Appendix D.2 Air Quality Assessment

Environmental Review Report

York Energy Centre Upgrades Project

Capital Power Corporation

SLR Project No.: 241.030524.00026

July 2024

Air Quality Assessment

York Energy Centre Upgrades Project

Capital Power Corporation

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Revision Record

Revision	Date	Revision Description
0	July 2024	Report issued for public review

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Acronyms and Abbreviations

AAQC	Ambient Air Quality Criteria
AQMS	air quality management system
CAAQS	Canadian Ambient Air Quality Standards
CCME	Canadian Council of Ministers of the Environment
CO	carbon monoxide
COC	contaminant of concern
ECA	Environmental Compliance Approval
ECCC	Ministry of Environment and Climate Change
EPA	*Environmental Protection Act*
ERR	Environmental Review Report
ESDM	Emission Summary and Dispersion Modelling
ESP	Environmental Screening Process for Electricity Projects
GLC	ground level concentration
GTG	gas turbine generator
ha	hectare
IESO	Independent Electricity System Operator
km	kilometre
m	metre
MECP	Ministry of the Environment, Conservation and Parks
MW	megawatt
NAPS	National Air Pollution Surveillance
NO_X	nitrogen oxide
PAH	polycyclic aromatic hydrocarbon
PM	particulate matter
POI	Point of Impingement
SO_2	sulphur dioxide
TSP	total suspended particulate
US	United States
US EPA	United States Environmental Protection Agency
VOC	volatile organic compound
YEC	York Energy Centre

1.0 Introduction

1.1 Project Overview

Capital Power Corporation (Capital Power), through its affiliate York Energy Centre LP., owns and operates the York Energy Centre (YEC). The YEC is a natural gas-fired, simple cycle, peaking generation power plant that generates an average gross output of 425 megawatts (MW) of electrical power. The YEC has been in operation since 2012, and since April of 2017, has been owned and operated by Capital Power. The YEC is located on two parcels of land, municipally known as 18781 and 18765 Dufferin Street located in the Township of King, Regional Municipality of York, hereafter referred to as the YEC Property (**Figure 1-1**).

Capital Power is proposing equipment upgrades at the YEC, referred to as the YEC Upgrades Project (the Project). The Project will provide approximately 30 MW of additional electricity generating capacity compared to current operations, which is reflective of an approximate 7.0 percent (%) increase in generating capacity. The proposed modifications of the YEC include:

- installation of a turbine upgrade package that will increase operational performance and reduce emissions of nitrogen oxides (NO_x);
- installation of an inlet fogging system;
- installation of larger transformer cooling fans; and
- adjustments to control logic.

The Project will result in improved efficiency, increased generation capacity and reduced NO_x emissions at the YEC. Installation of the upgrades will not result in changes to the footprint of the existing YEC, and there will be no changes to current use or maintenance practices at the facility. Installation of the upgrades will consist of component delivery, installation, and performance testing. Limited ground disturbance will be required within the footprint of the existing facility pad, and no construction work will occur within undisturbed or naturalized areas.

1.2 Objective

The objective of this Air Quality Assessment Report is to predict concentrations of selected air quality contaminants associated with the Project to demonstrate compliance with applicable regulatory limits. This report has been prepared in support of the Environmental Review Report (ERR) to meet the requirements of the Environmental Screening Process for Electricity Projects (ESP).

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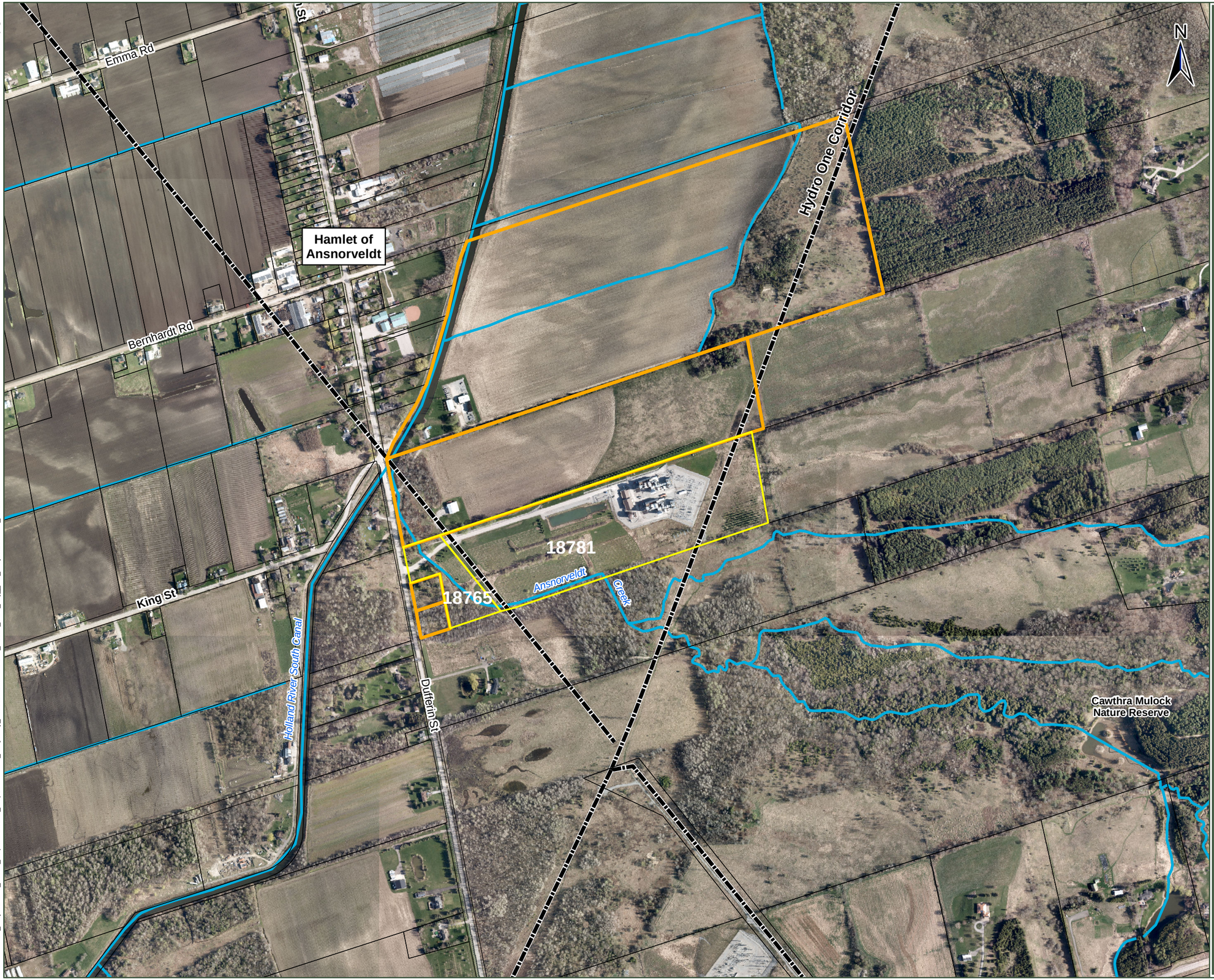
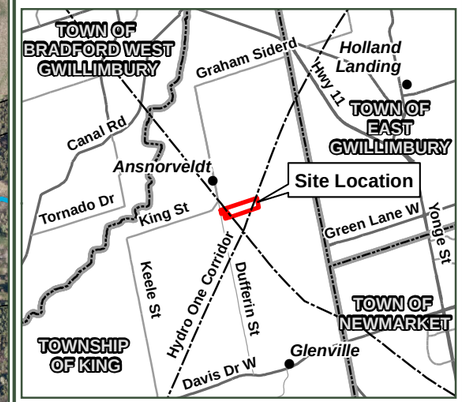


LEGEND:

- YEC Property
- Other CPC Owned Properties
- Parcel Fabric
- Watercourse/Drainage Feature
- Existing Utility Line



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YEC UPGRADES PROJECT

AIR QUALITY ASSESSMENT

PROJECT LOCATION

SLR

FIGURE NO:
1-1

DATE: July 2024

PROJECT NO: 241.30524.00023

2.0 Project and Site Context

2.1 Site Context

The YEC is located on two parcels, municipally known as 18781 and 18765 Dufferin Street, in the Township of King, Regional Municipality of York, just south of the Hamlet of Ansnorveldt and the Holland River. The generally rectangular property is approximately 15.3 hectares (ha) in size with approximately 80 metres (m) of frontage along Dufferin Street, and an approximate depth of 810 m. Located slightly east of the centre of the property is the main power generation facility and all of the associated infrastructure features including internal access roads and parking lots, high voltage substation and overhead transmission line for grid interconnection, natural gas supply and storage infrastructure, and stormwater management features. The remainder of the property predominantly features mowed lawn and open field areas. Ansnorveldt Creek extends along the south property line, intersecting the southwest portion of the property to feed into the Holland River South Canal located generally west of the YEC. The YEC's main site entrance is located in the northwest corner of the property. **Figure 2-1** provides context related to the location of the existing YEC and associated site features.

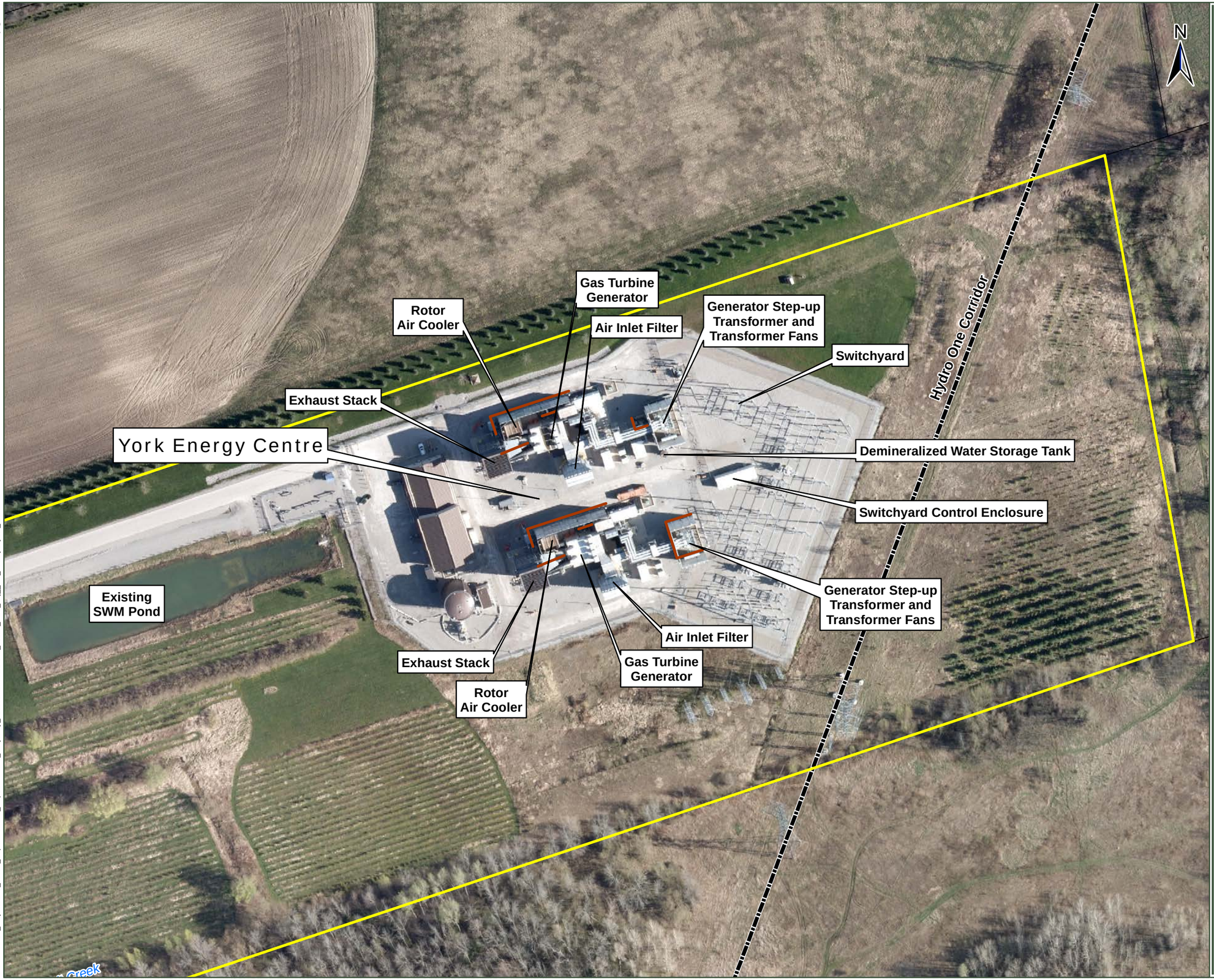
The YEC Property is exempt from the *Planning Act* as specified in Ontario Regulation 305/10 and is identified as a Countryside Site Specific Policy Area (C-SSPA-3) in the Township of King Official Plan. The YEC Property is not subject to the provisions of the Zoning Bylaw but is identified for descriptive purposes. Land use within approximately 500 m of the existing YEC include approximately 25 residences along Dufferin Street south of Bernhardt Road. Commercial and institutional land uses include the Ansnorveldt Public Library, Holland Marsh Christian Reformed Church, and several small businesses including King Firewood and Lonelm Construction Company (YorkMaps 2023 and Google Maps 2024). Other land uses include agriculture, the Cawthra Mulock Nature Reserve south of the YEC Property, and two Hydro One transmission lines bisecting the YEC Property.

2.2 YEC Context

The existing YEC has been in operation since 2012. It is a natural gas-fired, simple cycle, peaking generation power facility that primarily operates during intermediate and peak demand periods. The existing YEC consists of two combustion gas turbines and one standby diesel generator and is equipped with emission control/reduction technologies including Ultra Low NO_X combustors for the gas turbines. The YEC uses a Continuous Emissions Monitoring System (CEMS) to monitor emissions for compliance with regulatory limits.

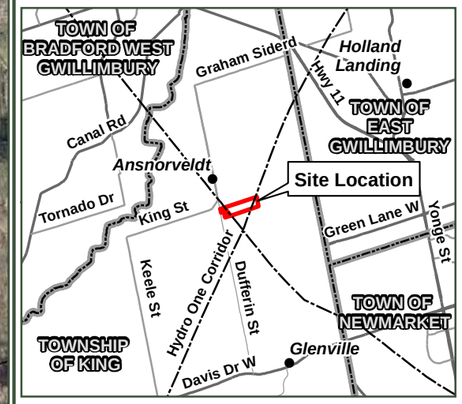
As a peaking facility, the YEC is dispatched by the IESO only when there is high (peak) demand for electricity or as a result of sudden system disturbances. Capable of coming online in under 30 minutes, the YEC has historically been dispatched to provide grid stability and power while other baseload facilities come online. Over the past five years, the YEC has been dispatched by the IESO an average of 146 hours annually, with an average run time of just under 3 hours per dispatch request. As a peaking facility, the YEC must operate for less than 1,500 hours annually.

The YEC operates in accordance with the facility's existing Environmental Compliance Approval (ECA) (Air & Noise) issued by the Ministry of the Environment, Conservation and Parks (MECP). The original YEC ECA was issued in March 2010 and has subsequently been amended, with the current version of ECA 7348-83GSVK issued in July 2014. The YEC's plant control and operation systems are currently programmed to limit each turbine's gross output in order to maintain compliance with the output value included in the facility's ECA.



LEGEND:

- YEC Property
- Parcel Fabric
- Existing Utility Line
- Existing Noise Barrier



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YEC UPGRADES PROJECT

AIR QUALITY ASSESSMENT

EXISTING YEC FACILITY LAYOUT

SLR

FIGURE NO:
2-1

DATE: July 2024

PROJECT NO: 241.V30524.00026

2.3 Project Context

The proposed modifications of the YEC include installation of a turbine upgrade package, an inlet fogging system, larger transformer cooling fans, and adjustments to control logic. These modifications are summarized below.

- **Turbine Upgrades:** Both of the existing gas turbines will be modified through the installation of an upgrade package offered and installed by the turbine manufacturer, Siemens Energy (SE). The upgrade package includes three distinct modifications:
    - *Advanced Turbine Efficiency Package (ATEP):* this performance upgrade will improve power turbine aerodynamics, provide more efficient use of cooling and sealing air flows in the turbine section, and use improved thermal barrier coatings and manufacturing technologies for the hot-gas-path components, resulting in improved efficiency and power output of the units. The turbine upgrade will provide an increased YEC capacity and improve the heat rate by upwards of 4%. This realised improvement will result in an increase in the thermal efficiency of each turbine unit, which in turn will result in an improved carbon dioxide emission factor (CO_2e)/MW.
    - *Ultra-Low NO_X Combustion System (ULN 3.0):* this upgrade will replace the existing ULN 2.0 system which will result in an improvement of the emissions performance of the YEC. Design changes in the combustor pilot control of the ULN 3.0 allows finer tuning of the equipment which results in lower emissions, increased stability/control at higher loads.
    - *Direct Air Injection System (DAIS):* this modification will pump compressed air into the turbine during shutdown to help equalize the temperature and prevent turbine damage from occurring.
- **Inlet Fogging:** An inlet fogging power augmentation system will be installed to cool intake air entering each of the existing turbines. The cooling of the intake air prevents a decrease in power during times of higher ambient air temperature, which results in optimal power generation for both turbines.
- **Transformer Cooling Fans:** The existing transformer cooling fans need to be replaced with larger fans to accommodate the additional power generated from the upgraded YEC. The fans themselves aid in cooling of the transformer.
- **Gas Turbine Control Updates:** Control logic limitations currently in place at the YEC to limit each turbine's gross output would be removed to allow the upgraded YEC equipment to operate at the designed maximum gross output.

The upgrades to the YEC will not materially change how the facility is dispatched by the IESO as a peaking power plant. The YEC is expected to continue to run infrequently and below the regulated 1,500-hour annual limit for peaking facilities. Dispatch forecasting suggests that the facility may run less than 180 hours annually, while 2027 would see the largest number of operating hours at approximately 260.

3.0 Regulatory Framework

The following sections provides an overview of provincial and federal regulatory frameworks relevant to the Air Quality Assessment.

3.1 Ontario Regulation 419/05

The Project is considered an emitter subject to O. Reg. 419/05 – Air Pollution – Local Air Quality, with statutory authority under the provincial *Environmental Protection Act* (EPA). Within this regulatory framework, the Project must meet the provincially regulated emission limits and will require an amendment to the existing YEC's ECA (Air & Noise) issued under the EPA.

3.1.1 Air Contaminant Benchmark List

The air contaminant benchmark list is intended for use primarily by an emitter who is required to prepare an Emission Summary and Dispersion Modelling (ESDM) report under O. Reg. 419/05. The applicable criteria from the benchmark list were used to compare to the Project specific dispersion modelling results to determine the Project's compliance with O. Reg 419/05.

3.1.2 Ambient Air Quality Criteria

Ambient Air Quality Criteria (AAQC) are set by the MECP, within the air contaminant benchmark list. They are provincially based, non-regulatory, ambient air quality values developed to protect against potentially adverse effects on human health and/or the environment. AAQCs are used to assess air quality from all emission sources and are most commonly used in environmental assessments.

3.1.3 Guideline A-5 Requirements

Guideline A-5, under O. Reg. 419/05, specifies emission limits for stationary combustion sources, including limits for natural gas fired turbines. For a natural gas fired turbine facility, these limits are calculated based on the power rating on the turbine as well as heat recovery units, where applicable. The A-5 guideline specifies equipment emission limits, at the source, for nitrogen oxides (NO_X), carbon monoxide (CO) and sulphur dioxide (SO_2) under normal operating conditions; unlike the AAQC, the emission limits are not predicted concentrations at a Point of Impingement (POI) but rather a limit on concentrations of contaminants exiting the exhaust stack. Under the A-5 Guideline, a >70 MW peaking turbine has an allowable emission rate of 140 g/GJ NO_X with a capped operating time of 1,500 hours per year.

3.2 Canadian Ambient Air Quality Standards

The Canadian Ambient Air Quality Standards (CAAQS) are federally based, non-regulatory, ambient air quality values. These standards are based on factors including health and environmental effects, current air quality levels in other jurisdictions, projected trends, and elements of achievability. CAAQS are intended to be used as indicators to help manage regional air quality and drive the improvement of air quality across the country. CAAQS are established to work with regional air quality management systems (AQMS) to control and monitor air quality at the regional level but not intended to be directly applied to individual facilities (CCME 2020) or the compliance of individual facilities.

For the purposes of this report, predicted ground level concentrations (GLC) at a POI beyond the fenceline of the YEC and at selected sensitive receptors were compared to identified provincial and federal regulatory frameworks and standards, where applicable.

4.0 Existing Environmental Conditions

The following sections provide the regional and local meteorology and air quality context relevant to the Project. Regional and local historical climate data were sourced from the Government of Canada Past Weather and Climate Historical Data set (Government of Canda 2023).

4.1 Regional Climate

The Project is in York Region. York Region and its nine local municipalities are part of the Greater Golden Horseshoe in southern Ontario. The Region stretches north from Toronto to Lake Simcoe, covering an area of 1,762 square kilometres (km^2). Over 1 million people reside in its nine local municipalities: Aurora, East Gwillimbury, Georgina, King, Markham, Newmarket, Richmond Hill, Vaughan and Whitchurch-Stouffville. Approximately 38% of York Region area is dedicated to farming activities while 25% are urban areas. **Figure 1-1** provides a regional view of the Project location.

According to Environment and Climate Change of Canada (ECCC), the mean annual temperature is recorded as 8.2°C. On average, January is the coldest month of the year, and July the warmest. Precipitation is relatively evenly distributed seasonally, though more precipitation is typically observed during the summer and fall months.

4.2 Local Meteorology and Ambient Air Quality Context

Understanding local climate and meteorological conditions and ambient air quality is important in determining any potential effects a project may have on the local environment. The YEC is in an agricultural region approximately 50 km north of downtown Toronto, 13 km south of Lake Simcoe, 4 km northeast of Bradford, and 30 km west of Uxbridge.

In this assessment, historical meteorological data from Toronto Pearson International Airport station[1] were used to identify climate normal and means of temperature, precipitation, and wind speed and wind direction for the purposes of characterizing local meteorological conditions.

Meteorological data collected from 1981–2010, monthly averages of temperature, precipitation, and wind speed and direction from the Toronto Lester B. Pearson International (INT'L) A station are summarized below. The chosen timeframe for the meteorological data (1981 – 2010) reflects the accessibility of official statistics from ECCC. For dispersion modelling purposes, pre-processed data sets by the MECP were used, as described the following sections.

4.2.1 Temperature

Daily average, maximum, and minimum temperatures for each month are presented in **Table 4-1**. The extreme maximum temperature recorded was 38.3°C in August, while the extreme minimum temperature recorded was -31.3°C in January.

[1] Toronto Lester B. Pearson INT'L A station is operated by NAV Canada, located at Latitude:43°40'38" N, Longitude:79°37'50" W, which is approximately 46 kilometers northeast of the YEC. Its elevation is 173.40 m, climate ID: 6158733, WMO ID: 71624.

Table 4-1: Monthly Average and Extreme Temperatures at Toronto Lester B. Pearson INT'L A Station, 1981 – 2010

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily Average (°C)	-5.5	-4.5	0.1	7.1	13.1	18.6	21.5	20.6	16.2	9.5	3.7	-2.2
Standard Deviation	3.2	2.3	2.0	1.6	1.9	1.6	1.5	1.5	1.6	1.5	1.5	2.6
Daily Maximum (°C)	-1.5	-0.4	4.6	12.2	18.8	24.2	27.1	26.0	21.6	14.3	7.6	1.4
Daily Minimum (°C)	-9.4	-8.7	-4.5	1.9	7.4	13.0	15.8	15.1	10.8	4.6	-0.2	-5.8
Extreme Maximum (°C)	17.6	14.9	25.6	31.1	34.4	36.7	37.6	38.3	36.7	31.6	25.0	20.0
Extreme Minimum (°C)	-31.3	-31.1	-28.9	-17.2	-5.6	0.6	3.9	1.1	-3.9	-8.3	-18.3	-31.1

Note: Data collected from Government of Canada's (2023) online repository for Past Weather and Climate: Historical Data

4.2.2 Precipitation

Table 4-2 provides monthly average precipitation, divided into rainfall and snowfall. The month with the highest average rainfall recorded was September with the lowest average rainfall being recorded in the month of January. The highest average snowfall over the recorded period was January, with the lowest average snowfall from April to September. The extreme daily rainfall is 121.4 mm occurring in October, and extreme daily snowfall is 39.9 cm occurring in February.

Table 4-2: Average Monthly and Extreme Precipitation at Toronto Lester B. Pearson INT'L A Station, 1981 – 2010

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (mm)	25.1	24.3	32.6	63.0	74.3	71.5	75.7	78.1	74.5	60.6	68.0	34.0
Snowfall (cm)	29.5	24.0	17.7	4.5	0.0	0.0	0.0	0.0	0.0	0.4	7.5	24.9
Precipitation (mm)	51.8	47.7	49.8	68.5	74.3	71.5	75.7	78.1	74.5	61.1	75.1	57.9
Extreme Daily Rainfall (mm)	58.7	31.8	41.7	55.8	92.7	53.8	118.5	80.8	108.0	121.4	86.1	40.9
Extreme Daily Snowfall (cm)	36.8	39.9	32.3	26.7	2.3	0.0	0.0	0.0	0.0	7.4	33.5	28.2

Note: Data collected from Government of Canada's (2023) online repository for Past Weather and Climate: Historical Data

4.2.3 Wind Speed and Direction

Table 4-2 provides monthly maximum wind speed and wind direction. The month with the highest maximum wind speed recorded was March on southwesterly direction (129 km/h). The month with the highest mean wind speed recorded was January on westerly direction (17.6 km/h). **Table 4-3** shows that predominant winds come from west through southwesterly directions.

Table 4-3: Average Monthly and Extreme Wind Speed at Toronto Lester B. Pearson INT'L A Station, 1981 – 2010

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Speed (km/h)	17.6	17.0	16.9	16.8	14.4	13.2	12.9	11.9	12.7	14.0	15.7	16.7
Most Frequent Direction	W	W	N	N	N	N	W	N	W	W	W	W
Maximum Hourly Speed (km/h)	64	69	129	64	80	43	48	37	42	55	64	72
Direction of Maximum Hourly Speed	SW	SW	SW	E	W	W	W	W	W	W	SW	SW
Note: Data collected from Government of Canada's (2023) online repository for Past Weather and Climate: Historical Data												

4.3 Ambient (Background) Air Quality

A review of the MECP and National Air Pollution Surveillance (NAPS) ambient monitoring stations in the Toronto area, was undertaken to identify monitoring stations that are near the Project and representative of background air quality concentrations. The ambient monitoring stations used for this assessment include:

- Newmarket (ID: 48006), Address: Eagle St. W./McCaffrey Rd. Years: 2019-2023, COCs: $PM_{2.5}$, NO_X.
- Toronto West (ID: 35125), Address: 125 Resources Rd. Years: 2019-2023, COCs: CO, SO_2.

PM_{10} is not measured in Ontario; therefore, background concentrations were estimated by applying a $PM_{2.5}/PM_{10}$ ratio of 0.54 (Lall et al. 2004). The 90th percentile ambient concentrations are provided in **Table 4-4**. In cumulative assessments, the 90th percentile of available monitoring data is commonly used as a conservative estimate of background air quality, as recommended by federal regulators (CEA Agency and CNSC, 2012). Consequently, the 90th percentile of measured concentrations is utilized to represent background air quality for parameters with shorter averaging periods (i.e., 1-hour, 8-hour, and 24-hour). The annual background concentrations are calculated based on the mean of the available data. The 90th percentile monitoring data is applicable as the background ambient air quality for both AAQC and CAAQS.

Table 4-4: Background Ambient Air Quality Concentrations (2018-2022)

COC	Averaging Period	90th Percentile Ambient Concentration (µg/m^3)	Monitoring Station
CO	1-hr	421.40	Toronto West (35125)
	8-hr	403.34	Toronto West (35125)
NO_X	1-hr	25.12	Newmarket (48006)
	24-hr	24.04	Newmarket (48006)
PM_{10}	24-hr	21.37	Newmarket (48006)

COC	Averaging Period	90th Percentile Ambient Concentration (µg/m3)	Monitoring Station
$PM_{2.5}$	24-hr	11.54	Newmarket (48006)
	Annual	8.55	Newmarket (48006)
SO_2	10-min	2.27	Toronto West (35125)
	1-hr	1.38	Toronto West (35125)
	Annual	0.80	Toronto West (35125)

These ambient concentrations were added to maximum modelled Project concentrations to estimate combined air quality concentrations at POIs and selected sensitive receptor locations in the air quality assessment spatial boundary, as defined in **Section 6.3**.

5.0 Air Contaminants and Air Quality Criteria

5.1 Project Air Contaminants

The combustion of natural gas associated with the generation of electricity from a gas turbine generation facility results in emissions of contaminants of concern (COCs) to the atmosphere. COCs identified for natural gas fueled turbines include:

- Nitrogen oxides (NO_X) (in the form of Nitrogen Dioxide or NO_2);
- Carbon monoxide (CO);
- PM; where total particulate matter and fine particulate matter are assessed for the Project, with fine particulate matter defined as particulate sizes 2.5 microns in diameter and less ($PM_{2.5}$), and 10 microns in diameter and less (PM_{10}); and
- Sulphur dioxide (SO_2).

Volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), and to a lesser extent, metals, can be detected in the exhaust stream, as a result of the combustion process. Emission quantifications were completed for the normal operating conditions for the above-mentioned compounds and predicted to be released in trace amounts. Due to the low emissions modeled, these compounds (VOCs, PAH, and metals) have not been included in the combined effects analysis.

5.2 Air Quality Assessment Criteria

Table 5-1 presents the COC assessment criteria used. Regulatory frameworks described in Section 3.0 of this report, are compared to modelled predictions for the following purposes:

- **Provincial O. Reg. 419/05 Limit** – required to meet compliance as this is the provincial standard for the ECA process.
- **Provincial AAQC Limit** – sets out provincial target concentrations for acceptable ambient air quality in a local airshed. These are not compliance standards but are used for guidance purposes.
- **Federal CAAQS Targets** – these are federal targets to determine appropriate air quality management actions within an air zone. These are not compliance standards but are used for guidance purposes.

Averaging periods are researched and developed by the Canadian Council of Ministers of the Environment (CCME) and provincial environmental agencies. Averaging periods differ depending on the COC, since each COC has a unique effect on human health and the environment.

Table 5-1: COC Assessment Criteria

COC	Averaging Period	O. Reg. 419/05 Limit (µg/m^3)	AAQC Limit (µg/m^3)	CAAQS (ppb)
NO_X	1-hour	400	400	42[1]
	24-hour	200	200[2]	-
	Annual	-	-	12
CO	1/2 hour	6,000		-
	1-hour	-	36,200	-
	8-hour	-	15,700	-
PM_{10}	24-hour	1203	50	-
$PM_{2.5}$	24-hour	-	27	27 (µg/m^3)[4]
	Annual	-	8.8	8.8 (µg/m^3)[5]
SO_2	10-minute	-	67 ppb	-
	1-hour	100	40 ppb	65[6]
	Annual	10	4 ppb	4

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

[2] Limit is for Nitrogen Dioxide (NO_2). NO_X concentrations were conservatively compared against this limit for this assessment.

[3] O. Reg. 419/05 limit for particulate matter is for total particulate matter.

[4] The 24-hr $PM_{2.5}$ CAAQS is based on the 3-year average of the annual 98th percentile of the 24-hr average concentrations.

[5] The annual $PM_{2.5}$ CAAQS is based on the average of the three highest annual average values over the study period.

[6] The 3-year average of the annual 99th percentile of the SO_2 daily maximum 1-hour average concentrations.

6.0 Methods

6.1 Existing YEC Emission Sources

Based on the ESDM report prepared in support of the current ECA (Dillon Consulting 2021), the current emission sources at the existing YEC include:

- Two (2) Siemens SGT6-5000F gas turbine generator sets and related equipment.
- Emergency diesel generator set.

The 2021 ESDM report showed that the existing YEC facility demonstrates regulatory compliance, since the predicted ground-level concentrations of COCs from the existing YEC are below the O. Reg. 419/05 thresholds.

Emissions are reported annually to the federal National Pollutant Reporting Inventory (NPRI) program, and data for this program is made available on an annual basis for public review. Data collected for the 2022 reporting year is provided below:

- CO: 87.10 tonnes
- $PM_{2.5}$: 1.23 tonnes
- PM_{10}: 1.23 tonnes

Substance releases for NO_X, ammonia, SO_2, VOCs, and PAHs were not reported for the 2022 reporting period (NPRI 2024). Ammonia is not released from the YEC facility as the turbine is not equipped with Selective Catalytic Reduction and NO_X, SO_2, VOCs, and PAHs did not meet the reporting threshold for 2022.

6.2 Project Emission Sources

The primary air emission sources from the Project are two dedicated exhaust stacks associated with the proposed turbine upgrades (ATEP, DAIS, Inlet Fogging). The United States Environmental Protection Agency (US EPA) publishes emission factors for stationary gas turbines. For the Project, NO_X, CO, and TSP turbine emission rates were based on manufacturer's specifications, whereas the emission factors for SO_2 used were from the US EPA AP-42 Chapter 3.1: Stationary Gas Turbines (US EPA 1996) (**Appendix B**).

VOCs, PAHs, and metals emissions were calculated based on US EPA AP-42 Chapter 1.4: Natural Gas Combustion (US EPA 1996). VOCs, PAHs, and metals emission rates were only included for the Normal Operating Scenario. Maximum emission rates per averaging period were calculated in accordance with requirements outlined in Guideline A-10: Procedure for Preparing an Emission Summary and Dispersion Modelling Report (MECP 2018).

Section 6.5 summarizes stack parameters and emissions data used for five operating scenarios modelled (Modelling Scenarios).

Total annual emissions will be dependent on the electricity demand and operating conditions in future years and will be publicly reported as part of the ongoing federal NPRI program.

6.3 Assessment Boundaries

The air quality assessment spatial boundary used a 16 x 16 km receptor grid for conducting the dispersion modelling. The dispersion modelling grid selected was based on the requirements described in Guideline A-11: Air Dispersion Modelling Guideline for Ontario (ADMGO 2017).

A receptor grid was placed over the Project following the ADMGO (2017) methods. Receptors were selected based on guidance provided in Section 7.1 of the ADMGO, which is in accordance with s.14 of O. Reg. 419/05. Specifically, the nested receptor grid used for modelling centered on the Project turbine stack and used the following spacing which provides for more receptors spread over a larger area compared to the guidance documentation:

- 20 m spacing between receptor points, within an area of 300 m by 300 m centred around the Project.
- 50 m spacing, within an area surrounding the area described in (a) with a boundary at 600 m by 600 m outside the boundary of the area described in (a).
- 100 m spacing, within an area surrounding the area described in (b) with a boundary at 1,100 m by 1,100 m outside the boundary of the area described in (b).
- 200 m spacing, within an area surrounding the area described in (c) with a boundary at 2,100 m by 2,100 m outside the boundary of the area described in (c).
- 500 m spacing, within an area surrounding the area described in (d) with a boundary at 5,100 m by 5,100 m outside the boundary of the area described in (d).
- 1,000 m spacing, within an area surrounding the area described in (e) with a boundary at 8,000 m by 8,000 m outside the boundary of the area described in (e).

In addition to using the nested receptor grid, POIs were also placed every 10 metres along the YEC Property's property line.

6.4 Points of Impingement (POI)

The dispersion model predicts concentrations of selected COCs at ground level or POI. POIs are maximum concentrations located at and beyond the property line of a Project Site. Two types of POI were included in the model: a general POI grid or nested grid covering the surrounding area, and six (6) sensitive receptors. Sensitive receptors were chosen to represent locations where extended human occupancy is experienced, such as residences and schools. Heights of these receptors are determined based on potential exposure to humans. **Table 6-1** and **Figure 6-1** present the locations of the six (6) sensitive receptors identified for modelling.

Table 6-1: Sensitive Receptor Locations

ID	Description	Coordinates (UTM Zone 17 – NAD83)	
		X (m)	Y (m)
R1	Senior Residence	618677.10	4881972.98
R2	Residential House	618724.97	4881490.90
R3	Residential House	617259.41	4880904.42
R4	Residential House	617002.54	4881242.50
R5	School/place of worship	617067.95	4881676.03
R6	Residential House	618631.56	4881698.75

Capital Power recently purchased 18855 Dufferin Street, located generally north of the YEC Property, and will be repurposed for non-sensitive receptor use. As such, this property has not been included as a sensitive receptor location in this study.

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GIS PATH: G:_Projects\241_30524_CapitalPower\1_Maps\RPT\RPT_AirQuality_Assessment\YEC\241_30524_YEC_AQ_6-1_SensitiveReceptors_revB.mxd

Emma Rd

1st

Hamlet of Ansnorveldt

Bernhardt Rd

R5

R1

R6

R2

York Energy Centre

R4

King St

Holland River South Canal

Ansnorveldt Creek

R3

Dufferin St

N

LEGEND:

- YEC Property
- Other CPC Owned Properties
- Parcel Fabric
- Watercourse/Drainage Feature
- Selected Sensitive Receptor Location

0 125 250 500 m

SCALE 1:8,000
PAGE SIZE: 11 x 17
NAD 1983 UTM Zone 17N

THIS MAP IS FOR CONCEPTUAL PURPOSES ONLY
AND SHOULD NOT BE USED FOR NAVIGATION

YEC UPGRADES PROJECT

AIR QUALITY ASSESSMENT

SELECTED SENSITIVE RECEPTOR LOCATIONS

SLR

FIGURE NO:
6-1

DATE: July 2024

PROJECT NO: 241.30524.00023

6.5 Modelling Scenarios

The following modelling scenarios were chosen for the assessment. These scenarios were chosen to represent conservative worst-case emissions (base load or peak load) under different operating and environmental conditions (ambient temperatures). These scenarios do not occur all the time; however, of the scenarios assessed, Scenario A, the Normal Operating Scenario, would occur most often. Scenario E is the Cold Start scenario which is a start-up condition where the turbines are starting from ambient temperature, all equipment is “cold”. Once equipment reaches required heat rates, emissions return to lower levels.

Annual average predicted concentrations were scaled based on maximum operating time per year by prorating the predicted annual average concentration result by the operating versus modelling time ratio (1,500 operating hours per year/8,760 hours per year modelled).

6.5.1 Scenario A - Normal Operating Scenario

This is intended to be the normal operating configuration for the Project. This scenario is indicative of the simple cycle facility operating in response to a high system demand where power is provided to the provincial electricity grid. This scenario is the annual average temperature and relative humidity experienced at the YEC Property.

The Guideline A-5 limits and calculations for this scenario have been included in **Appendix A**.

6.5.2 Scenario B - Winter Normal Scenario

This is intended to be the normal operating configuration for the Project where the simple cycle facility is operating during cold weather events.

6.5.3 Scenario C - Summer Normal Scenario

This scenario captures periods of high system demand during summer weather conditions.

6.5.4 Scenario D - Peak Firing Scenario

During periods of high system demand or when site maintenance or operational issues would otherwise reduce generation capability, peak-firing will be employed to increase generation. Peak firing increases firing temperatures and as a result, increased maintenance is required. This scenario is intended to only be used when required to meet generating capacity commitments.

6.5.5 Scenario E - Cold Start Scenario or Start-up Condition

As a peaking power plant, the SGT6-5000F turbine is capable of generating electrical output within 27 minutes of start-up. During a cold start the turbine uses existing site or grid electricity to initiate the rotation. Once adequate rotational speeds are achieved, the natural gas flow to the unit is turned on, at which time the gas turbine starts to operate under its own combustion power. Gas flow is increased to the gas turbine to increase power.

6.6 Change in Emission Rates

Guideline A-5 specifies emissions limits for natural gas fired turbines at the source (i.e., exhaust stack) for NO_X, CO and SO_2 under normal operating conditions. The emission rates for the Project were calculated using specified equations from the guideline to confirm that emissions from the exhaust stack will meet these provincial requirements.

The results of the calculations demonstrated that, following implementation of the Project, the YEC will continue to be compliant with the Guideline A-5 emission limits. The existing facility emission rates compared to the emission rates expected after the upgrades have been completed is presented in **Table 6-2**. Included in the SE turbine upgrades package is the implementation of a more advanced, ultra low NO_X combustion system which would decrease the rate of NO_X emissions during operation. With the implementation of the newer technology, it is anticipated that the NO_X emission rate will be reduced by 37%. There is no change expected in the SO_2 and PM emission rate. The analysis predicts a 5% increase in the CO emission rate from 19 lb/hr to 20 lb/hr.

Table 6-2: Net Change in Air Emission Rates

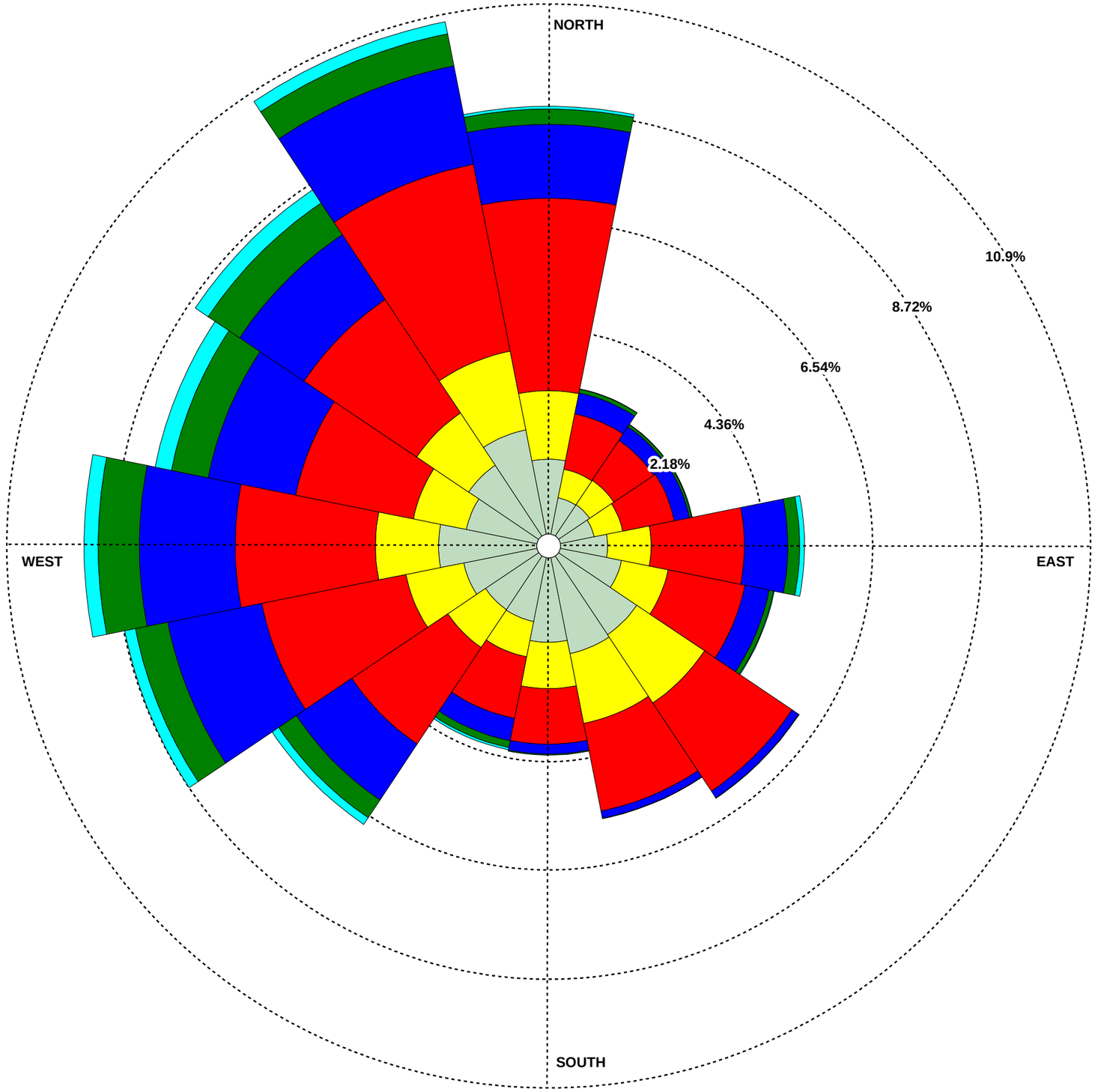
Contaminant	Air Emission Rates (lb/hr)		
	Existing Facility	Project	Net Change
NO_X	155	98	-57
CO	19	20	1
SO_2	13	13	0
PM	8	8	0

6.7 Dispersion Modelling Parameters

Dispersion modelling was completed using AERMOD version 22112 following the steps outlined in Guideline A-11 (ADMGO 2017). AERMOD combines stack parameter input data, emission rates, terrain, and meteorological data to model a Gaussian plume to simulate the dispersion of COCs into the atmosphere. Stack parameters and emission rates used for modelling are provided in **Table 6-3** through **Table 6-7.** Terrain (TIF) files for York region were used from MECP's website and WebGIS. The MECP pre-processed meteorological data for AERMOD for the crop environment was used in this assessment. This meteorological dataset considers surface data from Toronto Pearson International Airport and upper air sounding data from Buffalo, New York for five years (1996-2000).

The wind rose for this meteorological data set is provided in **Figure 6-2** and shows that predominant winds come from north through southwesterly directions. The average wind speed is approximately 3.97 m/s while the calm winds are 0.00%.

The AERMOD model includes a module to simulate the building downwash effects from point sources. The US EPA BPIP model with the Prime algorithm has been used to compute building and structure heights and apparent widths and to create the building downwash parameters for AERMOD input. Each scenario was modelled for NO_X, SO_2, PM, and CO. Modelled scenarios assumed all equipment would run 24 hours per day, 7 days per week which would represent the worst case for each of the scenarios presented below and is a conservative assumption.



LEGEND:

WIND SPEED (m/s)

- >= 11.10
- 8.80 - 11.10
- 5.70 - 8.80
- 3.60 - 5.70
- 2.10 - 3.60
- 0.50 - 2.10

Calms: 0.00%

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THIS MAP IS FOR CONCEPTUAL PURPOSES ONLY
AND SHOULD NOT BE USED FOR NAVIGATION

YEC UPGRADES PROJECT

AIR QUALITY ASSESSMENT

WIND ROSE

SLR

FIGURE NO:
6-2

DATE: July 2024

PROJECT NO: 241.V30524.00026

Table 6-3: Stack Parameters and Emission Data – Scenario A – Normal Operating Scenario

Source ID	Source Type	Source Description	Stack Parameters							Emission Data						
			Volumetric Flow Rate (m^3/s)	Exit Gas Temperature (°C)	Inner Diameter/ Initial Vertical Dispersion (m)	Exit Velocity (m/s)	Height Above Grade / Release Height (m)	Height Above Roof (m)	Source Coordinates (UTM Zone 17 NAD 83, m)		Contaminant	CAS #	Maximum Emission Rate (g/s)	Averaging Period	Emission Estimating Technique	Emissions Data Quality	% of Overall Emissions
GTG1	Point	NG-fired Turbine	1,344	594	9.92	17.39	27.4	N/A	617565	4881325	Nitrogen Oxides	10102-44-0	12.38	1, 24	EC	Average	50
											Carbon Monoxide	630-08-0	2.51	0.5	EC	Average	50
											Sulphur Dioxide	7446-09-5	1.69	1, annual	EC	Average	50
											Particulate Matter	N/A	1.14	24	EC	Average	50
GTG2	Point	NG-fired Turbine	1,344	594	9.92	17.39	27.4	N/A	617580	4881278	Nitrogen Oxides	10102-44-0	12.38	1, 24	EC	Average	50
											Carbon Monoxide	630-08-0	2.51	0.5	EC	Average	50
											Sulphur Dioxide	7446-09-5	1.69	1, annual	EC	Average	50
											Particulate Matter	N/A	1.14	24	EC	Average	50
Note: EC refers to Engineering Calculation.																	

Table 6-4: Stack Parameters and Emission Data – Scenario B – Winter Normal Operating Scenario

Source ID	Source Type	Source Description	Stack Parameters							Emission Data						
			Volumetric Flow Rate (m^3/s)	Exit Gas Temperature (°C)	Inner Diameter/ Initial Vertical Dispersion (m)	Exit Velocity (m/s)	Height Above Grade / Release Height (m)	Height Above Roof (m)	Source Coordinates (UTM Zone 17 NAD 83, m)		Contaminant	CAS #	Maximum Emission Rate (g/s)	Averaging Period	Emission Estimating Technique	Emissions Data Quality	% of Overall Emissions
GTG1	Point	NG-fired Turbine	1,294	594	9.92	16.74	21.34	N/A	617565	4881325	Nitrogen Oxides	10102-44-0	12.33	1, 24	EC	Average	50
											Carbon Monoxide	630-08-0	2.50	0.5	EC	Average	50
											Sulphur Dioxide	7446-09-5	1.68	1, annual	EC	Average	50
											Particulate Matter	N/A	1.14	24	EC	Average	50
GTG2	Point	NG-fired Turbine	1,294	594	9.92	16.74	21.34	N/A	617580	4881278	Nitrogen Oxides	10102-44-0	12.33	1, 24	EC	Average	50
											Carbon Monoxide	630-08-0	2.50	0.5	EC	Average	50
											Sulphur Dioxide	7446-09-5	1.68	1, annual	EC	Average	50
											Particulate Matter	N/A	1.14	24	EC	Average	50
Note: EC refers to Engineering Calculation.																	

Table 6-5: Stack Parameters and Emission Data – Scenario C – Summer Normal Operating Scenario

Source ID	Source Type	Source Description	Stack Parameters							Emission Data						
			Volumetric Flow Rate (m^3/s)	Exit Gas Temperature (°C)	Inner Diameter/ Initial Vertical Dispersion (m)	Exit Velocity (m/s)	Height Above Grade / Release Height (m)	Height Above Roof (m)	Source Coordinates (UTM Zone 17 NAD 83, m)		Contaminant	CAS #	Maximum Emission Rate (g/s)	Averaging Period	Emission Estimating Technique	Emissions Data Quality	% of Overall Emissions
GTG1	Point	NG-fired Turbine	1,332	597	9.92	17.23	21.34	N/A	617565	4881325	Nitrogen Oxides	10102-44-0	12.19	1, 24	EC	Average	50
											Carbon Monoxide	630-08-0	2.47	0.5	EC	Average	50
											Sulphur Dioxide	7446-09-5	1.66	1, annual	EC	Average	50
											Particulate Matter	N/A	1.14	24	EC	Average	50
GTG2	Point	NG-fired Turbine	1,332	597	9.92	17.23	21.34	N/A	617580	4881278	Nitrogen Oxides	10102-44-0	12.19	1, 24	EC	Average	50
											Carbon Monoxide	630-08-0	2.47	0.5	EC	Average	50
											Sulphur Dioxide	7446-09-5	1.66	1, annual	EC	Average	50
											Particulate Matter	N/A	1.14	24	EC	Average	50
Note: EC refers to Engineering Calculation.																	

Table 6-6: Stack Parameters and Emission Data – Scenario D – Peak Firing Scenario

Source ID	Source Type	Source Description	Stack Parameters							Emission Data						
			Volumetric Flow Rate (m^3/s)	Exit Gas Temperature (°C)	Inner Diameter/ Initial Vertical Dispersion (m)	Exit Velocity (m/s)	Height Above Grade / Release Height (m)	Height Above Roof (m)	Source Coordinates (UTM Zone 17 NAD 83, m)		Contaminant	CAS #	Maximum Emission Rate (g/s)	Averaging Period	Emission Estimating Technique	Emissions Data Quality	% of Overall Emissions
GTG1	Point	NG-fired Turbine	1,329	616	9.92	17.20	21.34	N/A	617565	4881325	Nitrogen Oxides	10102-44-0	20.77	1, 24	EC	Average	50
											Carbon Monoxide	630-08-0	2.53	0.5	EC	Average	50
											Sulphur Dioxide	7446-09-5	1.71	1, annual	EC	Average	50
											Particulate Matter	N/A	1.14	24	EC	Average	50
GTG2	Point	NG-fired Turbine	1,329	616	9.92	17.20	21.34	N/A	617580	4881278	Nitrogen Oxides	10102-44-0	20.77	1, 24	EC	Average	50
											Carbon Monoxide	630-08-0	2.53	0.5	EC	Average	50
											Sulphur Dioxide	7446-09-5	1.71	1, annual	EC	Average	50
											Particulate Matter	N/A	1.14	24	EC	Average	50
Note: EC refers to Engineering Calculation.																	

Table 6-7: Stack Parameters and Emission Data – Scenario E – Cold Start Scenario or Start-up Condition

Source ID	Source Type	Source Description	Stack Parameters								Emission Data						
			Volumetric Flow Rate (m^3/s)	Exit Gas Temperature (°C)	Inner Diameter/ Initial Vertical Dispersion (m)	Exit Velocity (m/s)	Height Above Grade / Release Height (m)	Height Above Roof (m)	Source Coordinates (UTM Zone 17 NAD 83, m)		Contaminant	CAS #	Maximum Emission Rate (g/s)	Averaging Period	Emission Estimating Technique	Emissions Data Quality	% of Overall Emissions
GTG1	Point	NG-fired Turbine	1,128	580	9.92	14.60	21.34	N/A	617565	4881325	Nitrogen Oxides	10102-44-0	14.00	1, 24	EC	Average	50
											Carbon Monoxide	630-08-0	91.71	0.5	EC	Average	50
											Sulphur Dioxide	7446-09-5	0.52	1, annual	EC	Average	50
											Particulate Matter	N/A	1.08	24	EC	Average	50
GTG2	Point	NG-fired Turbine	1,128	580	9.92	14.60	21.34	N/A	617580	4881278	Nitrogen Oxides	10102-44-0	14.00	1, 24	EC	Average	50
											Carbon Monoxide	630-08-0	91.71	0.5	EC	Average	50
											Sulphur Dioxide	7446-09-5	0.52	1, annual	EC	Average	50
											Particulate Matter	N/A	1.08	24	EC	Average	50

Note: EC refers to Engineering Calculation.

7.0 Modelling Results

Results for the dispersion modelling for NO_X, CO, SO_2, and PM arising from Scenario A to E, are provided in **Table 7-1** through **Table 7-8**. As the Normal Operating Scenario is the Base Load (Average Temperature), these results are discussed in more detail. Results are compared against the MECP O. Reg. 419/05 limits, as only the MECP emission limit is required for compliance purposes as discussed in **Section 3.0**.

7.1 Scenario A - Normal Operating Scenario

Modelling results predict that all COCs at POIs and sensitive receptors are below their respective O. Reg. 419/05 limits. An emission summary table including maximum results at each sensitive receptor and the maximum POI is included in **Section 8.0.** The emission summary table for this scenario is provided in **Table 7-1** and **Table 7-2**.

Results for VOCs, PAHs, and metals are included in **Table 7-3** and **Table 7-4**. All modelled results for VOCs, PAHs, and metals that have limits are within the O. Reg. 419/05 and AAQC standards. Natural gas turbine emissions typically have only trace amounts of these compounds, and the modelling results confirmed this is predicted to be the case for the Project.

As referenced in Section 6.6, there is expected to be a 5% increase in the CO emission rate from 19 lb/hr to 20 lb/hr. When applying this change in emission rate to predicted concentrations at POIs, this increase is anticipated to be negligible. For example, in the case of the predicted CO concentration at a worst-case POI for the Normal Operating Condition **Table 7-2**, the result for the Project is 0.12% of the applicable CO standard. Assuming this concentration is 5% greater than that for the existing facility operations, this is estimated to be an increase from 0.11% to the predicted 0.12% of the standard, or a change of 0.01%.

7.2 Scenario B - Winter Normal Operating Scenario

Modelling results predict that all COCs at POIs and sensitive receptors are below their respective O. Reg. 419/05 limits. The emission summary table for this scenario is provided in **Table 7-5**.

7.3 Scenario C - Summer Normal Operating Scenario

Modelling results predict that all COCs at POIs and sensitive receptors are below their respective O. Reg. 419/05 limits**.** The emission summary table for this scenario is provided in **Table 7-6**.

7.4 Scenario D – Peak Firing Scenario

Modelling results predict that all COCs at POIs and sensitive receptors are below their respective O. Reg. 419/05 limits**.** The emission summary table for this scenario is provided in **Table 7-7**.

7.5 Scenario E - Cold Start Scenario or Start-up Condition

Modelling results predict that all COCs at POIs and sensitive receptors are below their respective O. Reg. 419/05 limits**.** The emission summary table for this scenario is provided in **Table 7-8**.

Table 7-1: Maximum POI Concentrations for Scenario A for Normal Operation Scenario

Contaminant	Total Emission Rate (g/s)	Averaging Period	Maximum POI Concentration (µ/m^3)	Maximum Concentration at a Sensitive Receptor (µg/m^3)	MECP POI Limit (µg/m^3)	Percentage of MECP POI Limit (%)	Sensitive Receptor Percentage of MECP POI Limit (%)
Nitrogen Oxides	24.75	24-hour	4.963	1.783	200	2.48	0.89
		1-hour	30.162	14.053	400	7.54	3.51
Carbon Monoxide	5.02	½-hour	7.308	3.408	6,000	0.12	0.06
Sulphur Dioxide	3.37	1-hour	1.940	1.132	100	1.94	1.13
		annual	0.002	0.002	10	0.02	0.02
Particulate Matter	2.27	24-hour	0.457	0.164	120	0.38	0.14
Note: Averaging periods are taken from O. Reg. 419/05 Schedule 3: Standards with Variable Average Hours.							

Table 7-2: COC Concentrations at POI Compared to Scenario A Criteria for Normal Operation Scenario

Contaminant	CAS #	Total Emission Rate (g/s)	Air Dispersion Model Used	Maximum POI Concentration (µ/m^3)	Averaging Period (hours)	MECP POI Limit (µ/m^3)	Limiting Effect	Source Benchmark	Regulation Schedule #	Percentage of MECP POI Limit (%)
Nitrogen Oxides	10102-44-0	24.75	AERMOD	4.963	24	200	Health	Standard	B1	2.48
			AERMOD	30.162	1	400	Health	Standard	B1	7.54
Carbon Monoxide	630-08-0	5.02	AERMOD	7.308	0.5	6000	Health	Standard	B1	0.12
Sulphur Dioxide	7446-09-5	3.37	AERMOD	1.940	1	100	Health & Vegetation	Standard	B1	1.94
			AERMOD	0.002	annual	10	Health & Vegetation	Standard	B1	0.02
Particulate Matter	N/A	2.27	AERMOD	0.457	24	120	Particulate	Standard	B1	0.38

Table 7-3: VOC & PAH Concentrations at POI Compared to Scenario A Criteria for Normal Operations Scenario

CAS#	COC	Emission Factor (lb/MMBtu)	Emission Rate (g/s)	24-hour POI (µg/m^3)	Annual POI (ug/m^3)	MECP Limit (ug/m^3)	AAQC Limit (µg/m^3)	Percentage of MECP Limit (%)	Percentage of AAQC Limit (%)
91-57-6	2-Methylnaphthalene	2.35E-08	1.16E-05	4.67E-06	9.15E-08	35.5	-	0.000	-
71-43-2	Benzene	2.06E-06	1.02E-03	4.09E-04	8.01E-06	0.45 annual	0.45 annual	0.002	0.002
50-32-8	Benzo(a)pyrene	1.18E-09	5.82E-07	2.34E-07	4.58E-09	0.000001 annual	0.000001 annual	0.458	0.458
106-97-8	Butane	2.06E-03	1.02E+00	4.09E-01	8.01E-03	3550	-	0.012	-
25321-22-6	Dichlorobenzene	1.18E-06	5.82E-04	2.34E-04	4.58E-06	80	-	0.000	-
74-84-0	Ethane	3.04E-03	1.50E+00	6.03E-01	1.18E-02	14500	-	0.004	-
50-00-0	Formaldehyde	7.35E-05	3.64E-02	1.46E-02	2.86E-04	65	65	0.022	0.022
110-54-3	Hexane	1.76E-03	8.73E-01	3.50E-01	6.86E-03	7500	7500	0.005	0.005
91-20-3	Naphthalene	5.98E-07	2.96E-04	1.19E-04	2.33E-06	22.5	22.5	0.001	0.001
109-66-0	Pentane	2.55E-03	1.26E+00	5.06E-01	9.92E-03	35500	-	0.001	-
74-98-6	Propane	1.57E-03	7.76E-01	3.11E-01	6.10E-03	215000	-	0.000	-
108-88-3	Toluene	3.33E-06	1.65E-03	6.62E-04	1.30E-05	2000	2000	0.000	0.000

Table 7-4: Metals Concentrations at POI Compared to Scenario A Criteria for Normal Operations Scenario

CAS#	COC	Emission Factor (lb/MMBtu)	Emission Rate (g/s)	24-hour POI (µg/m^3)	Annual POI (µg/m^3)	MECP Limit (µg/m^3)	AAQC Limit (µg/m^3)	Percentage of MECP O. Reg 419/05 Limit (%)	Percentage of AAQC Limit (%)
7440-38-2	Arsenic	1.96E-07	9.70E-05	3.89E-05	7.63E-07	0.3	0.3	0.013	0.013
7440-39-3	Barium	4.31E-06	2.13E-03	8.57E-04	1.68E-05	10	10	0.009	0.009
7440-41-7	Beryllium	1.18E-08	5.82E-06	2.34E-06	4.58E-08	0.01	0.01	0.023	0.023
7440-43-9	Cadmium	1.08E-06	5.34E-04	2.14E-04	4.20E-06	0.025	0.025	0.857	0.857
7440-43-9	Cadmium	1.08E-06	5.34E-04	2.14E-04	4.20E-06	-	0.005 annual	-	0.084
7440-47-3	Chromium	1.37E-06	6.79E-04	2.73E-04	5.34E-06	0.5	0.5	0.055	0.055
7440-48-4	Cobalt	8.24E-08	4.08E-05	1.64E-05	3.20E-07	0.1	0.1	0.016	0.016
7440-50-8	Copper	8.33E-07	4.12E-04	1.65E-04	3.24E-06	50	50	0.000	0.000
7439-96-5	Manganese	3.73E-07	1.84E-04	7.40E-05	1.45E-06	0.4	50	0.018	0.000
7439-97-6	Mercury	2.55E-07	1.26E-04	5.06E-05	9.92E-07	2	2	0.003	0.003
7439-98-7	Molybdenum	1.08E-06	5.34E-04	2.14E-04	4.20E-06	120	120	0.000	0.000
7440-02-0	Nickel	2.06E-06	1.02E-03	4.09E-04	8.01E-06	0.04 annual	0.04 annual	0.020	0.020
7440-02-0	Nickel	2.06E-06	1.02E-03	4.09E-04	8.01E-06	-	0.1	-	0.409
7782-49-2	Selenium	2.35E-08	1.16E-05	4.67E-06	9.15E-08	10	10	0.000	0.000
7440-62-2	Vanadium	2.30E-06	1.14E-03	4.56E-04	8.93E-06	2	2	0.023	0.023
7440-66-6	Zinc	2.84E-05	1.41E-02	5.65E-03	1.11E-04	120	120	0.005	0.005

Table 7-5: COC Concentrations at POI Compared to Scenario B Criteria for Winter Normal Operation

Contaminant	CAS #	Total Emission Rate (g/s)	Air Dispersion Model Used	Maximum POI Concentration (µ/m^3)	Averaging Period (hours)	MECP POI Limit (µ/m^3)	Limiting Effect	Source Benchmark	Regulation Schedule #	Percentage of MECP POI Limit (%)
Nitrogen Oxides	10102-44-0	24.66	AERMOD	5.405	24	200	Health	Standard	B1	2.70
			AERMOD	34.105	1	400	Health	Standard	B1	8.53
Carbon Monoxide	630-08-0	5.00	AERMOD	8.298	0.5	6,000	Health	Standard	B1	0.14
Sulphur Dioxide	7446-09-5	3.36	AERMOD	2.133	1	100	Health & Vegetation	Standard	B1	2.13
			AERMOD	0.002	annual	10	Health & Vegetation	Standard	B1	0.02
Particulate Matter	N/A	2.27	AERMOD	0.499	24	120	Particulate	Standard	B1	0.42

Table 7-6: COC Concentrations at POI Compared to Scenario C Criteria for Summer Normal Operation

Contaminant	CAS #	Total Emission Rate (g/s)	Air Dispersion Model Used	Maximum POI Concentration (µ/m^3)	Averaging Period (hours)	MECP POI Limit (µ/m^3)	Limiting Effect	Source Benchmark	Regulation Schedule #	Percentage of MECP POI Limit (%)
Nitrogen Oxides	10102-44-0	24.38	AERMOD	4.984	24	200	Health	Standard	B1	2.49
			AERMOD	30.578	1	400	Health	Standard	B1	7.64
Carbon Monoxide	630-08-0	4.95	AERMOD	7.434	0.5	6000	Health	Standard	B1	0.12
Sulphur Dioxide	7446-09-5	3.32	AERMOD	1.951	1	100	Health & Vegetation	Standard	B1	1.95
			AERMOD	0.002	annual	10	Health & Vegetation	Standard	B1	0.02
Particulate Matter	N/A	2.27	AERMOD	0.466	24	120	Particulate	Standard	B1	0.39

Table 7-7: COC Concentrations at POI Compared to Scenario D Criteria for Peak Firing Operation

Contaminant	CAS #	Total Emission Rate (g/s)	Air Dispersion Model Used	Maximum POI Concentration (µ/m^3)	Averaging Period (hours)	MECP POI Limit (µ/m^3)	Limiting Effect	Source Benchmark	Regulation Schedule #	Percentage of MECP POI Limit (%)
Nitrogen Oxides	10102-44-0	41.53	AERMOD	8.390	24	200	Health	Standard	B1	4.20
			AERMOD	51.970	1	400	Health	Standard	B1	12.99
Carbon Monoxide	630-08-0	5.06	AERMOD	7.597	0.5	6000	Health	Standard	B1	0.13
Sulphur Dioxide	7446-09-5	3.41	AERMOD	1.982	1	100	Health & Vegetation	Standard	B1	1.98
			AERMOD	0.002	annual	10	Health & Vegetation	Standard	B1	0.02
Particulate Matter	N/A	2.27	AERMOD	0.460	24	120	Particulate	Standard	B1	0.38

Table 7-8: COC Concentrations at POI Compared to Scenario E Criteria for Cold Start or Start-up Condition

Contaminant	CAS #	Total Emission Rate (g/s)	Air Dispersion Model Used	Maximum POI Concentration (µ/m^3)	Averaging Period (hours)	MECP POI Limit (µ/m^3)	Limiting Effect	Source Benchmark	Regulation Schedule #	Percentage of MECP POI Limit (%)
Nitrogen Oxides	10102-44-0	28.00	AERMOD	8.773	24	200	Health	Standard	B1	4.39
			AERMOD	47.563	1	400	Health	Standard	B1	11.89
Carbon Monoxide	630-08-0	183.41	AERMOD	374.116	0.5	6000	Health	Standard	B1	6.24
Sulphur Dioxide	7446-09-5	1.03	AERMOD	0.909	1	100	Health & Vegetation	Standard	B1	0.91
			AERMOD	0.001	annual	10	Health & Vegetation	Standard	B1	0.01
Particulate Matter	N/A	2.15	AERMOD	0.670	24	120	Particulate	Standard	B1	0.56

8.0 Combined Concentration Results

In addition to meeting the applicable provincial regulatory compliance limits that will be required for MECP approval, a combined effects analysis was conducted to consider the existing ambient air quality conditions in the local region. Predicted results from dispersion modelling were added with the local, historical, ambient air quality data and are presented in **Table 8-1** through **Table 8-3**. The criteria used to evaluate the results of the dispersion modelling in the context of the regional air quality regime were the Provincial Ambient Air Quality Criteria (AAQC) and Federal Canadian Ambient Air Quality Standards (CAAQS).

Since the IESO will continue to dispatch the YEC as a peaking power plant, it is expected to continue to run infrequently and below the regulated 1,500-hour annual limit for peaking facilities. Dispatch forecasting suggests that the unit may run less than 180 hours annually, while 2027 would see the largest number of operating hours at approximately 260. Due to these expected operating conditions the air quality assessment is considered conservative since the modelled scenarios assume both turbines will run 24 hours per day, 7 days per week.

This analysis was conducted for Scenario A, which represents the Normal Operating Scenario, at the 6 selected sensitive receptors. Results of these analyses demonstrate that despite high background concentrations, the COC concentrations at sensitive receptors are within the AAQC and CAAQS thresholds. In the case of annual $PM_{2.5}$, the predicted combined concentrations are 97% of the 8.8 ($\mu g/m^3$) threshold recognized in both the AAQC and CAAQS. However, the total emissions from the Project contribute less than 1% to the combined concentration with the high background concentrations contributing to the air quality condition. It should be noted that the high concentration of ambient $PM_{2.5}$ is due to the smoke that migrated from the wildfires in Ontario and Quebec in June and August of 2023.

Table 8-1: Combined Concentration Results for Scenario A (Normal Operating Scenario) Compared to AAQC

Contaminant	Averaging Period	90th Percentile of Ambient Background Concentration (µg/m^3)	Highest Concentration (Project at Sensitive Receptor (µg/m^3)	Combined Maximum at Sensitive Receptor (µg/m^3)	AAQC Limits (µg/m^3)	Sensitive Receptor Percentage of Limit
NO_X	1-Hour	25.12	14.053	39.17	400	9.79
	24-Hour	24.04	1.783	25.83	200	12.91
CO	1-Hour	421.40	2.840	424.24	36,200	1.17
	8-Hour	403.34	1.587	404.93	15,700	2.58
SO_2	10-min	2.27	1.868	4.14	67 ppb (178.2 µg/m^3)	2.32
	1-Hour	1.38	1.132	2.51	40 ppb (106.4 µg/m^3)	2.36
	annual	0.80	0.002	0.81	4 ppb (10.6 µg/m^3)	7.50
PM_{10}	24-Hour	21.37	0.164	21.54	50	43.08
$PM_{2.5}$	24-Hour	11.54	0.164	11.71	27	43.36
	annual	8.55	0.001	8.55	8.8	97.12

Note:
[1] The AAQC limits for SO_2 and NO_2 are in the unit of Part Per Billion (ppb). The (ppb) unit converted to (µg/m^3) by using following factors:
SO_2: (µg/m^3) = (ppb) * 2.66
NO_2: (µg/m^3) = (ppb) * 1.88

Table 8-2: Combined Concentration Results for Scenario A (Normal Operating Scenario) Compared to CAAQS

Contaminant	Averaging Period	90th Percentile of Ambient Background Concentration (µg/m³)	Highest Concentration at Sensitive Receptor (µg/m³) *	Cumulative Concentration at Sensitive Receptor (µg/m³)	CAAQS Targets (ppb)	Sensitive Receptor Percentage of Targets (%)
NO_2	1-Hour	22.15	1.183	23.33	42 (78.9 µg/m³)	29.55
	annual	11.01	0.014	11.09	12 (22.5 µg/m³)	48.86
$PM_{2.5}$	24-Hour	11.54	0.063	11.60	27 (µg/m³)	42.97
	annual	8.55	0.001	8.56	8.8 (µg/m³)	97.17
SO_2	1-Hour	1.38	0.253	1.63	65 (172.9 µg/m³)	0.94
	Annual	0.79	0.002	0.80	4 (10.6 µg/m³)	7.44

Note:
[1] The CAAQS limits for SO_2 and NO_2 are in the unit of Part Per Billion (ppb). The (ppb) unit converted to (µg/m³) by using following factors:
SO_2: (µg/m³) = (ppb) * 2.66
NO_2: (µg/m³) = (ppb) * 1.88
***CAAQS Statistical Form:**
The 1-hour NO_2 CAAQS is based on the 3-year average of the annual 98th percentile of the NO_2 daily maximum 1-hour average concentrations.
The annual NO_2 CAAQS is based on the average over a single calendar year of all the 1-hour average NO_2 concentrations.
The 24-hr $PM_{2.5}$ CAAQS is based on the 3-year average of the annual 98th percentile of the 24-hr average concentrations.
The annual $PM_{2.5}$ CAAQS is based on the average of the three highest annual average values over the study period.
The 1-hour SO_2 CAAQS is based on the 3-year average of the annual 99th percentile of the SO_2 daily maximum 1-hour average concentrations.
The annual SO_2 CAAQS is based on the average over a single calendar year of all the 1-hour average SO_2 concentrations.

Table 8-3: COC Combined Concentrations Compared to AAQC/CAAQs Limits at Sensitive Receptors during Scenario A Normal Operating Conditions

Receptor	COC Specific Combined Concentrations at Sensitive Receptors for Normal Operations																											
	NO_X 24-Hour			NO_X 1-Hour			PM_{10} 24-Hour			$PM_{2.5}$ 24-hour			$PM_{2.5}$ annual			CO 1-Hour			CO 8-Hour			SO_2 10-minute			SO_2 1-Hour			SO_2 annual		
	Combined Concentration (ug/m^3)	Percentage of AAQC Limit	Percentage of Ambient Background Contribution	Combined Concentration (ug/m^3)	Percentage of AAQC Limit	Percentage of Ambient Background Contribution	Combined Concentration (ug/m^3)	Percentage of AAQC Limit	Percentage of Ambient Background Contribution	Combined Concentration (ug/m^3)	Percentage of CAAQs Target	Percentage of Ambient Background Contribution	Combined Concentration (ug/m^3)	Percentage of CAAQs Target	Percentage of Ambient Background Contribution	Combined Concentration (ug/m^3)	Percentage of AAQC Limit	Percentage of Ambient Background Contribution	Combined Concentration (ug/m^3)	Percentage of AAQC Limit	Percentage of Ambient Background Contribution	Combined Concentration (ppb)	Percentage of AAQC Limit	Percentage of Ambient Background Contribution	Combined Concentration (ppb)	Percentage of AAQC Limit	Percentage of Ambient Background Contribution	Combined Concentration (ppb)	Percentage of AAQC Limit	Percentage of Ambient Background Contribution
R1	24	12%	12%	36	9%	6%	22	43%	43%	12	43%	43%	8.55	97%	97%	424	1%	1%	405	3%	3%	2.1	3%	1%	0.9	2%	1%	0.31	8%	8%
R2	24	12%	12%	39	10%	6%	22	43%	43%	12	43%	43%	8.55	97%	97%	424	1%	1%	405	3%	3%	2.1	3%	1%	1.0	2%	1%	0.31	8%	8%
R3	24	12%	12%	29	7%	6%	21	43%	43%	12	43%	43%	8.55	97%	97%	422	1%	1%	404	3%	3%	1.7	2%	1%	0.7	2%	1%	0.30	8%	8%
R4	24	12%	12%	32	8%	6%	21	43%	43%	12	43%	43%	8.55	97%	97%	423	1%	1%	404	3%	3%	1.9	3%	1%	0.8	2%	1%	0.31	8%	8%
R5	24	12%	12%	29	7%	6%	21	43%	43%	12	43%	43%	8.55	97%	97%	422	1%	1%	404	3%	3%	1.7	3%	1%	0.7	2%	1%	0.31	8%	8%
R6	24	12%	12%	37	9%	6%	21	43%	43%	12	43%	43%	8.55	97%	97%	424	1%	1%	405	3%	3%	2.1	3%	1%	0.9	2%	1%	0.31	8%	8%

9.0 Summary of Findings

Following implementation of the upgrades, the YEC is predicted to remain in compliance with applicable provincial standards and guidelines. With the implementation of the newer ultra low NO_X combustion system technology, it is anticipated that the NO_X emission rate will be reduced by 37%, with little to no change in emission rates for other COCs. Dispersion modelling results show that all COCs are predicted to be below their respective O. Reg. 419/05 limits.

The results of the combined effects analysis demonstrated that despite high background concentrations, the COC concentrations at sensitive receptors are within the AAQC and CAAQC limits.

These assessments can be considered conservative since the dispersion modelling scenarios used to assess potential impacts assume the facility is operating both turbines, 24 hours, 7 days a week, while the intended use is to continue to operate the YEC as a peaking plant with operations to be intermittent and only in response to demand cycles, as scheduled by the IESO.

10.0 Closure

Should you have questions on the above report, please contact the undersigned.

Regards,

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Appendix A Guideline A-5 Requirements

Air Quality Assessment

York Energy Centre Upgrades Project

Capital Power Corporation

SLR Project No.: 241.030524.00026

July 2024

A.1 Guideline A-5 Requirements (Simple Cycle – Normal Operating Scenario)

Guideline A-5, under O. Reg. 419/05 specifies operating conditions which must be met for gas turbines, among other sources, in order to improve provincial air quality. For a gas turbine facility, these limits are calculated based on the power rating on the turbine as well as heat recovery units, where applicable. The limits and calculations have been included, the A-5 guideline specifies limits for NO_X, CO and SO_2 under normal operating conditions.

The emission limits for the pollutants of concern are determined based on the turbine operation and expressed as parts per million volume concentrations in the stack (ppmv) at Reference Conditions (i.e., 15% O_2 on a dry volume basis, 60% relative humidity, 15ºC ambient temperature, 101.3 kPa barometric pressure).

As the unit is expected to operate less than 1,500 hours per year, the 140 g/GJ output-based NO_X emission limit was used to calculate the applicable concentration-based NO_X limit. There is no direct recovery of thermal energy for heating purposes; hence, it will have no useful external heat output.

Under the turbine condition, the net thermal efficiency for this configuration is estimated to be 18.5%, based on the heating value of natural gas fuel.

Table A.1-1 below calculates the simple cycle NO_X limit based on equations from A-5. In this configuration the NO_X limit for the stack would be 16.2 ppmv and would be under the limit.

The carbon monoxide (CO) emission limit for combustion turbine systems of all sizes and fuel types is 50 ppmv, corrected to 15% O_2 at reference conditions. For the normal operating conditions, the expected CO concentration in the exhaust is predicted to be 20 ppmv based on the manufacturing data provided and this meets the limit.

For SO_2, the A-5 Guideline does not have an emission limit. Instead, the natural gas used on-site has to contain <120 milligrams per cubic metre of sulphur. This is regulated under Part 3 of the *Canadian Energy Regulator Act*. If the natural gas being used does not meet this requirement, then source testing will be expected for SO_2.

Table A.1-1: Simple Cycle A-5 Calculation

Parameter	Units	YEC
Heat input to combustion turbine	GJ/hr	4575.0
Heat input to combustion turbine	MW	1271.0
Heat input to auxiliary burner(s)	GJ/hr	0.0
Heat input to auxiliary burner(s)	MW	0.0
Cycle configuration	-	simple
Power output, combustion turbine	MW	234.8
Power output, Rankine cycle turbine	MW	0.0
Total power generation/output	MW	235.0
Thermal efficiency (Equation 10)	%	18.5%
F-factor for natural gas on a dry basis	DSm^3/GJ	240.0
Output-based NO_X emission limit (Table 1)	g/GJ	140.0
Calculated maximum NO_X emission rate (Equation 5)	g/hr	118,334.0
Calculated maximum concentration-based NO_X emission limit (Equation 2)	ppmv	16.2
Proposed applicable concentration-based NO_X emission limit (Table 2 or Equation 8)	ppmv	16.2
95% of NO_X as NO	ppmv	10.1
5% of NO_X as NO_2	ppmv	0.8

Appendix B Emission Factor and Calculation Tables

Air Quality Assessment

York Energy Centre Upgrades Project

Capital Power Corporation

SLR Project No.: 241.030524.00026

July 2024

B.1 Gas Turbine, GEN

B.1.1 Peak Firing, Normal Operation, Cold Start Simple Cycle Scenarios

Methodology: Manufacturer's Data

Emissions from the gas turbine (SGT 6-5000F) was provided by Siemens for both normal and peak firing scenarios. Data was provided for NO_X, CO, and PM based on the updated parameters from the turbines. Data for NO_X, CO and PM was provided in lb/hr. The following equation is an example of how this lb/hr value is converted to a g/s emission rate for NO_X.

$$Emission\ Rate\ \left(\frac{g}{s}\right) = Emission\ \left(\frac{lb}{hr}\right) * \frac{1(kg)}{2.2(lb)} * \frac{1000(gr)}{1(kg)}\ * \frac{1(hr)}{3600(s)}$$

$$Emission\ Rate\ \left(\frac{g}{s}\right) = 98\ \left(\frac{lb}{hr}\right) * \frac{1(kg)}{2.2(lb)} * \frac{1000(gr)}{1(kg)}\ * \frac{1(hr)}{3600(s)}$$

$$NOx\ Emission\ Rate\ = 12.37\ \left(\frac{g}{s}\right)$$

Methodology: Emission Factors

SO_2 data was not provided by the manufacturer, therefore US EPA AP-42 Chapter 3.1: Stationary Gas Turbines emission factors were used to calculate SO_2 emissions.

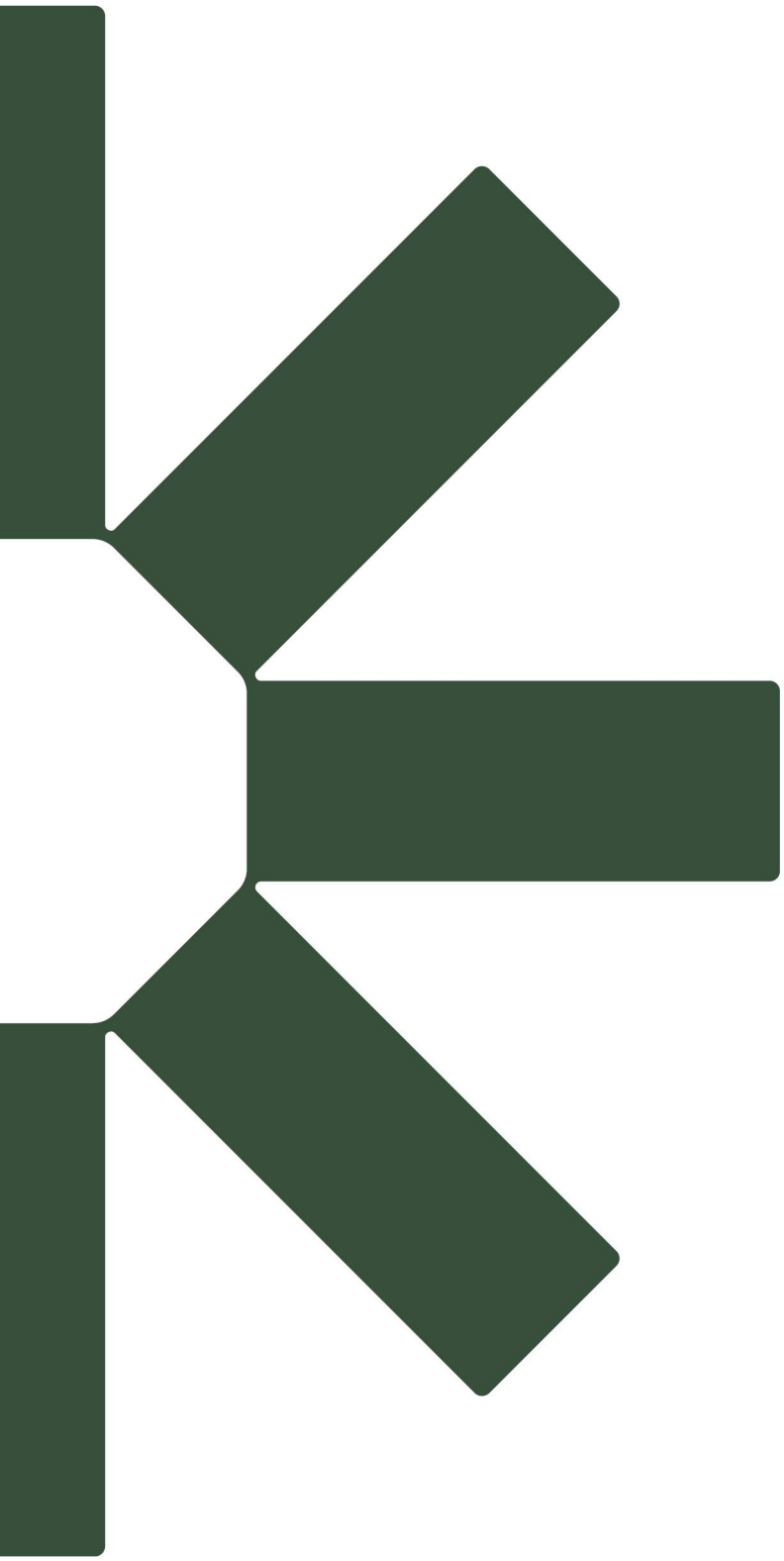
SO_2 Emission Factor = 0.0034 lb/MMbtu

$$SO2\ Emissions = Emission\ facotr\ *\ Energy\ Value\ (LHV)$$

$$SO2\ Emissions = 0.0034\left(\frac{lb}{MMbtu}\right) * 3927.87\ \left(\frac{MMbtu}{hr}\right)$$

$$SO2\ Emissions = 13.35\left(\frac{lb}{hr}\right) * \frac{1(kg)}{2.2(lb)} * \frac{1000(gr)}{1(kg)}\ * \frac{1(hr)}{3600(s)}$$

$$SO2\ Emission\ Rate = 1.68\ \left(\frac{g}{s}\right)$$



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