083	4875173	0.35	20.8	130	East of Nagle	EB2
14	AG	729083	4875173	729246	4875280	0.35	20.8	195	East of Nagle	EB2
15	AG	729246	4875280	729918	4875812	0.35	20.8	858	East of Nagle	EB2
16	AG	729918	4875812	730760	4876222	0.35	20.8	937	East of Nagle	EB2
17	AG	730753	4876238	729906	4875823	0.35	20.8	943	East of Nagle	WB2
18	AG	729906	4875823	729234	4875292	0.35	20.8	856	East of Nagle	WB2
19	AG	729234	4875292	729073	4875182	0.35	20.8	195	East of Nagle	WB2
20	AG	729073	4875182	728961	4875129	0.35	20.8	124	East of Nagle	WB2
21	AG	728632	4875990	728827	4875476	0.34	13.0	550	North of Hwy 401	IC1
22	AG	728827	4875476	728942	4875178	0.34	20.0	320	North of Hwy 401	IC1
23	BR	728942	4875178	728962	4875127	7.34	20.0	54	North of Hwy 401	IC1
24	BR	728962	4875127	728979	4875082	7.34	20.0	49	South of Hwy 401	IC2
25	AG	728979	4875082	729109	4874735	0.34	20.0	370	South of Hwy 401	IC2
26	AG	728394	4875006	728717	4875002	0.35	9.7	323	EB to NB/SB	R1
27	AG	728717	4875002	728923	4874939	0.35	9.7	215	EB to NB/SB	R1
28	AG	728923	4874939	729020	4874969	0.35	9.7	101	EB to NB/SB	R1
29	AG	729673	4875648	729268	4875389	0.35	9.7	481	WB to NB/SB	R2
30	AG	729268	4875389	729013	4875387	0.35	9.7	255	WB to NB/SB	R2
31	AG	729013	4875387	728879	4875343	0.35	9.7	141	WB to NB/SB	R2
32	AG	729021	4874970	729101	4875017	0.34	9.7	93	NB/SB to EB	R3
33	AG	729101	4875017	729199	4875199	0.34	9.7	207	NB/SB to EB	R3
34	AG	729199	4875199	729634	4875581	0.34	9.7	578	NB/SB to EB	R3
35	AG	728955	4875146	728931	4875275	0.34	9.7	131	NB/SB to WB	R4
36	AG	728931	4875275	729036	4875314	0.34	9.7	112	NB/SB to WB	R4
37	AG	729036	4875314	729080	4875205	0.34	9.7	118	NB/SB to WB	R4
38	AG	729080	4875205	728737	4875061	0.34	9.7	372	NB/SB to WB	R4

Notes:

(1) AG - at grade, BR - bridge

(2) Weighted average of assumed vehicle exhaust height is 0.34 m and 0.35 m. Replacement bridge height is approximately 7 m.

(3) Mixing zone widths are based on lane width * # of lanes + 6m.

(4) Calculated based on each link's starting and ending coordinates. Sample calculation: Length (m) = $SQRT((Y2-Y1)^2+(X2-X1)^2)$

Appendix G
Special Receptor Modelled Results

EXISTING (2016) SCENARIO																			
Background Concentration (µg/m^3)	**362**	**362**	**21.8**	**21.2**	**9.4**	**24.1**	**13.0**	**6.4**	**5.3E-05**	**2.3E-05**	**0.70**	**0.39**	**0.063**	**0.023**	**2.2**	**3.5**	**1.2**	**0.073**	**0.030**
Predicted Project Concentrations (µg/m^3)																			
Receptor ID	**CO**	**CO**	**NO_2**	**NO_2**	**NO_2**	**PM_{10}**	**$PM_{2.5}$**	**$PM_{2.5}$**	**B(a)P**	**B(a)P**	**Benzene**	**Benzene**	**1,3-Butadiene**	**1,3-Butadiene**	**Formaldehyde**	**Acetaldehyde**	**Acetaldehyde**	**Acrolein**	**Acrolein**
	1-hr	**8-hr**	**1-hr**	**24-hr**	**annual**	**24-hr**	**24-hr**	**annual**	**24-hr**	**annual**	**24-hr**	**annual**	**24-hr**	**annual**	**24-hr**	**0.5-hr**	**24-hr**	**1-hr**	**24-hr**
R001	500.1	289.3	37.9	3.2	3.3	2.6	1.7	0.5	**6.6E-05**	**1.8E-05**	0.029	0.0078	0.0066	0.0018	0.13	0.9	0.06	0.12	0.010
R002	588.4	325.5	44.6	2.6	1.9	2.1	1.3	0.2	**5.3E-05**	9.5E-06	0.023	0.0041	0.0052	0.001	0.10	1.0	0.05	0.14	0.008
R003	578.1	241.1	43.8	1.9	1.7	1.6	1.0	0.2	3.8E-05	8.8E-06	0.017	0.0038	0.0038	0.0009	0.07	1.0	0.04	0.13	0.006
R004	695.9	325.5	52.7	2.7	2.2	2.2	1.4	0.3	**5.6E-05**	**1.1E-05**	0.024	0.005	0.0055	0.0011	0.11	1.2	0.05	0.16	0.008
R005	621.6	265.2	47.1	2.1	2.0	1.8	1.1	0.3	4.3E-05	**1.0E-05**	0.019	0.0044	0.0043	0.001	0.08	1.1	0.04	0.15	0.007
R006	488.1	204.9	37.0	2.0	1.8	1.7	1.0	0.2	4.1E-05	9.2E-06	0.018	0.004	0.0041	0.0009	0.08	0.9	0.04	0.11	0.006
R007	356.0	180.8	26.9	1.7	1.7	1.5	0.9	0.2	3.6E-05	8.4E-06	0.015	0.0037	0.0036	0.0008	0.07	0.6	0.03	0.08	0.005
R008	478.6	229.1	36.2	2.0	2.0	1.8	1.1	0.3	4.2E-05	**1.0E-05**	0.018	0.0044	0.0042	0.001	0.08	0.8	0.04	0.11	0.006
R009	362.2	192.9	27.4	1.9	1.8	1.6	1.0	0.2	3.8E-05	9.2E-06	0.017	0.004	0.0038	0.0009	0.07	0.6	0.04	0.08	0.006
R010	323.1	180.8	24.4	1.8	1.8	1.6	1.0	0.2	3.7E-05	8.9E-06	0.016	0.0039	0.0037	0.0009	0.07	0.6	0.03	0.08	0.006
R011	299.2	180.8	22.6	1.8	1.7	1.6	1.0	0.2	3.7E-05	8.7E-06	0.016	0.0038	0.0037	0.0009	0.07	0.5	0.03	0.07	0.006
R012	279.1	168.8	21.1	1.8	1.7	1.6	1.0	0.2	3.7E-05	8.6E-06	0.016	0.0037	0.0037	0.0009	0.07	0.5	0.03	0.07	0.006
R013	257.4	168.8	19.4	1.7	1.7	1.6	0.9	0.2	3.6E-05	8.4E-06	0.016	0.0037	0.0036	0.0008	0.07	0.4	0.03	0.06	0.005
R014	240.3	156.7	18.1	1.7	1.7	1.7	0.9	0.2	3.5E-05	8.3E-06	0.015	0.0036	0.0035	0.0008	0.07	0.4	0.03	0.06	0.005
R015	230.7	156.7	17.4	1.7	1.7	1.8	1.0	0.2	3.5E-05	8.4E-06	0.015	0.0036	0.0035	0.0008	0.07	0.4	0.03	0.05	0.005
R016	230.0	168.8	17.3	1.8	1.7	2.2	1.1	0.3	3.7E-05	8.8E-06	0.016	0.0039	0.0037	0.0009	0.07	0.4	0.03	0.05	0.006
R017	271.7	180.8	20.5	2.1	1.9	2.2	1.1	0.3	4.2E-05	1.0E-05	0.018	0.0044	0.0042	0.001	0.08	0.5	0.04	0.06	0.006
R018	307.5	204.9	23.2	2.3	2.1	2.3	1.2	0.3	4.7E-05	**1.1E-05**	0.020	0.0048	0.0047	0.0011	0.09	0.5	0.04	0.07	0.007
R019	406.5	241.1	30.7	2.8	2.6	2.5	1.5	0.4	**5.7E-05**	**1.3E-05**	0.025	0.0058	0.0057	0.0013	0.11	0.7	0.05	0.09	0.009
R020	248.3	156.7	18.7	1.9	1.7	2.3	1.2	0.3	4.0E-05	8.9E-06	0.017	0.0039	0.004	0.0009	0.08	0.4	0.04	0.06	0.006
R021	260.8	156.7	19.7	1.9	1.7	2.0	1.1	0.2	4.0E-05	8.6E-06	0.017	0.0037	0.004	0.0009	0.08	0.5	0.04	0.06	0.006
R022	303.0	168.8	22.9	2.1	1.8	2.0	1.1	0.2	4.3E-05	9.0E-06	0.019	0.0039	0.0042	0.0009	0.08	0.5	0.04	0.07	0.006
R023	254.7	120.6	19.3	1.7	1.3	1.7	0.9	0.2	3.5E-05	8.4E-06	0.015	0.0037	0.0035	0.0008	0.07	0.4	0.03	0.06	0.005
R024	250.4	144.7	19.0	1.8	1.5	1.8	1.0	0.3	3.7E-05	9.2E-06	0.016	0.004	0.0037	0.0009	0.07	0.4	0.03	0.06	0.006
R025	441.5	337.6	33.5	3.0	2.7	2.8	1.6	0.5	**6.3E-05**	**1.7E-05**	0.027	0.0075	0.0063	0.0017	0.12	0.8	0.06	0.10	0.009
R026	264.4	120.6	20.0	1.5	1.2	1.3	0.8	0.2	3.1E-05	6.2E-06	0.014	0.0027	0.0031	0.0006	0.06	0.5	0.03	0.06	0.005
R027	285.6	132.6	21.6	1.4	1.1	1.2	0.7	0.1	2.8E-05	5.7E-06	0.012	0.0025	0.0028	0.0006	0.05	0.5	0.03	0.07	0.004
R028	430.9	192.9	32.6	1.9	1.5	1.7	1.0	0.2	4.0E-05	7.9E-06	0.017	0.0034	0.004	0.0008	0.08	0.8	0.04	0.10	0.006
R029	284.8	144.7	21.6	1.2	1.0	1.1	0.7	0.1	2.6E-05	5.1E-06	0.011	0.0022	0.0025	0.0005	0.05	0.5	0.02	0.07	0.004
R030	435.2	217.0	33.0	2.6	1.9	2.0	1.3	0.2	**5.3E-05**	9.7E-06	0.023	0.0042	0.0053	0.001	0.10	0.8	0.05	0.10	0.008
R031	492.7	265.2	37.3	3.2	3.1	2.7	1.6	0.4	**6.5E-05**	**1.7E-05**	0.028	0.0072	0.0065	0.0017	0.12	0.9	0.06	0.12	0.010
R032	212.3	132.6	16.1	2.0	1.2	1.6	1.0	0.2	4.1E-05	7.8E-06	0.018	0.0034	0.0041	0.0008	0.08	0.4	0.04	0.05	0.006
R033	298.9	204.9	22.6	2.6	1.6	2.2	1.3	0.3	**5.3E-05**	**1.1E-05**	0.023	0.0048	0.0053	0.0011	0.10	0.5	0.05	0.07	0.008
R034	600.7	434.0	45.5	4.2	2.6	3.6	2.2	0.4	**8.7E-05**	**1.8E-05**	0.038	0.0076	0.0086	0.0018	0.17	1.0	0.08	0.14	0.013
Maximum	695.9	434.0	52.7	4.2	3.3	3.6	2.2	0.5	**8.7E-05**	**1.8E-05**	0.038	0.0078	0.0086	0.0018	0.17	1.2	0.08	0.16	0.013

Note:

1. Maximum predicted concentrations are presented in the table.
2. Maximum predicted concentrations in bold are predicted to exceed the air quality criteria.

FUTURE (2041) ULTIMATE NO BUILD SCENARIO

Background Concentration (µg/m^3)	362	362	21.8	21.2	9.4	24.1	13.0	6.4	5.3E-05	2.3E-05	0.70	0.39	0.063	0.023	2.2	3.5	1.2	0.073	0.030
Predicted Project Concentrations (µg/m^3)																			
Receptor ID	**CO**	**CO**	**NO_2**	**NO_2**	**NO_2**	**PM_{10}**	**$PM_{2.5}$**	**$PM_{2.5}$**	**B(a)P**	**B(a)P**	**Benzene**	**Benzene**	**1,3-Butadiene**	**1,3-Butadiene**	**Formaldehyde**	**Acetaldehyde**	**Acetaldehyde**	**Acrolein**	**Acrolein**
	1-hr	**8-hr**	**1-hr**	**24-hr**	**annual**	**24-hr**	**24-hr**	**annual**	**24-hr**	**annual**	**24-hr**	**annual**	**24-hr**	**annual**	**24-hr**	**0.5-hr**	**24-hr**	**1-hr**	**24-hr**
R001	200.0	120.6	34.7	2.9	3.1	2.7	0.8	0.2	2.5E-06	6.8E-07	0.003	7.1E-04	2.5E-06	6.8E-07	0.006	0.12	0.009	0.009	7.4E-04
R002	236.7	132.6	41.0	2.3	1.7	2.0	0.6	0.1	2.0E-06	3.6E-07	0.002	3.7E-04	2.0E-06	3.6E-07	0.005	0.14	0.007	0.010	5.9E-04
R003	232.9	96.4	40.4	1.7	1.6	1.6	0.5	0.1	1.4E-06	3.3E-07	0.001	3.5E-04	1.4E-06	3.3E-07	0.004	0.14	0.005	0.010	4.3E-04
R004	279.7	132.6	48.5	2.5	2.1	2.2	0.7	0.1	2.1E-06	4.4E-07	0.002	4.5E-04	2.1E-06	4.4E-07	0.005	0.17	0.007	0.012	6.2E-04
R005	251.6	108.5	43.6	2.0	1.8	1.8	0.5	0.1	1.7E-06	3.8E-07	0.002	4.0E-04	1.7E-06	3.8E-07	0.004	0.15	0.006	0.011	5.0E-04
R006	197.6	84.4	34.3	1.9	1.7	1.7	0.5	0.1	1.6E-06	3.5E-07	0.002	3.6E-04	1.6E-06	3.5E-07	0.004	0.12	0.005	0.009	4.7E-04
R007	144.3	72.3	25.0	1.6	1.6	1.5	0.4	0.1	1.3E-06	3.2E-07	0.001	3.3E-04	1.3E-06	3.2E-07	0.003	0.09	0.005	0.006	4.0E-04
R008	194.2	84.4	33.7	1.9	1.9	1.8	0.5	0.1	1.6E-06	3.9E-07	0.002	4.0E-04	1.6E-06	3.9E-07	0.004	0.12	0.005	0.008	4.7E-04
R009	147.3	72.3	25.6	1.7	1.7	1.6	0.5	0.1	1.4E-06	3.5E-07	0.001	3.6E-04	1.4E-06	3.5E-07	0.004	0.09	0.005	0.006	4.3E-04
R010	131.8	72.3	22.9	1.7	1.7	1.6	0.5	0.1	1.4E-06	3.4E-07	0.001	3.5E-04	1.4E-06	3.4E-07	0.003	0.08	0.005	0.006	4.2E-04
R011	121.8	72.3	21.1	1.7	1.6	1.6	0.5	0.1	1.4E-06	3.3E-07	0.001	3.4E-04	1.4E-06	3.3E-07	0.003	0.07	0.005	0.005	4.2E-04
R012	113.6	72.3	19.7	1.7	1.6	1.6	0.5	0.1	1.4E-06	3.3E-07	0.001	3.4E-04	1.4E-06	3.3E-07	0.003	0.07	0.005	0.005	4.2E-04
R013	104.5	72.3	18.1	1.6	1.6	1.5	0.5	0.1	1.4E-06	3.2E-07	0.001	3.3E-04	1.4E-06	3.2E-07	0.003	0.06	0.005	0.005	4.1E-04
R014	97.4	60.3	16.9	1.6	1.6	1.6	0.5	0.1	1.4E-06	3.2E-07	0.001	3.3E-04	1.3E-06	3.2E-07	0.003	0.06	0.005	0.004	4.0E-04
R015	93.3	60.3	16.2	1.6	1.6	1.6	0.5	0.1	1.3E-06	3.2E-07	0.001	3.3E-04	1.3E-06	3.2E-07	0.003	0.06	0.005	0.004	4.0E-04
R016	92.7	72.3	16.1	1.7	1.6	1.9	0.5	0.1	1.4E-06	3.4E-07	0.001	3.5E-04	1.4E-06	3.3E-07	0.003	0.06	0.005	0.004	4.2E-04
R017	109.7	72.3	19.1	1.9	1.8	2.0	0.5	0.1	1.6E-06	3.8E-07	0.002	4.0E-04	1.6E-06	3.8E-07	0.004	0.07	0.006	0.005	4.8E-04
R018	124.3	84.4	21.6	2.1	2.0	2.1	0.6	0.2	1.8E-06	4.2E-07	0.002	4.4E-04	1.8E-06	4.2E-07	0.004	0.08	0.006	0.005	5.3E-04
R019	164.8	96.4	28.6	2.6	2.4	2.4	0.7	0.2	2.2E-06	5.1E-07	0.002	5.3E-04	2.2E-06	5.1E-07	0.005	0.10	0.008	0.007	6.5E-04
R020	98.4	60.3	17.1	1.8	1.6	2.0	0.6	0.1	1.5E-06	3.4E-07	0.002	3.6E-04	1.5E-06	3.4E-07	0.004	0.06	0.005	0.004	4.5E-04
R021	103.4	60.3	18.0	1.8	1.6	1.8	0.5	0.1	1.5E-06	3.3E-07	0.002	3.4E-04	1.5E-06	3.3E-07	0.004	0.06	0.005	0.005	4.5E-04
R022	120.3	60.3	20.9	1.9	1.7	1.9	0.5	0.1	1.6E-06	3.5E-07	0.002	3.6E-04	1.6E-06	3.5E-07	0.004	0.07	0.006	0.005	4.8E-04
R023	100.5	48.2	17.4	1.6	1.3	1.6	0.5	0.1	1.4E-06	3.2E-07	0.001	3.3E-04	1.4E-06	3.2E-07	0.003	0.06	0.005	0.004	4.0E-04
R024	103.6	60.3	18.0	1.7	1.4	1.7	0.5	0.1	1.4E-06	3.5E-07	0.001	3.7E-04	1.4E-06	3.5E-07	0.004	0.06	0.005	0.005	4.2E-04
R025	179.1	132.6	31.1	2.9	2.6	2.8	0.8	0.2	2.4E-06	6.8E-07	0.003	7.0E-04	2.4E-06	6.7E-07	0.006	0.11	0.008	0.008	7.3E-04
R026	104.8	48.2	18.2	1.4	1.1	1.3	0.4	0.1	1.2E-06	2.4E-07	0.001	2.4E-04	1.2E-06	2.4E-07	0.003	0.06	0.004	0.005	3.5E-04
R027	113.3	48.2	19.7	1.3	1.1	1.2	0.3	0.1	1.1E-06	2.2E-07	0.001	2.3E-04	1.1E-06	2.2E-07	0.003	0.07	0.004	0.005	3.2E-04
R028	171.0	84.4	29.6	1.8	1.5	1.7	0.5	0.1	1.5E-06	3.1E-07	0.002	3.2E-04	1.5E-06	3.1E-07	0.004	0.10	0.005	0.007	4.5E-04
R029	112.8	60.3	19.6	1.1	0.9	1.1	0.3	0.1	9.6E-07	2.0E-07	0.001	2.0E-04	9.6E-07	2.0E-07	0.002	0.07	0.003	0.005	2.9E-04
R030	171.8	84.4	29.8	2.4	1.8	2.0	0.6	0.1	2.0E-06	3.8E-07	0.002	3.9E-04	2.0E-06	3.8E-07	0.005	0.10	0.007	0.008	5.9E-04
R031	198.1	108.5	34.4	2.9	3.0	2.7	0.8	0.2	2.5E-06	6.5E-07	0.003	6.7E-04	2.5E-06	6.5E-07	0.006	0.12	0.009	0.009	7.4E-04
R032	86.1	48.2	14.9	1.9	1.1	1.7	0.5	0.1	1.6E-06	3.0E-07	0.002	3.1E-04	1.6E-06	3.0E-07	0.004	0.05	0.005	0.004	4.7E-04
R033	121.4	84.4	21.0	2.4	1.5	2.2	0.6	0.1	2.0E-06	4.3E-07	0.002	4.4E-04	2.0E-06	4.3E-07	0.005	0.07	0.007	0.005	6.1E-04
R034	244.0	180.8	42.3	3.9	2.5	3.6	1.0	0.2	3.3E-06	6.9E-07	0.003	7.1E-04	3.3E-06	6.9E-07	0.008	0.15	0.011	0.011	9.9E-04
Maximum	279.7	180.8	48.5	3.9	3.1	3.6	1.0	0.2	3.3E-06	6.9E-07	0.003	7.1E-04	3.3E-06	6.9E-07	0.008	0.17	0.011	0.012	9.9E-04

Note:

1. Maximum predicted concentrations are presented in the table.

FUTURE (2041) ULTIMATE BUILD SCENARIO																			
Background Concentration ($\mu g/m^3$)	**362**	**362**	**21.8**	**21.2**	**9.4**	**24.1**	**13.0**	**6.4**	**5.3E-05**	**2.3E-05**	**0.70**	**0.39**	**0.063**	**0.023**	**2.2**	**3.5**	**1.2**	**0.073**	**0.030**
Predicted Project Concentrations ($\mu g/m^3$)																			
Receptor ID	**CO**	**CO**	**NO_2**	**NO_2**	**NO_2**	**PM_{10}**	**$PM_{2.5}$**	**$PM_{2.5}$**	**B(a)P**	**B(a)P**	**Benzene**	**Benzene**	**1,3-Butadiene**	**1,3-Butadiene**	**Formaldehyde**	**Acetaldehyde**	**Acetaldehyde**	**Acrolein**	**Acrolein**
	1-hr	**8-hr**	**1-hr**	**24-hr**	**annual**	**24-hr**	**24-hr**	**annual**	**24-hr**	**annual**	**24-hr**	**annual**	**24-hr**	**annual**	**24-hr**	**0.5-hr**	**24-hr**	**1-hr**	**24-hr**
R001	245.7	144.7	45.3	3.6	3.6	3.3	0.9	0.3	2.8E-06	7.7E-07	0.003	8.0E-04	2.9E-06	7.7E-07	0.007	0.15	0.010	0.011	8.6E-04
R002	303.0	180.8	56.8	3.6	2.3	3.2	0.9	0.1	2.6E-06	4.4E-07	0.003	4.7E-04	2.7E-06	4.5E-07	0.007	0.18	0.009	0.013	8.1E-04
R003	295.1	132.6	55.1	2.9	2.2	2.6	0.7	0.1	2.0E-06	4.1E-07	0.002	4.4E-04	2.1E-06	4.2E-07	0.005	0.18	0.007	0.013	6.3E-04
R004	354.7	180.8	66.2	4.1	2.9	3.7	1.0	0.2	2.8E-06	5.5E-07	0.003	5.9E-04	3.0E-06	5.7E-07	0.007	0.21	0.010	0.015	9.0E-04
R005	318.9	144.7	59.7	3.3	2.9	3.2	0.9	0.2	2.2E-06	5.1E-07	0.002	5.6E-04	2.3E-06	5.4E-07	0.006	0.19	0.008	0.014	7.1E-04
R006	270.2	132.6	51.6	3.4	2.9	3.2	0.9	0.2	2.3E-06	5.0E-07	0.003	5.5E-04	2.4E-06	5.2E-07	0.006	0.16	0.008	0.012	7.3E-04
R007	227.1	132.6	44.5	3.4	3.1	3.3	0.9	0.2	2.1E-06	4.9E-07	0.002	5.5E-04	2.3E-06	5.2E-07	0.006	0.13	0.008	0.010	7.0E-04
R008	280.1	156.7	54.3	4.0	3.6	3.7	1.0	0.2	2.5E-06	6.0E-07	0.003	6.8E-04	2.7E-06	6.4E-07	0.007	0.17	0.010	0.012	8.2E-04
R009	241.2	144.7	47.3	3.8	3.7	3.8	1.0	0.2	2.4E-06	5.8E-07	0.003	6.7E-04	2.5E-06	6.2E-07	0.007	0.14	0.009	0.010	7.8E-04
R010	222.9	156.7	43.5	4.1	3.8	4.0	1.0	0.2	2.5E-06	5.9E-07	0.003	6.8E-04	2.7E-06	6.3E-07	0.007	0.13	0.010	0.009	8.2E-04
R011	212.5	156.7	41.6	4.3	4.0	4.1	1.0	0.2	2.5E-06	6.0E-07	0.003	6.9E-04	2.7E-06	6.4E-07	0.007	0.12	0.010	0.009	8.5E-04
R012	205.3	156.7	40.7	4.4	4.2	4.3	1.1	0.2	2.6E-06	6.3E-07	0.003	7.4E-04	2.8E-06	6.7E-07	0.007	0.12	0.010	0.008	8.8E-04
R013	196.5	168.8	42.6	5.0	4.7	4.8	1.2	0.3	2.9E-06	6.8E-07	0.003	8.1E-04	3.0E-06	7.3E-07	0.008	0.11	0.011	0.008	9.6E-04
R014	219.2	180.8	48.2	5.9	5.4	5.4	1.3	0.3	3.2E-06	7.6E-07	0.004	9.2E-04	3.4E-06	8.1E-07	0.009	0.12	0.012	0.009	1.1E-03
R015	265.0	217.0	58.4	7.0	6.8	6.3	1.5	0.4	3.8E-06	9.4E-07	0.005	1.2E-03	4.0E-06	9.9E-07	0.011	0.14	0.015	0.010	1.3E-03
R020	364.6	301.4	80.8	11.9	9.0	10.0	2.4	0.6	6.2E-06	1.5E-06	0.008	1.9E-03	6.5E-06	1.6E-06	0.018	0.20	0.024	0.014	2.1E-03
R021	228.1	180.8	49.6	6.9	4.7	6.0	1.5	0.3	3.9E-06	7.8E-07	0.005	9.4E-04	4.1E-06	8.1E-07	0.011	0.13	0.015	0.010	1.3E-03
R022	248.0	144.7	53.1	6.0	3.9	5.2	1.3	0.3	3.5E-06	6.7E-07	0.004	7.9E-04	3.7E-06	7.0E-07	0.010	0.15	0.013	0.011	1.2E-03
R023	190.5	120.6	41.2	3.5	3.3	3.5	0.9	0.2	2.1E-06	6.0E-07	0.002	7.0E-04	2.2E-06	6.2E-07	0.006	0.10	0.008	0.008	6.8E-04
R024	242.4	120.6	53.4	4.6	3.7	4.2	1.1	0.3	2.6E-06	7.2E-07	0.003	8.6E-04	2.7E-06	7.5E-07	0.007	0.13	0.010	0.010	8.7E-04
R026	179.5	84.4	36.2	2.9	1.7	2.7	0.7	0.1	1.9E-06	3.2E-07	0.002	3.5E-04	2.0E-06	3.3E-07	0.005	0.11	0.007	0.008	6.1E-04
R027	175.4	84.4	34.4	2.3	1.5	2.2	0.6	0.1	1.6E-06	2.8E-07	0.002	3.1E-04	1.6E-06	2.9E-07	0.004	0.10	0.006	0.008	4.9E-04
R028	231.8	108.5	43.4	2.9	2.0	2.9	0.8	0.1	2.1E-06	3.8E-07	0.002	4.2E-04	2.1E-06	3.9E-07	0.005	0.14	0.008	0.010	6.5E-04
R029	162.4	72.3	31.0	2.0	1.2	1.9	0.5	0.1	1.4E-06	2.4E-07	0.001	2.5E-04	1.4E-06	2.4E-07	0.004	0.10	0.005	0.007	4.3E-04
R030	214.8	108.5	39.4	3.3	2.0	3.0	0.9	0.1	2.4E-06	4.2E-07	0.003	4.4E-04	2.5E-06	4.2E-07	0.006	0.13	0.009	0.009	7.5E-04
R031	246.1	132.6	45.6	3.4	3.2	3.4	1.0	0.2	2.7E-06	6.8E-07	0.003	7.2E-04	2.7E-06	6.9E-07	0.007	0.15	0.009	0.011	8.2E-04
R032	125.0	84.4	24.1	2.5	1.3	2.4	0.7	0.1	1.9E-06	3.4E-07	0.002	3.6E-04	1.9E-06	3.4E-07	0.005	0.07	0.007	0.005	5.7E-04
R033	164.9	120.6	31.3	3.0	1.8	2.9	0.8	0.2	2.3E-06	4.6E-07	0.002	4.8E-04	2.4E-06	4.6E-07	0.006	0.10	0.008	0.007	7.2E-04
R034	288.4	204.9	52.7	4.6	2.7	4.5	1.3	0.2	3.6E-06	7.2E-07	0.004	7.5E-04	3.7E-06	7.2E-07	0.009	0.17	0.013	0.012	1.1E-03
Maximum	364.6	301.4	80.8	11.9	9.0	10.0	2.4	0.6	6.2E-06	1.5E-06	0.008	1.9E-03	6.5E-06	1.6E-06	0.018	0.21	0.024	0.015	2.1E-03

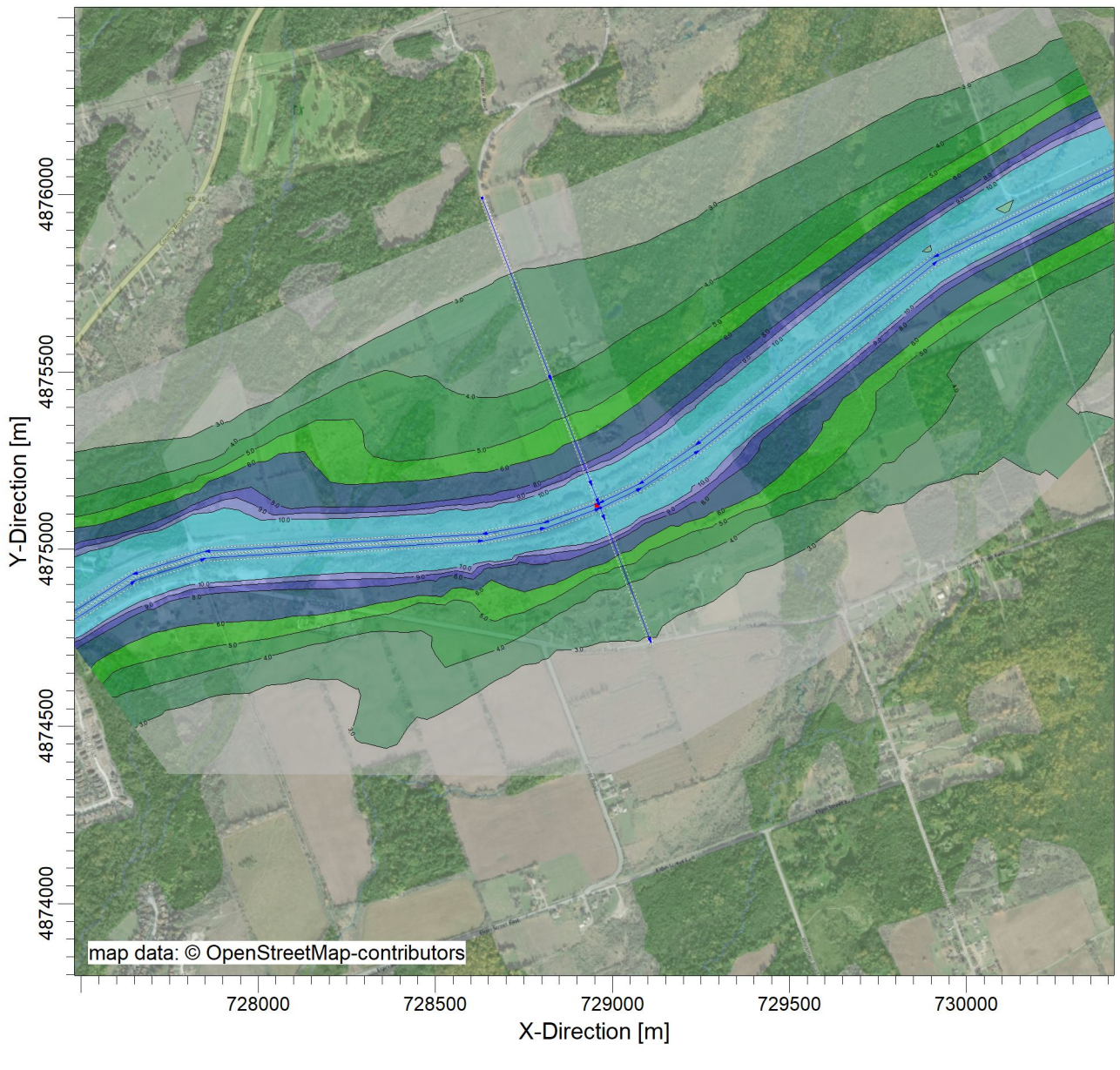
Note:

1. Maximum predicted concentrations are presented in the table.
2. Receptors R016, R017, R018, R019 and R025 will be property acquisitions for the future build scenario and the maximum predicted concentrations are not presented in this table.

Appendix H
Benzo(a)pyrene Contour Plots

PROJECT TITLE:

Existing Scenario
Predicted 24-Hour Concentrations for Benzo(a)pyrene without Background (pg/m3)



COMMENTS:

worst case meteorological year 2017

MODEL:

CAL3QHCR

LINKS:

25

RECEPTORS:

1130

COMPANY NAME:

Stantec Consulting Ltd.

DATE:

10/3/2022

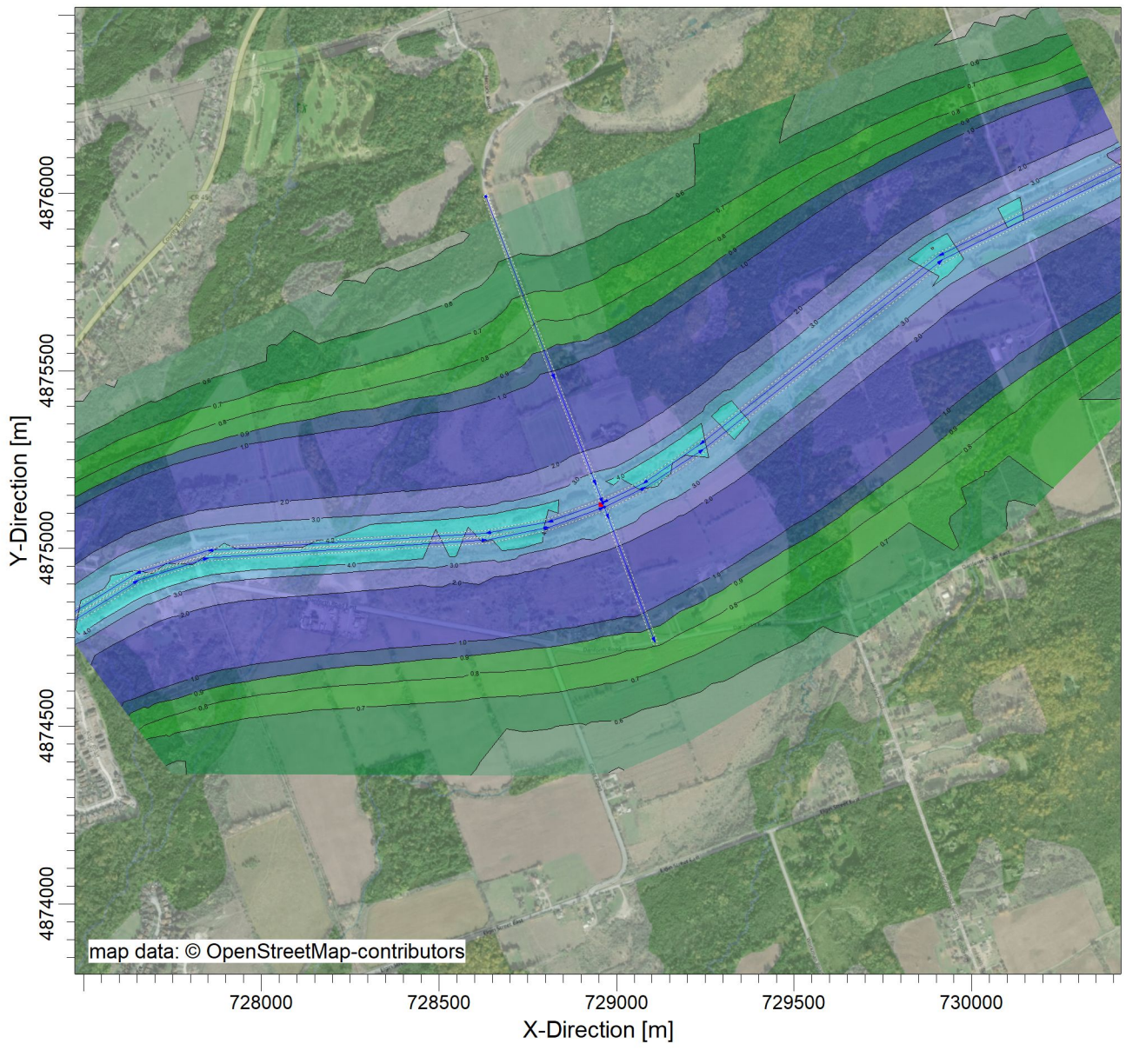
SCALE: 1:18,605

0 0.5 m

PROJECT / PLOT NO.:

PROJECT TITLE:

Existing Scenario
Predicted Annual Concentrations for Benzo(a)pyrene without Background (pg/m3)



COMMENTS:

worst case meteorological year 2017

MODEL:

CAL3QHCR

LINKS:

25

RECEPTORS:

1130

COMPANY NAME:

Stantec Consulting Ltd.

DATE:

10/3/2022

SCALE: 1:18,524

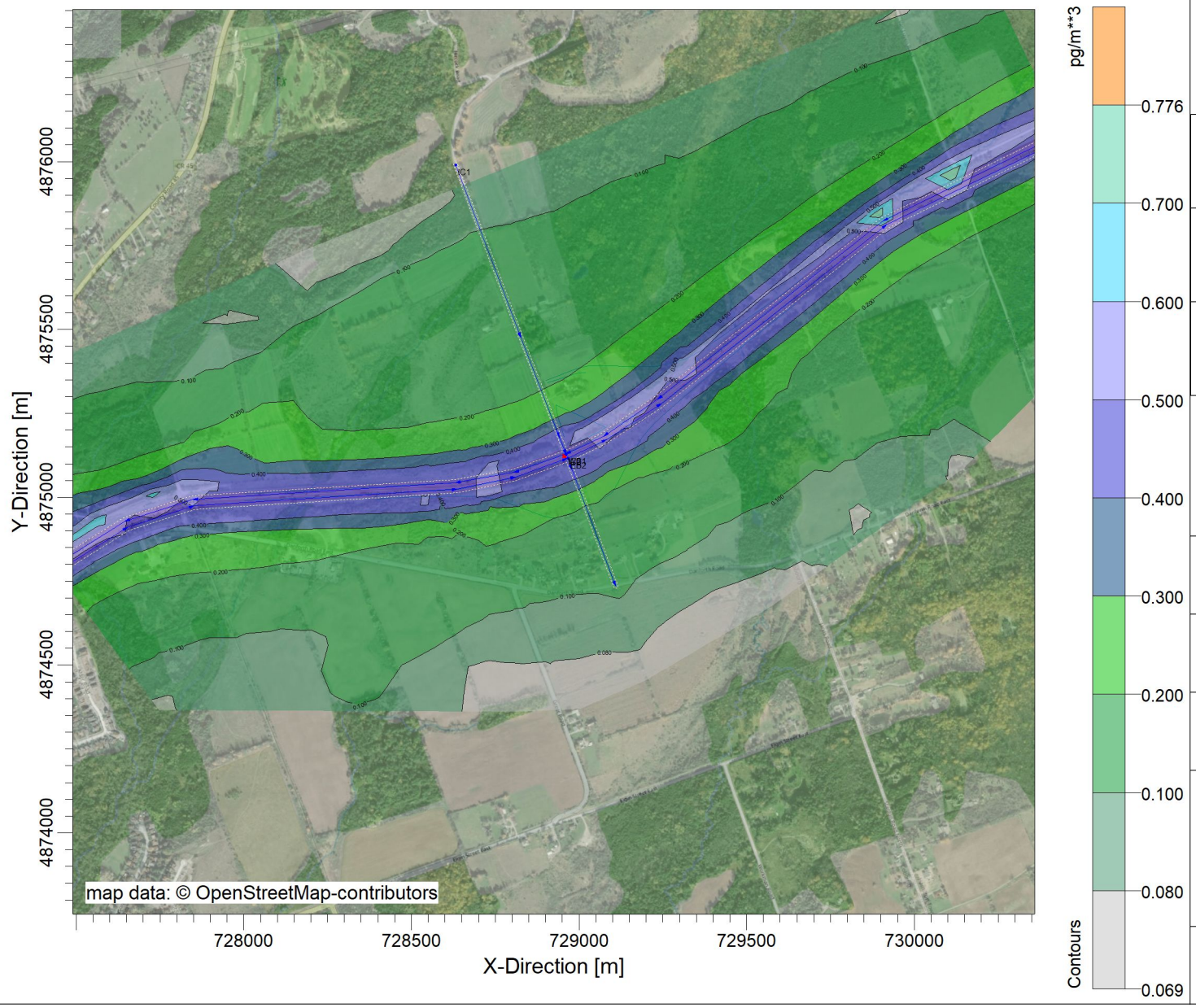
0 0.5 m

PROJECT / PLOT NO.:

PROJECT TITLE:

Future No Build

Predicted 24-Hour Concentrations for Benzo(a)pyrene without Background (pg/m3)



COMMENTS:

worst case meteorological year 2017

MODEL:

CAL3QHCR

LINKS:

25

RECEPTORS:

1130

COMPANY NAME:

Stantec Consulting Ltd.

DATE:

10/3/2022

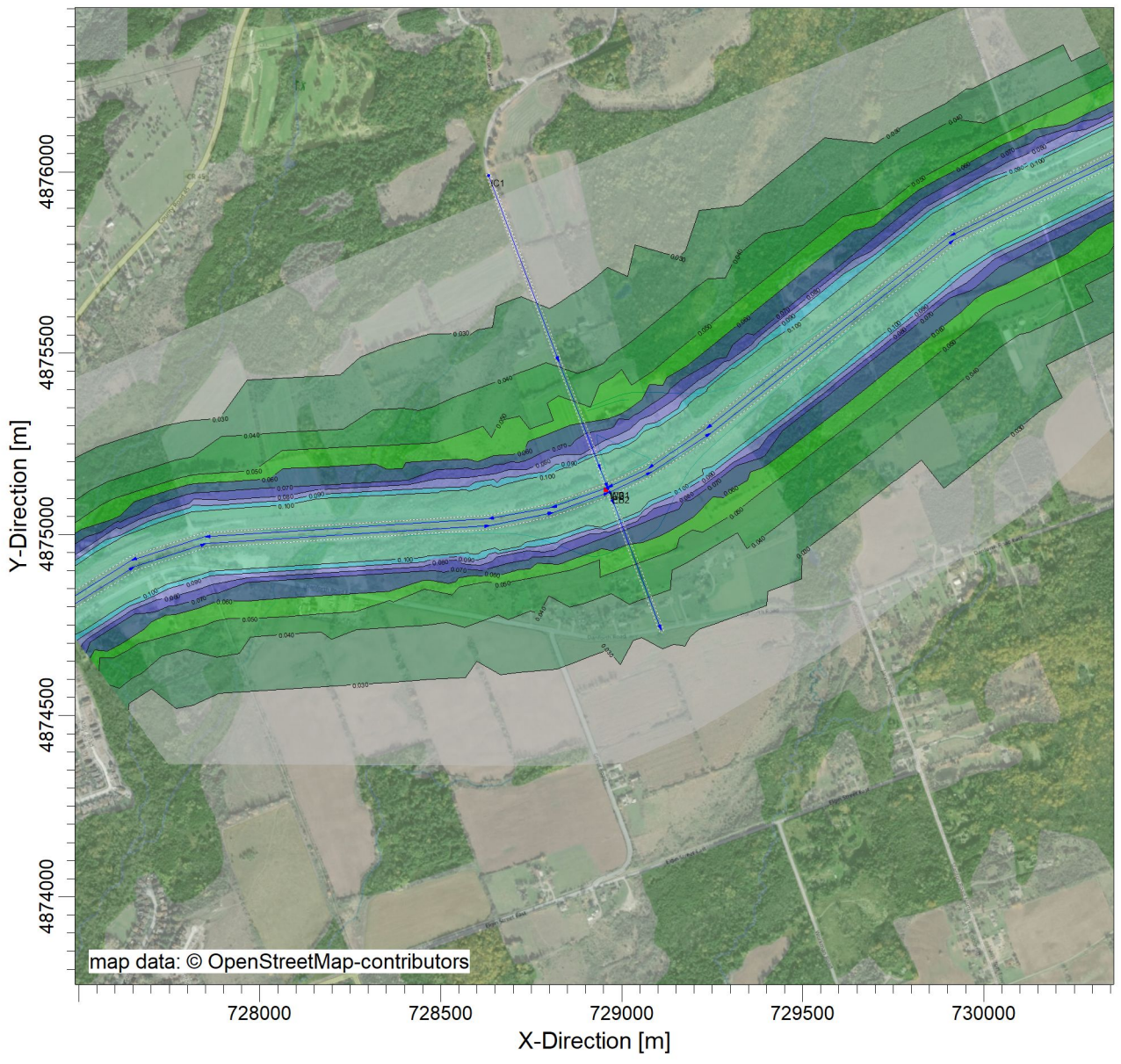
SCALE: 1:18,363

0 0.5 m

PROJECT / PLOT NO.:

PROJECT TITLE:

Future No Build
Predicted Annual Concentrations for Benzo(a)pyrene without Background (pg/m3)



COMMENTS:

worst case meteorological year 2017

MODEL:

CAL3QHCR

LINKS:

25

RECEPTORS:

1130

COMPANY NAME:

Stantec Consulting Ltd.

DATE:

10/3/2022

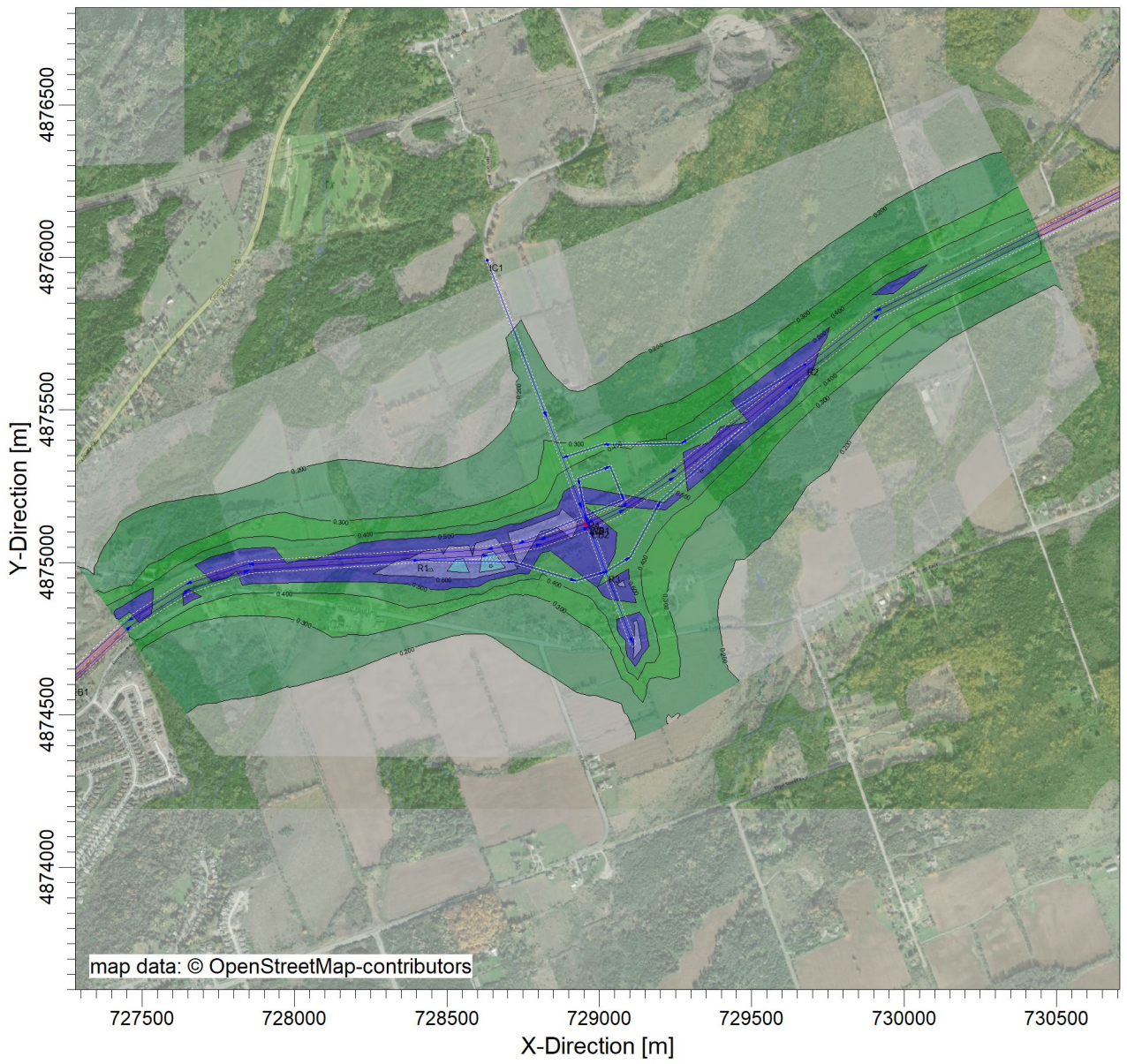
SCALE: 1:18,363

0 0.5 m

PROJECT / PLOT NO.:

PROJECT TITLE:

Future Build Scenario
Predicted 24-Hour Concentrations for Benzo(a)pyrene without Background (pg/m3)



COMMENTS:

worst case meteorological year 2014

MODEL:

CAL3QHCR

LINKS:

38

RECEPTORS:

1066

COMPANY NAME:

Stantec Consulting Ltd.

DATE:

10/3/2022

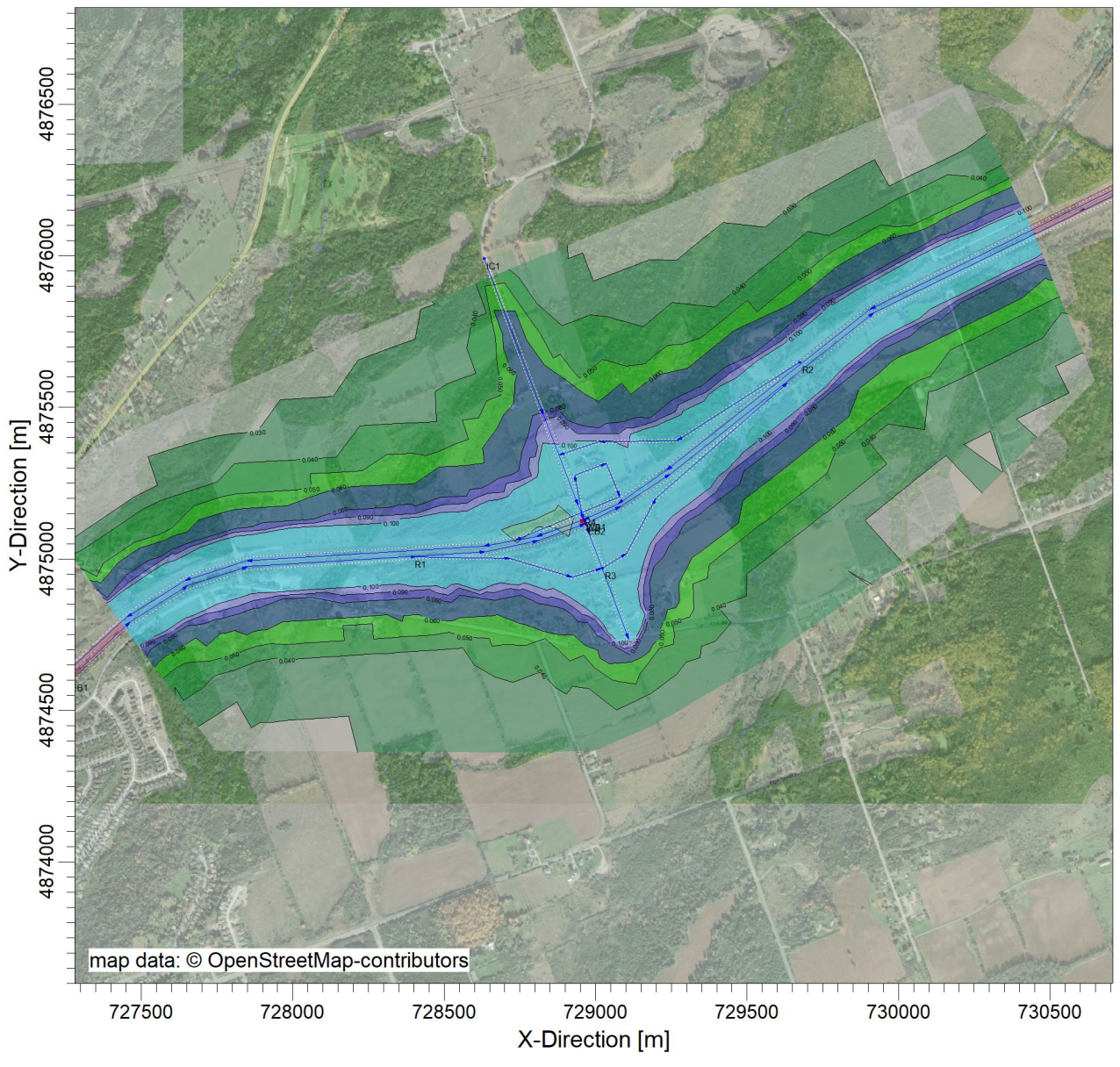
SCALE: 1:21,926

0 0.5 m

PROJECT / PLOT NO.:

PROJECT TITLE:

Future Build Scenario
Predicted Annual Concentrations for Benzo(a)pyrene without Background (pg/m3)



COMMENTS:

worst case meteorological year 2017

MODEL:

CAL3QHCR

LINKS:

38

RECEPTORS:

1066

COMPANY NAME:

Stantec Consulting Ltd.

DATE:

10/3/2022

SCALE: 1:21,926

0 0.5 m

PROJECT / PLOT NO.: