APPENDIX 7.6A

Human Health Risk Assessment

October 2017
Project No. 1535751

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TABLES

FIGURES

ANNEXES

LIST OF ACRONYMS

ATSDR	Agency for Toxic Substances and Disease Registry
CalEPA	California Environmental Protection Agency
CCME	Canadian Council of Minister of the Environment
CO	Carbon monoxide
COPC	chemicals of potential concern
CSM	conceptual site model
DPM	diesel particulate matter
EA	environmental assessment
ECCC	Environment and Climate Change Canada
HHRA	Human Health Risk Assessment
HQ	Hazard quotient
ILCR	incremental lifetime cancer risk level
LSA	local study area
MOE	Ontario Ministry of the Environment
MOECC	Ontario Ministry of the Environment and Climate Change
NAPS	National Air Pollution Surveillance Network
NO	Nitric oxide
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxides
PM	particulate matter
$PM_{2.5}$	particulate matter less than 2,5 microns in diameter
PM_{10}	particulate matter less than 10 microns in diameter
the Project	New Transmission Line to Pickle Lake Project
ROW	right-of-way
$S0_2$	Sulphur dioxide
TCEQ	Texas Commission on Environmental Quality
TRV	tolerable reference value
TSP	total suspended particulate
US EPA	United States Environmental Protection Agency
WHO	World Health Organization

LIST OF UNITS

km	kilometre
m	metre
$\mu g/m^3$	microgram per cubic metre
µm	micron

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7.6A1.0 INTRODUCTION

This appendix presents the Human Health Risk Assessment (HHRA) for the Phase 1 New Transmission Line to Pickle Lake Project (the Project) and includes an assessment of potential human health risks associated with changes in environmental quality due to chemical releases from the Project. Potential human health risks from noise from the Project are not evaluated as part of an HHRA which evaluates potential risks associated with chemical exposures only. Potential human health risks from noise are evaluated in Appendix 7.6B.

The HHRA follows the risk assessment framework endorsed by provincial and federal regulatory agencies (MOE 2005, Health Canada 2012). The framework provides a structured and clear approach for evaluating potential risks to human health from environmental stressors such as chemicals.

The scope of the HHRA includes the assessment of potential human health risks from inhalation of chemicals emitted to air during the construction stage of the Project. No other exposure pathways or stages of the Project are considered relevant to the evaluation of potential human health risks as described in Sections 3.3 and 4.2 of this appendix. The HHRA evaluates the potential risks to human health from short-term (or acute) and long-term (or chronic) inhalation exposure to chemicals and from exposure to particulate matter (PM) (i.e., diesel particulate matter [DPM], particulate matter less than 10 µm in diameter [PM_{10}] and particulate matter less than 2.5 µm in diameter [$PM_{2.5}$]) that are emitted to air. The HHRA relies upon the results of the air quality assessment (Section 5.3 of the Draft Environmental Assessment [EA] Report), specifically predicted concentrations of chemicals (including DPM, PM_{10} and $PM_{2.5}$) in air.

7.6A2.0 HUMAN HEALTH RISK ASSESSMENT FRAMEWORK AND APPROACH

7.6A2.1 Framework

The HHRA follows the risk assessment framework endorsed by provincial and federal regulatory agencies (MOE 2005, Health Canada 2012). The framework provides a structured and clear approach for evaluating potential human health risks, if any, to people associated with changes in environmental quality due to chemical releases from a project. For there to be a potential health risk, the following three conditions must be met:

- a receptor (i.e., people) must be present;
- there must be a way by which the receptor can come into contact with the chemical (i.e., an exposure pathway); and
- a chemical must be present at concentrations that could be harmful.

These three conditions are illustrated on Figure 7.6A-1, where potential human health risks may occur only when the three conditions are met.

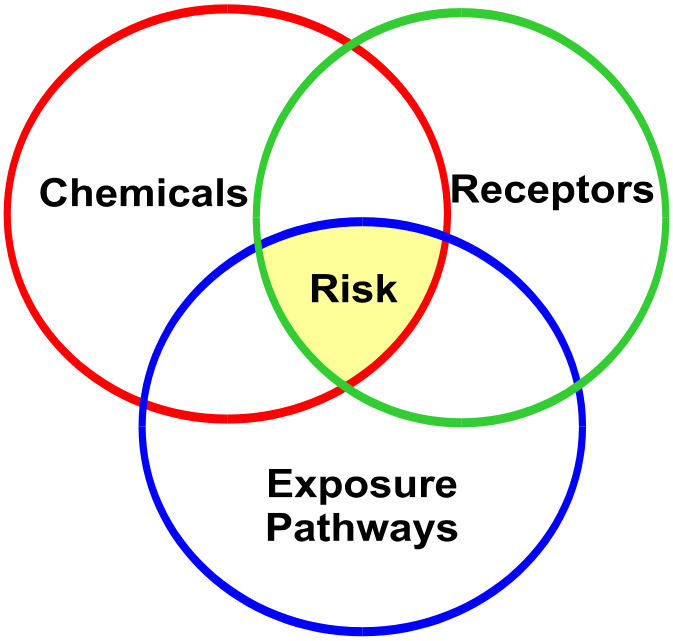


Figure 7.6A-1: Three Conditions for Potential Health Risk

To determine whether these conditions are present, the risk assessment framework used in Ontario (e.g., MOE 2005) and Canada (e.g., Health Canada 2012) typically involves four sequential components, as described below:

1) **Problem Formulation:** The problem formulation involves developing a focused understanding of how changes in environmental quality as a result of chemical releases from a project might affect the health of people. The problem formulation identifies the following: a representative set of receptors (i.e., people) that may be present near the Project; the pathways by which receptors may be exposed to chemicals released by the Project (e.g., inhalation of ambient air); and the chemicals released by the Project that may be present at levels harmful to receptors (i.e., chemicals of potential concern [COPCs]). The information from the problem formulation is summarized in a conceptual site model (CSM) which illustrates the pathways of the COPCs from their sources, through the relevant environmental media to the identified receptors.

2) **Toxicity Assessment:** The toxicity (or hazard) assessment provides the basis for assessing what is an acceptable or safe exposure to the COPCs and what level of exposure to the COPCs may adversely affect the health of receptors. For an inhalation assessment, this involves identification of the concentrations in air that people can be exposed to without experiencing adverse health effects. These values are called toxicity reference values (TRVs). For people, consideration is given to both non-carcinogenic and carcinogenic effects. These values are used as benchmarks for comparison with estimated concentrations of COPCs in air during risk characterization.

3) **Exposure Assessment**: The exposure assessment determines the amount of COPC to which receptors are exposed via each relevant exposure pathway identified in the problem formulation. For an inhalation assessment, exposure is expressed as estimated concentrations of COPCs in air. This permits the evaluation of exposure relative to the TRVs that are also expressed in this way.

4) **Risk Characterization:** The final component of a risk assessment determines the potential for adverse health effects or risks to occur. This is determined by comparing the estimated exposures received by the receptors (i.e., estimated concentrations of COPCs in air from the exposure assessment) with the level of exposure that is determined to be acceptable or safe (i.e., the TRVs from the toxicity assessment). The characterization of risks includes consideration of the uncertainty and conservatism in the risk assessment.

7.6A2.2 Approach

The HHRA provided herein evaluates the potential risks to human health from inhalation exposure to chemicals and from exposure to PM (i.e., DPM, PM_{10} and $PM_{2.5}$) that are emitted to air from the Project. The assessment evaluates chemicals emitted to air that may pose a health risk following short-term or acute exposure by people (e.g., 1-hour and 24-hour) and chemicals that may pose a health risk following long-term or chronic exposure by people (e.g., annual). Predicted air concentrations averaged over a 1-hour period and a 24-hour period were used to evaluate potential risks from acute exposure and predicted air concentrations averaged over an annual period were used to evaluate potential risks from chronic exposure.

Typically, in an assessment of potential risks from long-term or chronic exposure, consideration is given to both non-carcinogenic and carcinogenic effects in an HHRA. However, emissions to air from the Project are expected to only occur during the construction stage. The construction stage is expected to extend over approximately two years. People at a particular location would therefore only be expected to be exposed to COPCs emitted from the Project for a maximum of approximately two years. However, construction activities affecting air quality will be sequentially staggered and, therefore, will not take place concurrently at the same locations for the full duration of the construction stage. This duration is a small fraction of a person's expected lifespan and exposure to emissions for this brief period of time would be unlikely to appreciably affect the risk of developing cancer over a lifetime. Therefore, the HHRA considered only non-carcinogenic health effects in the assessment of chronic exposure.

The following cases were evaluated in the HHRA:

- The **"Base Case"** evaluates potential human health risks from measured ambient background air concentrations from existing environmental activities.
- The **"Project Case"** evaluates potential human health risks from predicted air concentrations associated with the construction of the Project.
- The "**Base + Project Case**" evaluates potential human health risks from measured ambient background air concentrations from existing environmental activities in addition to predicted air concentrations associated with the construction of the Project.

7.6A3.0 SITE CHARACTERIZATION

7.6A3.1 Regional Setting

The Project will be located in the Province of Ontario (Figure 1.1-1 of the Draft EA Report). Based on a preliminary corridor routing analysis, three corridors were identified:

- Preliminary proposed corridor extends from the settlement of Dinoric, near the City of Dryden, north to the Township of Pickle Lake.

- Corridor alternative around Mishkeegogamang originates 20 kilometres (km) west of the Township of Ignace and travels west around Mishkeegogamang First Nation before extending north to Pickle lake.
- Corridor alternative through Mishkeegogamang also originates 20 km west of the Township of Ignace, but travels east through Mishkeegogamang First Nation before extending north to Pickle Lake.

In this discussion, all three corridors are represented by "the Project", and all regional setting, existing environment and project environment information is applicable to all corridors unless otherwise stated.

The Project crosses a rugged and varied topography. The majority of the Project is located on Crown land. From south to north, the preliminary proposed corridor crosses the Dryden, Wabgigoon, English River and Lac Seul Forest Management Units. From south to north, the corridor alternatives traverse the Wabigoon, Easy English River and Caribou Forest Management Units. The Project is in two primary watersheds: Nelson River and Southwest Hudson Bay Drainage areas, and six tertiary watersheds: Wabigoon, Upper English, Central English– Lac Seul, Upper Albany-Cat, Otoskwin and Upper Ogoki (corridor alternatives only). The Project crosses provincial parks, areas of natural and scientific interest (ANSIs) and conservation reserves and more than 370 watercourses and waterbodies. Significant ecological areas, including designated old growth forests, significant woodlands and significant valleys are located in the parks and protected areas.

Recreational activities that occur in the region include camping, cultural, historical and nature viewing, hunting, trapping, fishing and berry picking. Hiking, cycling, use of off-road vehicles, cross-country skiing, snowmobiling, aquatic recreational activities (swimming, canoeing, kayaking and boating) and use of recreational properties also occurs in the region.

Seven Aboriginal communities with rights and interests in the Project are located in the region. Traditional activities that occur in the region include wildlife harvesting (hunting and trapping), traditional fish harvesting, traditional plant harvesting, and spiritual practices. Culturally important sites and areas such as canoe routes have also been identified in the region.

The study area for the HHRA uses the spatial boundaries identified in the air quality assessment (Section 5.3 of the Draft EA Report), specifically, the local study areas (LSAs). This is because the HHRA relies upon the predicted changes in air quality from the air quality assessment. The LSAs for air quality for the three corridors are defined by a 2-km-wide study corridor around the 40-m-wide transmission line right-of-way (ROW), a 1.5-km radius around the connection facility and transformer station footprint, a 500-metre (m) buffer around access roads and trails, a 500-m radius around the laydown area footprints, and a 500-m radius around the construction camps footprints. The LSAs for the HHRA are the same as those defined for air quality.

7.6A3.2 Existing Environment

The existing (or baseline or background) conditions of the environment must first be understood to determine the incremental changes in the environment due to chemical releases from the Project. A detailed description of the existing environment as it relates to air quality and which was relied upon in the HHRA is provided in Section 5.3 of the Draft EA Report. In brief, in Ontario, regional air quality is monitored through a network of air quality monitoring stations operated by the Ministry of the Environment and Climate Change (MOECC) and Environment and Climate Change Canada's (ECCC) National Air Pollution Surveillance Network (NAPS). The MOECC typically installs monitors in locations where air quality is an issue. Northern Ontario does not commonly have air quality issues as much of the landscape is natural and undisturbed. There are no active

monitoring stations within 100 km of the Project footprint, with the exception of two stations located in Experimental Lakes Area and Pickle Lake which only provide data on ozone concentrations. There are no man-made influences on air quality within the Project footprint. The nearest potential industrial emission source is the Musselwhite Mine, which is located approximately 150 km north of the Project. The only potential emission sources for the Project include naturally occurring sources and those from long range transport, however, the predominant west wind limits contributing emissions from Southern Ontario. For these reasons, it is assumed that background levels from the next closest stations located in Winnipeg and Thunder Bay are applicable for each of the corridors. These stations are located in much more urban environments than the Project, however, the Winnipeg Flood Pump station is located further away from major urban road intersections and was therefore selected as the most representative and used to characterize background air concentrations. This monitoring station is located on Flood Pump Street in Winnipeg, Ontario, approximately 300 km west of the nearest part of the Project footprint.

For this assessment, the data from 2000 to 2013 were used because complete datasets were available up until 2013, with only partial information available for 2014 and 2015. The 90th percentile of the 1-hour, 8-hour and 24-hour measurements were used to represent background air concentrations. The annual average concentration was used for annual background levels. Further discussion is provided in Section 5.3 of the Draft EA Report.

A summary of available background air concentrations used in the HHRA is provided in Table 7.6A-1. Background air concentrations provided were used to represent all three corridors.

Table 7.6A-1: Summary of Background Air Concentrations

Criteria Air Contaminant	Averaging Period	Background Concentration (µg/m³)
TSP	24-hour	44.70
	annual	22.73
PM_{10}	24-hour	22.35
$PM_{2.5}$	24-hour	11.17
	annual	5.68
NO_X (expressed as NO_2)	1-hour	31.98
	24-hour	26.58
	annual	12.70
SO_2	1-hour	2.62
	24-hour	2.62
	annual	0.75
CO	1-hour	572.73
	8-hour	687.27

Notes:

1-hour, 8-hour and 24-hour values are based on 90th percentile, while annual values are averaged over the five annual values available in the period. The 24-hour $PM_{2.5}$ is calculated according the requirements of the standard, which uses the three-year rolling average of the 98th percentile of the 24-hour observations.

Data are taken from the Winnipeg Station (Flood Pump), where data are available. Where data are not available, data were taken from the Winnipeg Station (65 Ellen Street).

TSP and PM_{10} concentrations are derived from $PM_{2.5}$ monitored data.

µg/m^3 = micrograms per cubic metre; TSP = total suspended particulate; PM_{10} = particulate matter less than 10 microns; $PM_{2.5}$ = particulate matter less than 2.5 microns; NO_x = nitrogen oxides, NO_2 = nitrogen dioxide; SO_2 = sulphur dioxide; CO = carbon monoxide.

7.6A3.3 Project Environment

The HHRA used predicted concentrations of chemicals in environmental media, as determined by other components of the EA, to determine potential human health risks associated with changes in environmental quality due to chemical releases from the Project. Specifically, the HHRA relied upon predicted air concentrations provided by the air quality discipline.

The development of the Project is planned to occur during two stages (Section 3.0 of the Draft EA Report):

- **Construction stage:** the period from the start of construction to the start of operation (approximately two years); and
- **Operation and maintenance stage:** encompasses operation and maintenance activities throughout the life of the Project, which is anticipated to be indefinite.

In the air quality assessment, the assessment of Project effects on air quality considered effects that occur during the construction stage as emissions are considered to be largest during this stage of the Project (Section 5.3 of the Draft EA Report). This timeframe was considered to be sufficient to capture the effects of the Project on air quality. Therefore, the HHRA considers the same timeframe (i.e., the construction stage) in the evaluation of potential human health risks from inhalation of chemicals emitted to air from the Project.

The details of the air quality modelling are provided in Section 5.3 of the Draft EA Report. In brief, the air quality assessment identified that Project activities during the construction stage of the Project, such as land clearing and material handling, vehicular emissions, fugitive dust from vehicles travelling on unpaved roads, concrete batching and power generation, could result in changes in ambient concentrations of criteria air contaminants (CACs) (i.e., NO_x, CO, SO_2, TSP [total suspended particulate], PM_{10}, $PM_{2.5}$) and fugitive dust emissions. Taking into consideration impact management measures and using a number of conservative assumptions, air concentrations over a representative approximately 5 km stretch of Project construction were predicted at approximately 100 m intervals from the transmission line ROW to the outer boundary of the LSAs (to a distance of approximately 1.5 km on either side of the ROW) using a screening dispersion model. Air concentrations were predicted based on a 1-hour averaging period, 24-hour averaging period and annual averaging period. The predicted air concentrations represent maximum air concentrations and are provided in Annex A, Table 1 (predicted 1-hour air concentrations), Table 2 (predicted 24-hour air concentrations) and Table 3 (predicted annual air concentrations). The predictions generated apply to all three corridors.

7.6A4.0 PROBLEM FORMULATION

As described in Section 7.6A2.0, the problem formulation identifies the following:

- a representative set of receptors (i.e., people) that may be present near the Project;
- the pathways by which receptors may be exposed to chemicals released by the Project (e.g., inhalation of ambient air by people); and
- the chemicals released by the Project that may be present at levels harmful to receptors (i.e., COPCs).

The information from the problem formulation is summarized in a CSM, which illustrates the pathways of the COPCs from their sources, through the relevant environmental media to the identified receptors.

7.6A4.1 Human Health Receptors

Human health receptors may include people living in (e.g., residents), working in or visiting (e.g., recreational users) the area that may be exposed to COPCs within the human health LSA. These receptors include people of all ages, including people at sensitive life stages such as infants, children and the elderly. Therefore, it was assumed that people may reside in the human health LSA and a resident was selected as a human health receptor.

Workers were not identified as human health receptors because it is assumed that worker health will be protected through compliance with appropriate workplace practices following requirements defined in the Ontario *Occupational Health and Safety Act* and other applicable regulatory instruments.

No other human health receptors of concern were identified.

7.6A4.2 Exposure Pathways

Exposure pathways are the means by which receptors come into contact with COPCs. In order for an exposure pathway to exist, a contaminant source, a release mechanism, transport media and a receptor must be present. Incomplete and/or negligible pathways were not evaluated in the HHRA. Rationale for inclusion or exclusion of potential pathways in the HHRA is provided in Table 7.6A-2.

Table 7.6A-2: Potential Exposure Pathways and Rationale for Inclusion/Exclusion in the Human Health Risk Assessment

Exposure Pathway	Evaluated in HHRA	Rationale
Inhalation of air	Yes	People may be exposed to airborne chemicals released to air during the construction stage of the Project.
Inhalation of dust	No	Airborne chemicals may deposit to soil and people may inhale soil dust particulates; however, emissions from the Project are anticipated to be minimal due to their short duration and intermittent frequency. As a result, the assessment focussed on concentrations of chemicals and fugitive dust in air.
Ingestion of groundwater as drinking water	No	Effects to groundwater quality as a result of the Project are expected to be negligible (Section 5.2 of the Draft EA Report); therefore, ingestion of groundwater as drinking water by people was not evaluated in the HHRA.
Ingestion of surface water	No	Effects to surface water quality as a result of the Project are expected to be negligible (Section 5.1 of the Draft EA Report); therefore, ingestion of surface water (incidentally or as drinking water) by people was not evaluated in the HHRA.
Dermal contact with surface water	No	If people swim or bathe in potentially affected waterbodies or watercourses, they would not receive exposures through this corridor alternatives relative to water ingestion. In addition, effects to surface water quality as a result of the Project are expected to be negligible (Section 5.1 of the Draft EA Report).
Ingestion of fish	No	Effects to surface water quality as a result of the Project are expected to be negligible (Section 5.1 of the Draft EA Report). Therefore, effects to fish tissue quality are also expected to be negligible.

Table 7.6A-2: Potential Exposure Pathways and Rationale for Inclusion/Exclusion in the Human Health Risk Assessment

Exposure Pathway	Evaluated in HHRA	Rationale
Ingestion of soil	No	Airborne chemicals may deposit to soil and people may incidentally ingest soil; however, emissions from the Project are anticipated to be minimal due to their short duration and intermittent frequency. As a result, the assessment focussed on concentrations of chemicals and fugitive dust in air.
Dermal contact with soil	No	Airborne chemicals may deposit to soil and people may come into dermal contact with the soils; however emissions from the Project are anticipated to be minimal due to their short duration and intermittent frequency. As a result, the assessment focussed on concentrations of chemicals and fugitive dust in air.
Ingestion of plants	No	People may consume plants (traditional plants and garden produce) that have received airborne deposition or that have taken up chemicals deposited to the soil from the air; however, emissions from the Project are anticipated to be minimal due to their short duration and intermittent frequency. As a result, the assessment focussed on concentrations of chemicals and fugitive dust in air.
Ingestion of animals	No	People may consume animals harvested from areas near the Project; however, emissions from the Project are anticipated to be minimal due to their short duration and intermittent frequency. As a result, the assessment focussed on concentrations of chemicals and fugitive dust in air.

Note: HHRA = human health risk assessment.

Based on the rationale provided in Table 7.6A-2, inhalation of COPCs in air emitted during the construction stage of the Project was identified as the only complete pathway of exposure to human receptors and was evaluated in the HHRA.

7.6A4.3 Chemicals of Potential Concern

Chemicals of potential concern are identified as those chemicals released by the Project that have the potential to be harmful to people. Emissions from construction are primarily comprised of fugitive dust and tailpipe emissions from the movement and operation of construction equipment and vehicles (see Section 5.3 of the Draft EA Report). Based on this, the air quality assessment identified CACs and fugitive dust as the types of chemicals that would likely be emitted to air during Project construction. Diesel particulate matter (DPM), which is a potential human health concern, may also be emitted to air during Project construction given the use of diesel in construction equipment and vehicles. The following chemicals were considered further in the HHRA:

- CACs (SO_2, CO, NO_x [as NO_2], TSP, PM_{10}, $PM_{2.5}$); and
- DPM.

7.6A4.3.1 Chemical Screening Process

The list of chemicals that would likely be emitted to air during Project construction was used to identify COPCs in air for the HHRA using a chemical screening process. Maximum predicted 1-hour, 24-hour and annual air concentrations were compared to corresponding 1-hour, 24-hour and annual air quality thresholds selected from various regulatory agencies (details on the selection of air quality thresholds, including the regulatory agencies that were consulted, are provided in Section 7.6A4.3.2). The following approach was used to identify COPCs in air:

- Chemicals with predicted concentrations below thresholds were not identified as COPCs. Comparison to air quality thresholds was considered to represent a conservative evaluation of the potential for the predicted concentrations to elicit adverse effects. Therefore, COPCs with concentrations less than thresholds were considered to pose negligible risk to human health and were not identified as COPCs for the HHRA.
- If the predicted concentration was greater than the threshold, the chemical was identified as a COPC and carried forward in the HHRA.
- Chemicals without thresholds were discussed further.

7.6A4.3.2 Selection of Air Quality Thresholds

Available air quality thresholds from the following regulatory agencies were compiled and reviewed:

- Canadian Council of Ministers of the Environment (CCME 1999, 2000, 2013a);
- Ontario Ministry of the Environment (MOE 2012);
- World Health Organization (WHO 2000, 2005);
- California Office of Environmental Health Hazard Assessment (California Environmental Protection Agency [CalEPA] 2016);
- Agency for Toxic Substances and Disease Registry (ATSDR 2016); and
- Texas Commission on Environmental Quality (TCEQ 2016).

Each of these agencies has derived air quality thresholds based upon a prescribed level of protection. Most often, these air quality thresholds are presented as air concentrations at and below which health (or other effects such as odour) are not expect to occur and may incorporate additional safety factors. Therefore, a predicted air concentration that is greater than its threshold indicates that a health effect is possible but not certain. Further assessment is required to determine the likelihood of that health effect occurring.

The air quality thresholds have been derived by each regulatory agency to achieve a target risk level that is considered to be protective of human health. The regulatory agencies set their target risk level based on science policy decisions on what is an acceptable risk to human health. In setting target risk levels for acute exposures, regulatory agencies consider non-carcinogenic and irritant health effects of chemicals, with the target risk level being defined as a hazard quotient (HQ). In setting target risk levels from chronic exposures, regulatory agencies consider both carcinogenic and non-carcinogenic effects of chemicals, with the target risk level for carcinogens being defined by an incremental lifetime cancer risk level (ILCR). Air quality thresholds can be converted to a different target risk level by using a ratio of the threshold and the target risk and determining what threshold would generate the desired risk level.

The air quality thresholds for non-carcinogens were converted to a target HQ of one for all chemicals, where required. A target HQ of one is considered to be protective for chemicals that are only expected to be present in air. Target HQs less than one can be used where exposure to chemicals is expected to occur via multiple exposure pathways. The health effects upon which the selected air quality thresholds are based have considered exposures only through inhalation. As noted in Section 7.6A2.2, only non-carcinogenic health effects are considered relevant in the HHRA. Therefore, air quality thresholds based on carcinogenic effects were not identified.

The lowest (i.e., most conservative) of the available thresholds for each of the 1-hour, 24-hour and annual averaging periods were selected as the air quality thresholds.

The available and selected 1-hour, 24-hour and annual air quality thresholds are presented in Annex B, Tables 1, 2 and 3, respectively. The toxicological endpoints (e.g., cardiovascular disease, respiratory effects) and a summary of the supporting technical rationale for the thresholds (if available) are also included in the tables. Air quality thresholds for an 8-hour averaging time have been developed for CO by the CCME (1999), MOE (2012) and WHO (2000). An 8-hour averaging time is considered an acute exposure time and these values have been included in Annex B, Table 1 for the 1-hour averaging time.

7.6A4.3.3 Chemical Screening Results

The detailed screening of predicted maximum 1-hour, 24-hour and annual air concentrations against selected air thresholds is provided in Annex A, Tables 1, 2 and 3, respectively. The results of the chemical screening are summarized in Table 7.6A-3, specifically the identified COPCs, corresponding averaging periods and the modelled locations for which exceedances of the selected air thresholds were found.

Table 7.6A-3: Chemicals of Potential Concern

COPC	Averaging Period	Modelled Location(s) With Exceedance(s)
NO_x (as NO_2)	1-hour	Approximately 100 and 200 m from transmission line ROW
PM_{10}	24-hour	Approximately 100 m from transmission line ROW
DPM	Annual	Approximately 100, 200, 300 and 400 m from transmission line ROW

Notes: COPC = chemical of potential concern; NO_x = nitrogen oxides; NO_2 = nitrogen dioxide; DPM = diesel particulate matter; PM_{10} = particulate matter less than 10 microns; ROW = right-of-way; m = metres.

There are no 1-hour air quality thresholds available for CO, NO_x, TSP, PM_{10} or $PM_{2.5}$. These are discussed further below:

- Nitrogen oxides are the sum of NO_2 and nitric oxide (NO). Emissions of NO_x consist mainly of NO, with some NO_2. In ambient air, NO converts to NO_2 (MOE 2012). Nitrogen dioxide has adverse health effects at much lower concentrations than NO (MOE 2012). Therefore, the 1-hour air quality threshold for NO_2 was adopted as the threshold for NO_x.
- While no 1-hour air quality thresholds are available for TSP, PM_{10} and $PM_{2.5}$, there are 24-hour and/or annual air quality thresholds available for these substances. Therefore, TSP, PM_{10} and $PM_{2.5}$ were screened for the 24-hour and annual averaging periods only.

- For the 1-hour averaging period, the selected air quality threshold for screening for CO was based on an 8-hour averaging time (discussed further below). Therefore, the predicted air concentrations for CO were converted from a 1-hour to 8-hour averaging time using the equation below (which is reproduced from MOE 2009), before comparison with the air quality threshold for CO.

$$C_1 = C_0 \times \left(\frac{t_0}{t_1}\right)^n$$

Where:

- C_0 = concentration at the averaging period t_0 (μg/m³);
- C_1 = concentration at the averaging period t_1 (μg/m³);
- t_0 = the shorter of:
  - The averaging period that the approved dispersion model was designed to be used for (hours); and,
  - The specified averaging period (h).
- t_1 = the longer of:
  - The averaging period that the approved dispersion model was designed to be used for (hours); and,
  - The specified averaging period (h).
- n = 0.28, the default stability dependent exponent (MOE 2009).

There are no 24-hour air quality thresholds available for CO, NO_x and DPM. These are discussed further below:

- The 24-hour air quality threshold for NO_2 was adopted as the threshold for NO_x based on the rationale provided previously for the 1-hour air quality threshold.
- CO was screened based on an 8-hour averaging period only.
- For DPM, an air quality threshold was available for the annual averaging period; therefore, this chemical was screened with respect to this averaging period only.

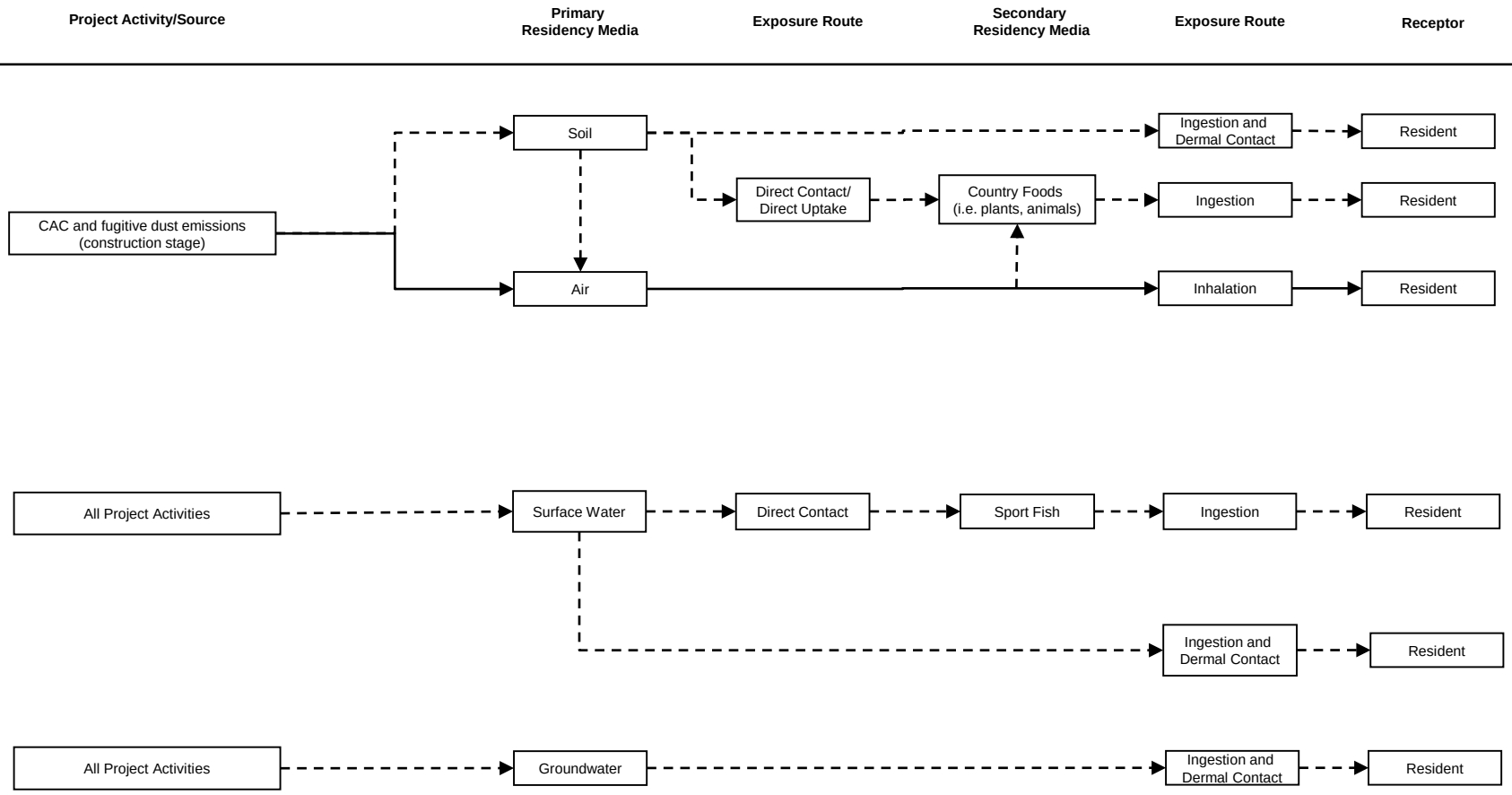
There are no annual air quality thresholds available for NO_x and CO. As discussed previously for the 1-hour and 24-hour averaging periods, CO was screened based on an 8-hour averaging period only and the air quality threshold for NO_2 was adopted for NO_x.

7.6A4.3.4 Conceptual Site Model

A CSM was developed for human health to summarize the results of the problem formulation. The CSM considers the parameters that occur on the Site at concentrations above air quality thresholds (i.e., COPCs), the environmental media in which the exceedances occur (e.g., air), people that may use the air quality study area, how these people may use the air quality study area and how people using the air quality study area may come in contact with the COPCs. The CSM for human health is provided on Figure 7.6A-2.

Conceptual Site Model for the Phase 1 New Transmission Line to Pickle Lake Project – Human Health

FIGURE 7.6A-2



NOTES

Solid lines indicate pathways that were considered to be complete and were evaluated in the human health risk assessment.

Dashed lines indicate pathways that were considered to be incomplete and were not evaluated in the human health risk assessment.

CAC = criteria air contaminant.

Date: October 2017	Golder Associates	CAD: TMG
Project: 1535751		CKD:

7.6A5.0 TOXICITY ASSESSMENT

The toxicity (or hazard) assessment component of the HHRA involves the classification of the potential harmful effects of COPCs and the estimation of the amounts of COPCs that can be tolerated by human receptors without resulting in adverse health effects (TRVs). It provides a basis for the interpretation of exposure estimates from the exposure assessment (Section 7.6A6.0).

7.6A5.1 Chemical Classification

Chemicals are quantitatively evaluated in a risk assessment based on their ability to cause cancer or non-cancer health effects. Chemicals that are considered to cause health effects other than cancer (i.e., non-cancer health effects) are considered to be threshold chemicals; that is, there is an acceptable health-based limit or threshold below which exposure to the chemical does not cause adverse health effects. Chemicals that are considered to be cancer causing are considered non-threshold chemicals; that is, there is no acceptable health-based limit or threshold below which exposure to the chemical does not cause adverse health effects. Any level of exposure to carcinogens is assumed to theoretically pose a potential for adverse health effects. Therefore, regulatory agencies classify chemicals based on their mode of action as threshold or non-threshold chemicals.

Typically in an assessment of long-term or chronic exposure, consideration is given to both non-carcinogenic and carcinogenic effects in an HHRA; however, as described in Section 7.6A2.2, emissions to air from the Project are expected to only occur during the construction stage of the Project. The construction stage is expected to extend over approximately two years. People at a particular location would therefore only be expected to be exposed to emissions from the Project for approximately two years. However, construction activities affecting air quality will be sequentially staggered and, therefore, will not take place concurrently at the same locations for the full duration of the construction stage. This duration is a small fraction of a person's expected lifespan and exposure to emissions for this brief period of time would be unlikely to appreciably affect the risk of developing cancer over a lifetime; therefore, the HHRA considered only non-carcinogenic health effects in the assessment of chronic exposure.

7.6A5.2 Dose-Response Assessment

For NO_x (as NO_2), the one-hour air quality threshold identified in Section 7.6A4.3.2 was used as the TRV for comparison with the predicted 1-hour concentration in the assessment of potential risks from acute exposure to this COPC.

For PM_{10}, the WHO guideline was used as the TRV for comparison with the predicted 24-hour concentration in the assessment of potential risks from acute exposure to this COPC. The WHO guideline for PM_{10} (50 µg/m^3) is based on the WHO $PM_{2.5}$ guideline of 25 µg/m^3, and an assumed $PM_{10}/PM_{2.5}$ ratio of 2. The WHO recommends that the guideline is adjusted based on the site-specific $PM_{10}/PM_{2.5}$ ratio which better reflects local conditions. For the 24-hour averaging period, the average $PM_{10}/PM_{2.5}$ ratio for all modelled locations was 2.5. Therefore, the WHO guideline was adjusted by the site-specific ratio, yielding a guideline of 63 µg/m^3. The WHO guideline was selected as the TRV for the 24-hour averaging period for the following reasons:

a) it is based upon long-term health effects of $PM_{2.5}$, which has been more reliably associated with health effects than PM_{10} (Health Canada and Environment Canada 1999);

b) it incorporates site-specific data in terms of the $PM_{10}/PM_{2.5}$ ratio; and

c) it serves as better comparison for the predicted PM_{10} concentrations at the modelled locations.

In the assessment of potential risks from chronic exposure to DPM, available TRVs for DPM were compiled from the following agencies:

- MOE (Ontario Ministry of the Environment) (2011, 2012);
- Health Canada (2010);
- US EPA's IRIS (United States Environmental Protection Agency's Integrated Risk Information System) Database (2016);
- CalEPA (2016);
- Agency for Toxic Substances and Disease Registry (ATSDR 2016);
- Netherlands National Institute of Public Health and the Environment (RIVM 2001); and
- WHO (2000, 2005).

The most conservative (i.e., lowest) of the available TRVs was selected for the assessment.

The selected TRVs for the acute and chronic assessments, including critical effects and the sources from which the TRVs were obtained are summarized in Table 7.6A-4. Details on the selected TRVs for the 1-hour and 24-hour averaging periods are provided in Annex B, Tables 1 and 2. Details on the selected TRV for the annual averaging period ise provided in Annex C, Table 1.

Table 7.6A-4: Toxicity Reference Values and Critical Effects

COPC	Averaging Period	TRV (µg/m^3)	Critical Effect(s)	Source
NO_x (as NO_2)	1-hour	190	Health	TCEQ 2016
PM_{10}	24-hour	63	Health and Environment	WHO 2005
DPM	Annual	5	Pulmonary inflammation and histopathology	US EPA 2016

Notes:

COPC = chemical of potential concern; µg/m^3 = micrograms per cubic metre; NO_x = nitrogen oxides; NO_2 = nitrogen dioxide; DPM = diesel particulate matter; PM_{10} = particulate matter less than 10 microns; TRV = toxicity reference value.

7.6A6.0 EXPOSURE ASSESSMENT

The exposure assessment estimates the amount of COPC to which each human health receptor is exposed via inhalation of COPCs in air. For the Base Case, the exposure estimates for the identified COPCs are the background air concentrations identified in Section 7.6A3.2.

The predicted maximum 1-hour, 24-hour and annual air concentrations were used as the concentrations to which human receptors would be exposed via inhalation during the construction stage of the Project (i.e., for the Project Case). The predicted concentrations for the identified COPCs at all modelled locations are provided in Annex A, Tables, 1, 2 and 3. The maximum predicted concentrations of all modelled locations with exceedances of the air quality thresholds were used as the exposure estimates.

The sums of the exposure estimates for the Base Case and the Project Case were used as the exposure estimates for the Base + Project Case. The exposure estimates used in the HHRA are summarized in Table 7.6A-5.

Table 7.6A-5: Exposure Estimates

COPC	Averaging Period	Exposure Estimate ($\mu g/m^3$)		
		Base Case	Project Case[(a)]	Base + Project Case
NO_x (as NO_2)	1-hour	31.98	326	358
PM_{10}	24-hour	22.35	26	48
DPM	Annual	0.0	1.4	1.4

Notes: COPC = chemical of potential concern; $\mu g/m^3$ = micrograms per cubic metre; NO_x = nitrogen oxides; NO_2 = nitrogen dioxide; DPM = diesel particulate matter; PM_{10} = particulate matter less than 10 microns.

a) Maximum predicted concentration from all receptor locations with exceedances.

7.6A7.0 RISK CHARACTERIZATION

Risk characterization determines the potential for risks or adverse health effects to occur. This is assessed by comparing the estimated exposures (from the exposure assessment) with those exposures that are determined to be acceptable or safe (from the toxicity assessment). The characterization of risks includes consideration of the uncertainty and conservatism in the HHRA.

Potential risks to people were characterized using an HQ approach. The HQ is the ratio of the exposure likely to be incurred by people and the amount of exposure that is considered to be safe (i.e., the TRV). An HQ of less than one indicates the level of exposure likely to be incurred by people is less than the level of exposure shown to adversely affect the health of people. An HQ of greater than one indicates that the level of exposure likely to be incurred by people may exceed the level of exposure where adverse effects on people may occur. That is, HQs of less than one indicate that risks to people are not expected and HQs of greater than one indicate the potential for risks to people. Chemicals of potential concern with HQs greater than one are evaluated further through review of the uncertainty and conservatism in the assessment.

7.6A7.1 Risk Estimates

The calculated HQs for COPCs for the Base, Project and Base + Project cases are provided in Table 7.6A-6.

Table 7.6A-6: Hazard Quotients

COPC	Averaging Period	Hazard Quotient		
		Base Case[(a)]	Project Case	Base + Project Case
NO_x (as NO_2)	1-hour	0.17	**1.7**	**1.9**
PM_{10}	24-hour	0.35	0.41	0.77
DPM	Annual	n/a	0.28	0.28

Notes: **Bolded** and shaded cells indicate an exceedance of the target HQ of one.

a) Background air concentrations were not available for DPM; therefore, an HQ was not calculated for the Base Case for this COPC.

COPC = chemical of potential concern; n/a = not applicable; NOx = nitrogen oxides; NO2 = nitrogen dioxide; DPM = diesel particulate matter; PM_{10} = particulate matter less than 10 microns; HQ = hazard quotient.

The calculated HQs for the Base Case were below the target HQ of one for all COPCs. The calculated HQs for the Project and Base + Project cases were also below the target HQ for PM_{10} and DPM. The calculated HQs for NO_x (as NO_2) for the 1-hour averaging period for the Project Case and Base + Project Case were greater than the target HQ of one, indicating the potential for risks to people from acute or short-term exposure to this COPC.

The HQs for NO_x (as NO_2) were calculated based on the maximum predicted concentration of all modelled locations with exceedances of the air quality threshold. The maximum predicted concentration occurred at a modelled location of 100 m from the transmission line alignment ROW. Exceedances of the air quality threshold for NO_x (as NO_2) also occurred at 200 m from the transmission line alignment ROW (Table 7.6A-3). The calculated HQs at this distance also exceeded the target HQ of one (HQ = 1.1 for the Project Case; HQ = 1.3 for the Base + Project Case). The exceedances of the target HQ of 1 at 100 and 200 m from the transmission line ROW were examined further with respect to potential human health receptors within this distance of the transmission line ROW for each of the three corridors.

For all three corridors, the Central Patricia residential area overlaps with the Project footprint. The closest potential human health receptor in the Central Patricia residential area is a church rectory located at 175 m from the transmission line alignment ROW. For the corridor alternative around Mishkeegogamang and corridor alternative through Mishkeegogamang, the Silver Dollar residential area is within 152 m of the Project footprint. The Mishkeegogamang First Nation Reserve is located approximately 100 m from the transmission line alignment ROW. This indicates the potential for risks to people in these residential areas from acute or short-term exposure to NO_x (as NO_2). However, as indicated in Section 5.3.6 of the Draft EA Report, once the preferred corridor is selected, potential sensitive human receptors within the Project footprint will be confirmed and avoided through detailed design, if required. Potential receptors located outside of the Project footprint, but within 100 m of the Project footprint will be verified with respect to their presence and use. Any confirmed receptors determined to be of use outside of, but within 100 m of the Project footprint will be avoided as a receptor as part of the Project detailed design. The presence of actively used specific receptors (e.g., residences) within 100 m of the Project footprint is not known at this time.

7.6A7.2 Uncertainty Assessment

The assessment of potential human health risks followed the risk assessment framework which involves four sequential components. There are uncertainties that are inherent to each component of the framework. These uncertainties influence the final assessment of potential human health risk. Where uncertainties exist, a conservative approach was taken such that the assessment likely overestimates the potential risks to human health. Uncertainties related to the HHRA and the potential implications that these uncertainties may have on the interpretation of risks are discussed in Table 7.6A-7.

Table 7.6A-7: Uncertainties in the Human Health Risk Assessment

Source of Uncertainty	Direction
Human health TRVs are generally based on the most sensitive endpoints, with the application of uncertainty factors to protect sensitive subpopulations. The uncertainty associated with TRVs is highly dependent on the number of studies available and whether the key study was based on humans (low uncertainty) or small mammals (high uncertainty). When few studies are available and the studies available are conducted using animals as test organisms, several types of uncertainty factors are applied to account for this uncertainty (e.g., factors for inter- and intra-species sensitivity). As such, use of the TRVs may overestimate toxicity and risk.	May overestimate risk
The TCEQ short-term effects screening level (ESL) was selected as the 1-hour air quality threshold and TRV for NO_2 (190 µg/m^3) for the assessment of potential acute health effects in the HHRA. The TCEQ short-term ESL was adopted from the US NAAQS for NO_2. This value was selected because it was the lowest (i.e., most stringent) of the available thresholds/TRVs. However, the CCME and Ontario MOECC, the relevant federal and provincial jurisdictions for the Project, provide an NAAQO and AAQC of 400 µg/m^3 (desirable level) and 400 µg/m^3, respectively. The maximum predicted 1-hour air concentration of NO_x (as NO_2; 326 µg/m^3) is less than the provincial and federal thresholds/TRVs. As such, use of the TCEQ ESL may overestimate risk from NO_2.	May overestimate risk
Most toxicity studies used to derive TRVs are conducted on single chemicals but exposures are rarely limited to single chemicals. Exposures are generally to more than one chemical (i.e., chemical mixtures). Chemicals in a mixture may interact in four general ways to cause a response in a receptor: i) **non-interacting –** chemicals in the mixture do not produce a response in combination with each other. The toxicity of the mixture is the same as the toxicity of the most toxic chemical in the mixture; ii) **additive –** chemicals in the mixture have similar targets and modes of action but do not interact. The toxicity of the mixture is simply the sum of toxicity for the individual chemicals; iii) **synergistic –** there is a positive interaction among the chemicals in the mixture such that the response is greater than would be expected if the chemicals acted independently or in an additive manner; and, iv) **antagonistic –** there is a negative interaction among the chemicals in the mixture such that the response is less than would be expected if the chemicals acted independently or in an additive manner.	May under- or overestimate risk
Exposures to people were determined based on predicted maximum concentrations of COPCs in air. Statistics on the predictions (e.g., 98th, 95th or 75th percentiles of the predicted concentrations), which would provide a reasonable maximum estimate of exposures taking into account the variability in concentrations for a project, would result in lower exposures to human health receptors.	May overestimate risk
The exposure assessment relies on predicted air concentrations provided by the air quality discipline. A number of conservative assumptions were used in the air quality modelling such that predicted concentrations have likely been overestimated. For a summary of the conservative assumptions used in the air quality modelling, refer to Section 5.3 of the Draft EA Report.	May overestimate risk

AAQC = Ambient Air Quality Criteria; CCME = Canadian Council of Ministers of Environment; COPC = contaminant of potential concern; EA = environmental assessment; ESL = effects screening level; HHRA = human health risk assessment; HQ = hazard quotient; LSA = local study area; MOECC = Ministry of the Environment and Climate Change; NAAQO = National Ambient Air Quality Objective; NO_2 = nitrogen dioxide; NO_x = nitrogen oxides; TCEQ = Texas Commission on Environmental Quality; TRV = toxicity reference value; US NAAQS = United States National Ambient Air Quality Standard; µg/m^3 = micrograms per cubic metre.

7.6A8.0 CONCLUSIONS

During Project construction, potential health risks were identified from acute or short-term exposure to NO_x (as NO_2; 1-hour) when construction emissions were considered alone (i.e., Project Case) and in combination with existing conditions (i.e., ambient background air concentrations; Base + Project Case). For NO_x (as NO_2), HQs of 1.7 and 1.9 were calculated for the Project Case and Base + Project Case, respectively, based on the maximum predicted concentration of all modelled locations with exceedances of the air quality threshold (i.e., for 100 m from the transmission line alignment ROW). Exceedances of the air quality threshold for NO_x (as NO_2) also occurred at 200 m from the transmission line alignment ROW, and the calculated HQs at this distance also exceeded the target HQ of one (HQ = 1.1 for the Project Case; HQ = 1.3 for the Base + Project Case). These exceedances were examined further with respect to potential human health receptors within 200 m of the transmission line alignment ROW for each of the three corridors.

For all three corridors, the Central Patricia residential area overlaps with the Project footprint. The closest potential human health receptor in the Central Patricia residential area is a church rectory located at 175 m from the transmission line alignment ROW. For the corridor alternative around Mishkeegogamang and corridor alternative through Mishkeegogamang, the Silver Dollar residential area is within 152 m of the Project footprint. The Mishkeegogamang First Nation Reserve is located approximately 100 m from the transmission line ROW. This indicates the potential for risks to people in Central Patricia, Silver Dollar and Mishkeegogamang First Nation Reserve from acute or short-term exposure to NO_x (as NO_2). Although potential health risks from acute or short-term exposure to NO_x were identified in the HHRA, there is a low likelihood of any receptor being exposed when the following points are considered:

- Exposures and health risks to people were determined based on predicted maximum concentrations of NO_x in air. The maximum concentrations may occur anywhere along a representative 5 km segment of Project construction and are not necessarily representative of concentrations at a specific location (e.g., a residence or commercial/industrial building in the residential areas of Central Patricia and Silver Dollar and the Mishkeegogamang First Nation Reserve).
- A person must be present at the exact location and time that the predicted maximum concentration is occurring for there to be a potential for a health effect.
- As indicated in Section 5.3.6 of the Draft EA Report, once the preferred corridor is selected, potential sensitive human receptors within the Project footprint will be confirmed and avoided through detailed design, if required. Potential receptors located outside of the Project footprint, but within 100 m of the Project footprint will be verified with respect to their presence and use. Any confirmed receptors determined to be of use outside of, but within 100 m of the Project footprint will be avoided as a receptor as part of the Project detailed design.

Overall, given the uncertainties noted in Table 7.6A-7 and in the points listed above, potential health risks to people from emissions of chemicals to air during the construction stage of the Project for all three corridors are not expected.

7.6A9.0 MONITORING PROGRAMS

Monitoring programs are not recommended based on the results of the HHRA.

7.6A10.0 REFERENCES

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ANNEX A

Air Quality Predictions and Screening

Table 1: 1-Hour Air Quality Predictions and Screening

Chemical	Air Threshold	Distance from Transmission Line ROW (m)														
		100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500
SO_2	26.2	8.80E-01	5.64E-01	4.22E-01	3.43E-01	2.87E-01	2.46E-01	2.12E-01	1.93E-01	1.75E-01	1.58E-01	1.47E-01	1.37E-01	1.27E-01	1.18E-01	1.18E-01
CO [(a)]	6000	2.69E+02	1.78E+02	1.37E+02	1.11E+02	9.11E+01	7.88E+01	7.12E+01	6.52E+01	6.03E+01	5.61E+01	5.26E+01	4.94E+01	4.66E+01	4.66E+01	4.66E+01
NO_x (as NO_2)	190	**3.26E+02**	**2.09E+02**	1.56E+02	1.27E+02	1.06E+02	9.11E+01	7.86E+01	7.14E+01	6.47E+01	5.85E+01	5.45E+01	5.08E+01	4.69E+01	4.36E+01	4.36E+01
TSP	NV	2.05E+02	1.32E+02	9.84E+01	8.00E+01	6.68E+01	5.74E+01	4.95E+01	4.50E+01	4.07E+01	3.68E+01	3.43E+01	3.20E+01	2.95E+01	2.75E+01	2.75E+01
Diesel Particulate Matter	63	2.33E+01	1.49E+01	1.12E+01	9.07E+00	7.57E+00	6.50E+00	5.61E+00	5.10E+00	4.62E+00	4.17E+00	3.89E+00	3.63E+00	3.35E+00	3.11E+00	3.11E+00
PM_{10}	NV	7.71E+01	4.95E+01	3.70E+01	3.01E+01	2.51E+01	2.16E+01	1.86E+01	1.69E+01	1.53E+01	1.38E+01	1.29E+01	1.20E+01	1.11E+01	1.03E+01	1.03E+01
$PM_{2.5}$	NV	3.14E+01	2.01E+01	1.51E+01	1.22E+01	1.02E+01	8.78E+00	7.57E+00	6.88E+00	6.23E+00	5.63E+00	5.25E+00	4.89E+00	4.52E+00	4.20E+00	4.20E+00

1.30E+01 = greater than 1-hour air quality threshold and therefore retained as a COPC.

All air concentrations are in units of µg/m^3.

[(a)] The threshold is based on an 8-hour averaging time. The maximum 1-hour predictions were converted to 8-hour averaging times using the following equation: $C_1 = C_0 * (t_0/t_1)^{0.28}$ (MOE, 2009).

CO = carbon monoxide; COPC = contaminant of potential concern; m = metre; µg/m^3 = microgram per cubic metre; NOx = nitrogen oxides; NO_2 = nitrogen dioxide; NV = no value; $PM_{2.5}$ = particulate matter less than 2.5 microns; PM_{10} = particulate matter less than 10 microns; ROW = Right of Way; SO_2 = sulphur dioxide; TSP = total suspended particulates.

Table 2: 24-Hour Air Quality Predictions and Screening

Chemical	Air Threshold	Distance from Transmission Line ROW (m)														
		100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500
SO_2	125	3.02E-01	2.05E-01	1.55E-01	1.26E-01	1.06E-01	9.45E-02	8.53E-02	7.79E-02	7.18E-02	6.67E-02	6.23E-02	5.82E-02	5.45E-02	5.09E-02	4.77E-02
CO	NV	1.59E+02	1.08E+02	8.17E+01	6.63E+01	5.61E+01	4.98E+01	4.50E+01	4.11E+01	3.79E+01	3.52E+01	3.28E+01	3.07E+01	2.87E+01	2.68E+01	2.51E+01
NO_X (as NO_2)	200	1.12E+02	7.57E+01	5.74E+01	4.66E+01	3.94E+01	3.50E+01	3.16E+01	2.89E+01	2.66E+01	2.47E+01	2.31E+01	2.16E+01	2.02E+01	1.88E+01	1.77E+01
TSP	120	7.05E+01	4.77E+01	3.61E+01	2.93E+01	2.48E+01	2.20E+01	1.99E+01	1.82E+01	1.68E+01	1.56E+01	1.45E+01	1.36E+01	1.27E+01	1.19E+01	1.11E+01
Diesel Particulate Matter	NV	7.99E+00	5.41E+00	4.10E+00	3.32E+00	2.81E+00	2.50E+00	2.25E+00	2.06E+00	1.90E+00	1.76E+00	1.65E+00	1.54E+00	1.44E+00	1.35E+00	1.26E+00
PM_{10}	25	**2.65E+01**	1.79E+01	1.36E+01	1.10E+01	9.32E+00	8.28E+00	7.47E+00	6.83E+00	6.29E+00	5.85E+00	5.46E+00	5.10E+00	4.77E+00	4.46E+00	4.18E+00
$PM_{2.5}$	25	1.08E+01	7.30E+00	5.53E+00	4.49E+00	3.79E+00	3.37E+00	3.04E+00	2.78E+00	2.56E+00	2.38E+00	2.22E+00	2.08E+00	1.94E+00	1.82E+00	1.70E+00

1.30E+01 = greater than 24-hour air quality threshold, and therefore retained as a COPC.

All air concentrations are in units of µg/m^3.

CO = carbon monoxide; COPC = contaminant of potential concern; m = metre; µg/m^3 = microgram per cubic metre; m = metres; NOx = nitrogen oxides; NO_2 = nitrogen dioxide; NV = no value; $PM_{2.5}$ = particulate matter less than 2.5 microns; PM_{10} = particulate matter less than 10 microns; SO_2 = sulphur dioxide; TSP = total suspended particulates.

Table 3: Annual Air Quality Predictions and Screening

Chemical	Air Threshold	Distance from ROW (m)														
		100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500
SO_2	10	5.20E-02	3.44E-02	2.61E-02	2.12E-02	1.78E-02	1.54E-02	1.35E-02	1.21E-02	1.09E-02	9.92E-03	9.08E-03	8.37E-03	7.75E-03	7.20E-03	6.71E-03
CO	NV	2.74E+01	1.82E+01	1.38E+01	1.12E+01	9.40E+00	8.12E+00	7.14E+00	6.37E+00	5.75E+00	5.23E+00	4.79E+00	4.41E+00	4.09E+00	3.80E+00	3.54E+00
NO_X (as NO_2)	40	1.93E+01	1.28E+01	9.67E+00	7.84E+00	6.60E+00	5.70E+00	5.01E+00	4.47E+00	4.04E+00	3.67E+00	3.36E+00	3.10E+00	2.87E+00	2.67E+00	2.49E+00
TSP	60	1.21E+01	8.03E+00	6.09E+00	4.94E+00	4.16E+00	3.59E+00	3.16E+00	2.82E+00	2.54E+00	2.31E+00	2.12E+00	1.95E+00	1.81E+00	1.68E+00	1.57E+00
Diesel Particulate Matter	0.5	**1.37E+00**	**9.10E-01**	**6.90E-01**	**5.59E-01**	4.71E-01	4.07E-01	3.58E-01	3.19E-01	2.88E-01	2.62E-01	2.40E-01	2.21E-01	2.05E-01	1.90E-01	1.77E-01
PM_{10}	25	4.56E+00	3.02E+00	2.29E+00	1.85E+00	1.56E+00	1.35E+00	1.19E+00	1.06E+00	9.55E-01	8.69E-01	7.96E-01	7.33E-01	6.79E-01	6.31E-01	5.88E-01
$PM_{2.5}$	8.8	1.86E+00	1.23E+00	9.32E-01	7.55E-01	6.36E-01	5.49E-01	4.83E-01	4.31E-01	3.89E-01	3.54E-01	3.24E-01	2.99E-01	2.76E-01	2.57E-01	2.40E-01

1.30E+01 = greater than annual air quality threshold, and therefore retained as a COPC.

All air concentrations are in units of $\mu g/m^3$.

CO = carbon monoxide; COPC = contaminant of potential concern; m = metre; $\mu g/m^3$ = microgram per cubic metre; m = metres; NOx = nitrogen oxides; NO_2 = nitrogen dioxide; NV = no value; $PM_{2.5}$ = particulate matter less than 2.5 microns; PM_{10} = particulate matter less than 10 microns; SO_2 = sulphur dioxide; TSP = total suspended particulates.

ANNEX B

Air Quality Thresholds

Table 1: 1-Hour Air Quality Thresholds

Chemical	1-Hour Air Quality Thresholds [µg/m³]							Basis of Air Quality Threshold
	Canadian NAAQO[a]	ON MOE AAQC[b]	WHO AQG[c,d]	CalEPA REL[e]	ATSDR MRL[f]	TCEQ ESL[g]	TCEQ ESL[g] Adjusted	
Carbon monoxide	**6000**[i]	15700[i]	10000[i]	23000	NA	40100	NR	NAAQO - health and environment
								MOE - health
								WHO - effects other than cancer or odour/annoyance: The threshold was selected based on COHb levels. To protect non-smoking, middle-aged and elderly populations with documented or latent heart diseases, and fetuses of non-smoking pregnant women from untoward hypoxic effects, a COHb level of 2.5% should not be exceeded.
	15000[i]							CalEPA - The CalEPA threshold is based on effects of angina in people with known cardiovascular diseases that are exercising heavily.
								TCEQ - health, criteria pollutant, must meet US NAAQS for CO of 35 ppm.
Nitrogen dioxide	400	400	200	470	NA	**190**	NR	NAAQO - health and environment
								MOE - health. NO_x are defined to be the sum of NO_2 and NO. Emissions of NO_x consist mainly of NO, with some NO_2. In ambient air, NO converts to NO_2. NO_2 has adverse health effects at much lower concentrations than NO. Therefore the AAQC is based on the health effects of NO_2.
								WHO - The WHO threshold is based on an increase in bronchial responsiveness in asthmatics.
	1000							CalEPA - The CalEPA threshold is based on increased airway reactivity in asthmatics.
								TCEQ - health, criteria pollutant, must meet US NAAQS for NO_2 of 100 ppb.
Nitrogen oxides (NO_x)	NA	NA	NA	NA	NA	NA	NA	No 1 hour thresholds are available
Sulphur dioxide	183	690	500[h]	660	**26.2**	200	NR	NAAQO – The 2013 Canadian Ambient Air Quality Standard represents a balance between achieving the best health and environmental protection possible and the feasibility and costs of reducing pollutant emissions; a value of 70 ppb is effective in 2020 and a value of 65 ppb is effective in 2025. This value is applicable to the arithmetic average over a single calendar year of all 1-hour average concentrations.
								MOE - health & vegetation
								WHO - The WHO threshold is based on changes in pulmonary function and respiratory symptoms.
								CalEPA - The CalEPA threshold was based on an equivalent 1 h concentration of 0.25 ppm. This value was derived from a consensus value from several studies. An uncertainty factor of 1 was applied. This REL is the California AAQS.
	170							ATSDR - The MRL was based on a minimal LOAEL of 0.01 ppm for bronchoconstriction in exercising asthmatics. An uncertainty factor of 9 was applied.
								TCEQ - health, criteria pollutant, must meet US NAAQS for SO_2 of 75 ppb.
$PM_{2.5}$	NA	NA	NA	NA	NA	NA	NA	No 1 hour thresholds are available
PM_{10}	NA	NA	NA	NA	NA	NA	NA	No 1 hour thresholds are available
Diesel particulate matter	NA	NA	NA	NA	NA	19	**63**	TCEQ - PM_{10}, health
Total suspended particulate	NA	NA	NA	NA	NA	NA	NA	No 1 hour thresholds are available

Centre for Disease Control and Prevention. (2003). Conversion Calculator. The National Institute for Occupational Safety and Health Publication No. 2004-101. Internet Site, last updated October 2003, accessed 15 March 2017 from http://www.cdc.gov/niosh/docs/2004-101/calc.html.

Target hazard quotient = 1.0.

Selection criteria:

The lowest air threshold was selected as the threshold for screening in the HHRA.

200 = selected threshold for screening in the HHRA.

a) Canadian Council of Ministers of the Environment (CCME). (1999). Canadian Environmental Quality Guidelines. Canadian National Ambient Air Quality Objectives (NAAQO).

b) Ontario Ministry of the Environment (MOE). (2012). Ontario's Ambient Air Quality Criteria (AAQC). Standards Development Branch.The MOE AAQCs are based on health, odour, vegetation, soiling, visibility, corrosion or other effects. The MOE does not provide background information on how the AAQCs were derived on a chemical basis.

c) World Health Organization (WHO). (2000). Air Quality Guidelines (AQG) for Europe, 2nd Ed. World Health Organization Regional Publications, European Series, No. 91. Copenhagen.

d) World Health Organization. (2005). WHO Air Quality Guidelines for Particulate Matter, Ozone, Nitrogen Dioxide and Sulfur Dioxide. Global Update, Summary of Risk Assessment.

e) California Environmental Protection Agency (CalEPA). (2016). Acute, 8-Hour and Chronic Reference Exposure Levels (REL). Office of Environmental Health Hazard Assessment, Air Toxicology and Epidemiology. Internet Site, last updated June 2016, accessed 15 March 2017 from http://oehha.ca.gov/air/allrels.html.

f) Agency for Toxic Substances and Disease Registry (ATSDR). (2016). Minimal Risk Levels (MRL). Internet Site, last updated March 2016, accessed 15 March 2017 from http://www.atsdr.cdc.gov/mrls/mrllist.asp. The ATSDR defines acute exposure as 14 days or less.

g) Texas Commission on Environmental Quality (TCEQ). (2016). Effects Screening Levels. Internet Site, last updated November 2016, accessed 15 March 2017 from http://www.tceq.texas.gov/toxicology/esl. The TCEQ ESLs are based on health, odour/nuisance potential, and vegetation effects. The TCEQ ESLs are based on a hazard quotient = 0.3 for non-carcinogens and were therefore adjusted with the following equation: threshold (µg/m³) = TCEQ value x 3.333. The TCEQ does not provide background information on how the ESLs were derived for all chemicals. All ESLs are interim, unless otherwise stated.

h) 10 minutes.

i) 8 hour. Air concentrations given in ppm were converted to µg/m³ with the following equation: X (ppm) = Y (mg/m³)*(24.45/MW)*1000.

AAQS = ambient air quality standard; CO = carbon monoxide; COHb = carboxyhemoglobin; h = hour; LOAEL = lowest observed adverse effect level; µg/m3 = microgram per cubic metre; MRL = minimal risk level; NO = nitric oxide; NO_2 = nitrogen dioxide; NOx = nitrogen oxides; NA = not available; NR = not required; $PM_{2.5}$ = particulate matter less than 2.5 microns; PM_{10} = particulate matter less than 10 microns; ppm = parts per million; ppb = parts per billion; SO2 = sulphur dioxide; US NAAQS = United States National Ambient Air Quality Standards.

Table 2: 24-Hour Air Quality Thresholds

Chemical	24-Hour Air Quality Thresholds [µg/m³]						Basis of Air Quality Threshold
	Canadian NAAQO[a]	ON MOE AAQC[b]	WHO AQG[c,d]	CalEPA REL[e]	ATSDR MRL[f]	TCEQ ESL[g] Adjusted	
Carbon monoxide	NA	NA	NA	NA	NA	NA	No 24-hour thresholds were available.
Nitrogen dioxide	**200**	200	NA	NA	NA	NA	NAAQO – health and environment
	300						MOE – health. NO_x are defined to be the sum of NO_2 and NO. Emissions of NO_x consist mainly of NO, with some NO_2. In ambient air, NO converts to NO_2. NO_2 has adverse health effects at much lower concentrations than NO. Therefore the AAQC is based on the health effects of NO_2.
Nitrogen oxides (NO_x)	NA	NA	NA	NA	NA	NA	No 24-hour thresholds were available.
Sulphur dioxide	150	275	**125**	NA	NA	NA	NAAQO – health and environment
	300						MOE – health & vegetation
							WHO – effects other than cancer or odour/annoyance: The WHO threshold is based on exacerbation of symptoms among panels of selected sensitive patients at 250 µg/m³. An uncertainty factor of 2 was applied.
$PM_{2.5}$	27	30	**25**	NA	NA	NA	NAAQO – The 2013 Canadian Ambient Air Quality Standard represents a balance between achieving the best health and environmental protection possible and the feasibility and costs of reducing pollutant emissions; a value of 28 µg/m³ is effective in 2015 and a value of 27 µg/m³ is effective in 2020. These values are applicable to the 3-year average of the annual 98th percentile of the daily 24-hour average concentrations.
							MOE – The MOE value is not technically an AAQC, but is the CWS for $PM_{2.5}$. The CWS is a long-term goal of minimizing risk that fine PM poses on human health and the environment. The MOE recommends that contribution of $PM_{2.5}$ from a single facility be less than 25 µg/m³ (24 h) to achieve the CWS target.
							WHO – The WHO AQG is based on a $PM_{2.5}$:PM_{10} ratio of 0.5. Therefore, the AQG reflects the relationship between the distributions of 24-h means (and its 99th percentile) and annual average concentrations.
PM_{10}	**25**	50	50 (63)	NA	NA	NA	NAAQO – a reference level above which there are demonstrated effects on human health and/or the environment; guideline established in 1998.
							MOE – interim AAQC, provided for decision making.
							WHO – Based on the $PM_{2.5}$ guideline and an assumed $PM_{10}/PM_{2.5}$ ratio of 2. It is recommended that a different value for this ratio, which better reflects local conditions, be employed when setting local guidelines. For the 24-hour averaging period, the average $PM_{10}/PM_{2.5}$ ratio for the Project is 2.5. The PM_{10} guideline was adjusted by this Project-specific ratio and is shown in parentheses.
Diesel particulate matter	NA	NA	NA	NA	NA	NA	No 24-hour thresholds were available.
Total suspended particulate	**120**	120	NA	NA	NA	NA	NAAQO – health and environment
	400						MOE – visibility

Air concentrations given in ppm were converted to µg/m³ with the following equation: X (ppm) = Y (mg/m³)*24.45/MW.

Centre for Disease Control and Prevention. (2003). Conversion Calculator. The National Institute for Occupational Safety and Health Publication No. 2004-101. Internet Site, last updated October 2003, accessed 15 March 2017 from http://www.cdc.gov/niosh/docs/2004-101/calc.html.

Target hazard quotient = 1.0.

Selection criteria:

The lowest air threshold was selected as the threshold for screening in the HHRA.

200 = selected threshold for screening in the HHRA.

a) Canadian Council of Ministers of the Environment (CCME). (1999). Canadian Environmental Quality Guidelines. Canadian National Ambient Air Quality Objectives (NAAQO).

b) Ontario Ministry of the Environment (MOE). (2012). Ontario's Ambient Air Quality Criteria (AAQC). Standards Development Branch. The MOE AAQCs are based on health, odour, vegetation, soiling, visibility, corrosion or other effects. The MOE does not provide background information on how the AAQCs were derived on a chemical to chemical basis.

c) World Health Organization (WHO). (2000). Air Quality Guidelines (AQG) for Europe, 2nd Ed. World Health Organization Regional Publications, European Series, No. 91. Copenhagen.

d) World Health Organization. (2005). WHO Air Quality Guidelines for Particulate Matter, Ozone, Nitrogen Dioxide and Sulfur Dioxide. Global Update, Summary of Risk Assessment.

e) California Environmental Protection Agency (CalEPA). (2016). Acute, 8-Hour and Chronic Reference Exposure Levels (REL). Office of Environmental Health Hazard Assessment, Air Toxicology and Epidemiology. Internet Site, last updated June 2016, accessed 15 March 2017 from http://oehha.ca.gov/air/allrels.html.

f) Agency for Toxic Substances and Disease Registry (ATSDR). (2016). Minimal Risk Levels (MRL). Internet Site, last updated March 2016, accessed 15 March 2017 from http://www.atsdr.cdc.gov/mrls/mrllist.asp.

The ATSDR defines intermediate exposure as 15 to 365 days.

g) Texas Commission on Environmental Quality (TCEQ). (2016). Effects Screening Levels. Internet Site, last updated November 2016, accessed 15 March 2017 from http://www.tceq.texas.gov/toxicology/esl. The TCEQ ESLs are based on health, odour/nuisance potential, and vegetation effects. The TCEQ ESLs are based on a hazard quotient = 0.3 for non-carcinogens and were therefore adjusted with the following equation: threshold (µg/m³) = TCEQ value x 3.333. The TCEQ does not provide background information on how the ESLs were derived for all chemicals. All ESLs are interim, unless otherwise stated.

AQG = Air Quality Guideline; CWS = Canada-wide Standard; h = hour; m³ = cubic metre; µg/m3 = microgram per cubic metre; MRL = minimal risk level; NO_2 = nitrogen dioxide; NO_x = nitrogen oxides; NA = not available; $PM_{2.5}$ = particulate matter less than 2.5 microns; PM_{10} = particulate matter less than 10 microns; ppm = parts per million; REL = Reference exposure level.

Table 3: Annual Air Quality Thresholds

Chemical	Annual Air Quality Thresholds (µg/m³)							Basis of Air Quality Threshold
	Canadian NAAQO[a]	ON MOE AAQC[b]	WHO AQG[c,d]	CalEPA REL[e]	ATSDR MRL[f]	TCEQ ESL[g]	TCEQ ESL[g] Adjusted	
Carbon monoxide	NA	NA	NA	NA	NA	NA	NA	No annual thresholds were available
Nitrogen dioxide	60	NA	**40**	NA	NA	99.73	NR	NAAQO - health and environment
								WHO - effects other than cancer or odour/annoyance: The WHO guideline was derived based on outdoor epidemiological studies that found exposures to NO_2 in ambient air associated with increased respiratory symptoms and lung function decreases in children.
	100							TCEQ - health, criteria pollutant, must meet US NAAQS. Texas defers to the US NAAQS for NO_2.
Nitrogen oxides (NO_x)	NA	NA	NA	NA	NA	NA	NA	No annual thresholds were available
Sulphur dioxide	**10**	55	50	NA	NA	NA	NA	NAAQO – The 2013 Canadian Ambient Air Quality Standard represents a balance between achieving the best health and environmental protection possible and the feasibility and costs of reducing pollutant emissions; a value of 5 ppm is effective in 2020 and a value of 4 ppm is effective in 2025. This value is applicable to the arithmetic average over a single calendar year of all 1-hour average concentrations.
								MOE - health & vegetation
	13							WHO - effects other than cancer or odour/annoyance: A LOAEL of 100 µg/m³ for respiratory symptoms and illnesses or differences in lung function values was the basis for the WHO threshold.
$PM_{2.5}$	**8.8**	NA	10	NA	NA	NA	NA	NAAQO – The 2013 Canadian Ambient Air Quality Standard represents a balance between achieving the best health and environmental protection possible and the feasibility and costs of reducing pollutant emissions; a value of 10 µg/m³ is effective in 2015 and a value of 8.8 µg/m³ is effective in 2020. This value is applicable to the 3-year average of the annual average concentrations.
								WHO - The AQG is based on cardiopulmonary and lung cancer mortality.
PM_{10}	NA	NA	**20 (25)**	NA	NA	NA	NA	WHO - Based on the $PM_{2.5}$ guideline and an assumed $PM_{10}/PM_{2.5}$ ratio of 2. It is recommended that a different value for this ratio, which better reflects local conditions, be employed when setting local guidelines. For the annual averaging period, the average $PM_{10}/PM_{2.5}$ ratio for the Project is 2.5. The PM_{10} guideline was adjusted by this Project-specific ratio and is shown in parentheses.
Diesel particulate matter	NA	NA	NA	5	NA	0.15	**0.50**	CalEPA - The chronic REL was based on respiratory effects.
								CalEPA - The unit risk was based on lung cancer risk in occupationally exposed individuals.
								TCEQ - PM_{10}, health
Total suspended particulate	**60**	60	NA	NA	NA	NA	NA	NAAQO - health and environment
	70							MOE - visibility

Air concentrations given in ppm were converted to µg/m³ with the following equation: X (ppm) = Y (mg/m³)*24.45/MW.

Centre for Disease Control and Prevention. (2003). Conversion Calculator. The National Institute for Occupational Safety and Health Publication No. 2004-101. Internet Site, last updated October 2003, accessed 15 March 2017 from http://www.cdc.gov/niosh/docs/2004-101/calc.html.

Target HQ = 1.0.

Selection criteria:

The lowest air threshold was selected as the threshold for screening in the HHRA.

200 = selected threshold for screening in the HHRA.

a) Canadian Council of Ministers of the Environment (CCME). (1999). Canadian Environmental Quality Guidelines. Canadian National Ambient Air Quality Objectives (NAAQO).

b) Ontario Ministry of the Environment (MOE). (2012). Ontario's Ambient Air Quality Criteria (AAQC). Standards Development Branch. The ON MOE AAQCs are based on health, odour, vegetation, soiling, visibility, corrosion or other effects.

c) World Health Organization (WHO). (2000). Air Quality Guidelines (AQG) for Europe, 2nd Ed. World Health Organization Regional Publications, European Series, No. 91. Copenhagen.

d) World Health Organization. (2005). WHO Air Quality Guidelines for Particulate Matter, Ozone, Nitrogen Dioxide and Sulfur Dioxide. Global Update, Summary of Risk Assessment.

e) California Environmental Protection Agency (CalEPA). (2016). Acute, 8-Hour and Chronic Reference Exposure Levels (REL). Office of Environmental Health Hazard Assessment, Air Toxicology and Epidemiology. Internet Site, last updated June 2016, accessed 15 March 2017 from http://oehha.ca.gov/air/allrels.html. The CalEPA OEHHA provides carcinogenic unit risks. Unit risks (based on a risk level of 1E-06) were adjusted to a risk based concentration and used as a screening value with the following formula: threshold (µg/m³) = 1E-06/unit risk (per µg/m³).

f) Agency for Toxic Substances and Disease Registry (ATSDR). (2016). Minimal Risk Levels (MRL). Internet Site, last updated March 2016, accessed 15 March 2017 from http://www.atsdr.cdc.gov/mrls/mrllist.asp. The ATSDR defines chronic exposure as 365 days or more.

g) Texas Commission on Environmental Quality (TCEQ). (2016). Effects Screening Levels. Internet Site, last updated November 2016, accessed 15 March 2017 from http://www.tceq.texas.gov/toxicology/esl. The TCEQ ESLs are based on health, odour/nuisance potential, and vegetation effects. The TCEQ ESLs are based on a hazard quotient = 0.3 for non-carcinogens and were therefore adjusted with the following equation: threshold (µg/m³) = TCEQ value x 3.333. The TCEQ does not provide background information on how the ESLs were derived for all chemicals. All ESLs are interim, unless otherwise stated.

AQG = Air quality guideline; LOAEL = lowest observed adverse effect level; µg/m3 = microgram per cubic metre; MRL = minimal risk level; NO_2 = nitrogen dioxide; NA = not available; NR = not required; $PM_{2.5}$ = particulate matter less than 2.5 microns; PM_{10} = particulate matter less than 10 microns; REL = reference exposure level; TSP = total suspended particulates; US NAAQS = United States National Ambient Air Quality Standards.

ANNEX B
Air Quality Thresholds

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ANNEX C

Toxicity Reference Values

Table 1: Toxicity Reference Values for the Evaluation of Long-term or Chronic Effects

COPC	Toxicity Reference Value (µg/m³)								Toxicological Endpoint and Derivation
	MOE RfC[a]	MOE AAQC[b]	Health Canada TC[c]	US EPA RfC[d]	CalEPA REL[e]	ATSDR MRL[f]	RIVM TCA[g]	WHO AQG[h]	
DPM	NV	NV	NV	**5**	5	NV	NV	NV	The US EPA RfC is based on a chronic rat inhalation study by Ishinishi et al. (1988). Rats were either exposed to 0.11, 0.41, 1.18 or 2.32 mg/m³ DPM from a light-duty engine or to 0.46, 0.96, 1.84 or 3.72 mg/m³ DPM from a heavy-duty engine for 16 h/d, 6 d/w for 30 months. A NOAEL of 0.46 mg/m³ for pulmonary inflammation and histopathology was selected as the critical effect. The NOAEL was adjusted for a human equivalent concentration, resulting in an adjusted NOAEL of 0.144 mg/m³. An uncertainty factor of 30 was applied (3 for interspecies extrapolation and 10 for interindividual human variation in sensitivity).
									The CalEPA has adopted the US EPA RfC as the chronic REL. See above for endpoints and derivation.

0.002 = selected TRV for use in the evaluation of potential chronic effects in the human health risk assessment

a) Ontario Ministry of the Environment (MOE). 2011. Rationale for the Development of Soil and Ground Water Standards for Use at Contaminated Sites in Ontario. April 15, 2011. Standards Development Branch.

b) Ontario Ministry of the Environment. 2012. Ontario's Ambient Air Quality Criteria (AAQC). Standards Development Branch.

c) Health Canada. 2010. Federal Contaminated Site Risk Assessment in Canada. Part II: Health Canada Toxicological Reference Values and Chemical-Specific Factors. Version 2.0. September 2010. Contaminated Sites Division, Safe Environments Directorate.

d) United States Environmental Protection Agency (US EPA). 2016. Integrated Risk Information System. Last updated 9 September 2016, Accessed 15 March 2017 from http://www.epa.gov/iris.

e) California Environmental Protection Agency (CalEPA). 2016. Office of Environmental Health Hazard Assessment Acute, 8-hour and Chronic Reference Exposure Level (REL) Summary. Last updated 28 June 2016, Accessed 15 March 2017 from http://oehha.ca.gov/air/general-info/oehha-acute-8-hour-and-chronic-reference-exposure-level-rel-summary.

f) Agency for Toxic Substances and Disease Registry (ATSDR). 2016. Minimal Risk Levels (MRL) for Hazardous Substances. Last updated March 2016, Accessed 15 March 2017 from http://www.atsdr.cdc.gov/mrls/mrllist.asp.

g) Rijksinstituut Voor Volksgezondheid en Milieu (National Institute of Public Health and the Environment) (RIVM). 2001. Re-evaluation of human-toxicological maximum permissible risk levels. March 2001.

h) World Health Organization (WHO). Air Quality Guidelines (AQG) for Europe, 2nd Ed. World Health Organization Regional Publications, European Series, No. 91. Copenhagen.

AAQC = Ambient Air Quality Criteria; AQG = Air Quality Guideline; COPC = chemical of potential concern; d/w = day/week; h/d = hour/day; DPM = Diesel Particulate Matter; mg/m3 = milligram per cubic metre; MRL = minimal risk level; NOAEL = no observed adverse effect level; NV = no value; REL = Reference Exposure Level; RfC = reference concentration; TC = tolerable concentration; TCA = tolerable concentration in air; m³ = cubic metre; µg/m³ = microgram per cubic metre; TRV = toxicity reference value.