REPORT

Schedule 'B' Municipal Class Environmental Assessment - Albion Vaughan Road and King Street, Town of Caledon, Ontario

Air Quality Report

Submitted to:

Jamie Garcia, P.Eng.
CIMA+
3027 Harvester Road, Suite 400
Burlington, Ontario
L7N 3G7

Region of Peel Project
16-4390

Submitted by:

Golder Associates Ltd.
6925 Century Avenue, Suite #100, Mississauga, Ontario, L5N 7K2, Canada

+1 905 567 4444

1664717

August 28, 2019

Distribution List

1 PDF Copy – CIMA +

1 PDF Copy - Golder Associates Ltd.

Table of Contents

TABLES

FIGURES

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) was retained by CIMA+ to conduct an air quality assessment for the proposed intersection improvements at Albion Vaughan Road and King Street in the Town of Caledon, Ontario (the Project). This assessment was conducted to support a Schedule “B” Municipal Class Environmental Assessment (EA). The primary goal of the air quality assessment is to provide an assessment of the air quality impacts resulting from the proposed Project. The air quality impacts will be compared to relevant federal and provincial standards and guidelines. Using the available background air quality data, the assessment was prepared to discuss the existing background air quality in the vicinity of proposed Project and the potential impacts of the proposed Project on local air quality.

2.0 METHODOLOGY

As per the general guidance provided in the Ontario Ministry of Transportation (MTO) Guidance Document *“Environmental Guide for Assessing and Mitigating the Air Quality Impacts and Greenhouse Gas Emissions for Provincial Transportation Projects, June 2012”* (MTO, 2012), the list of parameters focuses on the key pollutants released from mobile sources. As the Project is classified as “Class B”, the air quality assessment follows a primarily qualitative approach, as per the general guidance provided in the Ministry of the Environment, Conservation, and Parks (MECP) Central Region Draft Document “*Traffic Related Air Pollution: Mitigation Strategies and Municipal Class Environmental Assessment Air Quality Impact Assessment Protocol*”, (MECP, 2017).

This air quality assessment includes two main tasks, namely characterizing the existing conditions and assessing the net effects of the Project on air quality. This assessment is limited to the operational phase of the roadway (i.e., routine traffic) and does not address air quality impacts related to the construction activities to complete the intersection improvement work. It is assumed that emissions from construction operations will be managed through best management practices for construction operations and monitoring and mitigation requirements will be considered as part of the special provisions that are typically written to the construction tender documents.

3.0 BACKGROUND AIR QUALITY

The background air quality in the area around the proposed Project has been described by considering regional concentrations, based on publicly available monitoring data. The background air quality represents the existing conditions of air quality before the operation of the proposed Project. Sources include roadways, long range transboundary air pollution, small regional sources and large industrial sources.

This section details the selection of compounds considered in the assessment, applicable guidelines for this assessment, selection of the monitoring stations, and comparison of the selected data to the ambient air quality criteria (AAQCs).

3.1 Indicator Compounds

The assessment of background air quality focused on some criteria air contaminants (CACs), compounds that are expected to be released from mobile sources, such as specific VOCs for which relevant air quality criteria exist, and which are generally accepted as indicative of changing air quality. These compounds are emitted from fuel combustion from vehicles travelling on roadways. The indicator compounds for this project include:

- carbon monoxide (CO)
- nitrogen oxides, expressed as nitrogen dioxide (NO_2)
- suspended particulate matter[1] (SPM)
- particulate matter with a diameter of less than 10 microns (PM_{10})
- particulate matter with a diameter of less than 5 microns ($PM_{2.5}$)
- selected volatile organic compounds (VOCs), including benzene, 1-3 butadiene, formaldehyde, acetaldehyde and acrolein

3.2 Applicable Guidelines

The air quality criteria used for assessing the air quality effects of the Project include Ontario criteria, and federal standards and objectives where provincial guidelines are not available. The MECP has issued guidelines related to ambient air concentrations, which are summarized in *Ontario's Ambient Air Quality Criteria* (MECP, 2018a). There are two sets of federal objectives and criteria: the Canadian Ambient Air Quality Standards (CAAQSs) (formerly National Ambient Air Quality Standards (NAAQS)), and the National Ambient Air Quality Objectives (NAAQOs).

The NAAQOs are benchmarks that can be used to facilitate air quality management on a regional scale, and provide goals for outdoor air quality that protect public health, the environment, or aesthetic properties of the environment (CCME, 1999). The federal government has established the following levels of NAAQOs (Health Canada, 1994):

- the maximum desirable level defines the long-term goal for air quality and provides a basis for an anti-degradation policy for unpolluted parts of the country and for the continuing development of control technology
- the maximum acceptable level is intended to provide adequate protection against adverse effects on soil, water, vegetation, materials, animals, visibility, personal comfort, and well-being

The CAAQSs have been developed under the *Canadian Environmental Protection Act*, and include new standards for NO_2 to be implemented by 2020 and 2025.

A summary of the applicable Ontario and federal standards, objectives and criteria are listed in Table 1, along with the selected project criteria, which were selected to be the most stringent.

[1] SPM can also be referred to as total suspended particulate or TSP

Table 1: Ontario and Canadian Regulatory Air Quality Objectives and Criteria

Substance	Averaging Period	Ontario Ambient Air Quality Criteria[a]	Canadian Ambient Air Quality Standards[b]	National Ambient Air Quality Standards and Objectives[c]		Project Criteria
				Desirable	Acceptable	
CO (µg/m³)	1-Hour	36,200	—	15,000	35,000	15,000
	8-Hour	15,700	—	6,000	15,000	6,000
NO_2 (µg/m³)	1-Hour	400	79.1[d] (42 ppb)	—	400	79.1/400
	24-Hour	200	—	—	200	200
	Annual	—	22.6 (12 ppb)	60	100	60
SPM (µg/m³)	24-hour	120	—	—	120	120
	Annual	60	—	60	—	60
PM_{10} (µg/m³)	24-Hour	50	—	—	—	50
$PM_{2.5}$ (µg/m³)	24-Hour	30	28/27	—	—	27
	Annual	—	10/8.8	—	—	8.8
Acrolein (µg/m³)	1-Hour	4.5	—	—	—	4.5
	24-Hour	0.4	—	—	—	0.4
Acetaldehyde (µg/m³)	24-Hour	500	—	—	—	500
	½ hour	500	—	—	—	500
1,3-Butadiene (µg/m³)	24-Hour	10	—	—	—	10

Substance	Averaging Period	Ontario Ambient Air Quality Criteria[a]	Canadian Ambient Air Quality Standards[b]	National Ambient Air Quality Standards and Objectives[c]		Project Criteria
				Desirable	Acceptable	
	Annual	2	—	—	—	2
Benzene ($\mu g/m^3$)	24-hour	2.3	—	—	—	2.3
	Annual	0.45	—	—	—	0.45
Formaldehyde ($\mu g/m^3$)	24-hour	65	—	—	—	65

a) MECP 2018a
b) CAAQS published in the Canada Gazette Volume 147, No. 21 - May 25, 2013. Final standard phase in date of 2020 used.
c) CCME 1999
d) The Canadian ambient air quality standard is effective from 2025, based on the three-year average of the 98th percentile of the daily maximum 1-hour average concentration which is not readily provided by the air quality dispersion models for transportation sources. As a result, the Ontario AAQC is also provided for comparison.

— = No guideline available.

3.3 Monitoring Data

In Ontario, regional air quality is monitored through a network of air quality monitoring stations operated by the MECP and Environment and Climate Change Canada National Air Pollution Surveillance (NAPS) Network. These stations are operated under strict quality assurance and quality control procedures. Existing air quality for the Project area was characterized using background air concentrations from monitoring data sources in the Project area as well as representative areas. Data for the most recent five-year period with complete and quality assured data by Environment and Climate Change Canada at the time of the initial study (2011 to 2015) was used for this assessment.

The following stations have identified as being most relevant to the proposed Project:

- Brampton – 525 Main Street, Brampton
- Toronto West – 125 Resources Road, Toronto

The Project is located in a rural residential area on the limits of the community of Bolton, Ontario. There are no stations located in the Project area. The closest stations that monitor the required substances are the Brampton and Toronto West stations. Both the Brampton and Toronto West stations have a number of industrial sources influencing them, which may lead to a more conservative representation of the background, as there are less industrial sources near the Project area.

The Toronto West station was selected because it was the closest station to the Project that monitors CO. Since the station is near the Highway 401 and is in an urban area it will be a conservative representation of the background CO conditions in the Project area.

Details of the selected stations are provided in Table 2.

Table 2: Ambient Air Quality Monitoring Parameters

Station Name	NAPS Station ID	Data Available[a]							Distance from Project	Direction from the Project
		CO	NO_2	NO	SPM	PM_{10}	$PM_{2.5}$	VOCs[b]		
Brampton	60428	—	Y	Y	—	—	Y	Y	22 km	South-west
Toronto West[(a)]	60430	Y	Y	Y	—	—	Y	—	24 km	South

Note: "—" Station not used for obtaining compound data.

(a) SPM and PM_{10} data was calculated using the following ratios; PM_{10} = 2 x $PM_{2.5}$, SPM= 2 x PM_{10}.
(b) VOCs monitored include 1,3,-butadiene and benzene.

For analyzing monitoring data, the 90th percentile of the available monitoring data is typically considered a conservative estimate of background air quality (CEA Agency and CNSC, 2009). As a result, the 90th percentile of the measured concentrations have been used to represent background air quality for parameters with shorter averaging periods (i.e., 1-hour, 8-hour, and 24-hour). Annual background concentrations were calculated based on the mean of the available data. A summary of the background air quality concentrations for all compounds is provided below in Table 3 with further discussion in the following sections.

Table 3: Summary of Air Quality Monitoring Data

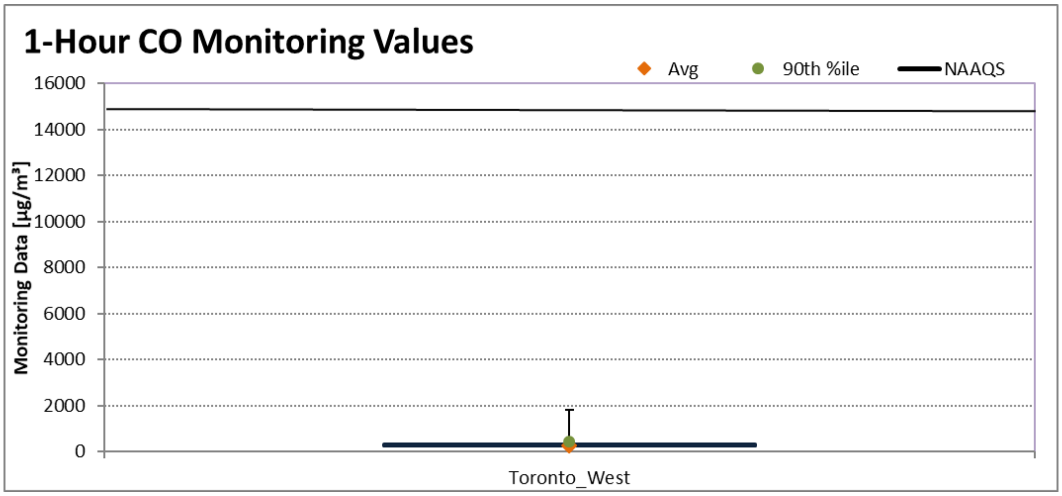
Indicator Compound	Averaging Period	Background Concentration [µg/m³][(a)]	Project Criteria [µg/m³]	% of Project Criteria
CO	1-Hour	458.10	15,000	3%
	8-Hour	501.04	6,000	8%
NO_2	1-Hour	45.14	79.1/400	57%/11%
	24-Hour	37.55	200	19%
	Annual	19.28	32	60%
SPM	24-Hour	47.86	120	40%
	Annual	21.07	60	35%
PM_{10}	24-Hour	26.59	50	53%
$PM_{2.5}$	24-Hour	14.36	27	53%
	Annual	6.32	8.8	72%
1,3,-Butadiene	24-Hour	0.09	10	1%
	Annual	0.04	2	2%
Benzene	24-Hour	0.88	2.3	38%
	Annual	0.54	0.45	119%

(a) All values are based on 90th percentile with the exception of annual averages.

It is understood that emission sources of indicator compounds in the Project area are accounted for in the background air quality, including local traffic, industrial, commercial, and residential sources.

3.3.1 CO Concentrations

Carbon monoxide is a colourless, odourless, tasteless gas, and at high concentrations can cause adverse health effects. It is produced primarily from the incomplete combustion of fossil fuels, as well as natural sources. The monitoring data assessed indicates that no exceedances of the 1-hour or 8-hour National AAQC for CO were recorded (Figure 1).



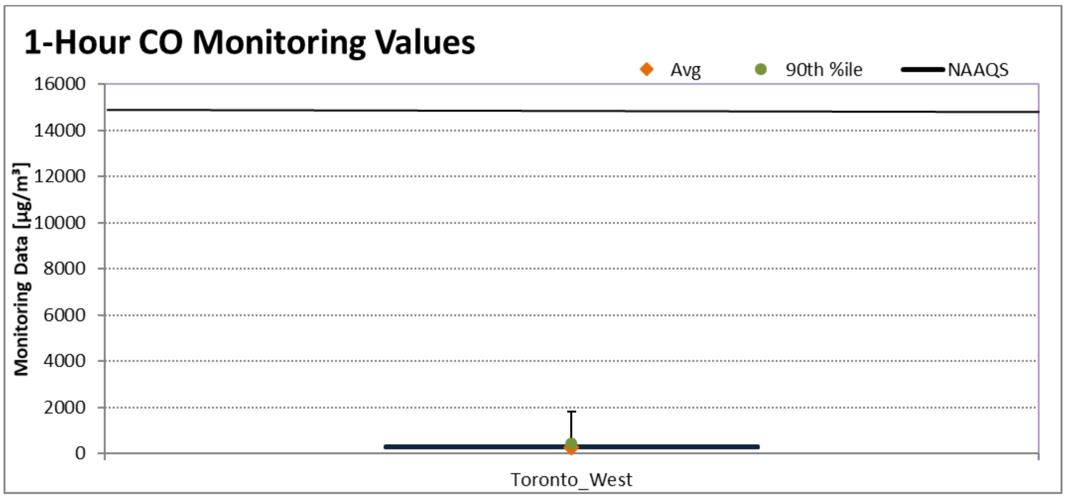


Figure 1: Measured Carbon Monoxide (CO) Concentrations at the Toronto West Station

3.3.2 NO_X and NO_2 Concentrations

NO_X is emitted in two primary forms: nitric oxide (NO) and NO_2. NO reacts with ozone in the atmosphere to create NO_2. The primary source of NO_X in the region is the combustion of fossil fuels. Emissions of NO_X result from the operation of stationary equipment such as incinerators, boilers, and generators, as well as the operation of mobile sources such as vehicles, haul trucks, and other equipment.

The presence of NO_2 in the atmosphere has known health effects (e.g., lung irritation) and environmental effects (e.g., acid precipitation, ground-level ozone formation) (MECP, 2015). As a result, regulatory guideline levels are based on NO_2 emissions and concentrations. Emissions of NO_2 in Ontario have shown a steady decline from 2004 (MECP, 2015). The monitoring data assessed shows that no exceedances of the 1-hour or 24-hour AAQC for NO_2 were recorded (Figure 2). The CAAQS has been exceeded over the past few years, but this standard does not come into effect until 2025.

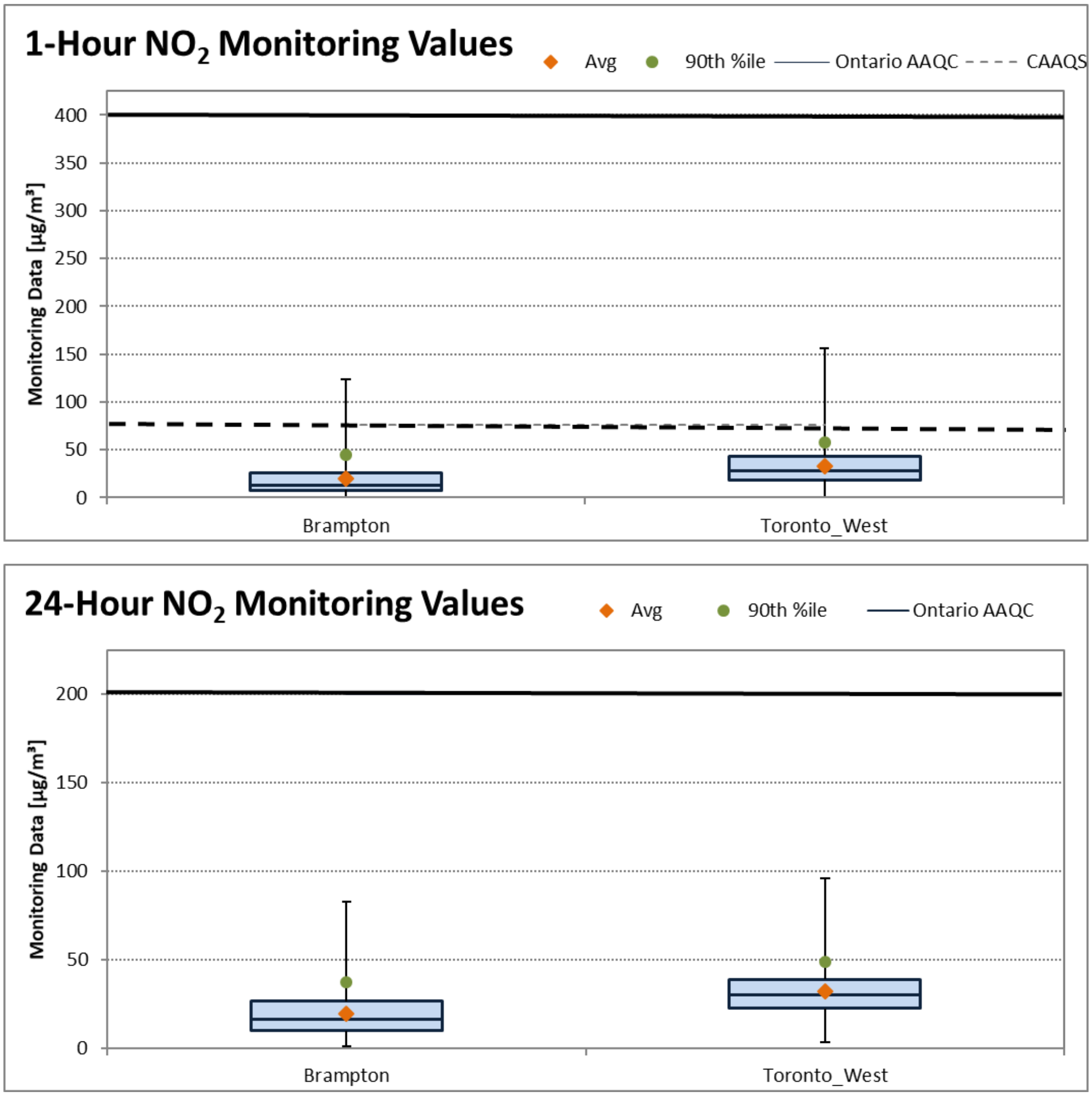


Figure 2: Measured 1-hour and 24-hour Nitrogen Dioxide (NO2) Concentrations at the Brampton and Toronto West Stations

3.3.3 Particulate Matter (SPM, PM_{10} and $PM_{2.5}$)

Particulate emissions occur due to anthropogenic activities, such as agricultural, industrial and transportation sources, as well as natural sources. Particulate matter is classified based on its aerodynamic particle size, primarily due to the different health effects that can be associated with the particles of different diameters. Fine particulate matter ($PM_{2.5}$) is of primary concern related as they can penetrate deep into the respiratory system and may results in health impacts (MECP, 2015). In Ontario, these emissions have been demonstrating a steady decline over time, decreasing by approximately 16% from 2007 to 2016 (MECP, 2018b). As presented in Figure 3 for 24-hour $PM_{2.5}$, measurements meet the Ontario AAQC value of 27 µg/m³ and are below the pending CAAQS of 8.8 µg/m³ (2020 phase in date). No local monitoring data was available for SPM and PM_{10}, however, an estimate of the background SPM and PM_{10} concentrations can be determined from the available $PM_{2.5}$ monitoring data. Fine particulate matter (i.e., $PM_{2.5}$) is a subset of PM_{10}, and PM_{10} is a subset of SPM. Therefore, it is reasonable to assume that the ambient concentrations of SPM will be greater than corresponding PM_{10} levels, and PM_{10} concentrations will be greater than the corresponding levels of $PM_{2.5}$. The mean levels of $PM_{2.5}$ in Canadian locations are found to be about 54% of the PM_{10} concentrations and about 30% of the SPM concentrations (Lall et al., 2004). By applying this ratio, it was possible to estimate the background SPM and PM_{10} concentrations for the region.

For 24-hour $PM_{2.5}$, measurements meet the Ontario Ambient Air Quality Criteria (AAQC) value of 25 µg/m³. The annual average $PM_{2.5}$ values are below the pending CAAQS of 8.8 µg/m³ (2020 phase in date).

Larger particles (i.e., SPM) can result in nuisance effects, such as soiling or visibility and, therefore, must be taken into consideration as part of the study. All derived SPM and PM_{10} values are below the relevant AAQC and NAAQOs.

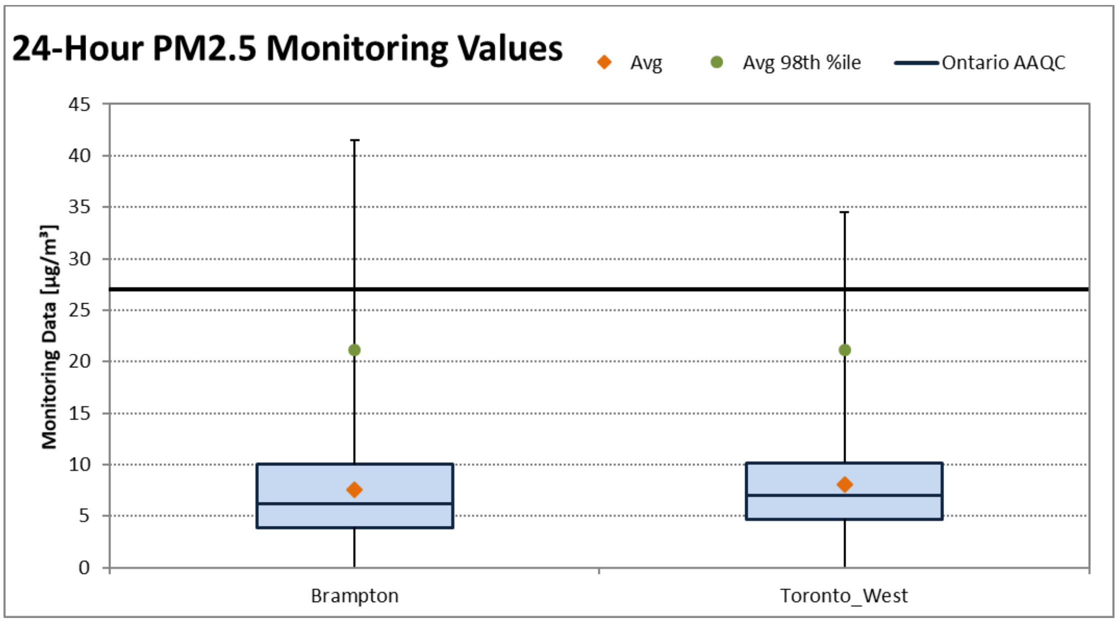


Figure 3: Measured 1-hour and 24-hour PM2.5 Concentrations at the Brampton and Toronto West Stations.

3.3.4 VOC Concentrations

Volatile organic compounds are primary precursors to the formation of ground level ozone and aerosols which are the main components of smog, known to have adverse effects on human health and the environment (ECCC 2015a). Ontario's major sources of VOCs includes transportation and general solvent use (MOECC 2015). The primary VOCs associated with traffic include benzene, 1,3-butadiene, acrolein, acetaldehyde and formaldehyde However, only benzene and 1,3- butadiene was available for assessment.

Benzene is mainly released from vehicle exhausts due to fuel combustion (ECCC 2015b). Similarly, 1,3-butadiene is typically a product of incomplete combustion, released into the atmosphere from transportation vehicle exhausts or fuel/biomass combustion in non-transportation sources (ECCC, 2015c). 1,3-butadiene may also be released from industrial facilities. The presence of both benzene and 1,3-butadiene in the atmosphere have known health and environmental effects.

The monitoring data for 1,3-butadiene indicates that there were no exceedances for the 24-hour (Figure 4) or annual AAQC for 1,3-butadiene and, additionally, that monitored values were observed to be significantly below the criteria.

From the monitoring data assessed, no exceedances of the 24-hour AAQC for benzene were recorded; however, the annual benzene concentration was exceeded every year, where the average annual benzene concentration was 119% of the AAQC. It should be noted, however, that annual monitored benzene concentrations exceed the AAQC across the Greater Toronto Area at all monitoring stations for which data is publicly available.

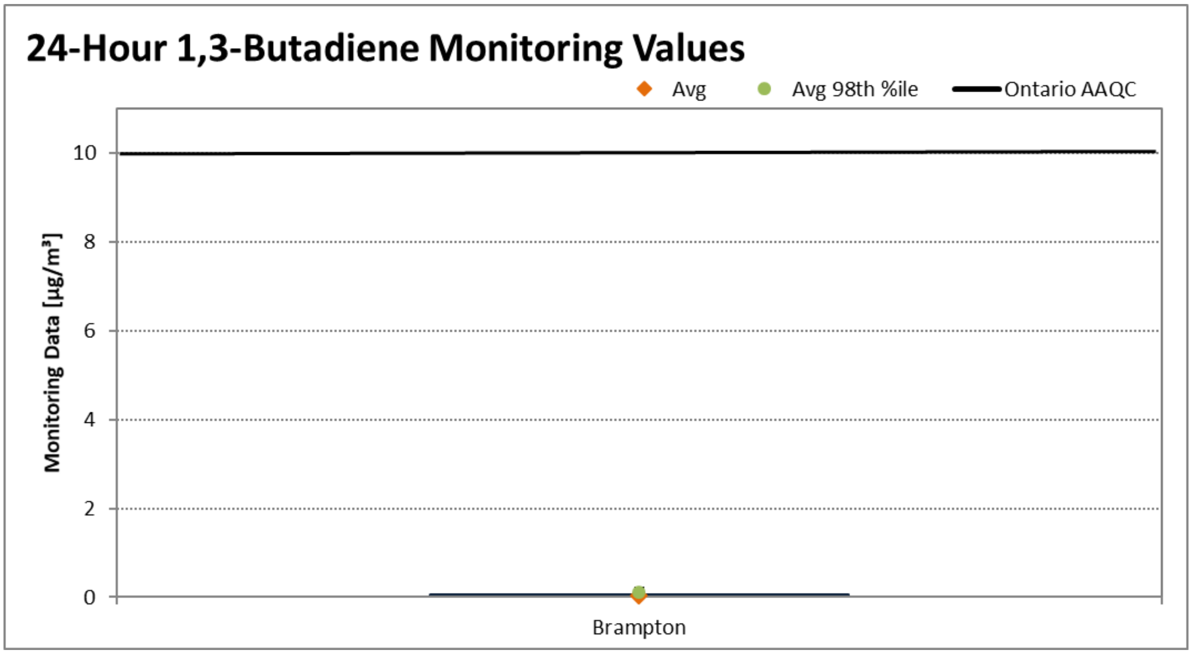


Figure 4: Measured 1,3-Butadiene at the Brampton Station

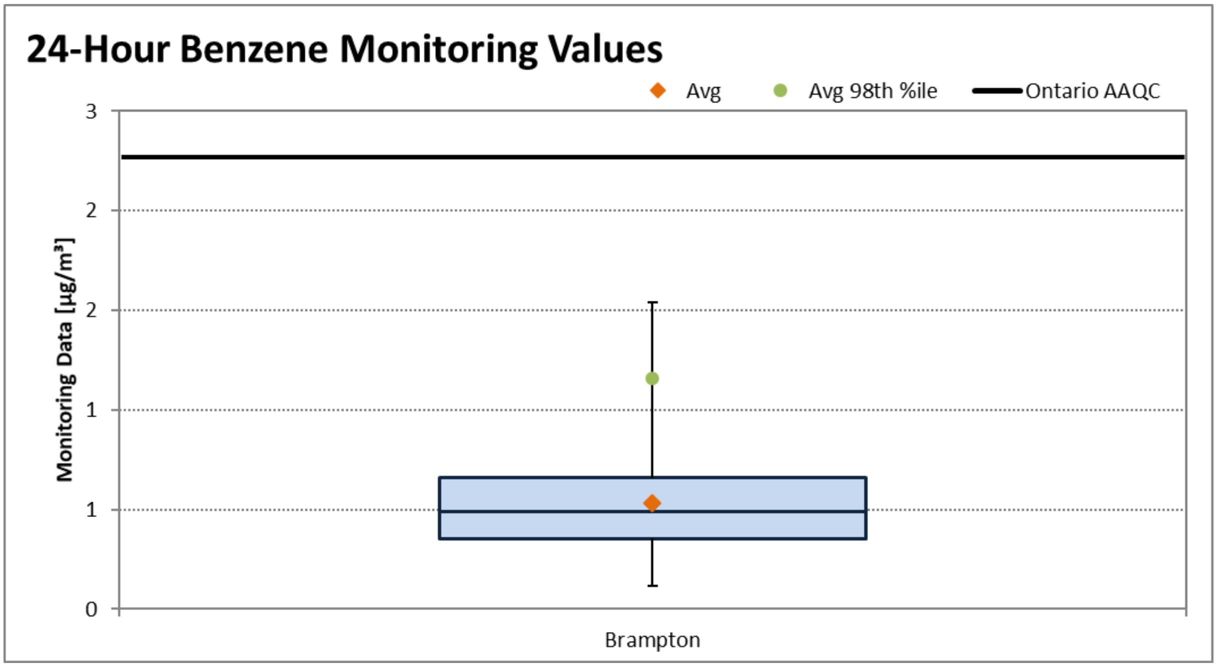


Figure 5: Measured Benzene at the Brampton Station

4.0 PROJECT EMISSIONS

The proposed Project involves intersection improvements at the Albion Vaughan Road and King Street intersection in the town of Caledon, Ontario. These improvements include widening Albion Vaughan Road, Caledon King Townline South, King Street, and King Road leading up to the intersection. The purpose of the intersection changes is to improved traffic flows and alleviate congestion.

The study area for this Project is shown in Figure 6.

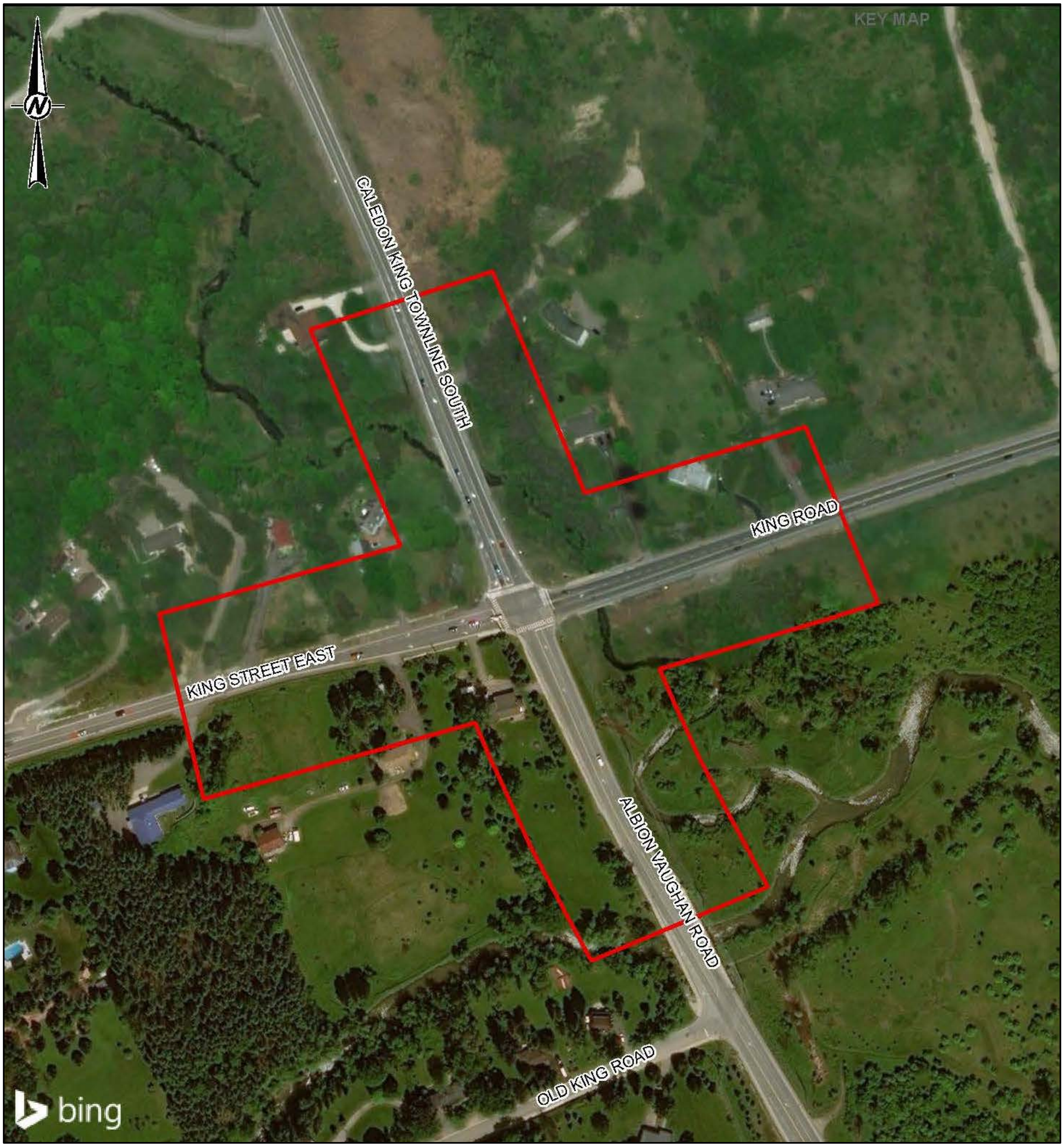


Figure 6: Project Study Area

Annual Average Daily Traffic (AADT) was provided for these stretches of road for years 2016 to 2031. The AADT and percent increase from 2016 to 2031 for the study area is shown in Table 4, below.

Table 4: Current and Future Traffic Volumes for Study Area

Road Section	2016 AADT	2031 AADT	Percent Change	Length of Road [km]	Vehicle m travelled (VKT) – 2016	Vehicle m travelled (VKT) - 2031
Albion Vaughan Road (northbound)	8,294	10,209	23%	0.2	1,659	2,042
Albion Vaughan Road (southbound)	4,908	6,398	30%	0.2	982	1,280
King Road (eastbound)	6,194	7,614	23%	0.2	1,239	1,523
King Road (westbound)	8,080	11,544	43%	0.2	1,616	2,309

The MOBILE6.2C (version 2010) model was run based on the posted speed limit of 60 km/h on both roads and a typical traffic breakdown for an arterial road. The arterial road option was chosen as both Albion Vaughan Road and King Road act as main connector roads between towns. The model was run for the month of July as this month produces the worst-case emissions. Emissions from the re-entrainment of the road dust from vehicles travelling on paved roads were excluded from the assessment as they will be consistent with the change in daily AADT and will not alter the outcome of this assessment. Annual emission rates are summarized in Table 5, below.

The traffic data from King Road (westbound) presented in Table 4, above, was used with the emission factor outputs from the MOBILE6.2C model to calculate the emissions per year from the current (2016) and future (2031) scenarios. King Road (westbound) was used as this section of the intersection has the highest VKT.

Table 5: Project Emission Rates for Current and Future Scenarios [kg/year]

Compound	Current Emissions [kg/year]	Future Emissions [kg/year]	Percentage Increase
NO_x	249.96	357.12	43%
CO	4,138.26	5,912.38	43%
SPM	6.27	7.07	13%
PM_{10}	6.27	7.07	13%
$PM_{2.5}$[1]	6.27	7.07	13%
Benzene	6.90	7.35	6%
1,3 Butadiene	0.89	0.95	7%
Formaldehyde	2.60	2.85	10%

Compound	Current Emissions [kg/year]	Future Emissions [kg/year]	Percentage Increase
Acetaldehyde	1.33	1.44	8%
Acrolein	0.11	0.11	9%

Notes:
Conservatively assumed that PM10 and PM2.5 emissions are the same as SPM emissions.

As evident from Table 5, future traffic emissions in 2031 are expected to result in as much as a 43% increase in annual emissions from the Study Area for some compounds. This increase in emissions is directly attributed to expected growth in the Region of Peel and resultant projected traffic volumes. As a result, and given the nature of the Project (intersection improvements / widening) dispersion modelling was not undertaken as the worst-case emissions would occur when the roadway is congested in both the current and future scenarios. However, the proposed Project would act to reduce the frequency of congestion. The reduction of congestion frequency highlights the importance of the proposed Project as the intersection improvements will be necessary to reduce flow disruption from increased volumes and will also act to minimize the air quality impact of increased traffic through improved traffic flows within the local vicinity of the Project.

5.0 RESULTS

Studies by the US EPA have found that roadways generally influence air quality within a few hundred metres downwind from a heavily travelled road. The actual distance varies by location, time of day, year and prevailing meteorology, topography and traffic patterns (US EPA, 2014). Concentrations will dissipate rapidly from the road source, therefore it is expected that this Project will have a negligible impact on regional air quality.

As outlined in the MTO guidance, sensitive receptors within 500 m of the study area should be identified and assessed. The area surrounding the Project is rural residential. The only sensitive receptors within 500 m of the study area are private properties located along Albion Vaughan Road, King Street E, and King Road.

These sensitive receptors are already located close to the intersection and will be impacted by projected traffic growth. The proposed Project will act to minimize the air quality impact of increased traffic through improved traffic flows and reduced queuing times at intersections within the local vicinity of the Project. As a result, the impact on air quality on the identified sensitive receptors is anticipated to be positive.

6.0 CONCLUSIONS

Based on the existing monitoring data in the Project area, the levels of NO_2, SO_2, CO and 1,3-butadiene are shown to be below the current standards and guidelines. For these compounds, the emissions from the Project are not expected to cause local air quality to exceed the current standards or guidelines. In the 5 year study period (2011 through 2015), the annual benzene concentration was greater than the applicable standard in all years, however, the Project will minimize the air quality impact associated with the projected increased traffic for the area through improved traffic flows within the local vicinity of the Project and reduced queuing times at the Albion Vaughan Road and King Street intersection. Given the projected increase in traffic due to the growth of the Region of Peel, some emissions (NOx, CO and total VOC) are expected to increase by 43% by 2031, while others will increase to a lesser extent. As a result, the proposed intersection improvements are necessary to help alleviate congestion and will in turn minimize the air quality impact in the Project area.

Overall, the Project itself is anticipated to be a relatively minor source when compared to other larger sources within the area, therefore the impact on overall air quality in the region is expected to be negligible.

7.0 REFERENCES

Canadian Council of Ministers of the Environment (CCME) (1999). *Canadian National Ambient Air Quality Objectives: Process and Status*. Available at ceqg-rcqe.ccme.ca/download/en/133/. Retrieved March 29, 2017.

Environment and Climate Change Canada (2015a). *Volatile Organic Compounds in Consumer and Commercial Products*. Retrieved October, 2017. http://www.ec.gc.ca/cov-voc/

Environment and Climate Change Canada (2015b). *Benzene*. Retrieved October 2017. https://www.ec.gc.ca/toxiques-toxics/Default.asp?lang=En&n=B6BEFB22-1

Environment and Climate Change Canada (2015c). *1,3-Butadiene*. Retrieved October 2017. https://www.ec.gc.ca/toxiques-toxics/Default.asp?lang=En&n=2A75F329-1

Health Canada. 1994. Canadian National Ambient Air Quality Objectives: Process and Status

Lall, R., Kendall, M., Ito, K., Thurston, G. (2004). Estimation of historical annual $PM_{2.5}$ exposures for health effects assessment. Atmospheric Environment 38(2004) 5217-5226.

MECP (2016). *Air Quality Ontario - Report for 2015*. Available at http://www.airqualityontario.com/downloads/AirQualityInOntarioReportAndAppendix2015.pdf. Retrieved October 2017.

MECP (2017). Traffic Related Air Pollution: Mitigation Strategies and Municipal Class Road Environmental Assessment Air Quality Impact Assessment Protocol

MECP (2018a). Ontario's Ambient Air Quality Criteria, PIBS #6570e01. Standards Development Branch, Ontario Ministry of Conservation and Parks.

MECP (2018b). Air Quality in Ontario 2016 Report, ISSN# 1710-8136.

MTO (2012). *Ministry of Transportation Environmental Standards and Practices: Environmental Guide for Assessing and Mitigating the Air Quality Impacts and Greenhouse Gas Emissions of Provincial Transportation Projects.*

US EPA (2014). Health: Frequently Asked Questions. Available at https://nepis.epa.gov/Exe/ZyPDF.cgi/P100NFFD.PDF?Dockey=P100NFFD.PDF. RetrievedOctober 2017.

Signature Page

Golder Associates Ltd.

Katie Armstrong, BSc. (Hons), MSc.	Natalie Jones, P.Eng.
Air Quality Specialist	*Associate*

AVW/KSA/CST/ca

\\golder.gds\gal\mississauga\active\2016\3 proj\1664714 cima_peel vaughan-king ea_caledon\11 - air quality\report\final\1664714 r-rev0 peel vaughan king ea - aq report 28aug_19.docx golder.com