APPENDIX L

Air Quality Impact Assessment Report

REPORT

Dufferin County Road 109/2nd Line Amaranth Realignment

Schedule C Municipal Class Environmental Assessment

Submitted to:

Dufferin County

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1.0 INTRODUCTION

Dufferin County is currently undertaking a Schedule C Municipal Class Environmental Assessment (EA) study in support of the realignment of Dufferin County Road 109 and 2nd Line Amaranth, in County of Dufferin, Ontario. As part of a proposed development located near Dufferin County Road 109 and 2nd Line Amaranth , 2nd Line Amaranth is proposed to be realigned as the fourth leg of the Dufferin County Road 109 and Dufferin County Road 3 intersection. This realignment could impact other intersections, namely Dufferin County Road 3 and Dufferin County Road 23, which is less than 100m south of the Dufferin County Road 109 and Dufferin County Road 3 intersection. The EA is being conducted to determine the potential impacts of the Dufferin County Road 109 and 2nd Line Amaranth realignment. As part of the EA, an Air Quality Impact Assessment (AQIA) is required to document the existing air quality and evaluate the impact of traffic related air pollution (TRAP) concentrations in the Study Area. The AQIA is based on information available at the time of the assessment and any future modification would be subject to assessment during the future design stages.

1.1 Preferred Alternative

The Recommended Plan includes the following modifications to the following existing roads:

- 2nd Line Amaranth will be realigned to form the fourth leg of the Dufferin County Road 109 and Dufferin County Road 3 intersection. The intersection will be converted from stop-controlled to a four-way signalized intersection.
- The existing Dufferin County Road 109 will be widened to four lanes (two in each direction) with right- and left-turn lanes eastbound and westbound.
- The existing Dufferin County Road 3 will be realigned to remove the channelized northbound right turn lane and to improve the intersection geometry;
- Dufferin County Road 23 will be realigned further south of the existing Dufferin County Road 23 to ensure the intersection of Dufferin County Road 3 and Dufferin County Road 23 does not conflict with the proposed four-legged intersection. In addition, realignment of Dufferin County Road 23 provides adequate left turn storage and taper for vehicles turning left from Dufferin County Road 3 onto Dufferin County Road 23
- As a result of realigning Dufferin County Road 23 to the south, the existing Paula Court will be extended further south to maintain a T-intersection with Dufferin County Road 23.

1.2 Study Area

The study area is located within Township of Amaranth and Township of East Garafraxa and is adjacent to Town of Orangeville. It includes lands surrounding the Dufferin County Road 109, 2nd Line Amaranth and Dufferin County Road 3 intersection, Dufferin County Road 23 and Dufferin County Road 3 intersection and is shown in Figure 1.The Study Area extends 300 m from the preferred alternative. The study area is currently a mixture of agricultural land and residential and industrial buildings.

Figure 1: Study Area

2.0 METHODOLOGY

2.1 Approach

The AQIA assessment follows methodology outlined in the Ministry of the Environment, Conservation and Parks (MECP) Central Region Draft Document "Traffic Related Air Pollution: Mitigation Strategies and Municipal Road Class Environmental Assessment Air Quality Impact Assessment Protocol" dated July 2017 (MECP Protocol) for a Schedule C Municipal Class EA. The MECP Protocol provides guidance on assessment methodologies that can be applied to AQIA for transportation related projects. Based on the nature and complexity of the project, only a partial AQIA is required as outlined in the MECP Protocol.

The main objectives of the Study are to:

- Define the Study Area;
- Identify sensitive receptors in the Study Area;
- Establish existing conditions in the Study Area;
- Compare the existing ambient air quality data in the vicinity of the project to applicable provincial and federal air quality thresholds;
- Identify emission sources from surrounding industrial activities;

- Calculate and compare emission data based on existing, future build, and future no build scenarios;
- Discuss potential air quality impacts, including greenhouse gas (GHG) emissions, that could arise from the project during construction and operations to the receptors; and,
- Discuss potential mitigation measures, if required.

2.2 Contaminants of Concern

The assessment of air quality in the Study Area focused on criteria air contaminants (CACs) and GHGs, that are expected to be released from vehicular sources, and contaminants which are generally accepted as indicators of changing air quality. These indicators are emitted from fuel combustion and from vehicles travelling on roadways. The indicators selected for this assessment include:

- Total suspended particulates (TSP);
- Particulate matter less than 10 microns in diameter (PM_{10});
- Particulate matter less than 2.5 microns in diameter ($PM_{2.5}$);
- Nitrogen oxides expressed as nitrogen dioxide (NO_2);
- Carbon monoxide (CO);
- 1,3-Butadiene;
- Acetaldehyde;
- Acrolein;
- Benzene; and,
- Formaldehyde.

Volatile organic compounds (VOCs) were assessed using 1,3-butadiene, acetaldehyde, acrolein, benzene, and formaldehyde as surrogates to assess potential impacts from vehicles travelling on roadways.

Carbon dioxide equivalents (CO_2eq) will be calculated to assess greenhouse gas impacts and will be compared to provincial and Dufferin County GHG inventories and targets.

2.3 Air Quality Indicators

The MECP and the Canadian Council of Ministers of the Environment (CCME) has issued guidelines related to ambient air concentrations, which are summarized in the Ontario Ambient Air Quality Criteria (AAQC) (MECP, 2020) and the Canadian Ambient Air Quality Standards (CAAQS).

The Ontario AAQC and CAAQS list desirable concentrations of contaminants in air based on protection against adverse effects on health and/or the environment. The AAQC and CAAQS are developed by the MECP and the CCME and have varying time-weighted averaging periods (e.g., annual, 24-h, 8-hour, 1-hour, and 30-minutes) appropriate for the adverse effect that they are intended to protect against (i.e., acute or chronic). The adverse effects considered may be related to health, odour, vegetation, soiling, visibility, and/or corrosion. The AAQC and CAAQS may be changed from time to time based on the state-of-the-science for a contaminant (MECP, 2020).

The AAQC and CAAQS is referred to as “air quality indicators” in this AQIA. Table 1 outlines the applicable air quality objective for each contaminant assessed in this study.

Table 1: Applicable Air Quality Thresholds

Contaminant	Averaging Period	CAAQS [1] (µg/m^3)	AAQC [2] (µg/m^3)	Statistical Form / Notes
Total Suspended Particulates (TSP)	24 h	—	120	Estimated based on PM_{10} concentration
	Annual	—	60	
PM_{10}	24 h	—	50	3-year average of the most recent consecutive annual 98th percentile of the daily 24-hour average concentrations - converted from $PM_{2.5}$
$PM_{2.5}$	24 h	27	27	3-year average of the most recent consecutive annual 98th percentile of the daily 24-hour average concentrations
	Annual	8.8	8.8	3-year average of the most recent consecutive annual 98th percentile of the 1-hour average concentrations
NO_2	1 h	**79** (2025) 113 (2020)	400	3-year average of the most recent consecutive annual 98th percentile of the daily maximum 1-hour average concentrations
	24 h	—	200	5-year average of 90th percentile
	Annual	**23 (2025)** 32 (2020)	—	3-year average of the most recent consecutive annual average of all 1-hour averages
Carbon Monoxide (CO)	1 h	—	36,200	5-year average of 90th percentile
	8 h	—	15,700	5-year average of 90th percentile
1,3-Butadiene	24 h	—	10	5-year average of 90th percentile
	Annual	—	2	5-year average of 24-hour concentrations converted to an annual averaging period

Contaminant	Averaging Period	CAAQS [1] (µg/m³)	AAQC [2] (µg/m³)	Statistical Form / Notes
Acetaldehyde	30 min	—	500	5-year average of 24-hour concentrations converted to a 30 min averaging period
	24 h	—	500	5-year average of 90th percentile
Acrolein	1 h	—	4.5	5-year average of 90th percentile
	24 h	—	0.4	5-year average of 90th percentile
Benzene	24 h	—	2.3	5-year average of 90th percentile
	Annual	—	0.45	5-year average of 24-hour concentrations converted to an annual averaging period
Formaldehyde	24 h	—	65	5-year average of 90th percentile

Notes:
[1] CAAQS obtained from the Canadian Council of Ministers of the Environment (CCME). 2022.
[2] AAQC obtained from the Ontario Ministry of the Environment, Conservation and Parks (MECP). 2020. Ambient Air Quality Criteria publication.
Bold indicates that the value was used as the applicable Project threshold.

3.0 EXISTING AIR QUALITY

The existing air quality in the Study Area has been described by considering regional concentrations based on publicly available historical ambient air monitoring data. The existing air quality represents the current conditions of air quality before the implementation of the proposed Project. Sources contributing to the existing air quality conditions include industrial activities, roadways, long-range transboundary air pollution, and small regional sources. This section discusses the selection of the representative monitoring stations, and comparison of the selected data to the applicable air quality indicator.

3.1 Ambient Monitoring Stations

The concentrations of the selected contaminants for this assessment resulting from background sources were estimated by analyzing historical meteorological and ambient air monitoring data from Environment and Climate Change Canada (ECCC). The ambient air data was obtained from the National Air Pollution Surveillance (NAPS) stations and the MECP air monitoring stations in the vicinity of the Study Area. Consideration was given to assess the representativeness of the data for the stations selected for use in this assessment.

The ambient air monitoring data was selected for the latest available years and excludes data that has not been through rigorous quality assurance and quality control (QA/QC) or data which may have been influenced by the COVID-19 pandemic.

WSP reviewed the ambient air monitoring data from stations in Ontario and selected representative existing data from the Guelph Exhibition Park (Guelph), Toronto West – 125 Resources Rd (Toronto West) and Simcoe Experimental Farm (Simcoe) stations for the air quality indicators in this assessment. More than one station was required due to some contaminants not being measured at representative locations for the Study Area. The location of the selected stations is presented in Figure 2.

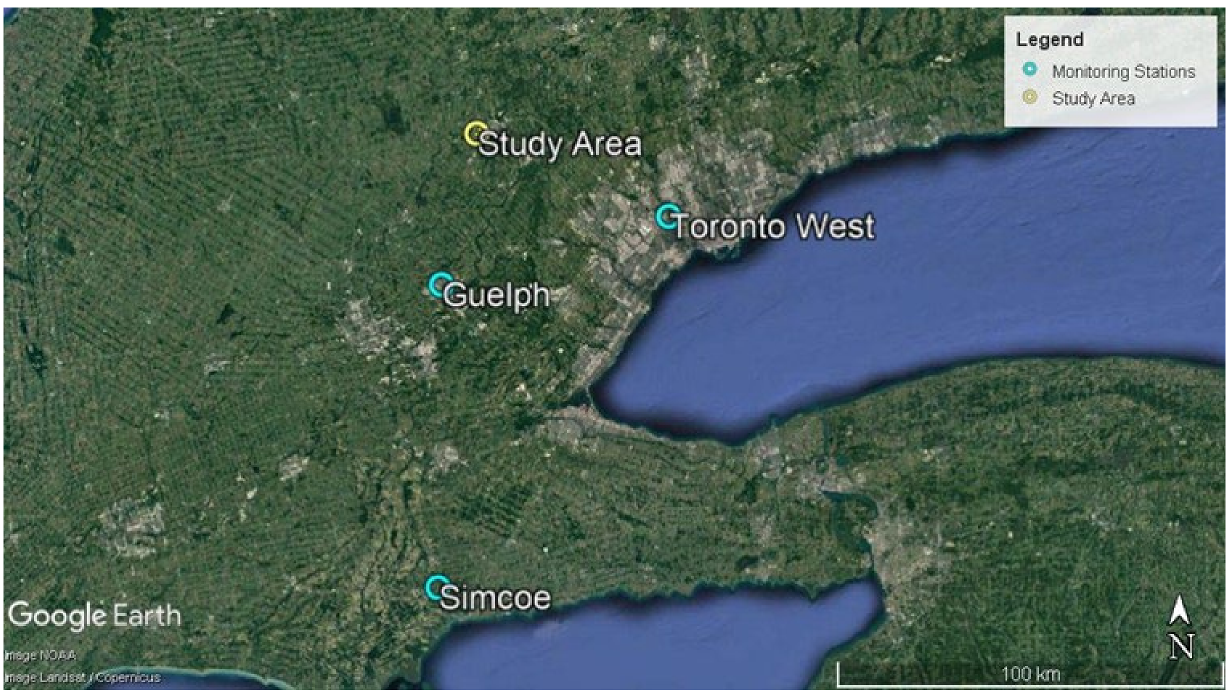

Figure 2: Location of Ambient Monitoring Stations

The availability of data varies for each contaminant based on accessibility to quality assured data from ECCC and the MECP. The station information and period of analysis are listed in Table 2. Data from the Guelph station was used for PM_{10}, $PM_{2.5}$, TSP and NO_2. The Simcoe station was used for acetaldehyde, formaldehyde, 1,3-butadiene, benzene, and acrolein. Lastly, the Toronto West station was used for CO. The Guelph station was selected because of the station proximity to the Study Area, data availability, as well as the station being in a similar geographic region with similar local land use. The Toronto West station was selected because of the station proximity to the Study Area and data availability. Toronto West represents a worst-case scenario for CO due to the proximity of the station to the Ontario Highway 401, which carries more vehicular traffic than the surrounding land uses of the Study Area. The Simcoe Experimental Farm station was selected for use because of similar geographic region and data availability.

Table 2: Representative Air Monitoring Stations and Data Availability for Selected Contaminants

		DATA AVAILABLE							
STATION NAME	NAPS/MECP STATION ID	$PM_{2.5}$	CO	NO_2	BENZENE, 1,3-BUTADIENE	ACETALDEHYDE, FORMALDEHYDE	ACROLEIN	YEARS OF DATA ASSESSED	APPROX. DISTANCE FROM PROJECT (KM)
Guelph	61802	Y	N	Y	N	N	N	2015 - 2019	40
Toronto West	60430	Y	Y	Y	Y	N	N	2015 - 2019	53
Simcoe	62601	Y	N	Y	Y[1]	Y[1]	Y[2]	2014 - 2019	117

Notes:

[1] Due to data availability from the Experimental Farm Simcoe station (62601), five years of data were available from 2014 - 2015 and 2017 - 2019

[2] Due to data availability from the Experimental Farm Simcoe station (62601), four years of data were available for acrolein from 2014 - 2017

The 90th percentile background concentration for each contaminant was determined from the stations listed in Table 2. The 90th percentile over the five-year dataset is representative of ambient background conditions for averaging periods of 30 minutes, 1 hour, 8 hour, and 24 hours. Due to data availability a four-year dataset was used for acrolein. For contaminants with an annual averaging period and where hourly or 24-hour values were available, the average annual mean over the number of years of data available was used. Table 3 summarizes the background concentrations representative of the Study Area, and the associated ambient air quality criteria.

Table 3: Summary of Ambient Background Concentrations from Representative Stations

CONTAMINANT	AVERAGING PERIOD	BACKGROUND CONCENTRATION (µg/m³)	AIR QUALITY THRESHOLD (µg/m³)	% OF THRESHOLD
TSP[A]	24 h	44	120	37%
	Annual	24	60	40%
PM_{10}[B]	24 h	22	50	44%
$PM_{2.5}$	24 h	13	27	48%
	Annual	7.3	8.8	83%
NO_2	1 h	42	79	53%
	24 h	21	200	11%
	Annual	11	23	48%

CONTAMINANT	AVERAGING PERIOD	BACKGROUND CONCENTRATION (µg/m³)	AIR QUALITY THRESHOLD (µg/m³)	% OF THRESHOLD
CO	1 h	406	36,200	1%
	8 h	368	15,700	2%
Acrolein	1 h	0.04[C]	4.5	1%
	24 h	0.02	0.4	5%
Benzene	24 h	0.5	2.3	22%
	Annual	0.06	0.45	13%
1,3-Butadiene	24 h	0.02	10	0.2%
	Annual	0.002	2	0.1%
Acetaldehyde	30 min	6.1[D]	500	1%
	24 h	2.1	500	0.4%
Formaldehyde	24 h	1.3	65	2%

Notes:

[A] TSP = $PM_{2.5}$ / 0.3. Reference: Lall et al., 2004 ("Estimation of historical annual $PM_{2.5}$ exposures for health effects assessment", published in the Journal of Atmospheric Environment)

[B] PM_{10} = $PM_{2.5}$ / 0.6. References: Lall et al., 2004 ("Estimation of historical annual $PM_{2.5}$ exposures for health effects assessment", published in the Journal of Atmospheric Environment), Brook, Dann & Burnett, 1997 ("The Relationship Among TSP, PM_{10}, $PM_{2.5}$, and Inorganic Constituents of Atmospheric Participate Matter at Multiple Canadian Locations", published in the Journal of the Air & Waste Management Association)

[C] The 1-hour concentration was converted from the 24-hour concentration. Reference: Ontario Ministry of the Environment, Conservation, and Parks, 2018 ("Procedure for Preparing an Emission Summary and Dispersion Modelling Report")

[D] The 30-minute concentration was converted from the 24-hour concentration. Reference: Ontario Ministry of the Environment, Conservation, and Parks, 2018 ("Procedure for Preparing an Emission Summary and Dispersion Modelling Report")

The air quality objectives listed in Table 3 represent desirable levels of contaminants in ambient air and are not enforceable within any jurisdiction; they represent a 'road map' for ambient air quality provincially. A value above an air quality indicator does not indicate a concern but is used to describe the air quality qualitatively. Based on existing ambient data presented in Table 3, the existing air quality in the Study Area is considered good as the air quality criteria are met for the indicator contaminants selected.

3.2 Meteorological Data

As part of the Study, WSP obtained historical climate data from the ECCC website and reviewed the meteorological data for the Study Area. The Mono Centre Station (Climate ID # 6157000) was selected based on its proximity to the Study Area (located approximately 17 km northeast of the Study Area), data availability and representative wind conditions for the Study Area.

The Mono Centre Station average wind data from 2014 to 2018 was analyzed to evaluate the frequency that the wind could contribute to air quality impacts in the Study Area. A 'blowing to' wind rose was produced for the aforementioned period and is included in this report as Figure 3. The prevailing wind direction in the Study Area is blowing to the east northeast, accounting for 12.4%, or 45 equivalent days of the year.

Figure 3: Study Area Wind Rose for January 1, 2014 to December 31, 2018

3.3 Surrounding Industrial Facilities

Nearby industrial facilities have the potential to impact existing air quality conditions surrounding the Study Area. Facilities have been identified within 1 km of the Study Area which may contribute to existing air quality conditions. Within 1 km of the Study Area there were no facilities identified reporting to the National Pollutant Release Inventory (NPRI) in 2021, which corresponds to the latest available year with data that has been quality assured by ECCC. Facilities which may contribute to existing air quality conditions not reporting to NPRI are listed in Table 4, along with the anticipated potential air quality impacts.

Table 4: Industrial Facilities within 1 km

Facility	Address	Description	Potential Emissions	Approximate Distance to Study Area (m)
Tire Discounter Group	65379 Dufferin County Road 3	Distribution service	Combustion emissions from vehicles on site	0
Greenwood Construction	205467 Dufferin County Road 109	Concrete, aggregates and asphalt supplier	Combustion emissions from vehicles on site, dust from vehicles on unpaved roadways and the movement of gravel and soil (TSP, PM_{10}, $PM_{2.5}$)	348
Brut Automotive	205487 Dufferin County Road 16	Auto repair shop	Combustion emissions from vehicles on site	494
Hyde-Whipp Heating & Air Conditioning	205242, Dufferin County Road 109	HVAC contractor	Combustion emissions from vehicles on site, dust emissions from vehicles on unpaved roadways (TSP, PM_{10}, $PM_{2.5}$)	642
GT Marine	473006 Dufferin County Road 11	Marine supply store		655
GT Auto	473001-473006 Dufferin County Road 11	Auto accessories wholesaler		655
Watermaker Inc.	16 Shannon Court, Amaranth	Bottled water supplier		713
Bramcity Logistics Inc	473019 Dufferin County Road 11	Trucking services		746
Whispering Pines Landscaping	473020, Dufferin County Road 11	Landscape designer	Combustion emissions from vehicles on site, dust emissions from vehicles on unpaved roadways (TSP, PM_{10}, $PM_{2.5}$)	773
Dufferin Transfer & Recycling	473051 Dufferin County Road 11	Recycling centre		778

Facility	Address	Description	Potential Emissions	Approximate Distance to Study Area (m)
Amarlinc Earthworks Inc.	513151 2nd Line Amaranth	Aggregate supplier	Combustion emissions from vehicles on site, dust from vehicles on unpaved roadways and the movement of gravel and soil (TSP, PM_{10}, $PM_{2.5}$)	796
Hydro One Orangeville Transmission Station	473093, Dufferin County Road 11	Electrical substation	Combustion emissions from vehicles on site, dust emissions from vehicles on unpaved roadways (TSP, PM_{10}, $PM_{2.5}$)	810
Lauer Machine & Manufacturing	14 Shannon Court	Manufacturing		810
DSE Automotive	473034 Dufferin County Road 11	Auto repair shop		838
Standard Drive Services Inc	13 Shannon Court	Machine repair service		864
Parker's Auto Body	11 Shannon Court, Amaranth	Auto repair shop		864
Avertex Utility Solutions Inc	205235 Dufferin County Rd 109	General contractor	Combustion emissions from vehicles on site, dust from vehicles on unpaved roadways and outdoor equipment storage (TSP, PM_{10}, $PM_{2.5}$)	897
Alder Street Community Center[1]	275 Alder Street, Orangeville	Community center	Combustion emissions from vehicles on site, heating equipment on site and an emergency generator	908

Facility	Address	Description	Potential Emissions	Approximate Distance to Study Area (m)
Kreator Equipment & Svc[2]	473036 Dufferin County Road 11	Industrial equipment supplier	Combustion emissions from vehicles on site, dust from vehicles on unpaved roadways and outdoor equipment storage (TSP, PM_{10}, $PM_{2.5}$), VOC emissions from facility activities as outlined in an EASR	953
Westgate Trailers	205222 Dufferin County Rd 109	Trailer dealer	Combustion emissions from vehicles on site, dust from vehicles on unpaved roadways and outdoor equipment storage (TSP, PM_{10}, $PM_{2.5}$)	998
JEMEV Waste Recycling Inc.[1]	205337 Dufferin County Rd 109	Top Soil/Recycle Yard		660

Notes:
[1] Facility has a registered ECA
[2] Facility has a registered EASR

3.4 Greenhouse Gas Emissions

Reported GHG emission inventories for Dufferin County were reviewed and compared to Ontario's GHG emission inventory. Based on the Dufferin County Community Greenhouse Gas Inventory Report for 2016, which is the latest GHG inventory report available for the Dufferin County, 215,499 tonnes CO2eq were reported from the transportation sector. This accounts for approximately 0.1% of the 2016 Ontario total GHG inventory.

3.5 Sensitive Receptors

As outlined in the MECP Protocol, sensitive receptors within a 300 m radius of the Study Area were identified in the assessment. The area surrounding the Study Area is comprised of agricultural, commercial, industrial, and residential land uses. Two sensitive receptors as well as areas of residential dwellings have been identified within 300 m of the Study Area.

- Residential dwellings;
- One school; and,
- One place of worship.

The location of sensitive receptors is shown in Figure 4.

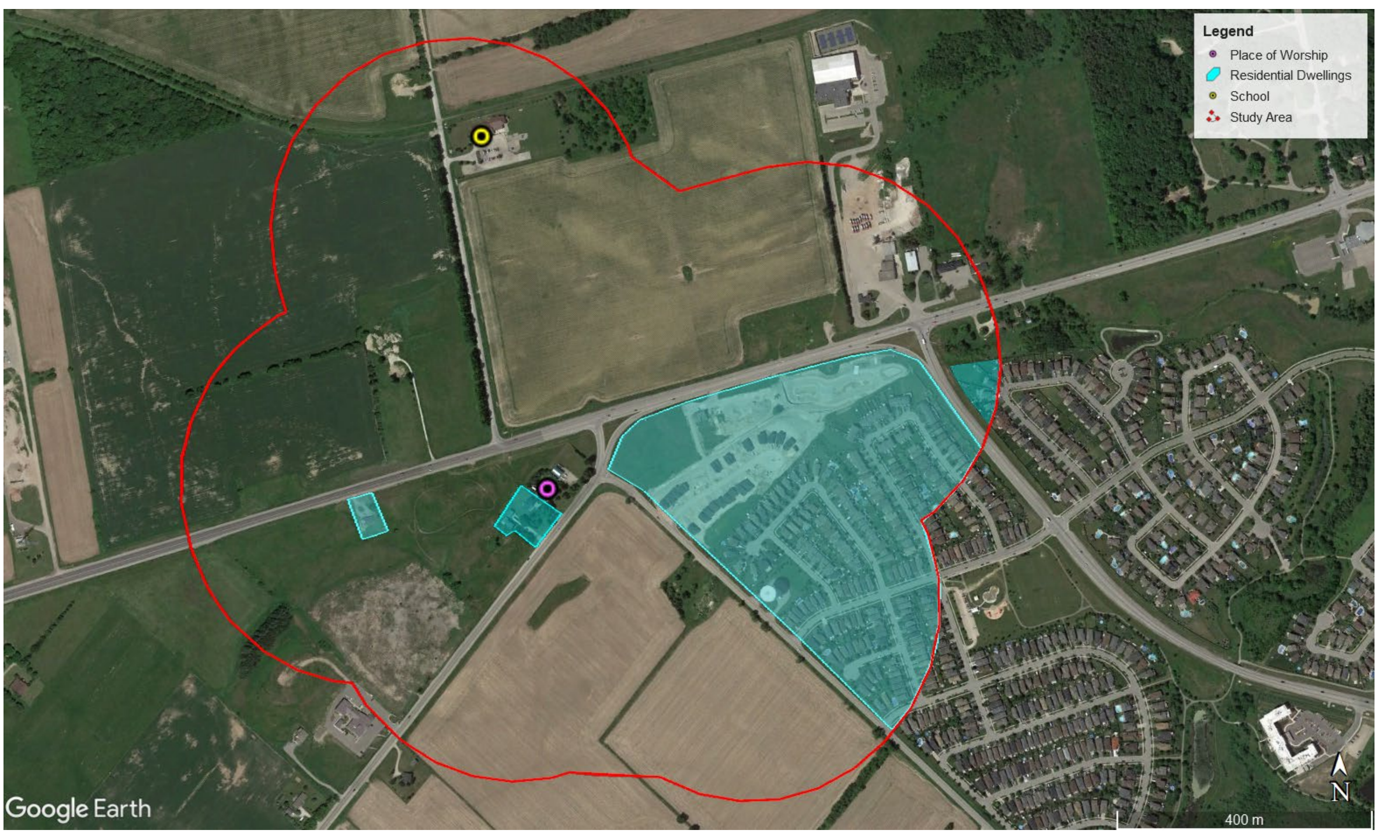

Figure 4: Location of Surrounding Sensitive Receptors

4.0 PROJECT AIR QUALITY IMPACTS

There are several sources of air emissions from vehicular travel in the Study Area. Vehicle emission rates were calculated for the existing (2023) and future (2041) scenarios for the Project build and without the Project build. For ease of review, given the same methodology is used to assess the existing vehicular emissions, they are presented within this section.

4.1 Traffic Data

Existing (2023) traffic data was estimated using Annual Average Daily Traffic (AADT) values for 2021 and 2022, obtained from the Dufferin County Road Traffic Counts online database, with an annual growth rate of 1.5% applied. The WSP transportation team provided future AADT values for 2027 and 2041 build and no build scenarios. For this assessment, 2041 was assessed as the future horizon year as this would allow for a better understanding of air quality impacts during the operations phase of the Project. Percentage of passenger vehicles and trucks, heavy trucks, and medium trucks for each road segment were estimated using truck traffic data obtained from the Dufferin County Road Traffic Counts online database. A summary of 2023 and 2041 traffic data in the Study Area is presented in Table A-1 to Table A-3 of Appendix A.

4.2 Vehicle Emission Rates

Vehicle emission rates for the existing (2023) and future (2041) conditions were estimated using the US EPA Motor Vehicle Emission Simulator (MOVES), version MOVES3. MOVES is an approved and recommended emission estimating model for use by the MTO and the MECP. The MOVES model allows for coverage of multiple geographic scales and can generate emission estimates for various time periods (hour, day, month, and year). Emission rates for the assessment were estimated using AADT data, default vehicle fleet age distribution and emissions inspection and maintenance, and fuel properties were adjusted to reflect the geographic area of the Project (Ontario). In the absence of reliable published data on the fleet composition, it is assumed that both the existing and future fleet vehicles are running on conventional fuels and no reductions for use of hybrid vehicles or electric vehicles has been applied to the emission factors calculated. This will lead to some overprediction of the emissions from the vehicles. Emission rates for resuspended particulate matter were calculated separately using US EPA emission factors and added to the MOVES outputs. MOVES option selections are presented in Table A-4 and emission rates are presented in Table A-5 of Appendix A.

4.3 Greenhouse Gas Emissions

GHGs are contributors to the radiative warming effect of the environment that results in global climate change. To investigate the impact of the Project on GHG emissions, the GHG emissions from the Project no build and Project full build scenarios were compared to existing conditions.

The GHGs included in this assessment are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) which are emitted from fuel combustion as well as other anthropogenic and natural sources. Carbon dioxide is the main product of combustion while the other two gases are by-products of incomplete combustion. Methane and nitrous oxide have lower concentrations in the atmosphere than carbon dioxide, but their potential impact on global warming potential (GWP) per molecule is larger than for carbon dioxide. The 100-year global warming potential (GWP) factors shown in Table 5 were used to convert the GHGs emissions estimated using MOVES into CO2eq. Existing (2023) and future (2041) annual CO_2, CH_4, and N_2O emissions are provided in Appendix B.

Table 5: Contaminant Global Warming Potential

CONTAMINANT	GLOBAL WARMING POTENTIAL [A]
Nitrous Oxide (N2O)	265
Methane (CH4)	28
Carbon Dioxide (CO2)	1

Notes: [A] Ontario Regulation 390/18: Greenhouse gas emissions: quantification, reporting and verification (January 1, 2023)

5.0 RESULTS

5.1 Air Quality Impacts

Vehicle emission rate results for the CACs and other contaminants of concern are reported in this section as a gram per second emission rate for the Study Area. A comparison between the future Project build and no build scenarios was used to quantify the impact of the Project on local air quality.

This section includes predicted emission rate results for the following two scenarios:

» Full Build Scenario: 2041 horizon (future scenario) with Project; and,

» No Build Scenario: 2041 horizon (future scenario) without Project.

A summary of AADT values for each road segment in the Study Area is presented in Table 6. Vehicle miles travelled (VMT) for existing conditions and future scenarios are presented in Table 7. Vehicle emission rates for existing conditions were compared to future emission rates and are presented in Table 8 and Table 9.

Table 6: Summary of AADT in Study Area

ROAD SEGMENT	2023 AADT	2041 NO BUILD AADT	% CHANGE 2023-2041 NO BUILD	2041 FULL BUILD AADT	% CHANGE 2023-2041 FULL BUILD
Dufferin County Road 109	17,426	21,740	25%	31,140	79%
2nd Line Amaranth	1,592	2,020	27%	10,010	529%
Dufferin County Road 3	5,698	7,280	28%	8,390	47%
Dufferin County Road 23	3,074	4,100	33%	5,050	64%
TOTAL	**27,791**	**35,140**	**26%**	**54,590**	**96%**

Table 7: Summary of VMT in Study Area

ROAD SEGMENT	2023 VMT	2041 NO BUILD VMT	% CHANGE 2023-2041 NO BUILD	2041 FULL BUILD VMT	% CHANGE 2023-2041 FULL BUILD
Dufferin County Road 109	7,090	8,846	25%	12,670	79%
2nd Line Amaranth	332	421	27%	2,120	539%
Dufferin County Road 3	949	1,213	28%	1,398	47%
Dufferin County Road 23	555	741	33%	1,034	86%
TOTAL	**8,927**	**11,220**	**26%**	**17,222**	**93%**

Table 8: Summary of Impacts to the Study Area – Project No Build Scenario

CONTAMINANT	2023 EMISSION RATE (g/s)	2041 NO BUILD EMISSION RATE (g/s)	% CHANGE
Carbon Monoxide	2.93E-01	1.66E-01	-44%
Benzene	1.89E-04	9.32E-05	-51%
1,3-Butadiene	1.19E-05	0.00E+00	-100%
Formaldehyde	2.48E-04	4.86E-05	-80%
Acetaldehyde	1.46E-04	5.93E-05	-59%
Acrolein	1.99E-05	5.31E-06	-73%
Nitrogen Dioxide	2.02E-02	2.22E-02	10%
Benzo(a)pyrene gas	7.75E-10	2.89E-10	-63%
TSP	4.48E-02	5.54E-02	24%
PM_{10}	4.48E-02	5.54E-02	24%
$PM_{2.5}$	1.11E-02	1.27E-02	14%

Table 9: Summary of Impacts to the Study Area - Project Full Build Scenario

CONTAMINANT	2023 EMISSION RATE (g/s)	2041 FULL BUILD EMISSION RATE (g/s)	% CHANGE
Carbon Monoxide	2.93E-01	2.62E-01	-11%
Benzene	1.89E-04	1.46E-04	-23%
1,3-Butadiene	1.19E-05	0.00E+00	-100%
Formaldehyde	2.48E-04	7.78E-05	-69%
Acetaldehyde	1.46E-04	9.53E-05	-35%
Acrolein	1.99E-05	8.53E-06	-57%
Nitrogen Dioxide	2.02E-02	3.62E-02	79%
Benzo(a)pyrene gas	7.75E-10	4.56E-10	-41%
TSP	4.48E-02	7.03E-02	57%
PM_{10}	4.48E-02	7.03E-02	57%
$PM_{2.5}$	1.11E-02	1.57E-02	41%

5.2 Greenhouse Gas Impacts

The annual GHG emissions for each road segment are presented in Table 10. The future (2041) GHG emissions are compared to the Dufferin County and provincial GHG emission targets in Table 11 and Table 12, which were obtained from Ontario's Emissions Scenario as of March 25, 2022 report and Dufferin Climate Action Plan 2021.

In the absence of reliable published data on the fleet composition, it is assumed that both the existing and future fleet vehicles are running on conventional fuels and no reductions for use of hybrid vehicles or electric vehicles have been applied to the emission factors calculated. As a result, emission rates are conservative.

Table 10: Total GHG Emissions (as CO2eq) per Road Segment

ROAD SEGMENT	2023 (TONNES/YEAR)	2041 NO BUILD (TONNES/YEAR)	2041 FULL BUILD (TONNES/YEAR)	% CHANGE 2023-2041 NO BUILD	% CHANGE 2023-2041 FULL BUILD
Dufferin County Road 109	1.61E+03	1.56E+03	2.24E+03	-3%	39%
2nd Line Amaranth	1.10E+02	1.09E+02	5.46E+02	-1%	397%
Dufferin County Road 3	3.22E+02	3.20E+02	3.69E+02	0%	15%
Dufferin County Road 23	1.59E+02	1.64E+02	2.12E+02	3%	34%
TOTAL	**2.20E+03**	**2.15E+03**	**3.36E+03**	**-2%**	**53%**

Table 11: GHG Emissions (as CO2eq) Comparison to Dufferin County GHG Target for Transportation

ROAD SEGMENT	2041 NO BUILD EMISSIONS (TONNES/YEAR)	2041 FULL BUILD EMISSIONS (TONNES/YEAR)	2040 DUFFERIN COUNTY TARGET (TONNES/YEAR) [A]	2041 NO BUILD (% OF DUFFERIN COUNTY TARGET)	2041 FULL BUILD (% OF DUFFERIN COUNTY TARGET)
Dufferin County Road 109	1.56E+03	2.24E+03		1.8%	2.6%
2nd Line Amaranth	1.09E+02	5.46E+02		0.1%	0.6%
Dufferin County Road 3	3.20E+02	3.69E+02	8.60E+04	0.4%	0.4%
Dufferin County Road 23	1.64E+02	2.12E+02		0.2%	0.2%
TOTAL	**2.15E+03**	**3.37E+03**		**2.5%**	**3.9%**

Notes: [A] The Dufferin County 2040 GHG emission target is 40% of the 2016 GHG emissions reported in the Dufferin Climate Action Plan 2021.

Table 12: GHG Emissions (as CO2eq) Comparison to Provincial Target

ROAD SEGMENT	2041 NO BUILD EMISSIONS (TONNES/YEAR)	2041 FULL BUILD EMISSIONS (TONNES/YEAR)	2030 PROVINCIAL TARGET (TONNES/YEAR) [A]	2041 NO BUILD (% OF PROVINCIAL TARGET)	2041 FULL BUILD (% OF PROVINCIAL TARGET)
Dufferin County Road 109	1.56E+03	2.24E+03		<0.01%	<0.01%
2nd Line Amaranth	1.09E+02	5.46E+02		<0.01%	<0.01%
Dufferin County Road 3	3.20E+02	3.69E+02	1.44E+08	<0.01%	<0.01%
Dufferin County Road 23	1.64E+02	2.12E+02		<0.01%	<0.01%
TOTAL	**2.15E+03**	**3.37E+03**		**<0.01%**	**<0.01%**

Note: [A] The Ontario 2030 GHG emission target is 30% below the 2005 levels per the 2021 National Inventory Report.

6.0 DISCUSSION

6.1 Existing Air Quality

Existing sources of air emissions in the Study Area include industrial activities, roadways, long-range transboundary air pollution, and small regional sources. Based on existing ambient monitoring data, air quality in the Study Area is considered good as the air quality criteria are met for the indicator contaminants selected for this assessment.

6.2 Project Air Quality Impacts

The contaminant emission rates presented in Table 8 and Table 9 indicate that emissions of carbon monoxide, benzene, 1,3-butadiene, formaldehyde, acetaldehyde, acrolein, and benzo(a)pyrene are expected to decrease for the future (2041) Project full build and Project no build scenarios when compared to the existing (2023) scenario. The Project no build scenario is predicted to have a larger decrease in emissions of these contaminants as a result of a smaller increase in AADT and VMT in the Study Area. Overall, the decrease in emissions of these contaminants in the Project full build scenario indicates that the Project is not expected to adversely impact air quality in the Study Area.

The contaminant emission rates presented in Table 8 and Table 9 indicate that emissions of nitrogen dioxide, TSP, PM_{10}, and $PM_{2.5}$ are expected to increase for the future (2041) Project full build and Project no build scenarios when compared to the existing (2023) scenario; however, existing ambient concentrations of these contaminants are below their respective air quality thresholds. The Project full build scenario is predicted to have a larger increase in emissions of these contaminants as a result of a larger increase in AADT and VMT in the Study Area. Particulate matter emissions include exhaust emissions, tire wear, and brake wear; therefore, it is expected that an increase in AADT and VMT will result in an increase in particulate matter emissions. As previously stated, no reductions for use of hybrid vehicles or electric vehicles have been applied to the emission factors calculated; therefore, emission rates are conservative. It is predicted that overall emissions of NO_2 will further decrease with advancements in vehicle technology, fuel efficiency and exhaust control efficiency.

Following the construction of this Project it is predicted that overall emission rates will further decrease with advancements in vehicle technology, fuel efficiency and exhaust control efficiency. Emission rates are also expected to decrease as public transit and alternative transportation uses in the area increase to continue to support the reduction of emissions to meet the regional and provincial GHG emission targets.

6.3 Project GHG Impacts

The GHG emissions in the Study Area were predicted to increase for the Project full build scenario when compared to the Project no build scenario. The increase in GHG emissions for the Project full build scenario is likely a result of a significant increase in AADT and VMT in the Study Area, particularly on 2nd Line Amaranth; however, the increase in GHG emissions is less than the increase in AADT and VMT. As previously mentioned, GHG emission rates are conservative as they do not account for fleet improvements as a result of increased use of electric and hybrid vehicles. It is predicted that overall GHG emissions will decrease with advancements in vehicle technology, fuel efficiency and exhaust control efficiency.

GHG emission estimates for the Project no build and Project full build scenarios is approximately 2.5% and 3.9%, respectively, of the 2040 regional GHG emission target as presented in Table 11. The GHG emission data indicates that the Project full build could result in a 1.4% increase in GHG emissions from transportation sources; however, this is not expected to significantly impact Dufferin County's overall GHG targets.

The Project was also compared to the provincial GHG target for 2030 of 144 Mt/year. GHG emission estimates for both future scenarios are less than 0.01% of the provincial GHG target, as presented in Table 12. The GHG emission data indicates that the Project full build is not expected to significantly impact Ontario's overall GHG targets.

6.4 Construction and Operation Mitigation

This section documents a qualitative assessment of the potential effects that may occur during construction and operation of the Project and proposed mitigation measures and monitoring activities (as applicable) identified to minimize the predicted effects on air quality.

6.4.1 Operation Emissions and Mitigation

The results presented for the Project full build scenario in Section 6.2 show an overall decrease in predicted emission rates during operations for all contaminants except for NO_2, TSP, PM_{10}, and $PM_{2.5}$. The increase in emissions of these contaminants is expected due to an increase in future traffic volumes and associated tailpipe emissions; however, existing ambient concentrations of these contaminants are below their respective air quality thresholds. It is predicted that overall emissions of NO_2 will further decrease with advancements in vehicle technology, fuel efficiency and exhaust control efficiency; therefore, no mitigation measures are recommended for NO_2 emissions. Project operations could result in an increase in particulate matter emissions; therefore, it is recommended that regular road maintenance, such as street sweeping, be performed to minimize adverse impacts from particulate matter.

6.4.2 Construction Emissions and Mitigation

Construction activities have the ability to impact local air quality through increased particulate matter from fugitive dust and from combustion by-products through equipment mobilization. The construction activities associated with the Project consist of the construction and alignment of roadways. Air emissions associated with construction typically include:

- TSP, PM_{10}, and $PM_{2.5}$ resulting from:
  - Stockpiling of soils and other friable material;
  - Granular material loading and unloading activities;
  - Transportation of soils and other friable materials via dump trucks;
  - Soil excavation and filling activities;
  - Movement of heavy and light vehicles on paved and unpaved roads; and,
  - Cutting of concrete.
- Emissions resulting from the combustion engines of construction equipment.

Construction activities are exempt from air regulatory requirements in Ontario due to their temporary nature. Nuisance fugitive dust (coarse particulate such as TSP and PM_{10}) are the primary air quality impact during the construction phase of the Project. Nuisance fugitive dust can be managed through a Construction Air Quality Management Plan (CAQMP) for fugitive dust following the recommendations outlined in the Environment and Climate Change Canada (ECCC) guidance document "Best Practices for the Reduction of Air Emissions from Construction and Demolition Activities", dated March 2005. Air Quality Management Plans should ensure that dust from construction and demolition activities do not impact surrounding environmentally sensitive areas such as aquatic habitats and fisheries, terrestrial vegetation, and faunal communities, as well as residential properties in proximity to work areas.

To mitigate construction activities a CAQMP should be developed to address construction equipment vehicle exhaust, potential traffic disruptions and congestion, fugitive dust, and odour. Potential mitigation measures that may be incorporated in the CAQMP include:

- Dust suppression measures (e.g., application of water wherever appropriate, or the use of approved non-chloride chemical dust suppressants, where the application of water is not suitable);
- Use of dump trucks with retractable covers for the transport of soils and other friable materials;
- Minimize the number of loadings and unloading of soils and other friable materials;
- Minimize drop heights, use enclosed chutes, and cover bins for debris associated with deconstruction of affected structures;
- Washing of equipment and/use of mud mats where practical at construction site exits to limit the migration of soil and dust off-site;
- Stockpiling of soil and other friable materials in locations that are less exposed to wind (e.g., protected from the wind by suitable barriers or wind fences/screens, or covered when long-term storage is required) and away from sensitive receptors to the extent possible;
- Reduction of unnecessary traffic and implementation of speed limits;
- Permanent stabilization of exposed soil areas with non-erodible material (e.g., stone or vegetation) as soon as practicably possible after construction in the affected area is completed;
- Ensuring that all construction vehicles, machinery, and equipment are equipped with current emission controls, which are in a state of good repair; and,
- Dust-generating activities should be minimized during conditions of high wind.

In addition to the CAQMP, construction activities should be monitored by a qualified environmental inspector who will review the effectiveness of the mitigation measures and construction best management practices to confirm they are functioning as intended. If mitigation is found to not be effective, revised mitigation measures designed to improve effectiveness will be implemented. Dust levels should be monitored daily by the designated contractor and frequently by the environmental inspector to assess the effectiveness of dust suppression measures and adjust as required. Monitoring should continue throughout the construction phase until activities are complete, the exposed soils have been stabilized, and the construction waste has been removed from site. A complaint response protocol will be established for nuisance effects, such as dust, for residents to provide feedback. Regular inspections of dust emissions should be carried out by the designated contractor (frequency to be defined prior to Project construction) to confirm dust control watering frequency and rates are adequate for control. Site supervisors should monitor the site for wind direction and weather conditions to ensure that high-risk dust generating activities are reduced when the wind is blowing consistently towards nearby sensitive receptors. The site supervisor should also monitor for visible fugitive dust and take action to determine and correct the cause. Specific details regarding monitoring should be included in the CAQMP.

7.0 CONCLUSIONS AND RECOMMENDATIONS

The results of the AQIA indicate the following:

- The existing air quality in the Study Area is good as the air quality criteria are met for the indicator contaminants selected for this assessment.
- The Project is expected to result in a significant increase in traffic volume within the Study Area.

- Emissions of carbon monoxide, benzene, 1,3-butadiene, formaldehyde, acetaldehyde, acrolein, and benzo(a)pyrene are expected to decrease for the future (2041) Project full build and Project no build scenarios when compared to the existing (2023) scenario. Overall, the decrease in emissions of these contaminants in the Project full build scenario indicates that the Project is not expected to adversely impact air quality in the Study Area.
- Emissions of NO_2, TSP, PM_{10}, and $PM_{2.5}$ are expected to increase for the future (2041) Project full build and Project no build scenarios when compared to the existing (2023) scenario as a result of increase future traffic volumes. The highest increase was predicted for the Project full build scenario; however, it is predicted that overall emissions of NO_2 will further decrease with advancements in vehicle technology, fuel efficiency and exhaust control efficiency, and particulate emissions can be mitigated.
- The GHG emissions in the Study Area were predicted to increase for the Project full build scenario when compared to the Project no build scenario as a result of a significant increase in AADT and VMT in the Study Area; however, the increase in GHG emissions is less than the increase in AADT and VMT.
- The GHG emission data indicates that the Project full build is not expected to have a significant impact on Dufferin County and provincial GHG targets.
- It is expected that overall emission rates beyond 2041 will further decrease with advancements in vehicle technology, fuel efficiency and exhaust control efficiency. Emission rates are also expected to decrease as public transit and alternative transportation uses in the area increases to continue to support the reduction of emissions to meet the regional and provincial GHG targets.
- It is recommended that regular road maintenance be performed as part of operations to minimize particulate matter emissions. To mitigate potential impacts during construction activities a CAQMP should be developed to address construction equipment vehicle exhaust, potential traffic disruptions and congestion, fugitive dust, and odour.

8.0 REFERENCES

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Signature Page

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APPENDIX A

Traffic Data and Emission Rates

Table A1-1: Annual Average Daily Traffic (vehicles/day)

	2023			
	Segment			
Vehicle Class	1	2	3	4
Passenger Cars	7,816	714	2,590	1,490
Passenger Trucks	7,816	714	2,590	1,490
Single Unit Short Haul	897	82	259	48
Combination Long Haul	897	82	259	48
Total	17,426	1,592	5,698	3,074

Table A1-2: Annual Average Daily Traffic (vehicles/day)

	2041 No Build			
	Segment			
Vehicle Class	1	2	3	4
Passenger Cars	9,750	906	3,309	1,986
Passenger Trucks	9,750	906	3,309	1,986
Single Unit Short Haul	1,120	104	331	64
Combination Long Haul	1,120	104	331	64
Total	21,740	2,020	7,280	4,100

Table A1-3: Annual Average Daily Traffic (vehicles/day)

	2041 Full Build			
	Segment			
Vehicle Class	1	2	3	4
Passenger Cars	13,966	4,489	3,813	2,447
Passenger Trucks	13,966	4,489	3,813	2,447
Single Unit Short Haul	1,604	516	382	78
Combination Long Haul	1,604	516	382	78
Total	31,140	10,010	8,390	5,050

Table A2-1: Annual Average Daily Traffic Fractions

	2023			
	Segment			
Vehicle Class	1	2	3	4
Passenger Cars	45%	45%	45%	48%
Passenger Trucks	45%	45%	45%	48%
Single Unit Short Haul	5%	5%	5%	2%
Combination Long Haul	5%	5%	5%	2%

Table A2-2: Annual Average Daily Traffic Fractions

	2041 No Build			
	Segment			
Vehicle Class	1	2	3	4
Passenger Cars	45%	45%	45%	48%
Passenger Trucks	45%	45%	45%	48%
Single Unit Short Haul	5%	5%	5%	2%
Combination Long Haul	5%	5%	5%	2%

Table A2-3: Annual Average Daily Traffic Fractions

	2041 Full Build			
	Segment			
Vehicle Class	1	2	3	4
Passenger Cars	45%	45%	45%	48%
Passenger Trucks	45%	45%	45%	48%
Single Unit Short Haul	5%	5%	5%	2%
Combination Long Haul	5%	5%	5%	2%

Table A3-1: Daily Vehicle Miles Travelled (vehicle-miles/day)

	2023			
	Segment			
Vehicle Class	1	2	3	4
Passenger Cars	3.55E+03	1.66E+02	4.75E+02	2.78E+02
Passenger Trucks	3.55E+03	1.66E+02	4.75E+02	2.78E+02
Single Unit Short Haul	4.07E+02	1.91E+01	4.75E+01	8.88E+00
Combination Long Haul	4.07E+02	1.91E+01	4.75E+01	8.88E+00
Total VMT (vehicle-mi)	7.90E+03	3.70E+02	1.04E+03	5.73E+02
Segment Length (mi)	0.45	0.23	0.18	0.19
Segment Length (km)	0.73	0.37	0.30	0.30

Table A3-2: Daily Vehicle Miles Travelled (vehicle-miles/day)

	2041 No Build			
	Segment			
Vehicle Class	1	2	3	4
Passenger Cars	4.42E+03	2.11E+02	6.07E+02	3.70E+02
Passenger Trucks	4.42E+03	2.11E+02	6.07E+02	3.70E+02
Single Unit Short Haul	5.08E+02	2.42E+01	6.07E+01	1.18E+01
Combination Long Haul	5.08E+02	2.42E+01	6.07E+01	1.18E+01
Total VMT (vehicle-mi)	9.86E+03	4.69E+02	1.33E+03	7.64E+02
Segment Length (mi)	0.45	0.23	0.18	0.19
Segment Length (km)	0.73	0.37	0.30	0.30

Table A3-3: Daily Vehicle Miles Travelled (vehicle-miles/day)

	2041 Full Build			
	Segment			
Vehicle Class	1	2	3	4
Passenger Cars	6.34E+03	1.06E+03	6.99E+02	5.17E+02
Passenger Trucks	6.34E+03	1.06E+03	6.99E+02	5.17E+02
Single Unit Short Haul	7.27E+02	1.22E+02	7.00E+01	1.65E+01
Combination Long Haul	7.27E+02	1.22E+02	7.00E+01	1.65E+01
Total VMT (vehicle-mi)	1.41E+04	2.36E+03	1.54E+03	1.07E+03
Segment Length (mi)	0.45	0.24	0.18	0.21
Segment Length (km)	0.73	0.38	0.30	0.34

Table A-4: MOVES Options Selected

Tab	Input	Selections 2023	Selections 2041
Description	Text	Dufferin CR109 Year: 2023 Contaminants: TRAP, GHGs Passenger Vehicles, Medium and Heavy Trucks	Dufferin CR109 Year: 2041 Contaminants: TRAP, GHGs Passenger Vehicles, Medium and Heavy Trucks
Scale	Model	Onroad	Onroad
	Domain/Scale	County	County
	Calculation Type	Emission Rates	Emission Rates
Time Spans	Years	2023	2041
	Months	July	July
	Days	Weekdays	Weekdays
	Hours	00:00 - 23:59	00:00 - 23:59
Georaphic Bounds	State	New York	New York
	County	Niagara County	Niagara County
Onroad Vehicles	Source Use Types	Passenger Car	Passenger Car
		Passenger Trucks	Passenger Trucks
		Single Unit Short Haul	Single Unit Short Haul
		Combination Long Haul	Combination Long Haul
Road Types	Selected	Off-network	Off-network
		Rural Restricted Access	Rural Restricted Access
		Rural Unrestricted Access	Rural Unrestricted Access
		Urban Restricted Access	Urban Restricted Access
		Urban Unrestricted Access	Urban Unrestricted Access
Pollutants	Selected	PM2.5	PM2.5
		PM10	PM10
		Acetaldehyde	Acetaldehyde
		Acrolein	Acrolein
		Benzene	Benzene
		1,3-butadiene	1,3-butadiene
		formaldehyde	formaldehyde
		NO2	NO2
		CO	CO
		Methane	Methane
		Nitrous Oxide	Nitrous Oxide
		Atmospheric CO2	Atmospheric CO2
		CO2-eq	CO2-eq

Table A-5. Emission Rate Summary (g/s) by segment

Segment	Contaminant	2023 ER (g/s)	2041 No Build ER (g/s)	2041 Full Build ER (g/s)
1	Carbon Monoxide	2.10E-01	1.18E-01	1.68E-01
	Methane	1.02E-03	6.41E-04	9.18E-04
	Nitrous Oxide	3.00E-04	3.01E-04	4.31E-04
	Benzene	1.32E-04	6.34E-05	9.08E-05
	1,3-Butadiene	8.51E-06	0.00E+00	0.00E+00
	Formaldehyde	1.81E-04	3.50E-05	5.01E-05
	Acetaldehyde	1.07E-04	4.31E-05	6.17E-05
	Acrolein	1.46E-05	3.85E-06	5.51E-06
	Nitrogen Dioxide	1.49E-02	1.61E-02	2.30E-02
	Atmospheric CO2	5.08E+01	4.94E+01	7.08E+01
	CO2-eq	5.09E+01	4.95E+01	7.09E+01
	Benzo(a)pyrene gas	5.45E-10	2.02E-10	2.90E-10
	PM10 (Tot+BW+TW+Resuspension)	2.67E-02	3.23E-02	4.63E-02
	PM2.5 (Tot+BW+TW+Resuspension)	6.71E-03	7.36E-03	1.05E-02
2	Carbon Monoxide	1.60E-02	9.32E-03	4.66E-02
	Methane	8.36E-05	5.56E-05	2.78E-04
	Nitrous Oxide	2.62E-05	2.67E-05	1.33E-04
	Benzene	1.05E-05	5.15E-06	2.57E-05
	1,3-Butadiene	6.79E-07	0.00E+00	0.00E+00
	Formaldehyde	1.45E-05	3.01E-06	1.50E-05
	Acetaldehyde	8.71E-06	3.79E-06	1.89E-05
	Acrolein	1.18E-06	3.38E-07	1.68E-06
	Nitrogen Dioxide	1.33E-03	1.57E-03	7.85E-03
	Atmospheric CO2	3.48E+00	3.46E+00	1.73E+01
	CO2-eq	3.49E+00	3.47E+00	1.73E+01
	Benzo(a)pyrene gas	4.31E-11	1.59E-11	7.95E-11
	PM10 (Tot+BW+TW+Resuspension)	5.79E-03	7.26E-03	1.02E-02
	PM2.5 (Tot+BW+TW+Resuspension)	1.43E-03	1.73E-03	2.12E-03
3	Carbon Monoxide	4.22E-02	2.43E-02	2.81E-02
	Methane	2.16E-04	1.42E-04	1.64E-04
	Nitrous Oxide	7.92E-05	8.10E-05	9.33E-05
	Benzene	2.89E-05	1.48E-05	1.71E-05
	1,3-Butadiene	1.82E-06	0.00E+00	0.00E+00
	Formaldehyde	3.94E-05	7.81E-06	9.00E-06
	Acetaldehyde	2.33E-05	9.78E-06	1.13E-05
	Acrolein	3.19E-06	8.72E-07	1.01E-06
	Nitrogen Dioxide	3.21E-03	3.73E-03	4.29E-03
	Atmospheric CO2	1.02E+01	1.01E+01	1.17E+01
	CO2-eq	1.02E+01	1.02E+01	1.17E+01
	Benzo(a)pyrene gas	1.12E-10	4.22E-11	4.86E-11
	PM10 (Tot+BW+TW+Resuspension)	6.34E-03	7.91E-03	9.11E-03
	PM2.5 (Tot+BW+TW+Resuspension)	1.54E-03	1.77E-03	2.04E-03

		2023	2041 No Build	2041 Full Build
Segment	Contaminant	ER (g/s)	ER (g/s)	ER (g/s)
4	Carbon Monoxide	2.55E-02	1.43E-02	1.88E-02
	Methane	1.14E-04	6.87E-05	8.95E-05
	Nitrous Oxide	4.44E-05	4.62E-05	5.85E-05
	Benzene	1.77E-05	9.80E-06	1.27E-05
	1,3-Butadiene	8.64E-07	0.00E+00	0.00E+00
	Formaldehyde	1.30E-05	2.81E-06	3.65E-06
	Acetaldehyde	7.52E-06	2.72E-06	3.50E-06
	Acrolein	9.82E-07	2.54E-07	3.27E-07
	Nitrogen Dioxide	7.58E-04	8.42E-04	1.08E-03
	Atmospheric CO2	5.01E+00	5.17E+00	6.72E+00
	CO2-eq	5.03E+00	5.19E+00	6.74E+00
	Benzo(a)pyrene gas	7.46E-11	2.90E-11	3.80E-11
	PM10 (Tot+BW+TW+Resuspension)	6.03E-03	7.98E-03	4.75E-03
	PM2.5 (Tot+BW+TW+Resuspension)	1.45E-03	1.86E-03	1.02E-03

APPENDIX B

Greenhouse Gas Emission Rates

Table B-1: Summary of Greenhouse Gas Emissions (g/s)

Segments	Contaminant	2023 ER (g/s)	2023 Emissions (tonnes/year)	2023 CO2-eq Emissions (tonnes/year)	2041 No Build ER (g/s)	2041 No Build Emissions (tonnes/year)	2041 No Build CO2-eq Emissions (tonnes/year)	2041 Full Build ER (g/s)	2041 Full Build Emissions (tonnes/year)	2041 Full Build CO2-eq Emissions (tonnes/year)
1	Methane	1.02E-03	3.23E-02	1.61E+03	6.41E-04	2.02E-02	1.56E+03	9.18E-04	2.89E-02	2.24E+03
	Nitrous Oxide	3.00E-04	9.46E-03		3.01E-04	9.49E-03		4.31E-04	1.36E-02	
	Atmospheric CO2	5.08E+01	1.60E+03		4.94E+01	1.56E+03		7.08E+01	2.23E+03	
2	Methane	8.36E-05	2.64E-03	1.10E+02	5.56E-05	1.75E-03	1.09E+02	2.78E-04	8.76E-03	5.46E+02
	Nitrous Oxide	2.62E-05	8.25E-04		2.67E-05	8.41E-04		1.33E-04	4.19E-03	
	Atmospheric CO2	3.48E+00	1.10E+02		3.46E+00	1.09E+02		1.73E+01	5.45E+02	
3	Methane	2.16E-04	6.81E-03	3.22E+02	1.42E-04	4.49E-03	3.20E+02	1.64E-04	5.18E-03	3.69E+02
	Nitrous Oxide	7.92E-05	2.50E-03		8.10E-05	2.55E-03		9.33E-05	2.94E-03	
	Atmospheric CO2	1.02E+01	3.21E+02		1.01E+01	3.19E+02		1.17E+01	3.68E+02	
4	Methane	1.14E-04	3.58E-03	1.59E+02	6.87E-05	2.17E-03	1.64E+02	8.95E-05	2.82E-03	2.12E+02
	Nitrous Oxide	4.44E-05	1.40E-03		4.62E-05	1.46E-03		5.85E-05	1.85E-03	
	Atmospheric CO2	5.01E+00	1.58E+02		5.17E+00	1.63E+02		6.72E+00	2.12E+02	

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