Appendix H:
Air Quality

Section H.1:
Air Quality Study

Note: This appendix refers to Area A as Focus Area 1 and to Area B as Focus Area 2, a reflection of previous project nomenclature.

RE35-1- WATERFRONT EAST LRT UNION STATION - QUEENS QUAY LINK

Baseline Design Review Submission – Air Quality Study

Project # OISO52004

Prepared for:

Toronto Transit Commission
1900 Yonge Street, Toronto, ON M4S 1Z2

REP-025 R5

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Prepared by:	Akhter Iqbal, M.S., P.Eng. Senior Air Quality Engineer Caleb Vandenberg, P.Eng. Senior Air Quality Engineer	Date: August / 03 / 2021
Reviewed by:	Linda Lattner Associate Air Quality Engineer	Date: August / 03 / 2021
Approved by:	Alex Breido, PhD, P.Eng. Senior Associate Air Quality Engineer	Date: August / 03 / 2021

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1.0 Introduction

1.1 Project Description

WSP E&I Canada Limited (WSP) (formerly Wood Environment & Infrastructure), has been retained by Toronto Transit Commission (TTC) to complete the Preliminary Design and Engineering to produce a Baseline Design (approximately 30% design completion), together with a Class 3 MCE Construction Cost Estimate and Level 3 project delivery schedule for the expansion of the existing Union Light Rail Transit (LRT) and Queens Quay LRT Stations and new running tunnel and portal as part of the Waterfront East LRT project.

The primary project goal is the construction of a high order streetcar line in a dedicated transit right-of-way in order to provide fast and reliable transit service in the East Bayfront (EBF) Area of the Waterfront. The expansion of the Union LRT and Queens Quay LRT Stations is required to accommodate the additional streetcar lines and passenger volume. This project is critical to the new waterfront transit plan in the East Bayfront Precinct.

The Preliminary Air Quality Study defines a baseline of the current air quality in the vicinity of the Project. This baseline presents the air quality in the absence of the project and the study provides a qualitative discussion about the project impact on local air quality and recommendations for the next steps of the project.

1.2 Study Area

The project contains three focus areas:

Managed by TTC,

(a) **Focus Area 1** - Below Grade (Union Station Loop to future Portal east of Bay Street on Queens Quay), which includes:

- the Union LRT Station Expansion, including new crossover tracks; Queen Quay LRT Station Expansion;
- the new streetcar tunnel and portal structures along Queens Quay between Bay Street and Yonge Street; and
- track works within the tunnel and portal structures.

Managed by Waterfront Toronto,

(a) **Focus Area 2A**: Queens Quay East (Future Portal to Parliament vicinity ancillary Queens Quay surface/public realm between Bay & future portal); and

(b) **Focus Area 2B** (Provisional): Queens Quay East Extension & Cherry (Parliament vicinity to West Don Lands Loop).

WSP's Scope of Work (SOW) pertains to Focus Area 1 (the study area for this project) only and includes a collaborative effort among the City of Toronto, the Toronto Transit

Commission, and Waterfront Toronto. Figure **1.2.1** shows the three focus areas described above.

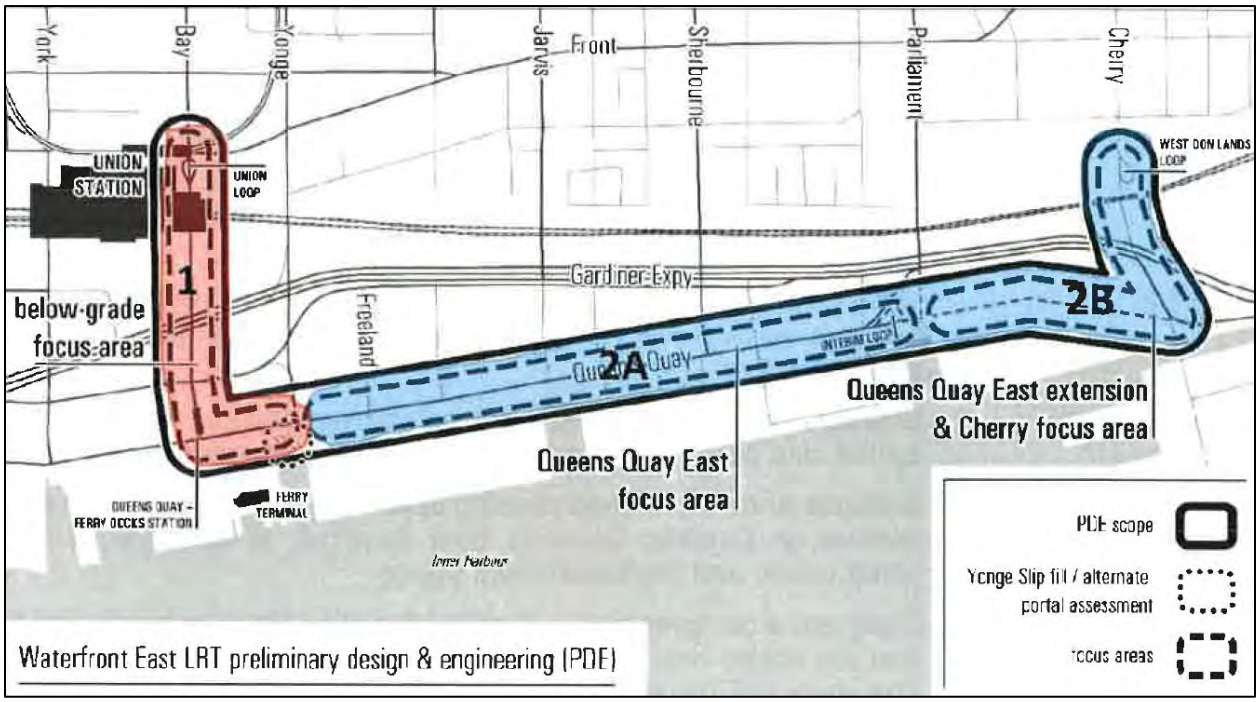

Figure 1.2.1. Study Area – Focus Area 1

Please reach out to the Project Team should you require alternative text for this image.

2.0 Air Quality Project Scope

The provision of air quality specialty support for the project should include the preparation of a Preliminary Air Quality Study, and inform the project design where permitting/registration of equipment or air emissions sources may be needed, or where there is the potential for notable air quality effects.

The Preliminary Air Quality Study requires that a baseline of the current air quality in the vicinity of the Project is defined; this baseline presents the air quality in the absence of the project. The baseline report should also detail the sources and activities that influence air quality and should identify the local land uses and receptors that may be affected by the Project. Ambient air measurement of air contaminants for this phase of the project are not included as there are reliable air monitoring data available from several locations in Toronto that provide longer term data which reflect both seasonal and year-to-year variations.

The air quality specialty support for the Project should focus on the operational phase of the Project as the TPAP assessments are not part of the current scope; there are some aspects of the design that are also excluded from the air quality scope, specifically mechanical and electrical design.

The milestones of the project are as follows:

- Background information review;
- Gap analysis;
- Review of applicability of federal, provincial, and municipal legislative guidance documents and regulations;
- Identification of sensitive receptors surrounding the proposed construction site and operational sources of air emissions;
- Identification of Air Contaminants of Concern;
- Development of an air quality baseline; and
- Proposed air dispersion modelling approach in support of next steps of the Project.

3.0 Background Information Review

This section outlines all the documents, including plans, policies, guidelines, and environmental assessment (EA) studies, that were reviewed to prepare this report.

3.1 City of Toronto Central Waterfront Secondary Plan (2018)

The Central Waterfront Secondary plan (CWSP) provides a 30-year plan and framework for the renewal of Toronto's Waterfront, emphasizing sustainable actions, policies and a planning process that reduces automotive dependence, prioritizes transit, cycling and walking, and removes physical barriers between the Waterfront and the rest of Toronto. It is built on four core principles that have been used to guide the Lower Yonge TMP, including:

1. Removing barriers / Making connections;
2. Building a network of spectacular waterfront parks and public spaces;
3. Promoting a clean and green environment; and
4. Creating dynamic and diverse new communities.

The CWSP has set the context and provided strategic direction for the redevelopment of the waterfront with the implementation of several precinct plans in the waterfront.

No air quality section is presented in the study.

3.2 Lower Yonge Transportation Master Plan Environmental Assessment (2014)

The *Lower Yonge Transportation Master Plan Environmental Assessment* was undertaken with the objective to inform the Lower Yonge Precinct Plan with the goal of establishing the planning context to guide future development. The Lower Yonge Precinct is situated within the area covered by the CWSP, which is the primary guidance for waterfront precinct planning. It is adjacent to neighbouring precinct East Bayfront, the waterfront development on the south side of Queens Quay East, including Pier 27 and Redpath, an existing industrial use. The study area for the *Lower Yonge Transportation Master Plan Environmental Assessment* was slightly larger than the Lower Yonge Precinct. It included the streets surrounding the Precinct (Queens Quay East, Lake Shore Boulevard, Yonge Street and Lower Jarvis Street). It also included the

stretch of Harbour Street between Lower Simcoe Street and Yonge Street, which currently functions as a one-way eastbound service road for the Gardiner Expressway and should likely be affected by road network changes in the Lower Yonge Precinct. Westbound Lake Shore Boulevard, in the Lower Yonge Precinct, largely runs underneath the Gardiner Expressway.

In this study, it is stated that the Central Waterfront Secondary Plan (CWSP) requires new development to minimize potential issues such as noise, vibration, dust, odour, and air quality impacts.

3.3 East Bayfront Transit Class Environmental Assessment (2010)

In 2010, Toronto Transit Commission (TTC), Waterfront Toronto, and the City of Toronto undertook the *East Bayfront Transit Class Environmental Assessment* with the objective to identify the transportation improvements and the road right-of-way required to support planned development in the East Bayfront Precinct. The overall purpose of the undertaking was:

> *"To determine the transit facilities appropriate to serve the long term residential, employment, tourism, and waterfront access needs in the study area while achieving the City's and Waterfront Toronto objectives for land use, design and environmental excellence."*

The initial study area extended from west of Bay Street, in the west, to Cherry Street, in the east, and encompasses the area between Union Station to the north and Lake Ontario to the south.

As the EA evolved, the eastern study limit was reduced to Parliament Street and the area between Parliament Street and Cherry Street was incorporated into the Lower Don Lands Class EA Master Plan initiated by Waterfront Toronto in April 2008. In September 2007, Waterfront Toronto initiated the *Queens Quay Revitalization Class EA* to address transportation and public realm improvements on Queens Quay Boulevard between Bathurst Street and Lower Jarvis Street.

As a result of the overlap and the close collaboration between the two EA studies, the surface portion of Queens Quay Boulevard west of Yonge Street was incorporated into the Queens Quay Revitalization EA, while the underground portion of Queens Quay east of Bay Street and Bay Street south of Union Station remained within the scope of the East Bayfront Transit EA.

The following table outlines the air quality commitments made to mitigation that were made in the *East Bayfront Transit Class Environmental Assessment.*

Discipline	Potential Effect	Commitments/Mitigation
Air Quality	• Construction-related dust and airborne emissions may contribute to adverse health effects	• Adequate dust control measures are to be in place prior to initiation of work in order to prevent the uncontrolled generation of dust as well as to minimize creation of smog. • Dust Control Plans to be developed in consultation with the Toronto Public Health, to ensure methods adequately mitigate the potential health effects from the generation of dust during construction activities. • Dust controls are to be monitored regularly by the construction contractor and at a minimum, observations of compliance with the air quality and dust control objectives are to be recorded daily. • Apply water and calcium during construction as required.

3.4 Queens Quay Revitalization Municipal Class Environmental Assessment (2009)

In September 2007, Waterfront Toronto, and the City of Toronto, initiated the *Queens Quay Revitalization Municipal Class Environmental Assessment* study to revitalize Queens Quay. The assessment was undertaken with the objective to develop, examine, and evaluate a number of alternative solutions and design concepts for vehicular, transit, and pedestrian routes along Queens Quay. The purpose was to create a plan for Queens Quay that successfully accommodates the various uses - recreational, transit, bicycle, pedestrian, vehicular – while enhancing the landscape and the public realm within the corridor.

The Queens Quay EA study area limits are Bathurst Street to the west, Jarvis to the east, Lake Ontario to the south and Lake Shore Boulevard to the north. The evaluations of the Alternative Planning Solutions and Alternative Design Concepts concluded with the selection of South Side Transit with Expanded Public Realm and Two-way Operations as the Preferred Design as this design supported the principles and policies for the Central Waterfront described in the *City of Toronto Official Plan* and *Central Waterfront Secondary Plan.*

The following table outlines the air quality commitments made to mitigation that were made in the *Queens Quay Revitalization Municipal Class Environmental Assessment.*

Discipline	Potential Effect	Commitments/Mitigation
Air Quality	• Reduced air quality due to airborne dust and migration during construction	• Monitor dust emissions during construction • Use dust control and suppression measures • Ensure all equipment in good working order • Minimize vehicle traffic on exposed soils • Avoid excavation and other construction activities that may generate dust during periods of high winds • Follow City by-laws regarding vehicle idling

3.5 East Bayfront Class Environmental Assessment Master Plan (2006)

The Waterfront Toronto (formerly the Toronto Waterfront Revitalization Commission (TWRC)) and the City of Toronto (the City) worked closely in the development of the *Central Waterfront Secondary Plan*, and the *East Bayfront Precinct Plan*. In order to expedite the delivery of public infrastructure to support revitalization, the TWRC and the City worked as co-proponents to prepare the *East Bayfront Class Environmental Assessment Master Plan*. This Class Environmental Assessment Master Plan (Class EA Master Plan) was prepared under the Municipal Class Environmental Assessment, June 2000, with the objective to support the East Bayfront Precinct. The Class EA Master Plan addressed the same area as the *East Bayfront Precinct Plan* plus the area between Parliament Street and Cherry Street.

Both, the East Bayfront Precinct Plan and Master Plan recommended the provision of exclusive transit Rights-of-Way (ROW) on the roadways identified in the Central Waterfront Secondary Plan.

This study mentioned air emissions source categories (industry, transportation, fuel combustion, and miscellaneous activities primarily dry cleaning, painting, solvent use, and fuel marketing) in the City of Toronto, but no emission quantification or modelling was completed to determine the air quality impacts in the study area.

3.6 East Bayfront Precinct Plan (2005)

Precinct Plans are intended to outline development principles and guidelines for an area that allows the City to move from Official Plan and Central Waterfront Secondary Plan (CWSP) policies to specific Zoning By-law provisions that encourage sustainable development. Developed in 2005, the East Bayfront Precinct extends from Jarvis Street in the west to Cherry Street in the east, between the lakefront and the Gardiner corridor. The *East Bayfront Precinct Plan* focuses on the area between Jarvis and Parliament Streets. The plan sets out the goals and aspirations for the new community as well as the general framework for the public realm and new development in the East Bayfront area. It provides design concepts and development guidelines for the implementation of

public infrastructure (streets, parks and trails, and community facilities) as well as the built form of new development.

Air quality was not discussed in this study.

4.0 Gap Analysis

The East Bayfront Transit Class Environmental Assessment and Queens Quay Revitalization Municipal Class Environmental Assessment were completed in 2010 and 2009 respectively to identify the transportation improvements surrounding the study areas.

The East Bayfront Transit Environmental study report qualitatively discussed the airborne particulates emissions from the construction activities and mitigation measures. It also recommended monitoring of dust during construction.

The Queens Quay Revitalization Environmental Assessment also provided a qualitative analysis of the effects on air quality surrounding the study areas. It discussed the local increase of diesel particulate emissions due to construction equipment and activities. Mitigation measures included monitoring dust emissions during construction, dust control using water application, avoiding unnecessary idling of construction equipment, and preparation of a traffic management plan to address the redistribution of rerouted traffic.

Since the completion of these studies, are number of guidelines have been published/updated to assess transportation projects in Ontario including:

- *Ministry of Transportation (MTO) Environmental Guide for Assessing and Mitigating the Air Quality Impacts and Greenhouse Gas Emissions of Provincial Transportation Projects, first published June 2012, updated June 2020;*
- *Environmental Guide: Recommended Approach for Assessing and Mitigating Air Quality Impacts and Greenhouse Gas Emissions of Metrolinx Public Transit Projects, first published August 2015, updated as DRAFT November 2019.; and*
- *The Ministry of the Environment, Conservation and Parks' (MECP's) Guide to Environmental Assessment Requirements for Transit Projects, January 2014.*

The study areas are surrounded by a mixture of commercial and residential land uses.

Based upon the current guidance and requirements, a number of gaps were identified in the work completed for the previous EAs. The effect of the construction phases of the project on local air quality should be assessed quantitatively using air dispersion modelling, and considering the sensitive receptors near the study areas. The Operation Phase assessment should consider sources such as the portal and ventilation shafts. The background concentrations in the study area should be established using the most recently available data/ from MECP air quality monitoring stations.

5.0 Air Contaminants of Concern

In Ontario, the Environmental Protection Act prohibits release of a contaminant into the natural environment, if the discharge causes or may cause an adverse effect.

Airborne contaminants of relevance to construction projects, including particulate matter, nitrogen oxides, carbon monoxide, benzo(a)pyrene, and VOCs (specifically benzene, 1-3 butadiene, formaldehyde, acetaldehyde, and acrolein), have standards and Ambient Air Quality Criteria (AAQCs) in Ontario that were set based upon the potential health or environmental effects of exposure to these pollutants. Further, the Metrolinx Environmental Guide identifies carbon monoxide (CO), nitrogen oxides (NO_X, expressed as NO_2), particulate matter, and VOCs as contaminants that are to be considered in air quality assessments (Metrolinx, 2019). The list of relevant contaminants is consistent with the Metrolinx Environmental Guide.

These potential contaminants were all considered qualitatively, and where warranted, were considered quantitatively through the use of air dispersion modelling to predict off-site air concentrations associated with construction activities.

Particulate Matter

Particulate matter is subcategorized in several ways to support discussions of emission sources and potential air quality, health, and nuisance effects. The two categories pertinent to this assessment are inhalable PM_{10} and respirable $PM_{2.5}$.

Inhalable Particulate (PM_{10})

PM_{10} has a particle size range up to 10 µm in aerodynamic diameter. The PM_{10} size fraction includes the smaller particles referred to as $PM_{2.5}$; it is emphasized that PM_{10} and $PM_{2.5}$ are not separate compounds, nor are they additive. In addition to the nuisance effects, there are possible health effects that may be attributed to PM_{10}. The interim AAQC is based upon these potential health effects.

In general, fugitive dusts are generated from open sources that are susceptible to air dispersion to areas off-site. Common sources of fugitive dust include unpaved roadways, aggregate storage piles, and heavy construction operations. PM_{10} should be assessed as a surrogate for total fugitive dust as per the Metrolinx Environmental Guide.

Respirable Particulate ($PM_{2.5}$)

$PM_{2.5}$ has a particle size range up to 2.5 µm in aerodynamic diameter. $PM_{2.5}$ is the most important particle size range from a respiratory public health perspective. Current AAQCs and CAAQS have been established for $PM_{2.5}$ that are protective of health. $PM_{2.5}$ is released to the air as a by-product of fuel combustion and as fugitive dust. There is also a potential for the release of respirable silica during cutting, demolition, or repair of concrete structures. This has not been quantitatively assessed in the same manner as fugitive dusts from other sources due to the infrequent and short-term nature of such activities. Intensive dust control is imperative when carrying out such activities, and air sampling for respirable silica is recommended until it can be demonstrated that mitigation is effective and air quality effects are found to be lower than the AAQC for respirable silica.

PM_{10} and $PM_{2.5}$ fractions consider the effects of tailpipe emissions from diesel engines, material handling and fugitive dust that may be generated at the project site.

Nitrogen Oxides

Nitrogen oxides (NO_X) are a mixture of compounds of oxygen and nitrogen, including nitric oxide (NO), nitrous oxide (N_2O), nitrogen dioxide (NO_2), and others. These compounds are formed during fuel combustion, and are emitted from sources such as vehicles, boilers, and diesel generators, as examples.

Carbon Monoxide

Carbon monoxide (CO) is a colourless, odourless, tasteless gas, which is produced primarily through the combustion of fossil fuels due to incomplete combustion. Most of the CO produced in Ontario is from the transportation sector (87%), and the combined effect of power generation, buildings, heating and industrial operations is approximately 13% of the total (MECP, 2019).

Volatile Organic Compounds (VOCs) and Polycyclic Aromatic Hydrocarbons (PAHs)

Volatile organic compounds (VOCs) are an aggregate grouping of many organic substances that readily volatilize and undergo photochemical reactions in the atmosphere. There are a number of VOCs that are created as a by-product of fuel combustion, however discussions of air quality effects from diesel equipment and the transportation sector generally involve the following five VOCs which are associated with health effects and designated as air toxics by the Ministry of Transportation (MTO, 2012):

- Benzene,
- 1,3-Butadiene,
- Formaldehyde,
- Acetaldehyde, and
- Acrolein.

Polycyclic aromatic hydrocarbon (PAH) are hydrocarbons that are composed of multiple aromatic rings. There are numerous compounds that are classified as PAHs; benzo(a)pyrene (B[a]P) is a common PAH that is used in air quality assessments in Ontario as a surrogate for Total PAHs. B(a)P is most commonly found in the solid phase bound to diesel particulate matter but may also be present in the vapour phase at elevated temperatures in tailpipe emissions.

The quantitative assessment and air dispersion modelling should consider the potential effects of emissions of these five VOCs and B(a)P from equipment and vehicles associated with the Project.

Odour

Odour emissions have the potential to become a nuisance to people who live near odour sources, or to people who frequent sports fields, community centres, or other sensitive land uses in the Study Area. Odour becoming a nuisance varies widely from

person to person and there are varying degrees of sensitivity and opinions about what is considered offensive. Five factors that contribute to odour nuisance have been defined to help deal with the complex and subjective nature of odours, referred to as the FIDOL factors:

- **Frequency** – how often odour is detected
- **Intensity** – how strong is the odour
- **Duration –** are odours very brief or are episodes lengthy
- **Offensiveness -** the hedonics or descriptors (putrid, solvent)
- **Location –** is someone present to smell the odour

Various combinations of these five factors may lead to odour complaints or adverse effects, and all five must be considered for effective odour management.

6.0 Baseline Air Quality

The objective of this assessment is to provide quantitative analysis of the significance of baseline ambient air quality for the project development.

For the construction and development projects, the Environmental Protection Act in Ontario prohibits release of a contaminant into the natural environment, if the discharge causes or may cause an adverse effect, and encompasses potential health, environmental, and nuisance effects. Odour, fine particulate matter, nitrogen oxides, carbon monoxide, sulphur dioxide, and Volatile Organic Compounds (VOCs), specifically benzene, benzo(a)pyrene, 1-3 butadiene, carbonyls [formaldehyde, acetaldehyde, and acrolein] that have standards and Ambient Air Quality Criteria (AAQCs) in Ontario which were established based upon the potential health or environmental effects of exposure to these pollutants.

To establish baseline, for contaminants that are assessed for the 1-hour, 8-hour, and 24-hour averaging times, the 90th

percentile of the measured background concentrations were used as representative baseline. For contaminants that have AAQCs for the annual averaging period, the average of the monitoring data was used as baseline.

For most contaminants, five-years of recent monitoring data were processed to establish appropriate baseline concentrations. The only exceptions were carbonyls (formaldehyde, acetaldehyde, and acrolein), where only four years of data are available close to the project area, and VOCs (benzene, and 1,3-butadiene) where data for 2010-2014 were available.

6.1 Approach

To achieve the objective of the report, the following tasks were completed to establish the baseline:

- Define the study areas in terms of geographical features, pollutants of interest, and typical meteorological conditions;

- Find the closest air monitoring stations to the study area that are operated by a regulatory agency (i.e., the MECP or Environment and Climate Change Canada [ECCC]);
- Define the most recent and robust dataset;
- Analyze the monitoring data available for each contaminant of concern;
- Where complete datasets are not available, use the MECP method to fill in data gaps; and
- Establish the baseline concentration for each contaminant.

6.2 Existing Ambient Conditions

There are a number of air quality monitoring stations operated by the Ontario MECP and part of the ECCC National Air Pollution Surveillance (NAPS) program that are located within reasonable distances of the study area and representative of existing regional air quality in the study area. Local sources would not influence these stations, however the more regional influences from transboundary sources such as the Ohio Valley region of the US, residential heating, and general commercial, industrial, and agricultural uses would be reflected in the MECP monitoring data.

For contaminants that are assessed for the 1-hour, 8-hour, and 24-hour averaging times, the 90th percentile of the measured background concentrations were used as representative baseline. The use of maximum measured ambient concentrations for the assessment of cumulative effects would be overly conservative for these shorter averaging periods, as the assumption would be that the worst-case emissions from the site would coincide with unfavorable weather conditions in the direction of the receptor and maximum contributions from all regional sources. For this reason, the 90th percentile concentration is used, by convention, as a conservative baseline. The 90th percentile is expected to be exceeded only under extreme weather conditions or other air quality influences. This approach has been accepted by MECP and ECCC for other air quality studies reviewed as part of the EA process, and is specifically cited in the both the Alberta and Saskatchewan Air Quality Modelling Guides (Alberta Environment Air Quality Model Guide (2013), Saskatchewan Air Quality Modelling Guideline (2012)); the Alberta guide cites the use of the 90th percentile to allow for some variability due to anthropogenic or unusual local sources. For contaminants that have AAQCs for the annual averaging period, the average of the monitoring data was used as baseline.

A five-year dataset was used to calculate the average background concentration for the contaminants, with the exception of three of the carbonyls (formaldehyde, acetaldehyde, and acrolein). For these carbonyls, a four-year (2014-2017) dataset was used, due to the available published data. There were no PM_{10} data monitored in reasonable proximity to the study area, therefore the PM_{10} concentration was estimated based upon an assumed $PM_{2.5}/PM_{10}$ ratio of 0.54 (Lall et.al.,2004). The monitoring stations used to establish regional baseline conditions for the Study Area are identified in Table 6.2.1.

Table 6.2.1. NAPS/MECP Monitoring Stations

Station ID		Location		Distance from Study Area (km) and Direction	Contaminants	Years of Processed Data
NAPS ID	Name	Latitude	Longitude			
60433	Toronto Downton Bay and Wellesley	43.66	-79.39	2 km, S	$PM_{2.5}$, NO_2	2014 -2018
60439	Toronto - U of T 200 College Street	43.66	-79.40	2 km, NW	formaldehyde, acetaldehyde, acrolein, B(a)P	2014-2017 2014
60427	Toronto - U of T 223 College St	43.66	-79.40	2 km, NW	benzene, 1,3-butadiene, B(a)P	2010-2014 2015
60438	Toronto West 125 Resource Rd	43.71	-79.54	15 km, NW	SO_2, CO, O_3 B(a)P	2014 -2018 2016-2018

6.3 Commentary on the Data Analysis

Datasets were chosen with the aim of having robust and recent data, and data collected as near to the Project as possible. For most compounds, including NO_2, $PM_{2.5}$, CO, SO_2, and O_3, the datasets comprised of five-years of data from 2014-2018, and within reasonable distance from the study area. For the carbonyls (formaldehyde, acetaldehyde, and acrolein) concentration data was available for a four-year period at the U of T station. For the VOCs (benzene and 1,3-butadiene), the Toronto station at 223 College Street for 2010-2014 was used due to the proximity to the study area.

The NAPS stations recording B(a)P in Toronto changed every 1-2 years. Hence, a combined five-year data set of three stations was used for establishing baseline. These stations are U of T station at 200 College St. (2014, NAPS ID: 60439), U of T at 223 College St. (2015, NAPS ID: 60427), and Toronto West (2016-2018, NAPS ID: 60438).

For some compounds, such as acrolein and acetaldehyde, the concentrations were measured only on 24-hour averaging period. These compounds have AAQCs for shorter averaging time, and therefore, the baseline value estimated using *Ontario's Procedure for Preparing an Emission Summary and Dispersion Modeling Report [Guideline A-10]* methodology for converting between averaging periods.

For the missing data, in accordance with the MECP guidance, gaps of six days or more in raw background data measurements were filled using the 90th percentile of the existing data set for each station.

For the future modelling, if any, background ozone was also assessed seasonally for modelling of atmospheric NO_2 conversion.

6.4 Baseline Concentration Summary

The background concentrations considered for the assessment are summarized in Table 6.4.1.

Table 6.4.1. Background Concentrations

Compound	CAS Number	Averaging Time	Baseline Concentration ($\mu g/m^3$)	Reference for Baseline Concentration
PM_{10}	n/a	1-hour	27.8	$PM_{2.5}/PM_{10}$ = 0.54 (Lall et. all, 2004)
		24-hour	25.9	
$PM_{2.5}$	n/a	24-hour	14	90th percentile of 24-hr averaging data measured at Toronto Downtown, combined (2014-2018)
		Annual	7.9	Annual average measured at Toronto Downtown, combined (2014-2018)
		1 hr	15	90th percentile of 1-hr averaging data measured at Toronto Downtown, combined (2014-2018)
Nitrogen Dioxide (NO_2)	05-09-46	1-hour	45.1	90th percentile of 1-hr averaging data measured at Toronto Downtown, combined (2014-2018)
		24-hour	38.2	90th percentile of 24-hr averaging data measured at Toronto Downtown, combined (2014-2018)
		Annual	24.6	Annual average measured at Toronto Downtown, combined (2014-2018)
Sulphur Dioxide (SO_2)	7446-09-5	1-hour	3.7	90th percentile of 1-hr averaging data measured at Toronto West, combined (2014-2018)
		24-hour	2.8	90th percentile of 24-hr averaging data measured at Toronto West, combined (2014-2018)

Compound	CAS Number	Averaging Time	Baseline Concentration (µg/m^3)	Reference for Baseline Concentration
		Annual	1.7	Annual average measured at Toronto West, combined (2014-2018)
Carbon monoxide (CO)	630-08-0	8-hour	458	As a conservative assumption, same value with one hour average background was assumed.
		1-hour	458	90th percentile of 1-hr averaging data measured at Toronto West, combined (2014-2018)
Benzo(a)pyrene	50-32-8	Annual	6.8E-05	Annual average measured at Toronto, combined (2014-2018)
		24 Hour	1.2E-04	90th percentile of 24-hr averaging data measured at Toronto, combined (2014-2018)
Benzene	71-43-2	Annual	0.78	Annual average measured at Toronto, combined (2010-2014)
		24-hour	0.98	90th percentile of 24-hr averaging data measured at Toronto, combined (2010-2014)
Acetaldehyde	75-07-0	24-hour	1.98	90th percentile of 24-hr averaging data measured at University of Toronto, combined (2014-2017)
		1/2-hour	5.9	Approximated from 24-hour averaging value
Acrolein	107-02-8	24-hour	0.07	90th percentile of 24-hr averaging data measured at University of Toronto, combined (2014-2017)
		1-hour	0.17	Approximated from 24-hour averaging value
1,3-Butadiene	106-99-0	Annual	0.08	Annual average measured at Toronto, combined (2010-2014)

Compound	CAS Number	Averaging Time	Baseline Concentration (µg/m³)	Reference for Baseline Concentration
		24-hour	0.11	90th percentile of 24-hr averaging data measured at Toronto, combined (2010-2014)
Formaldehyde	500-00-0	24-hour	3.34	90th percentile of 24-hr averaging data measured at University of Toronto, combined (2014-2017)

Baseline concentrations for the contaminants of concern are intended to represent the existing conditions, inclusive of existing anthropogenic and natural sources, such that the effects of new project(s) can be analyzed considering the pre-existing conditions. Cumulative concentrations determined through air dispersion modelling can be used to assess the theoretical impact of existing and proposed sources on receptors.

Ambient air quality at the Project site is expected to be influenced by mostly anthropogenic sources at the local and regional scales, including:

- Vehicle traffic in the vicinity of the Study area;
- Comfort heating, from all the residential and commercial buildings nearby;
- Construction activity in the vicinity of the study area;
- Project construction phase, including tunneling; and
- Project operational phase.

The baseline concentrations were established, based on the available recent robust dataset in the vicinity of the study area. The data were processed to obtain the 90th percentile for the contaminants with 1-hour and 24-hour averaging AAQCs, and mean value for the contaminants with annual averaging AAQCs.

All baseline values are well below the air quality criteria, except for benzene and benzo(a)pyrene. the baseline concentrations for B(a)P and benzene are the baseline concentrations are already approaching, or exceeding, the AAQC and the additional emissions from the Project are appreciably lower than this baseline. Therefore, in lieu of quantification or monitoring, the focus for these should be mitigation measures that target on-site engines to help to reduce the incremental contribution of ambient concentration for these species to the Study Area.

7.0 Regional Climate and Meteorology

Air quality is affected by both the emission sources that release pollutants into the air, and by atmospheric conditions, such as wind speed, wind direction, and temperature.

7.1 Wind Speed and Direction

The wind rose depicted in Figure 7.1.1 for the nearest weather station at Toronto City Centre (at Billy Bishop Airport). The climate ID for this station is 6158359, Latitude

43°37'39" N, and Longitude 79°23'46" W. The wind data were processed based on the hourly wind data for five years (2015-2019).

A wind rose depicts the predominant wind patterns for a site by graphically illustrating the distribution of wind speed and wind direction. The wind rose is comprised of two parts: the frequency that winds blow from each specified direction around the rose, and the distribution of wind speed indicated by the colours on each bar that represent wind speed ranges.

The easterly-westerly wind is predominant wind profile.

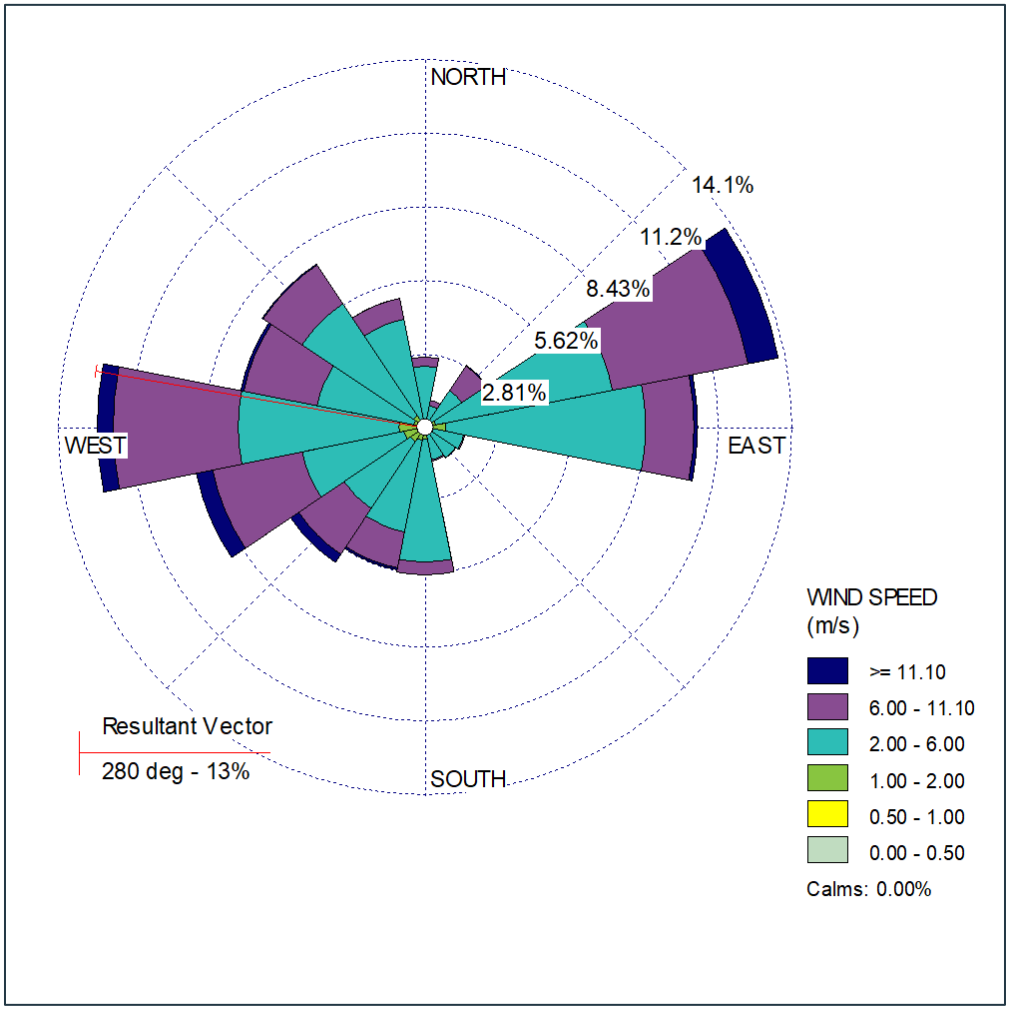

Figure 7.1.1. - Windrose for the Study Area (Toronto City Centre) (2015-2019)

Please reach out to the Project Team should you require alternative text for this image.

7.2 Temperature and Precipitation

For this project, the Toronto City met station at Latitude 43°40'00"N, and Longitude 79°24'00" W, was selected due to the due to the proximity of the station to the project. The Toronto met station is approximately 3 km north of the study area. The climate ID for this met station is 6158350.

According to the Canadian Climate Normals (calendar years 1981 to 2010) for this station, the mean annual temperature is estimated at 9.4°C. The warmest month of the year is July with an average temperature of 26.6°C and the coldest month is January with an average temperature of -6.7°C. The meteorological station recorded a total average annual precipitation of 831.1 mm, of which 714.0 mm was rainfall. Precipitation is distributed throughout the year, with most of the rain occurring between April and November. The maximum mean monthly rainfall is 84.7 mm and occurs in September. Climate Normals (1981-2010) for the Toronto meteorological station are summarized in Table 7.2.1.

These parameters are significant to discussions of potential fugitive dust and air quality effects as precipitation acts as a natural dust suppressant, and lower temperatures reduce the speed at which soils and aggregate materials dry following a precipitation event. Although this is not reflected in the air dispersion modelling, fugitive dust mitigation should be intensified during summer months and into October (when compared with the colder months and those with snow cover).

Table 7.2.1. Toronto City-Weather Station 30-Year Climate Normals

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Daily Average Temperature (°C)	-3.7	-2.6	1.4	7.9	14.1	19.4	22.3	21.5	17.2	10.7	4.9	-0.5	9.4
Daily Maximum Temperature (°C)	-0.7	0.4	4.7	11.5	18.4	23.8	26.6	25.5	21.0	14.0	7.5	2.1	12.9
Daily minimum Temperature (°C)	-6.7	-5.6	-1.9	4.1	9.9	14.9	18.0	17.4	13.4	7.4	2.3	-3.1	5.9
Rainfall (mm)	29.1	29.7	33.6	61.1	82.0	70.9	63.9	81.1	84.7	64.3	75.4	38.2	714.0
Snowfall (cm)	37.2	27.0	19.8	5.0	0.0	0.0	0.0	0.0	0.0	0.1	8.3	24.1	121.5
Precipitation (mm)	61.5	55.4	53.7	68.0	82.0	70.9	63.9	81.1	84.7	64.4	84.1	61.5	831.1

8.0 Identification of Sensitive Receptors

Exposure should be assessed for all off-site sensitive receptors (300m distance on each side of the Study Area as per the Metrolinx Guideline should be considered the zone of influence (ZOI) for consideration) potentially exposed to emissions associated with Project. Examples of sensitive receptors are:

- permanent or seasonal residences
- hotels/motels
- nursing/retirement homes
- rental residences
- hospitals
- campgrounds
- noise sensitive buildings such as schools and places of worship

Taking into consideration the nature of urban development in the surrounding area, not only the ground level receptors but also the elevated receptors representing high-rise buildings should be added to the assessment.

9.0 Air Dispersion Modelling Approach

Under the fundamental methodology approach, the "worst-case" scenario should be defined based on the number of trains and highest traffic volumes at the stations and emissions from vent raises (e.g., operations or maintenance activities), ground-level construction sites, and portals near sensitive receptors.

The potential air quality impacts of contaminant emissions from both the operational emissions, maintenance, and commuter vehicle emissions should be assessed as applicable.

The U.S. EPA AERMOD model and/or the CAL3QHCR model (as applicable) may be used for modelling contaminant emissions from the Project. The appropriate model should be selected after the project team receives and reviews the project data, depending on the applicability and modelling requirements.

AERMOD model should be run for appropriate averaging times that give predictions that can be directly compared to the applicable Ontario Ambient Air Quality Criteria (AAQC) and federal criteria (CAAQS) to assess the environmental effects of Future No Build and Future Build scenarios on air quality.

The Ontario Regional 5-year Meteorological Data Set, available on the MECP website, or site-specific meteorological data should be used. If applicable, wind dependent building/obstacle dimensions should be entered as model inputs. The building data should be processed with the Building Profile Input Processor (BPIP) developed by the U.S. EPA. Terrain data for the study area, available from the MECP website and evaluated using AERMOD's terrain processor (AERMAP), should be used in the dispersion modelling.

The CAL3QHCR model is a CALINE3 based model, with queuing and hot spot calculations and with a traffic model to calculate delays and queues that occur at signalized intersections as applicable. This is the U.S. EPA's and MECP's preferred model for line sources from road traffic. CAL3QHCR requires local meteorological data, and each segment of the road or rail traffic is represented as a set of "links" with emissions, traffic and signalization data.

The project's impacts (incremental changes in pollutant concentration determined by dispersion modelling) should be added to corresponding background pollution levels (determined via published data or monitoring as applicable) the cumulative effect on sensitive receptors.

10.0 Applicable Regulatory Criteria and Guidelines

In Ontario, local air quality impacted by industry is regulated under the Environmental Protection Act (EPA) and O. Reg. 419 "Air Pollution – Local Air Quality" (O. Reg. 419). Any stationary discharge to the environment requires an Environmental Compliance Approval (ECA) or an Environmental Activity and Sector Registry (EASR) registration under Section 9 of the Ontario EPA. This regulation and the requirement for permitting do not extend to mobile or fugitive sources, however there is still the potential for on-site construction activities to affect air quality in the Study Area.

The EPA* also has a prohibition on causing an adverse effect (Section 14 of the Ontario Environmental Protection Act), with adverse effect is defined as:

- Impairment of the quality of the natural environment for any use that can be made of it,
- Injury or damage to property or to plant or animal life,
- Harm or material discomfort to any person,
- An adverse effect on the health of any person,
- Impairment of the safety of any person,
- Rendering any property or plant or animal life unfit for human use,
- Interference with normal conduct of business,
- Loss of enjoyment of normal use of property.

*Source: EPA, RSO 1990, c. E.19, as amended, s.1(1).

Based upon this definition, odour, as well as nuisance dust, may cause an adverse effect even at concentrations where no health or other environmental effects are expected.

The decision about the required ECA approvals or EASR registrations should be made at later stages of the Project.

10.1 Air Quality Assessment Criteria

This air quality assessment requires a comparison of the predicted effects, which are the air concentrations predicted by air dispersion modelling, to applicable air quality criteria. This allows for assessment of the potential for, and significance of, adverse effects on the environment and human health in the Study Area. Various regulatory

agencies (including Provincial and Federal agencies) set specific target criteria to be protective of human health and the environment. Ontario's Ministry of the Environment, Conservation, and Parks (MECP) has established ambient air quality criteria (AAQC) for various parameters, including most of the target pollutants identified for this Air Quality Assessment. The AAQCs are set to determine a desirable concentration for a location, inclusive of all sources and background. The AAQC levels are not compliance standards but set to provide guidance for acceptable ambient air quality in Ontario. The MECP has not set an AAQC for PM_{10}, but rather provides a suggested "interim AAQC" value for PM_{10} of 50 $\mu g/m^3$ for the 24-hour averaging time. In contrast, the Ontario Regulation 419/05 standards are used only for facility specific emissions and are used for permitting and compliance purposes. In many cases, the AAQC criteria and the Ontario Regulation 419/05 standards are numerically the same.

For this assessment, it is appropriate to compare the modelled effects to the respective Ontario AAQCs. The Ontario AAQC limits used for the assessment include limits for different averaging times, depending upon the substance.

In addition to the Provincial criteria, there are Canadian Ambient Air Quality Standards (CAAQS) for fine particulate matter $PM_{2.5}$ and nitrogen dioxide (NO_2) adopted by the Canadian Council of Ministers of the Environment (CCME) that were considered in this assessment. The CAAQS are not intended for the assessment of specific emission sources but rather to characterize air quality where people are living, or at other sensitive receptors. Therefore, comparison of the modelled worst-case concentrations directly to the CAAQS would be overly conservative, as the CAAQS does not pertain to the maximum daily but to the 3-year average of the 98^{th} percentile for $PM_{2.5}$ and NO_2. The CAAQS may be used as targets or aspirational goals for long-term studies, however for this study the AAQCs were used for comparison with the modelled effects.

Lastly, Metrolinx has established Threshold Exposure Levels (TEL) Applicable to Metrolinx Construction Projects for the 15-minute averaging time for both $PM_{2.5}$ and PM_{10} that may be more easily assessed and are protective of the 24-hour AAQC and can be incorporated into an air monitoring program as a trigger for investigating the cause of increased air concentrations and initiating an appropriate response.

A summary of the applicable AAQCs, CAAQS, and TELs is provided in Table 10.1.

Table 10.1. Ambient Air Quality Criteria and Project Limits

Parameter	CAS Number	Averaging Time	Ontario AAQC µg/m³	Federal CAAQS µg/m³	Metrolinx TEL µg/m³
PM_{10}	n/a	24-hour	50	—	—
		15-minute	—	—	150
$PM_{2.5}$	n/a	24- hour	27	27	—
		Annual	8.8	8.8	—
		15-minute	—	—	84
Nitrogen dioxide (NO_2)	10102-44-0	1-hour	400	120	—
		24-hour	200	—	—
		Annual	—	30	—
Carbon monoxide (CO)	630-08-0	1-hour	36,200	—	—
		8-hour	15,700	—	—
Acetaldehyde	75-07-0	24-hour	500	—	—
		½-hour	500		
Acrolein	107-02-8	24-hour	0.4	—	—
		1-hour	4.5	—	—
Benzene	71-43-2	Annual	0.45	—	—
		24-hour	2.3	—	—
Benzo(a)pyrene	50-32-8	Annual	0.00001	—	—
		24-hour	0.00005	—	—
1,3-Butadiene	106-99-0	Annual	2	—	—
		24-hour	10	—	—
Formaldehyde	50-00-0	24-hour	65	—	—

11.0 Modelling results analyses based on applicable air standards

The modelling results should be compared against the applicable AAQC and CAAQS.

12.0 Conclusions

This report presents the Preliminary Air Quality Study conducted for the expansion of the existing Union Light Rail Transit (LRT) and Queens Quay LRT Stations and new running tunnel and portal as part of the Waterfront East LRT (WELRT) project. The criteria outlined in this report should be used as supporting materials in developing the Air Quality Impact Assessment.

The key findings of this Preliminary Air Quality Study are summarized as follows:

- This Study defines a baseline of the current air quality in the vicinity of the Project;
- Existing documentation reviewed as part of the gap analysis was outdated;
- The baseline values are well below the respective air quality criteria, with two exceptions of benzene and benzo(a)pyrene. The baseline concentrations for

B(a)P and benzene are already approaching, or exceeding, the AAQC and the additional emissions from the Project are expected to be appreciably lower than the baseline. Therefore, mitigation measures that target the on-site engines should help to reduce the incremental contribution of ambient concentration for these species to the Study Area.

- Airborne contaminants of concern to construction projects include particulate matter, nitrogen dioxide, carbon monoxide, benzo(a)pyrene, and VOCs (specifically benzene, 1-3 butadiene, formaldehyde, acetaldehyde, and acrolein). These contaminants have standards and Ambient Air Quality Criteria (AAQCs) in Ontario that were set based upon potential health or environmental effects of exposure to these pollutants. Further, the Metrolinx Environmental Guide identifies carbon monoxide (CO), nitrogen oxides (NO_X, expressed as NO_2), particulate matter, and VOCs as contaminants that are to be considered in air quality assessments (Metrolinx, 2019). The list of relevant contaminants is consistent with the Metrolinx Environmental Guide;
- Exposure should be assessed for all off-site sensitive ground level and elevated receptors potentially exposed to emissions associated with Project (300m distance on each side of the Study Area should be considered the zone of influence (ZOI), per the Metrolinx Guideline);
- The U.S. EPA AERMOD model and/or the CAL3QHCR model (as applicable) should be used for air dispersion modelling of contaminant emissions from the Project. The appropriate model should be selected after the project team receives and reviews the project data, depending on the applicability and modelling requirements;
- In Ontario, local air quality is regulated under the Environmental Protection Act (EPA) and O. Reg. 419 “Air Pollution – Local Air Quality” (O. Reg. 419);
- This air quality assessment requires a comparison of the predicted effects, which are the air concentrations predicted by air dispersion modelling, to applicable air quality criteria. For this assessment, it is appropriate to compare the modelled effects to the respective Ontario AAQCs;

  In addition to the Provincial criteria, there are federal air quality criteria. Canadian Ambient Air Quality Standards (CAAQS) for $PM_{2.5}$ and NO_2, adopted by the Canadian Council of Ministers of the Environment (CCME) were considered in this assessment; and
- Metrolinx has established Threshold Exposure Levels (TEL) Applicable to Metrolinx Construction Projects for the 15-minute averaging time for both $PM_{2.5}$ and PM_{10} that may be more easily assessed and are protective of the 24-hour AAQC and can be incorporated into an air monitoring program as a trigger for investigating the cause of increased air concentrations and initiating an appropriate response.

13.0 Next Steps

- Construction phase air dispersion modelling. The goal of this step is to provide the stress test assessment of potential air quality impacts on sensitive receptors located in the area surrounding the Project;
- Based on the preliminary assessment of air quality it is recommended that;
    - An Air Quality Management Plan (AQMP) should be prepared prior to construction phase of the project,
    - A Best Management Practice Plan (BMPP) should be prepared to identify dust and odour impacts associated with construction phase of the project, and mitigation measure, and
    - An Ambient Air Monitoring Plan (AAMP) should be prepared.
- The above-mentioned modelling and Plans would have to comply with applicable provincial and municipal guidance documents, and would have to be consistent with construction schedules and allocation of construction equipment at the project site when these documents are available.

14.0 References

1. Ontario Regulation 419/05: AIR POLLUTION – LOCAL AIR QUALITY
2. Ontario Regulation 1/17: REGISTRATIONS UNDER PART II.2 OF THE ACT - ACTIVITIES REQUIRING ASSESSMENT OF AIR EMISSIONS
3. Ontario Regulation 524/98: Exemptions from Section 9 of the EPA
4. Ontario Regulation 231/08: Transit Projects and Metrolinx Undertakings
5. Ontario Regulation 255/11: Environmental Compliance Approvals
6. Ontario Regulation 245/11: Environmental Activity and Sector Registry
7. MECP (January 2014). Guide to Environmental Assessment Requirements for Transit Projects
8. Canadian Council of Ministers of the Environment (CCME). Canadian Ambient Air Quality Standards (CAAQS). https://www.ccme.ca/en/current_priorities/air/caaqs.html [accessed Nov.11,2020]
9. Metrolinx (November 2019). ENVIRONMENTAL GUIDE: Recommended Approach for Assessing and Mitigating Air Quality Impacts and Greenhouse Gas Emissions of Metrolinx Public Transit Projects (DRAFT)
10. Ontario Ministry of the Environment, Conservation and Parks (MECP). (March 2018). Guideline A-10: Procedure for Preparing and Emission Summary Dispersion Modelling Report, Version 4.1, PIBS #3614e04.1
11. Ontario Ministry of the Environment, Conservation and Parks (MECP). (February 2017). Guideline A-11: Air Dispersion Modelling Guideline for Ontario, Version 3.0, PIBS #5165e03

12. Ontario Ministry of the Environment, Conservation and Parks (MECP) (February 2017). Air Dispersion Modelling Guideline for Ontario, Version 3.0, PIBs # 5165e03
13. Air Contaminants Benchmarks" (ACB) List (MECP), Standards Development Branch, Environmental Standards and Sciences Division, Version 2.0 -April 2018.