Stantec

Centre Village Renewables Integration and Grid Security Synchronous Condensing/Generation Facility Project - Human Health Risk Assessment

March 23, 2026

Prepared for:
PROENERGY Holding Company, Inc.

Prepared by:
Stantec Consulting Ltd.

File Number:
121418452

Limitations

The conclusions in the Report titled Centre Village Renewables Integration and Grid Security Synchronous Condensing/Generation Facility Project - Human Health Risk Assessment are Stantec's professional opinion, as of the time of the Report, and concerning the scope described in the Report. The opinions in the document are based on conditions and information existing at the time the scope of work was conducted and do not take into account any subsequent changes. The Report relates solely to the specific project for which Stantec was retained and the stated purpose for which the Report was prepared. The Report is not to be used or relied on for any variation or extension of the project, or for any other project or purpose, and any unauthorized use or reliance is at the recipient's own risk.

Stantec has assumed all information received from PROENERGY Holding Company, Inc. (the "Client") and third parties in the preparation of the Report to be correct. While Stantec has exercised a customary level of judgment or due diligence in the use of such information, Stantec assumes no responsibility for the consequences of any error or omission contained therein.

This Report is intended solely for use by the Client in accordance with Stantec's contract with the Client. While the Report may be provided by the Client to applicable authorities having jurisdiction and to other third parties in connection with the project, Stantec disclaims any legal duty based upon warranty, reliance or any other theory to any third party, and will not be liable to such third party for any damages or losses of any kind that may result.

Executive Summary

PROENERGY Holding Company, Inc. retained Stantec Consulting Ltd. to complete a Human Health Risk Assessment (HHRA) for the proposed Centre Village Renewables Integration and Grid Security Project (the Project). The Project consists of a 500-MW electricity grid-support and dispatchable power-generation facility designed to stabilize renewable energy supply in New Brunswick. The facility is expected to run predominantly in synchronous condensing mode, which provides grid stability without fuel combustion or air emissions. Electricity generation during normal operations will use natural gas as the fuel. Ultra-low sulphur diesel (ULSD) may be used as a backup fuel in the very unlikely event of a natural gas supply interruption.

Facility construction, operation, and decommissioning have the potential to introduce contaminants to environmental media. During construction, potential emissions are expected to be limited to road dust and diesel exhaust associated with typical construction activities. During operations, air emissions occur only during electricity generation by the CTGs; no emissions are produced during synchronous condensing. Water discharges from the facility are limited to reject water generated by onsite groundwater treatment processes; the power-generation system itself produces no wastewater.

The HHRA follows Health Canada's established framework for Project-based human health risk assessments and evaluates whether predicted changes in environmental quality may result in adverse health effects for people living, working, or carrying out land-use activities in the surrounding area.

Based on the Project design and surrounding land use, air inhalation was identified as the only complete exposure pathway for human receptors. Other potential pathways (including those related to soil, groundwater, surface water, and country foods) were screened out on the basis that the Project is not expected to introduce contaminants into these media at levels relevant to human health. Consistent with documented land use, potential receptor groups for this pathway include residential, Indigenous, and recreational receptors.

Two contaminants of potential concern were retained for quantitative assessment: nitrogen dioxide (NO_2) and fine particulate matter ($PM_{2.5}$). Both are non-threshold pollutants for which health effects have been documented at low ambient concentrations. Under planned operating conditions, which involve intermittent operation of the CTGs using natural gas as the fuel, health risk estimates (hazard quotients, HQs) for both short-term and long-term inhalation exposure do not exceed the acceptable target limit of 1.0, indicating negligible or minimal health risk. Although annual $PM_{2.5}$ HQs slightly exceed 1.0, this reflects existing baseline regional air quality conditions, with the Project's incremental contribution being negligible.

In the unlikely contingency scenario where natural gas supply is interrupted and the CTGs operate on ULSD, conservative air dispersion modelling indicates that predicted NO_2 and $PM_{2.5}$ concentrations at human receptor locations would meet applicable air quality guidelines, indicating negligible potential for adverse health effects.

The HHRA incorporates conservatism across emissions modelling, exposure assumptions, and toxicity information leading to overestimates rather than underestimates of Project-related exposures. However, the HHRA framework does not capture potential positive population-level health effects from reduced regional reliance on coal-fired electricity generation (which would be expected to reduce contaminant exposures at a regional level), meaning the assessment may overstate the Project's net effect on human health.

Overall, the HHRA concludes that the Project-related risk to human health is negligible to minimal. No human-health-specific monitoring is required, though routine operational air-emissions monitoring is recommended to confirm the accuracy of modelling predictions. Assumptions regarding groundwater and surface water should be verified upon completion of the associated environmental assessments.

Table of Contents

List of Tables

List of Figures

List of Appendices

Acronyms / Abbreviations

AAQO	ambient air quality objectives
AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model (Atmospheric Dispersion Modeling System)
ATV	all-terrain vehicle
CAAQS	Canadian Ambient Air Quality Standards
CIP	Clean-in-Place
CO	carbon monoxide
CO_2	carbon dioxide
COPC	contaminant of potential concern
CSM	conceptual site model
CTG	combustion turbine generator
ECCC	Environment and Climate Change Canada
EIA	Environmental Impact Assessment
GHG	greenhouse gas
GNB	Government of New Brunswick
HHRA	Human Health Risk Assessment
HQ	Hazard Quotient
IAAC	Impact Assessment Agency of Canada
IPD	Initial Project Description
kV	kilovolt
LAA	Local Assessment Area
M&NP	Maritimes and Northeast Pipeline
MW	megawatt
NB Power	New Brunswick Power Corporation
NB SARA	New Brunswick *Species at Risk Act*
NH_3	ammonia
NOx	nitrogen oxides

NO_2	nitrogen dioxide
PDA	Project Development Area
PM	Particulate matter
$PM_{2.5}$	Particulate matter ≤ 2.5 microns
PM_{10}	Particulate matter ≤ 10 microns
PROENERGY	PROENERGY Holding Company Inc.
Project	Centre Village Renewables Integration and Grid Security Project
SO_2	sulfur dioxide
TRV	toxicity reference values
TSP	total suspended particulates
ULSD	ultra-low sulfur diesel

1 Introduction

PROENERGY Holding Company, Inc. (PROENERGY) retained Stantec Consulting Ltd. (Stantec) to conduct a Human Health Risk Assessment (HHRA), the purpose of which is to evaluate whether potential changes in environmental quality associated with the proposed Centre Village Renewables Integration and Grid Security Project (the Project) could result in future adverse health effects for people living, working, or carrying out traditional land-use activities in the surrounding area.

The Project is an electricity grid-support facility and dispatchable power generation solution designed to support grid stability and renewable energy integration in New Brunswick. Dispatchable power generation refers to electricity that can be brought online as needed in response to grid conditions, rather than operating continuously, and is intended to complement variable renewable energy sources during periods of supply shortfall or elevated system demand. Construction, operation, and decommissioning of the Project, including associated infrastructure, may introduce contaminants to environmental media, potentially resulting in plausible pathways for human exposure.

Given the Project’s potential to introduce contaminants to the environment under certain operating conditions, the HHRA provides a structured, evidence-based approach for evaluating whether predicted changes in environmental quality may pose unacceptable health risks. The assessment also supports regulatory decision-making by identifying relevant exposure pathways, characterizing potential health effects and uncertainties, and informing appropriate mitigation and monitoring measures, where appropriate.

This document is the HHRA associated with chemicals in the environment. Occupational exposure to chemicals is typically addressed under provincial regulations. Potential effects of noise were assessed using the New Brunswick *Noise Compliant Response Guidelines* (NBDELG 2023), as documented in Addendum #1 (Stantec 2025).

2 Project Overview

The proposed Project is an electricity grid support facility and dispatchable power generation solution for New Brunswick, with an installed capacity of up to 500 megawatts (MW). The Project is intended to support grid stability and facilitate increased integration of renewable energy while meeting growing energy demand as the province transitions toward a net-zero electric grid.

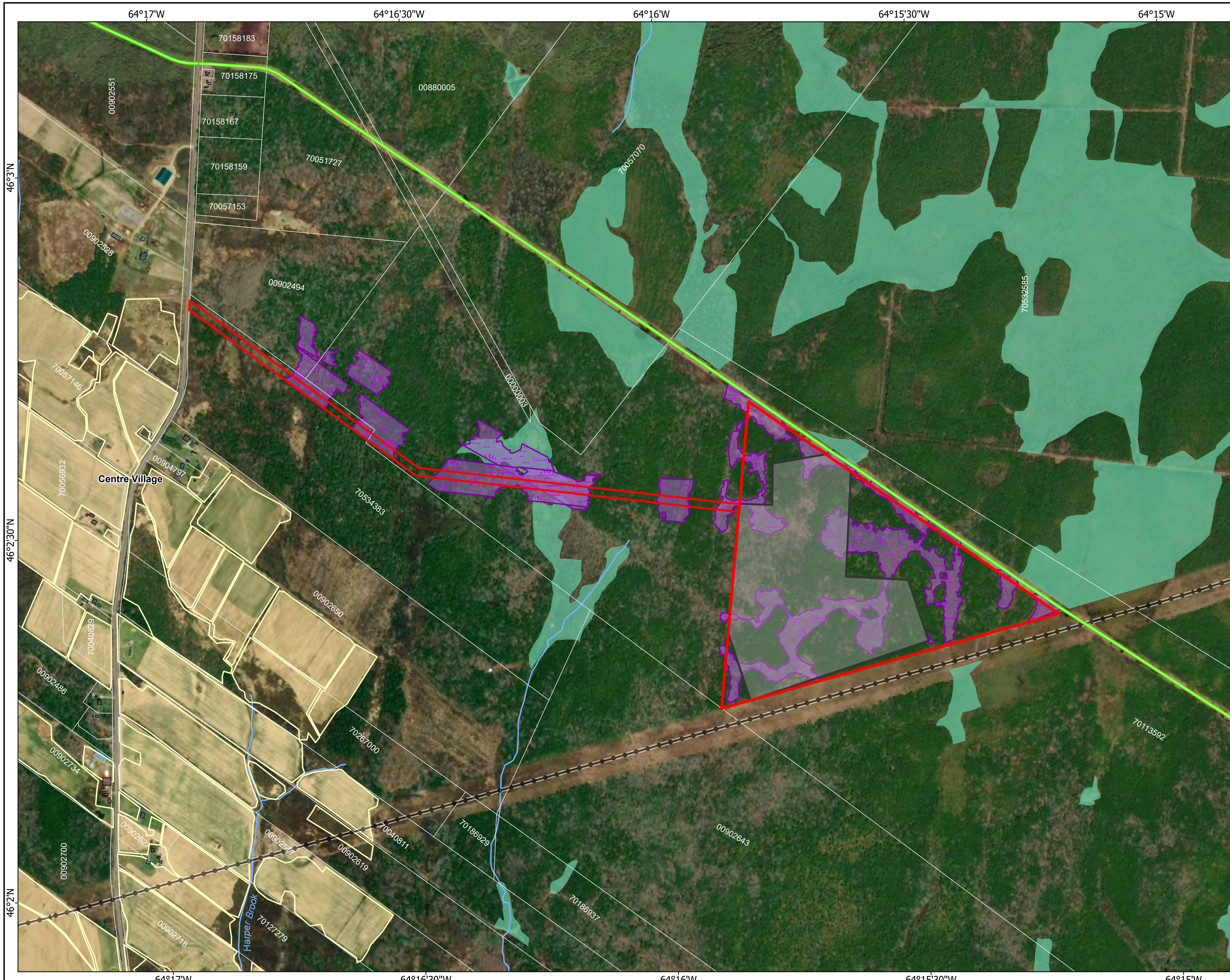
The Project will use synchronous condensing technology paired with aeroderivative combustion turbine generators (CTGs). In synchronous condensing mode, the facility provides voltage support and system inertia to the electricity grid without fuel combustion or air emissions, acting as a 'shock absorber' for the electricity grid to smooth the effects of sudden fluctuations associated wind and solar generation. When required, the facility can operate in electricity-generation mode to provide fast-start, dispatchable power during periods of renewable supply shortfall or elevated system demand.

The Project site, located within Westmorland County, New Brunswick, was selected due to its proximity to existing energy infrastructure, including a 138 kilovolt (kV) transmission line owned and operated by New Brunswick Power Corporation (NB Power) and the Maritimes and Northeast Pipeline (M&NP) 30-inch natural gas pipeline (Figure 2.1). The facility will connect directly to NB Power's existing 138-kV transmission network adjacent to the generating station.

Air emissions associated with the Project occur during periods of electricity generation by the CTGs and are not produced during synchronous condensing operations. Under normal operations, the CTGs will run on natural gas that is delivered to the facility via pipeline. Ultra-low sulphur diesel (ULSD) may be used as a backup fuel in the unlikely event of a natural gas supply interruption, such as during extreme weather events.

By providing flexible grid support and limited dispatchable generation, the Project is expected to help displace higher-emitting electricity sources within the regional power system, including reducing reliance on coal-fired generation. NB Power estimates that the Project could result in a net reduction of up to 250,000 tonnes of carbon dioxide (CO_2) per year, including approximately 150,000 tonnes per year of avoided coal-related emissions.

The following sections provide a summary of the Project-related chemical releases, environmental setting, and land use characteristics relevant to the HHRA. Additional Project Description information is provided in the Initial Project Description / Environmental Impact Assessment (IPD/EIA) Registration (PROENERGY 2025) and Addendum #1 (Stantec 2025).



Stantec

Legend

- Project Area
- Development Footprint (Approximate)

Built Infrastructure

- Road
- Transmission Line (Existing)
- Pipeline (Existing)
- Building

Land Use

- Property Boundary
- Agricultural Land (ARMS)

Wetlands and Waterways

- Watercourse
- Wetland (NBDELG)
- Wetland (Stantec)

N

0 100 200 300 400 500 m

(At original document size of 11x17)
1:10,000

Notes

1. Coordinate System: NAD 1983 CSRS New Brunswick Stereographic
2. Data Sources: NB Power; Stantec; GeoNB (NBHN, NBRN); NB Natural Resources and Energy Development; NB Environment and Local Government; NB Agriculture, Aquaculture and Fisheries; Service NB.
3. Background: Vantor, Esri, CGIAR, USGS

Project Location:

Project Location Prepared by AC on 2025-06-02
Centre Village, NB

Client/Project 121418452
WattBridge Energy LLC
RIGS-Centre Village

Figure No.
2.1

Title
Project Site and Access Road

\\Ca0181-ppfss01\workgroup\1214\active\121418134\2_drawings\mapping\aprx\121418452_CentreVillage_RIGS\121418452_CentreVillage_RIGS_IPD.aprx Revised: 2025-11-12 By: acuff

2.1 Potential Chemical Releases

The Project has the potential to produce air, liquid, and solid wastes throughout its construction, operation, and decommissioning. This may result in emissions and the release of contaminants into the environment.

2.1.1 Air Contaminants

During construction, the Project will generate air emissions primarily from land clearing, earthworks, material handling, and the movement and operation of heavy-duty equipment. These activities will result in the release particulate matter (dust) as well as combustion by-products such as nitrogen oxides (NO_x), sulphur dioxide (SO_2), carbon monoxide (CO), and fine particulates ($PM_{2.5}$). Similar types of emissions may also occur intermittently during decommissioning as equipment is dismantled and areas are regraded.

Air contaminant emissions occur during periods of electricity generation, when the CTGs are operating. In these instances, emissions result from the combustion of natural gas under normal operating conditions, with ULSD used only as a contingency backup fuel in the unlikely event of a natural gas supply interruption. Operational air contaminants include NO_x, SO_2, CO, and particulate matter (total suspended particulates [TSP] and $PM_{2.5}$). Ammonia (NH_3) may also be released in small quantities as a by-product of the emissions-control system.

No air emissions will be produced during synchronous condensing operations, as this mode does not involve fuel combustion.

2.1.2 Liquid Effluent and Stormwater

Liquid effluent from the Project will be generated through the water purification system, which includes reverse osmosis and electrodeionization processes. These treatment processes remove dissolved solids and other impurities from groundwater, resulting in an effluent (reject water) with concentrations approximately three times higher than the raw groundwater.

Reject water is produced when groundwater is withdrawn and processed through the water treatment system, which occurs primarily when the facility is generating electricity. As a result, the volume of reject water will fluctuate with facility operating conditions: effluent flows will range from zero during periods when groundwater is not being pumped to substantially higher flows during times when CGTs are operating.

Additional intermittent effluent streams include:

- Backwash water generated from filter cleaning, which may contain elevated suspended solids. This water will be directed to the onsite stormwater pond for gravity settling.
- Clean-in-Place (CIP) water, a chemically concentrated cleaning solution used for maintaining the reverse osmosis membranes. Due to its higher chemical strength and infrequent production, CIP water will be collected and transported offsite for appropriate disposal.

PROENERGY is evaluating two discharge options for the reject water: routing to a site ditch leading to a wetland west of the facility or conveying it to the provincial roadside ditch along Route 940. Both options require further environmental study, particularly concerning potential effects on groundwater, surface water, and fish habitat, as well as regulatory approvals under provincial and federal frameworks.

Stormwater will be managed throughout construction, operation, and decommissioning using ditches, swales, culverts, and a stormwater management pond designed to control runoff quantity and quality. This system will help prevent erosion, manage suspended solids, and keep stormwater separate from process wastewater, thereby ensuring compliance with regulatory expectations and reducing environmental impacts.

2.1.3 Solid Wastes

The Project will generate several categories of solid wastes during construction, operation, and decommissioning. Non-hazardous domestic solid waste will include everyday refuse such as food waste, office waste, and packing materials. Hazardous solid wastes will also be produced, including oily materials (filters, rags, waste oil, lubricants), batteries, and paints, which require special handling. In addition, construction and demolition wastes such as scrap metal, insulation, asphalt, and concrete will accumulate as site development and maintenance activities proceed. The Project will also generate organic materials during construction, including cleared vegetation and excavated soils and rocks

Merchantable timber removed during site clearing will be managed through agreements with J.D. Irving, Limited, which manages woodlands in the region. Clean, uncontaminated excavated soil and stone will be reused onsite as backfill, for berm construction, or landscaping. Other wastes will be sorted, stored properly, and transported offsite for disposal at licensed waste management facilities. Small quantities of hazardous wastes (e.g., oily rags) will be kept in a designated storage area before being transported by a licensed contractor in accordance with the Transportation of Dangerous Goods Act.

2.2 Environmental Setting

The Project is situated within the Eastern Lowlands ecoregion of New Brunswick, an area characterized by a humid continental climate with long, cold winters and warm summers. Local climate patterns are primarily shaped by the region’s relatively flat topography and its distance from the Atlantic Ocean. Baseline climate data from the nearby Sackville weather station indicate an annual precipitation of 1,147 mm, including 231 cm of snowfall, highlighting a moisture-rich environment typical of the Maritime provinces.

Air quality in the region reflects its location within New Brunswick’s central air zone, the largest of the province’s three air management zones and one that includes major population centers such as Moncton, Fredericton, and Miramichi. This zone hosts several industrial emitters and is supported by 11 continuous ambient monitoring stations. Baseline air quality conditions near the Project site indicates good regional air quality with room for improvement in particulate levels. Additional discussion of air quality is provided in Section 4.2.1

The Project area sits on relatively low-relief terrain and is supported by groundwater systems typical of the Maritime Carboniferous Basin. Shallow groundwater flows toward tributaries of the Tantramar River, while deeper flow patterns follow the regional gradient toward the Bay of Fundy. Surficial materials consist largely of thin glacial till, with permeable sedimentary bedrock allowing groundwater movement through both matrix porosity and fractured zones. Groundwater quality data within 10 km of the Project site indicate generally good conditions, with occasional exceedances of aesthetic objectives for iron and manganese, typical of regional geology rather than anthropogenic influence.

Ecologically, the region contains mixed-wood forests, wetlands, and diverse terrestrial and aquatic habitats. Wetlands are common in the landscape. Although fish habitat is absent from the wetland immediately west of the Project site, downstream tributaries may contain fish habitat, and these areas have been flagged for additional assessment. Wildlife typical of the Maritime Lowlands, such as small mammals, migratory birds, and wetland-dependent species, use the surrounding habitat.

2.3 Land Use

Human use of the land surrounding the Project site is limited, with no sensitive human receptors such as schools, hospitals, daycares, or parks identified within a 5-km radius of the facility. The surrounding landscape is primarily rural and undeveloped, and residential presence appears sparse, with few potential residences identified around the Project area. Residences are expected to obtain their potable water from private water wells. Other land use in the vicinity includes informal recreational access, notably all-terrain vehicle (ATV) and snowmobile use along existing transmission line and pipeline rights-of-way.

For Indigenous land use, the Amlamgog (Fort Folly) First Nation and Metepenagiag Mi’kmaq Nation have reserves closest to the Project, with the closest (Fort Folly) 23 km away. Although traditional land and resource use may occur in the region, the immediate Project area does not appear to be regularly used for hunting, gathering, or cultural land activities. However, the EIA (PROENERGY 2025) acknowledges the potential for regional traditional land use and states that engagement with Indigenous groups is ongoing to assess such interactions.

3 Regulatory Context and Human Health Risk Assessment Framework

This section provides an overview of the regulatory context and methodological framework applied in completing the HHRA for the Project. The HHRA follows the structure and best-practice approaches described in Health Canada's guidance for evaluating human health effects in impact assessments, which outlines the key steps required to assess potential project-related changes in human health. The guidance underscores the iterative nature of risk assessment, recognizing that data needs, exposure pathways, or receptor groups may be refined as additional information becomes available.

The following subsections describe the regulatory setting relevant to this assessment and outline each component of the HHRA framework applied in this study.

3.1 Regulatory Setting

The HHRA for this Project was completed following nationally recognized best practices for evaluating potential human health effects in the context of impact assessments. In the absence of jurisdiction-specific HHRA guidance, the assessment relied on Health Canada's suite of guidance documents developed to support consistent, transparent, and scientifically defensible evaluations of project-related health effects, namely:

- Guidance for Evaluating Human Health Effects in Impact Assessment: Human Health Risk Assessment (Health Canada 2023a)
- Guidance for Evaluating Human Health Effects in Impact Assessment: Air Quality (Health Canada 2023b)
- Guidance for Evaluating Human Health Effects in Impact Assessment: Country Foods (Health Canada 2023c)
- Guidance for Evaluating Human Health Effects in Impact Assessment: Drinking and Recreational Water Quality (Health Canada 2023d)

3.2 Risk Assessment Framework Overview

The potential for human health risk from a contaminant depends on the intersection of three fundamental factors:

1. A receptor – an individual or group that may be exposed to Project-related contaminants, identified based on location, proximity to sources, and potential sensitivity (e.g., residences, recreational users, or sensitive populations such as daycares or hospitals).
2. A contaminant of potential concern (COPC) - a substance with inherent properties that warrant evaluation based on predicted or measured concentrations, toxicity, and potential to cause adverse effects.

3. An exposure pathway - a complete route by which the COPC can reach the receptor, considering the environmental media (air, water, soil, country foods), transport mechanisms, and receptor activities.

As illustrated in Figure 3.1, risk can only exist when all three factors overlap, meaning a receptor is exposed to a COPC through a complete exposure pathway. If any one of these factors is absent (for example, if no exposure pathway exists, or if a receptor is present but not located where changes in COPC concentrations occur), then a project-related health risk is not expected.

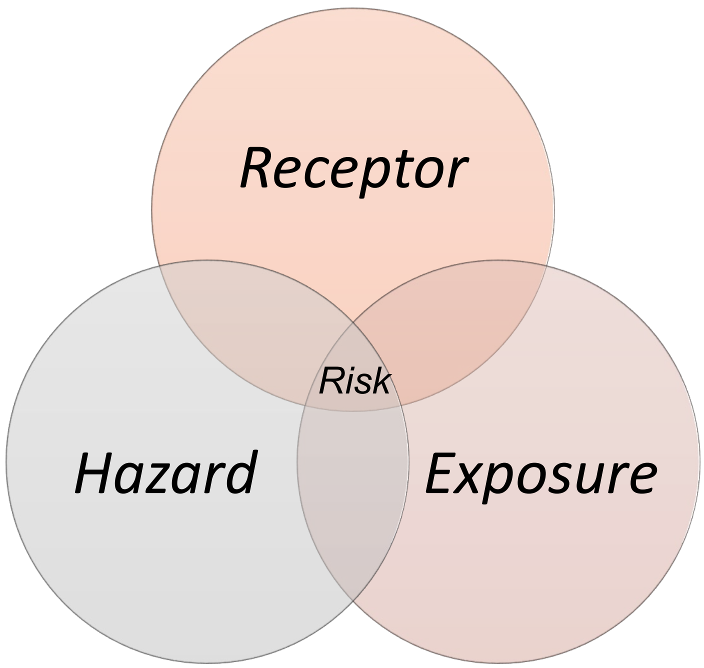


Figure 3.1 Risk Venn Diagram

However, where all three factors are present, the magnitude of risk depends on additional considerations, such as the concentration of the COPC at receptor locations, the duration and frequency of exposure, receptor characteristics, and the toxicity of the COPC under the relevant exposure scenario. These details are further assessed during the exposure assessment and toxicity assessment steps.

This conceptual triad is reflected in the development of the conceptual site model (CSM), which schematically links Project-related COPCs, receptors, and exposure pathways. The CSM forms the foundation for determining what level of detail, ranging from simple and qualitative to complex and quantitative, should be applied to the HHRA.

3.3 Components of a Human Health Risk Assessment

Risk assessment follows a widely recognized framework that progresses from an initial qualitative problem formulation through exposure and toxicity assessments, and culminates in risk characterization supported by uncertainty and sensitivity assessment. These components are discussed below.

- Problem formulation: The problem formulation step defines the scope and focus of the HHRA and identifies the key factors that must be considered. This stage compiles information on the assessment boundaries, COPCs, human receptors, and potential exposure pathways, and presents them within an illustrative CSM. Problem formulation directs the assessment to the relevant project-related issues and allows data gaps and information needs to be recognized early in the process.
- Toxicity assessment: The toxicity assessment characterizes the potential health effects associated with exposures to COPCs. This step identifies toxicity reference values (TRVs) or other health-based benchmarks used to interpret exposure estimates. These values represent doses or concentrations below which adverse health effects are not expected, based on federal or other regulatory guidance.
- Exposure assessment: The exposure assessment estimates the amount of each COPC that receptors may take in through complete (or operable) exposure pathways identified in the problem formulation. This step documents predicted or measured COPC concentrations in relevant environmental media and calculates exposure doses or concentrations for all receptors and scenarios associated with the project. It provides the quantitative basis for determining whether exposures may lead to potential health effects.
- Risk characterization: Risk characterization integrates the results of the exposure and toxicity assessments to determine what human health risks are associated with potential exposures to Project-related COPCs. This step qualitatively or quantitatively compares estimated exposures to TRVs, evaluates whether any predicted risks exceed acceptable thresholds, and identifies the key pathways or receptors that drive risk estimates.
- Uncertainty and sensitivity assessment: The uncertainty and sensitivity assessment describes the limitations and assumptions that influence the risk estimates, including uncertainties in input data, predictive modelling, exposure assumptions, or toxicological information. Evaluating uncertainty helps determine the confidence in the risk estimates, while sensitivity analysis identifies variables that most strongly influence the results.

Risk assessment is an iterative process. Initial steps are typically based on conservative assumptions to avoid underestimating potential health risks. If these preliminary evaluations suggest possible concerns, the analysis can be refined in additional steps using more detailed or site-specific or Project-specific information that results in reduced uncertainty and more accurate characterization of potential risks. This iterative approach is consistent with Health Canada’s guidance and is applied throughout both the qualitative and quantitative components of the HHRA.

4 Problem Formulation

The problem formulation defines the key elements that guide the HHRA by identifying the study boundaries, potential COPCs, human receptors, and exposure pathways relevant to the Project. This stage establishes the critical factors that must be considered in the HHRA and provides the foundation for developing the CSM that links contaminant sources, transport mechanisms, receptors, and exposure routes.

4.1 Study Boundaries

For the HHRA, the study boundaries define the geographic areas within which project-related effects may reasonably occur (spatial boundaries) and the time periods over which these effects may persist across the phases of the Project (temporal boundaries). The study boundaries also define the assessment scenarios that establish the conditions under which potential human health risks are characterized. Together, these boundaries provide a clear and structured basis for evaluating project-related changes in a manner that is technically robust, transparent, and aligned with applicable Health Canada (2023a) guidance.

4.1.1 Spatial Boundaries

The spatial boundaries for the HHRA have been established to reflect the extent of potential Project-related changes to environmental quality across air, water, and soil. As outlined in HHRA guidance (Health Canada 2023a), spatial boundaries should encompass the area that may be affected by Project emissions, not only the Project footprint, and should consider the fate and transport of contaminants across relevant environmental media.

The assessment of potential environmental interactions between the Project and human health is focused on the Project Development Area (PDA) and a Local Assessment Area (LAA).

The PDA is defined as the anticipated area of physical disturbance on the Project site (i.e., approximate Development Footprint) and the proposed access road (Figure 2.1). The LAA for human health has been delineated based on the potential extent of Project-related environmental releases and their anticipated transport pathways. This includes consideration of how contaminants may disperse in air, migrate in surface water and groundwater, or deposit onto soil and other environmental media. Of these contaminant transport mechanisms, airborne dispersion is expected to extend COPCs the farthest due to the capacity of air emissions to travel long distances before depositing or interacting with other media. As a result, the LAA for air quality is an appropriate boundary for human health.

The LAA for air quality has been defined as a 25-kilometre radius surrounding the PDA (Stantec 2025). This boundary reflects the area within which measurable air-quality changes from Project activities are expected to occur. Previous assessments for facilities indicate that construction and operation emissions are unlikely to influence air quality beyond this distance (Stantec 2025). This is supported by air dispersion modelling, which demonstrated that predicted ground-level concentrations of assessed contaminants diminish rapidly with distance (Stantec 2025).

4.1.2 Temporal Boundaries

Temporal boundaries identify when a potential interaction is assessed in relation to specific Project phases and activities. The temporal boundaries for the assessment include the following periods:

- Construction – Q1 2026 to Q2-Q3 2028
- Operation and maintenance – Q3 2028 to 2053
- Decommissioning and abandonment – 2053 – 2055

4.1.3 Assessment Scenarios

In accordance with Health Canada's guidance, an HHRA should be used to evaluate potential human health risks under multiple assessment scenarios to capture how project-related changes may influence exposures relative to existing and future conditions. Because HHRAs for proposed projects are predictive in nature, evaluating several scenarios supports a transparent understanding of how a project contributes to overall risks.

Three assessment scenarios are typically included in the HHRA:

- Baseline Scenario: This scenario characterizes current environmental conditions in the absence of the Project. It serves as the foundation for comparison with other scenarios and represents the minimum risk level prior to project development.
- Project Alone Scenario: This scenario estimates risks associated with Project emissions and activities only, relative to baseline conditions. It isolates the Project's contribution to potential health risks.
- Baseline + Project Scenario: This scenario combines the baseline and Project-alone conditions to reflect future environmental conditions if the Project proceeds. It represents the primary scenario used to evaluate potential human health impacts for regulatory decision-making.

Where appropriate, a fourth scenario, the Cumulative Scenario (Baseline + Project + Reasonably Foreseeable Future Development) may be considered to assess the Project in combination with other reasonably foreseeable developments. This cumulative scenario helps to understand how multiple activities in the region might interact to influence future exposures and risks.

4.2 Contaminants of Potential Concern

As a conservative first step, chemicals that may increase in environmental media due to Project activities may be identified as COPCs. However, where predicted Project-related concentrations combined with baseline conditions are below applicable health-based screening criteria, these chemicals do not need to be carried forward as COPCs further quantitative risk assessment (Health Canada 2023a).

The screening of COPCs for this HHRA is conducted on a media-specific basis, focusing on air, water, and country foods. Consistent with Health Canada's HHRA guidance, the objective of COPC screening is to identify the contaminants that warrant further evaluation based on their potential presence in relevant environmental media, their predicted concentrations, and their potential for human exposure. As such, the screening must consider both baseline conditions and modelled future conditions, recognizing that concentrations used in the assessment may derive from measured baseline data and predicted values (e.g., air dispersion modelling, surface water quality predictions).

The identification of COPCs draws on multiple information sources, including emissions expected from Project activities, contaminants assessed in similar projects, and relevant regulatory or guidance documentation. Contaminants not carried forward are excluded with documented rationale. Key considerations include:

- predicted concentrations in each environmental medium
- conservative comparison against applicable guidelines (air, water)
- the presence and sensitivity of human receptors, and
- relevance of exposure pathways for both current and future conditions.

4.2.1 Air

During construction, the Project will generate air emissions primarily from land clearing, earthworks, material handling, and the movement and operation of heavy-duty equipment. These activities will release particulate matter (dust) and combustion-related air contaminants associated with diesel-powered equipment. Similar types of emissions may also occur intermittently during decommissioning as equipment is dismantled and areas are regraded. Vehicles and equipment used during construction and decommissioning will meet applicable federal emission standards. To further reduce emissions, idling will be minimized, vehicles and equipment will be properly maintained, and dust-control measures such as road watering, limiting work during high winds, and promptly stabilizing or revegetating disturbed surfaces will be implemented. With these mitigation measures in place, Project-related releases of air contaminants during construction and decommissioning are not expected to result in exceedances of provincial or federal air quality objectives or standards (Stantec 2025).

During normal operations, air contaminant emissions are associated with periods of electricity generation, when the CTGs are operating and running on natural gas.. Ultra-low sulphur diesel (ULSD) may be used as a backup fuel in the unlikely event of a natural gas supply interruption. Operational air contaminants potentially emitted by the Project include NO_x, SO_2, CO, and particulate matter (total suspended particulates [TSP], $PM_{2.5}$), with NH_3 released as a by-product of the emissions-control system. No air emissions are produced during synchronous condensing operations, as this operating mode does not involve fuel combustion.

Air emissions during operations were assessed using the AERMOD regulatory dispersion model within a 50 km × 50 km study domain centered on the Project site. Modelling incorporated five years (2020–2024) of meteorological data processed with AERMET, terrain elevations developed using AERMAP, and a receptor grid of 4,222 locations, including 20-m spacing at the facility fence line with increasing grid spacing at greater distances. No schools, hospitals, daycares, or parks were identified within 5 km of the Facility.

Two operational scenarios were modelled to assess the effects of Project-related emissions to air quality (Stantec 2025). These scenarios were intentionally designed to be conservative and to bound potential short-term and long-term exposure conditions associated with operation of the CTGs.

- Base case: The base case represents operating conditions under which the facility generates electricity for 537 hours per year). This scenario assumes a higher frequency of turbine start-ups and shut-downs, which results in elevated short-term emission rates for certain contaminants, particularly nitrogen oxides (NO_x).
- Stress case: The stress case represents an upper-bound operating scenario in which the facility generates electricity for 2,727 hours per year. Under this scenario, the CTGs are assumed to operate more continuously.

For short-term averaging periods (e.g., 1-hour and 24-hour), dispersion modelling was conducted using a deliberately conservative approach to estimate maximum potential ground-level concentrations. Although the CTGs are expected to operate for 537 hours per year, with an upper-bound of 2,727 hours per year, the short-term emission scenarios were modelled assuming that the applicable emission rates occurred continuously across the five-year meteorological dataset (2020–2024). This approach results in predicted short-term concentrations that capture the range of meteorological conditions associated with maximum downwind impacts. For each contaminant and averaging period, the higher of the emission rates associated with natural gas or ULSD was modelled, depending on operating condition. Together, these assumptions provide an upper bound estimate of maximum 1-hour and 24-hour concentrations.

For annual averaging periods, emissions for both operational scenarios were estimated assuming a temporary interruption of natural gas supply, with ULSD used for up to seven days per year. This assumption intentionally over-predicts annual emissions associated with diesel use to provide an upper bound estimate of maximum annual average concentrations.

Additional details regarding processing of baseline air quality data, development of the air emissions inventory, and the air dispersion modelling are provided in Addendum #1 (Stantec 2025).

Predicted ground-level concentrations were compared against applicable ambient air quality standards, including the New Brunswick ambient air quality objectives (NB AAQOs). Baseline concentrations were established using regional monitoring data from the ECCC Moncton and Miramichi stations. The Baseline, Project Alone, and Baseline + Project scenario concentrations are summarized in Table 4.1.

Health Canada (2023b) indicates that additional health assessment of air contaminants is generally not needed when predicted concentrations are well below the Canadian Ambient Air Quality Standards (CAAQS) or other relevant criteria (such as NB AAQOs). However, a health-based risk assessment is recommended for contaminants that have no safe exposure level (non-threshold contaminants) or for contaminants with predicted concentrations that approach or exceed applicable guidelines. Contaminants without guidelines should also be included in a quantitative HHRA if modelled concentrations are above background levels. Based on this guidance, the following contaminants potentially emitted by the Project were identified as COPCs in air for the HHRA:

- NO_2: The maximum modelled 1-hour NO_2 concentrations exceed the proposed NB AAQOs. Because NO_2 is considered a non-threshold contaminant (see Section 5), it is carried forward for additional assessment.
- $PM_{2.5}$: The maximum modelled 24-hour $PM_{2.5}$ concentrations exceed the proposed NB AAQOs. Because $PM_{2.5}$ is considered a non-threshold contaminant (see Section 5), it is carried forward for additional assessment.

Concentrations of other air contaminants do not approach the NB AAQOs (or other relevant guidelines) nor have they been identified as non-threshold contaminants.

Table 4-1 Baseline and Modelled Air Contaminant Concentrations from Stantec (2025)

Contaminant	Modelled Case	Fuel Type	Averaging Period	NB AAQO Current[a] / Proposed[b] (µg/m³)	Assessment Scenarios		
					Baseline (µg/m³)	Project Alone (Maximum) (µg/m³)	Baseline + Project (µg/m³)
CO	Base/Stress Case[c]	Natural Gas	1-hour	35,000 / 30,000	279	216	495
	Base/Stress Case[c]	Natural Gas	8-hour	15,000 / 10,000	273	98.6	372
NH_3	Base/Stress Case[c]	Natural Gas	24-hour	- / 30	-	15.6	15.6
NO_2	Base/Stress Case[c]	Diesel	1-hour	400 / 200	7.7	215	**223**
	Base Case	Diesel	24-hour	200 / 80	5.8	40.5	46.3
	Stress Case	-	Annual	100 / 23	3.6	0.4	3.9
$PM_{2.5}$	Base Case	Diesel	24-hour[d]	- / 23	8.9	15.4	**24.4**
	Stress Case	-	Annual	- / 8.8	5.6	0.2	5.8
SO_2	Base/Stress Case[c]	Diesel	1-hour	900 / -	0.52	3.8	4.3
	Base/Stress Case[c]	Diesel	24-hour	300 / 173	0.38	1.7	2.1
	Stress Case	-	Annual	60 / 11	0.84	0.03	0.9
TSP	Base Case	Diesel	24-hour	120 / 120	42.2	37.6	79.8
	Stress Case	-	Annual	70 / 70	25.9	0.2	26.2

Notes:
"-" – Not applicable or no value available
Concentrations greater than NB AAQO in **bold**
[a] Schedule B, NB Air Quality Regulation 97-133
[b] Proposed New Brunswick Ambient Air Quality Objectives (NBDELG 2025)
[c] The emissions rates for the base case and stress case were the same for this averaging period and contaminant
[d] 3-year average of the annual 98th percentile of the daily 24-hour average concentrations

4.2.2 Soil

Project activities do not involve industrial processes that will release chemical contaminants to surrounding soils. Construction-phase emissions will consist primarily of particulate matter (dust) and combustion by-products, while operational emissions will be dominated by gaseous combustion products from the generators, along with NH_3 from the emissions-control system. The contaminants evaluated in the atmospheric assessment (NO_2, SO_2, CO, PM, and NH_3) are predominantly gaseous, stack-released emissions, with only small quantities of particulate matter generated. As a result, deposition of these contaminants to soil is expected to be minimal, spatially diffuse, and insufficient to accumulate to levels that would result in soil contamination.

Localized potential sources of chemicals within the PDA (such as fuel storage and temporary hazardous materials storage) will be managed using established spill-prevention and containment measures. These controls are designed to prevent or limit releases, and in the unlikely event of a spill, response actions would be implemented based on the substance released, the volume involved, environmental conditions, and mitigation effectiveness, as described in the EIA documentation (PROENERGY 2025).

Based on this analysis, no COPCs for soil were carried forward.

4.2.3 Groundwater and Surface Water

The Project's potential effects on groundwater and surface water are limited to the discharge of reject water from the on-site groundwater treatment system. Groundwater from on-site wells will serve as process water and will undergo a series of purification steps, including activated charcoal filtration, reverse osmosis, and electrodeionization. Water discharged from the facility is limited to the reject water generated by these treatment processes. The power-generation system itself produces no wastewater.

Because the reject water represents concentrated minerals naturally present in the source groundwater, its composition reflects baseline groundwater quality with elevated mineral content due to the treatment process. No industrial chemicals, fuels, or process reagents are introduced into the water system; therefore, potential contaminants of concern originate from existing groundwater chemistry.

Groundwater investigations for the Project are ongoing. Preliminary results of sampling test wells installed within the PDA indicate that some general chemistry and metal parameters (such as chloride, iron, and sodium) exceed applicable drinking water guidelines; however, these exceedances are typically limited to aesthetic objectives rather than health-based criteria.

Potential COPCs for water include metals, nutrients (including total phosphorus, nitrite, nitrate, total nitrogen, and ammonia), and salinity-related ions. These parameters reflect natural groundwater composition, although potentially 1.5 to 3 times higher due to treatment concentration. Two potential discharge pathways are under evaluation:

- A site drainage ditch leading to a wetland approximately 300 m west of the generating station; and
- A provincial ditch adjacent to Route 940.

Mitigation measures are expected to reduce the potential for people to be exposed to potential COPCs in water. A suite of mitigation measures has been proposed to minimize potential human exposures. This includes comprehensive monitoring, hydrological modelling, wetland protection, and contingency measures for affected private wells.

With respect to onsite groundwater use, groundwater is fully treated prior to use. A formal groundwater monitoring plan is under development to define sampling locations, frequencies, and analytes to confirm potential effects. With respect to offsite groundwater use, baseline well sampling has been completed within an approximate 2-km radius of the Project and follow-up testing will be conducted if concerns arise. NB Power has stated that they will supply temporary water and/or repair or replace affected wells if Project activities negatively impact a private water supply.

Monitoring of the reject water will include continuous tracking of flow and pH, supplemented by monthly grab samples to assess metals, nutrients, and other constituents discharged to the receiving environment. The Surface Water Management Plan will incorporate drainage design, erosion control, and flow-management measures to minimize potential surface water impacts.

Project activities are not anticipated to introduce new chemical substances to groundwater or surface water. Project-related discharge is limited to treated reject water, which consists of naturally occurring groundwater constituents concentrated through the treatment process. While certain parameters may be elevated relative to baseline conditions, these constituents reflect the intrinsic chemistry of the source groundwater and are not expected to result in changes to groundwater or surface-water quality that are meaningful or relevant from a human-health perspective. Accordingly, no Project-related alterations to water chemistry are anticipated that would warrant the identification of COPCs for groundwater or surface water at the screening stage.

4.2.4 Country Foods

No COPCs have been carried forward for the country foods pathway because no transport mechanisms to country food are expected. Health Canada’s HHRA guidance indicates that a quantitative or qualitative assessment of country foods is required only when Project activities could elevate COPCs in environmental media such as soil, water, vegetation, or wildlife tissues, thereby creating exposure to local receptors. Where no predicted contamination of environmental media exists, a screening-level rationale is considered sufficient (Health Canada 2023a).

For COPCs to accumulate in vegetation, fish, or terrestrial wildlife, the Project would need to introduce contaminants into soils or waterbodies. As described below, the Project is not expected to contaminate soil or surface water, and therefore there is no mechanism for COPCs to enter plants or animals harvested as country foods.

Project activities do not include industrial processes that would release contaminants to surrounding soils. Construction emissions will consist mainly of particulate matter (dust) and combustion by-products, while operational emissions will be dominated by gaseous combustion emissions from the CTGs, along with NH_3 from the emissions-control system. The modeled air contaminants (NO_2, SO_2, CO, PM, NH_3) are primarily gaseous emissions dispersed from point-source stacks, with only small quantities of particulate matter. As a result, deposition to soil is expected to be minimal, spatially diffuse, and unlikely to accumulate to levels that would constitute contamination or lead to uptake by vegetation or wildlife.

Localized potential sources of chemicals within the PDA, such as fuel storage and temporary hazardous materials storage, will be managed using established spill-prevention and containment measures. These measures are intended to prevent or limit releases, and in the unlikely event of a spill, response actions would be implemented based on the substance, volume, environmental conditions, and mitigation effectiveness.

The Project's only planned release to surface water is the discharge of reject water from the on-site groundwater treatment system. As described in Section 4.2.3, the chemical composition of this reject water reflects natural groundwater quality and does not contain bioaccumulative substances, meaning it does not represent a source of COPCs to aquatic foods.

Because the Project is not expected to introduce contaminants into soil, vegetation, surface water, or wildlife, there are no viable pathways by which plants or animals could accumulate chemicals in their tissues. This supports the conclusion that country foods will not experience Project-related changes in chemical quality, and therefore no COPCs have been carried forward for assessment of country foods, consistent with Health Canada's pathway-based approach to determining HHRA requirements.

4.3 Human Receptors

Potential human receptors within the LAA were identified based on documented land use, human activity patterns, and Health Canada guidance, which defines receptors as people who may be present either permanently or temporarily in locations where exposure to environmental media could occur (Health Canada 2023a).

The following receptor groups were identified:

- Residential Receptors - The Project is situated within the Town of Tantramar's Rural Planning Area, where residential properties, rural homesteads, and community members may be present. Residential populations represent individuals with regular and long-term presence in the area and include non-Indigenous individuals living in or near the LAA who may also use surrounding land for gardening, recreational access, or country-food harvesting.
- Recreational Receptors - Recreational receptors were identified due to the public use of nearby rights-of-way (e.g., ATV and snowmobile travel) and other seasonal activities such as berry picking and wildlife observation within the LAA (PROENERGY 2025). These individuals may have an episodic presence in the area and therefore a potential for intermittent but repeated exposure to COPCs while engaged in these activities.
- Indigenous Receptors - Indigenous receptors were identified based on information in the IPD/EIA Registration describing how Indigenous communities (e.g., Amlamgog First Nation, Metepenagiag Mi'kmaq Nation) may use the area for traditional harvesting, cultural practices, and other unique land-based activities (PROENERGY 2025). Engagement with Indigenous groups is ongoing to confirm the extent and nature of land use and to support accurate characterization of exposure pathways.

In the assessment of risk from potential exposure to COPC, these receptor groups consider individuals across life stages (infants through adults). Sensitive subpopulations (such as pregnant people, infants/toddlers, elderly adults, individuals with respiratory conditions, and Indigenous people with higher traditional-food reliance) are also explicitly considered, consistent with Health Canada's definition of "sensitive human receptors."

Occupational exposures of Project workers are not included in this HHRA, as worker health and safety is governed by provincial and federal occupational regulations. Off-site exposures during non-work hours are equivalent to those of other receptors already identified.

4.4 Exposure Pathways

Exposure pathways describe the process by which a contaminant moves from its source through environmental media to the point where it may contact and enter the body of a human receptor. Only pathways with a reasonable potential for exposure (i.e., a complete exposure pathway) are carried forward in the HHRA.

The following sections provide a media-specific discussion of the complete and incomplete exposure pathways relevant to the Project, with a summary provided in Table 4.1.

4.4.1 Air

Project-related activities will emit COPCs to the atmosphere, where they will disperse some distance from the Project through ambient air. Residential, Recreational, and Indigenous Receptors located outside the PDA may inhale these contaminants as vapours or particulates. Therefore, inhalation of COPCs from air emissions represents a complete exposure pathway for the three receptor groups and was carried forward in the HHRA.

Based on the results of the air dispersion modelling (which conservatively assessed emissions from the CTGs under bounding operating conditions, including the assumed use of ULSD), NO_2 and fine particulate matter ($PM_{2.5}$) were retained for further assessment of this pathway. Other modelled air contaminants (SO_2, CO, $PM_{2.5}$, TSP, and NH_3) were predicted to remain well below, and not approach, applicable air quality guidelines under Baseline, Project Alone, and Baseline plus Project assessment scenarios.

Consistent with Health Canada guidance, both short-term (acute) and long-term (chronic) inhalation exposures were evaluated for the retained COPCs.

4.4.2 Soil

Soil was considered as a potential exposure medium in accordance with Health Canada (2023a), which identifies incidental soil ingestion, dermal contact with soil, and inhalation of soil particulates as potential exposure pathways. Project activities do not include processes that would release contaminants to surrounding soils. Air emissions are dominated by gaseous combustion products and small quantities of particulate matter released from point-source stacks, with modelling showing that contaminants (NO_2, SO_2, CO, PM, NH_3) disperse widely with minimal deposition. As a result, soil deposition is expected to be minimal, spatially diffuse, and insufficient to lead to soil contamination.

Based on this assessment, soil-related exposure pathways are incomplete and were not carried forward in the HHRA.

4.4.3 Groundwater

Groundwater is used as a potable water source for residential properties within the LAA, which rely on private wells for drinking water and domestic use. Groundwater will also be extracted onsite to support Project activities; however, this water will undergo treatment prior to use.

Project-related releases to groundwater are limited to the discharge of treated reject water from the onsite groundwater treatment system, as documented in the EIA materials. Potential COPCs in the reject water included metals, nutrients (including total phosphorus, nitrite, nitrate, total nitrogen, and ammonia), and salinity-related ions. The reject water reflects the natural chemical composition of groundwater, with concentrations potentially 1.5 to 3 times higher due to the treatment process. These COPCs are non-volatile and therefore not expected to migrate via vapour or pose an inhalation risk.

Health Canada's HHRA guidance allows exclusion of an exposure pathway when evidence demonstrates that the Project is not expected to contaminate groundwater, or when the pathway will not result in human exposure. Consistent with this guidance, the non-volatile nature of the constituents, the lack of a mechanism for subsurface release, and the similarity of the reject water to naturally occurring groundwater chemistry together indicate that Project-related COPCs are unlikely to affect the quality of offsite groundwater used by residential receptors. Accordingly, groundwater ingestion is considered an incomplete exposure pathway for the three receptor groups and was not carried forward in the HHRA. A groundwater monitoring plan is being developed as part of ongoing Project commitments to confirm that groundwater quality remains protective of users.

4.4.4 Surface Water

Where Project activities may affect surface water quality, Health Canada (2023a) recommends evaluating the ingestion, dermal contact, and recreational use of surface water as potential exposure pathways.

For this Project, potential chemical releases to surface water are limited to the discharge of reject water from the onsite groundwater treatment system, as described in the IPD/EIA Registration (PROENERGY 2025). The Addendum (Stantec 2025) further indicates that studies related to effluent discharge scenarios are ongoing, including assessments of potential effects on receiving watercourses and aquatic habitat.

The reject water reflects the natural composition of groundwater and contains non-volatile constituents. As a result, the discharge is not expected to introduce COPCs to surface water that could contribute meaningfully to human exposure. No other Project activities are expected to release contaminants to surface water, and there is no indication that surface water within the LAA is used as a drinking-water source by human receptors.

Given the lack of a mechanism for Project-related contamination of surface water at levels relevant to human health, and in accordance with Health Canada's guidance allowing exclusion of pathways where no exposure is reasonably expected, surface-water exposure pathways (ingestion, dermal contact, and inhalation of water vapours) are considered incomplete and were not carried forward in the HHRA.

4.4.5 Country Foods

Country foods were evaluated as a potential exposure pathway in accordance with Health Canada (2023a), which identifies ingestion of vegetation, fish, or wildlife affected by contaminants in soil, surface water, or other environmental media as potential human exposure routes.

Project-related activities are not expected to introduce COPCs into environmental media that support country foods. Project emissions consist primarily of gaseous combustion products and small quantities of particulate matter from stack releases, with minimal and spatially diffuse deposition to soil. This level of deposition is not sufficient to result in soil contamination or uptake into vegetation or wildlife.

Similarly, surface-water contamination is not expected, as Project releases are limited to treated reject water that reflects the natural composition of groundwater. Although additional characterization studies of the Project-related effects to receiving watercourses are underway, there is no evidence of COPCs that could bioaccumulate or affect fish tissue quality.

Health Canada guidance states that exposure pathways may be excluded from the HHRA when evidence demonstrates that the Project will not contaminate the relevant environmental media. Because the Project is not expected to introduce contaminants into soil, vegetation, surface water, or wildlife, country-foods ingestion is considered an incomplete pathway for all receptor groups and was not carried forward in the HHRA.

A summary of the potential exposure pathways evaluation is provided in Table 4-2.

Table 4-2 Summary of Potential Exposure Pathway Evaluation

Environmental Media	Exposure Pathways	Receptors		
		Residential Receptor	Recreational Receptor	Indigenous Receptor
Air	Inhalation of suspended particulates or vapours in air	✓	✓	✓
Soil	Incidental soil ingestion	O	O	O
	Dermal absorption of COPCs from soil adhering to skin	O	O	O
	Inhalation of suspended soil particulates	O	O	O
	Inhalation of vapours migrating from soil to air	✗	✗	✗
Groundwater	Ingestion of groundwater if used as water for drinking/cooking	O	✗	O
	Inhalation of vapour if used for showering/cooking	✗	✗	✗
	Inhalation of vapour migrating from subsurface contaminated groundwater to air	✗	✗	✗
	Dermal contact with groundwater if used for bathing/showering	O	✗	O
Surface Water	Incidental surface water ingestion during recreational activities	O	O	O
	Ingestion of surface water if used as water for drinking/cooking	✗	✗	✗
	Dermal contact with surface water during recreational activities or bathing/showering	O	O	O
	Inhalation of vapour if used for showering/cooking	✗	✗	✗

Table 4-2 Summary of Potential Exposure Pathway Evaluation

Environmental Media	Exposure Pathways	Receptors		
		Residential Receptor	**Recreational Receptor**	**Indigenous Receptor**
Country Foods	Vegetation: ingestion of vegetation (berries and plants) grown on impacted soil or affected by aerial deposition of COPCs	O	O	O
	Fish and shellfish: ingestion of fish and shellfish harvested from impacted surface water bodies and/or surface water bodies with impacted sediment	O	O	O
	Wild game: ingestion of wild game that may be impacted via consumption of impacted soil, vegetation, surface water, and/or prey items	O	O	O

Notes:
✓ Complete (operable) pathway
✗ Incomplete (inoperable) pathway
O Potentially complete pathway, but negligible

4.5 Conceptual Site Model

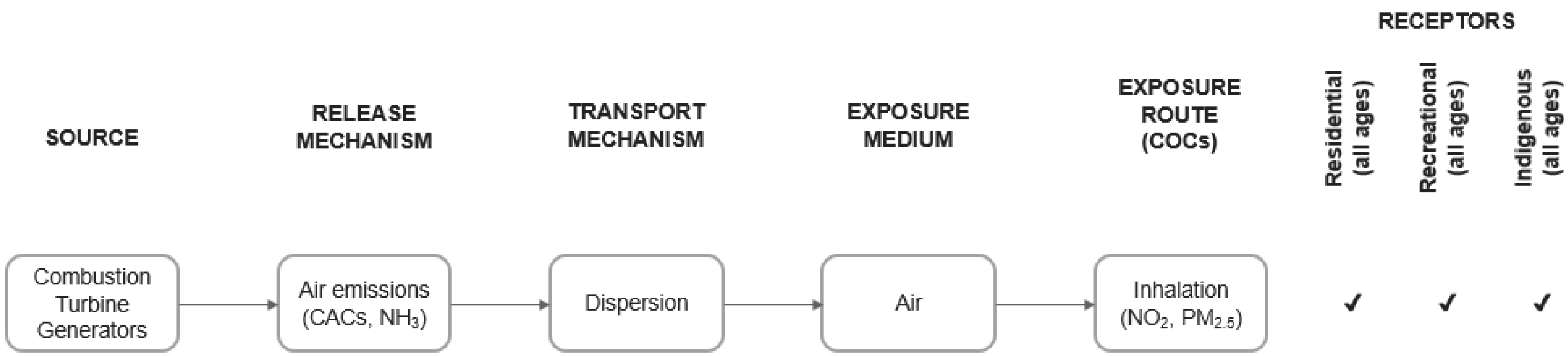
The CSM describes how Project-related contaminants could move through the environment and potentially reach human receptors. This includes identifying contaminant sources, release mechanisms, transport through environmental media, and potential exposure routes.

No air emissions are produced during synchronous condensing operations, as this mode does not involve fuel combustion. Emissions to air occur during times when the CTGs are used for power generation and release gaseous combustion products with small amounts of particulate matter. Air dispersion model results demonstrate that these contaminants disperse broadly in the atmosphere. Project activities are not expected to contaminate soil or surface water, and treated reject water discharged from onsite groundwater treatment reflects the natural composition of groundwater. Fuel and hazardous materials stored onsite will be managed using spill-prevention and containment measures, consistent with commitments outlined in the EIA documentation.

Human receptors include Residential, Recreational, and Indigenous users of the LAA, and include individuals with permanent or temporary presence in the area, including sensitive subpopulations.

Based on the assessment of environmental media, only the inhalation of contaminants in air represents a complete exposure pathway. Soil, groundwater, surface water, and country foods do not represent complete pathways because the Project is not expected to introduce contaminants into these media at levels that could result in non-negligible exposure.

Based on this conceptual site model, Figure 4.1 illustrates a single operable exposure linkage: air emissions to human receptors through inhalation. As indicated in the figure, while air emissions include a number of combustion by-products (including particulate matter) and NH_3, only NO_2 and $PM_{2.5}$ are carried forward in the HHRA since the other modelled contaminants were predicted to remain below, and not approach, applicable air-quality guidelines even under conservative emission assumptions.



Notes

CAC	Criteria air contaminants: carbon monoxide (CO), nitrogen dioxide (NO_2), fine particulate matter ($PM_{2.5}$), sulphur dioxide (SO_2)
NH_3	Ammonia
✓	Complete (operable) pathway
✗	Incomplete (inoperable) pathway
O	Potentially complete pathway, but negligible risk

Figure 4.1 Conceptual Site Model – Human Health

5 Toxicity Assessment

The toxicity assessment evaluates the potential health effects associated with exposure to COPCs and involves selecting or developing appropriate TRVs. The TRVs are typically derived by national and international agencies to characterize potential risks from environmental contaminants. Depending on the chemical and endpoint being assessed, TRVs may reflect either threshold or non-threshold responses or modes of action.

For threshold responses (generally non-carcinogenic effects), TRVs represent tolerable daily intakes or tolerable concentrations, representing exposure levels below which adverse effects are not expected. In contrast, non-threshold responses (such as carcinogenic effects) are expressed as slope factors or unit risks that quantify the incremental increase in risk per unit of exposure. Non-threshold effects may also be expressed as a risk-specific dose or concentration, which acknowledges a level of risk associated with the TRV.

Some COPCs exhibit both threshold and non-threshold responses, and in such cases, TRVs are selected to appropriately reflect each relevant response. The selected TRVs must match the applicable exposure route and duration relevant to the assessment and be supported by current, well-documented toxicological information.

As shown in Section 4, only the inhalation of contaminants in air represents a complete exposure pathway. Both long-term and short-term inhalation exposures are relevant for people living within LAA. Long-term exposures apply primarily to individuals residing at permanent dwellings, as chronic inhalation TRVs represent continuous exposure over many years or a lifetime. In contrast, exposures occurring outside residential properties (such as during harvesting activities, traditional land use, or recreational visits) are considered short-term and intermittent. Health Canada (2023a) specifies that short-term exposures should be assessed when individuals access an assessment area only periodically or for limited durations, and that sub-chronic or short-duration TRVs may be required to appropriately evaluate intermittent exposure patterns.

Based on the problem formulation for this assessment, only the common ambient air NO_2 and $PM_{2.5}$ were retained as COPCs for quantitative evaluation. Health Canada (2023b) emphasizes that these pollutants are associated with well-established short-term and long-term human health effects, including both non-cancer and, for $PM_{2.5}$ in particular, cancer-based outcomes. The toxicity assessment therefore summarizes the key health concerns associated with elevated exposure to these pollutants and provides the TRVs used to evaluate whether predicted exposures may result in adverse health effects.

5.1 Nitrogen Dioxide

Nitrogen dioxide (NO_2) is a combustion-related air pollutant associated with transportation sources and other fuel-burning activities. Health Canada (2023b) identifies NO_2 as a non-threshold pollutant, meaning that health effects can occur at any level of exposure, and therefore population health risks increase with concentration even below regulatory criteria such as the CAAQS. Health Canada (2016), (2023b) further concludes that NO_2 is causally associated with both acute-exposure respiratory morbidity and chronic respiratory effects. There is consistent evidence supporting associations with acute respiratory symptoms, asthma exacerbation, hospital admissions, and chronic respiratory disease development.

The WHO Global Air Quality Guidelines (WHO 2021) provide the most current, health-protective exposure limits for NO_2. Health Canada (2023b) explicitly acknowledges these WHO guideline levels and references them as the basis for evaluating NO_2 health effects in federal impact assessments. As a result, WHO guideline values are applied as TRVs for inhalation exposure in this HHRA as follows:

- Short-term (1-hour; acute) TRV of 200 $\mu g/m^3$ – This value represents the lowest concentration above which WHO judges adverse short-term respiratory effects to be reliably observed in the population.
- Short-term (24-hour; acute) TRV of 25 $\mu g/m^3$ – This value reflects evidence linking daily NO_2 fluctuations to respiratory morbidity, including asthma-related outcomes.
- Long-term (annual; chronic) TRV of 10 $\mu g/m^3$ - The WHO annual guideline for NO_2 represents the concentration below which long-term respiratory morbidity and mortality risks are minimized.

5.2 Fine Particulate Matter

Fine particulate matter ($PM_{2.5}$) is a mixture of airborne solid and liquid particles ≤2.5 μm in aerodynamic diameter that can penetrate deep into the lungs and enter the bloodstream. Health Canada (2022) identifies $PM_{2.5}$ as one of the leading environmental causes of death and disease in Canada despite Canada having relatively low ambient levels.

Consistent with Health Canada (2023b), $PM_{2.5}$ is treated as a non-threshold pollutant, with health effects observed at concentrations even below current CAAQS. Epidemiological evidence demonstrates a linear or supralinear concentration-response relationship extending to very low ambient levels (3 to 6 $\mu g/m^3$), with no apparent population threshold (Health Canada 2022) (Health Canada 2023b). As with NO_2, the WHO Global Air Quality Guidelines (WHO 2021) provide the most current, health-protective exposure limits for $PM_{2.5}$. Accordingly, WHO guideline values are applied as TRVs for inhalation exposure in this HHRA as follows:

- Short-term (24-hour; acute) TRV of 15 $\mu g/m^3$ - This value reflects robust evidence linking short-term $PM_{2.5}$ exposure to respiratory and cardiovascular morbidity and mortality.
- Long-term (annual; chronic) TRV of 5 $\mu g/m^3$ - The WHO annual guideline for $PM_{2.5}$ reflects strong evidence for long-term effects including premature mortality, chronic cardiovascular disease, respiratory disease, and lung cancer.

5.3 Summary

The health-based inhalation exposure limits applied as TRVs in this HHRA are summarized in Table 5-1.

Table 5-1 Inhalation Exposure Limits Applied as TRVs

COPC	Exposure Period	Exposure Limit / TRV ($\mu g/m^3$)	Critical Effect	Reference
Nitrogen Dioxide (NO_2)	Acute (1-hour)	200	Respiratory effects	(WHO 2021)
	Acute (24-hour)	25	Mortality and respiratory effects	(WHO 2021)
	Chronic (Annual)	10	Mortality	(WHO 2021)
Fine Particulate Matter ($PM_{2.5}$)	Acute (24-hour)	15	Mortality	(WHO 2021)
	Chronic (Annual)	5	Mortality	(WHO 2021)

6 Exposure Assessment

The exposure assessment develops quantitative estimates of exposure to COPCs and, consistent with Health Canada's framework (Health Canada 2023a), considers COPC concentrations in environmental media together with receptor characteristics and relevant exposure pathways. For airborne contaminants, exposure is characterized based on ambient air concentrations. No distinction is made between indoor and outdoor air concentrations; therefore, the modelled ground-level COPC concentrations near buildings are assumed to represent both indoor and outdoor exposure. This approach is consistent with Health Canada's guidance for evaluating potential health effects from airborne contaminants in impact assessments (Health Canada 2023b).

As described in Section 4.2.1, air dispersion modelling conducted for the air quality assessment applied conservative operating assumptions, including the use of ULSD as a fuel source for the CTGs, to bound potential short-term and long-term air quality impacts under contingency operating conditions (i.e., interruption of natural gas supply). While this approach is appropriate for screening and hazard identification, planned Project operations are expected to involve CTG operation using natural gas as the primary fuel, and ULSD use limited to unlikely backup scenarios.

To estimate representative air concentrations for human exposure under planned operating conditions, the air dispersion modelling described in Section 4.2.1 was therefore repeated using natural-gas-only emission rates for the CTGs. Maximum modelled ground-level concentrations, as well as modelled concentrations at the five nearest residences, are provided in Appendix A. These modelled concentrations were used to assess inhalation exposure for the retained COPCs.

Receptors are assumed to be exposed over the relevant averaging periods associated with the TRVs for each COPC as follows:

- Short-term (acute) exposures: based on the 1-hour or 24-hour modelled concentrations
- Long-term (chronic) exposures: based on annual average concentrations, assuming continuous exposure (24 hours per day, 7 days per week, 52 weeks per year) over an assumed lifetime of 80 years

These exposure estimates provide the input values for the subsequent risk characterization. A summary of the modelled maximum ground level concentrations at the boundary of the PDA for planned operations is provided in Table 6.1.

Table 6-1 Maximum Modelled COPC Concentrations for Planned Operations

Contaminant	Averaging Period	Assessment Scenarios		
		Baseline (µg/m³)	Project Alone (Maximum) (µg/m³)	Baseline + Project (µg/m³)
NO_2	1-hour	7.7	96.8	105
	24-hour *	5.8	12.2	18.0
	Annual	3.6	0.3	3.9
$PM_{2.5}$	24-hour *	8.9	6.3	15.2
	Annual	5.6	0.2	5.8

Notes:
* 99th percentile (fourth highest 24-hour value)

7 Risk Characterization

Risk characterization integrates the results of the toxicity assessment and exposure assessment to evaluate the potential health risks from exposure to COPCs. This step brings together the predicted COPC concentrations, exposure assumptions, and health-based TRVs to determine whether the estimated exposures may result in unacceptable health risks.

Risk characterization for the Project is presented in two parts to reflect differences between planned operating conditions and contingency operating scenarios. Quantitative risk estimates are developed for planned operations, which are representative of normal facility use, while potential risks associated with unlikely contingency operations are addressed qualitatively.

7.1 Planned Operations

As described in Section 6.0, planned operations involve CTGs running on natural gas for 537 hours per year (base case) to 2,727 hours per year (stress case). Air dispersion modelling for risk characterization therefore uses modelled concentrations derived from natural-gas emissions, as provided in Table 6 1. These concentrations are considered representative of anticipated operating conditions.

Because inhalation exposures in this HHRA are expressed directly as ambient concentrations, risk characterization is quantified by calculating the Hazard Quotient (HQ) as:

$$Hazard\ Quotient\ (HQ) = \frac{COPC\ Concentration}{Toxicological\ Reference\ Value\ (TRV)}$$

Interpretation of HQs follows Health Canada conventions:

- HQ ≤ 1.0 indicates that predicted exposures are below the TRV and adverse health effects are unlikely.
- HQ > 1.0 indicates the potential for adverse health effects and warrants further consideration.

A summary of the HQs based on the maximum predicted ground level concentrations (i.e., maximum HQs) associated with the Project is provided in Table 7.1.

Air dispersion modelling indicates that the maximum NO_2 HQs for the planned operational scenario for both short-term (1-hour and 24-hour) and long-term (annual) exposure are less than 1.0, indicating that predicted exposures are below the TRV. While the maximum $PM_{2.5}$ HQs for short-term exposure meet the health-based benchmark, the HQ for long-term exposure to $PM_{2.5}$ is greater than 1.0 for the Baseline and Baseline + Project assessment scenarios. As shown in Table 7.1, the resulting HQs were 1.1 (Baseline), 0.04 (Project Alone), and 1.2 (Baseline + Project). These results indicate that baseline conditions are already higher than the WHO annual guideline (i.e., the TRV), and that the Project contributes only a very small incremental increase, raising the HQ by 0.04 at the location of maximum ground-level concentrations. Project contributions at the nearest residences are indistinguishable from background, as evidenced by the annual $PM_{2.5}$ HQs for Baseline and Baseline + Project being the same (HQ=1.11, as shown in Appendix A).

Table 7-1 Hazard Quotients based on Maximum Predicted Ground Level Concentrations – Planned Operating Conditions

Contaminant	Averaging Period	Assessment Scenarios		
		Baseline	Project Alone (Maximum)	Baseline + Project (Maximum)
NO_2	1-hour	0.04	0.49	0.53
	24-hour	0.23	0.49	0.72
	Annual	0.36	0.03	0.39
$PM_{2.5}$	24-hour	0.59	0.42	1.0
	Annual	**1.1**	0.04	**1.2**

Note:
Hazard Quotients (HQ) greater than 1.0 in **bold**

Given its non-threshold behaviour, any incremental increase in long-term $PM_{2.5}$ exposure is associated with some degree of population-level risk. However, in the context of this Project, the incremental contribution is small relative to both baseline levels and the exposure ranges associated with observed effects in the epidemiological literature. The Project does not meaningfully influence annual $PM_{2.5}$ concentrations at the nearest residential receptor locations, and the combined maximum concentration of 5.8 µg/m³ remains near baseline conditions and within the lower end of the exposure range associated with long-term health effects reported in major cohort studies cited by Health Canada (2022) and WHO (2021).

Overall, while existing baseline concentrations of annual $PM_{2.5}$ are already above the WHO health-based guideline, the Project's incremental contribution is negligible and does not materially alter long-term $PM_{2.5}$ exposure or risk for receptors in the region.

7.2 Contingency Operations

In addition to planned operations, the Project includes the capability to operate the CTGs using ULSD as a contingency fuel in the unlikely event of a natural gas supply interruption. While diesel operation is not expected to occur routinely, emissions associated with ULSD combustion were explicitly considered in the air quality assessment (Stantec 2025).

Conservative air dispersion modelling conducted for the air quality assessment identified localized, short-term exceedances of air-quality guidelines for NO_2 and $PM_{2.5}$ under contingency operating scenarios that include diesel use (Table 4-1). These exceedances were spatially limited, occurring near the PDA boundary along an existing pipeline corridor within undeveloped wetland and forested land, and concentrations were predicted to decrease rapidly with distance. Even under the very conservative modelling assumptions used in the air quality assessment, modelled exceedances when diesel is used as the fuel source do not extend into residential or agricultural areas (Stantec 2025, Appendix A).

Health Canada guidance recognizes that short-term health effects associated with NO_2 and $PM_{2.5}$ are influenced by both concentration and duration of exposure, and that meaningful exposure occurs only if individuals are physically present within the affected microenvironment during the period of peak concentrations. Given the remote location, limited accessibility, and land use along the pipeline corridor, potential receptor activity in this area would be intermittent and transient, such as occasional recreational use (e.g., ATV or snowmobile travel), rather than continuous or residential occupancy. As a result, sustained short-term exposure consistent with the averaging periods associated with the modelled exceedances is unlikely.

While both NO_2 and $PM_{2.5}$ are considered non-threshold contaminants for which any incremental increase theoretically contributes to population-level risk, the predicted exceedances are associated with unlikely contingency conditions, would be of short duration, and occur in areas with limited, if any, human presence. In this context, risk of adverse health effects is negligible.

8 Uncertainty and Sensitivity Assessment

Health Canada’s HHRA guidance emphasizes that uncertainty and sensitivity analyses should be performed for all risk estimates, acknowledging that predictive risk assessments rely on models, estimated inputs, and simplifying assumptions (Health Canada 2023a). These factors can lead to either over- or under-estimation of risks, and should be transparently documented to support interpretation of the results. The key sources of uncertainty in this HHRA relate to:

- Modelling inputs and assumptions
- Screening of groundwater and surface water pathways
- Exposure assumptions
- Toxicity information and TRVs for $PM_{2.5}$ and NO_2
- The inability of the HHRA framework to capture potential positive health effects associated with regional emissions reductions

A qualitative sensitivity discussion is provided to indicate how these uncertainties may influence overall conclusions.

8.1 Modelling Inputs and Assumptions

As Health Canada (2023a) notes, risk estimates for proposed projects are inherently uncertain because they rely on predictive modelling rather than measured project data and therefore depend on the accuracy of model parameters and assumptions.

Air dispersion modelling was conducted using the AERMOD model with five years of recent meteorological data (2020-2024) to predict ground-level concentrations of NO_2, $PM_{2.5}$, and other contaminants. For short-term averaging periods, the modelling assumed that the CTGs would generate emissions continuously over the five-year period as a conservative approximation (i.e., 8,760 hours per year), even though planned CTG operation is much less, ranging from approximately 537 hours per year (base case) to 2,727 hours per year (stress case).

These choices introduce several uncertainties.

- Conservatism in emissions: Using continuous emissions for short-term modelling over-represents the frequency of the maximum predicted ground-level concentrations (e.g., the 99^{th} percentiles used for 24-hour exposures are not true 99^{th} percentiles, since most of the time the Project will not generate any air emissions).
- Meteorological representativeness: While recent meteorology improves relevance, Health Canada notes that all models involve simplifications and limited datasets, which can introduce uncertainty in how well predicted concentrations reflect the full range of possible dispersion conditions.

Background air quality concentrations for $PM_{2.5}$ and NO_2 were sourced from the nearest available regional monitoring stations because no local monitors exist near the Project site. While this represents an uncertainty, the use of regional data is unlikely to affect the conclusions of the risk assessment. For short-term exposure scenarios, Project-related contributions were substantive sources of exposure whereas for long-term exposure, Project-related contributions were negligible.

Taken together, modelling assumptions are collectively health-protective and more likely to overestimate rather than underestimate Project-related concentrations, which increases confidence that health risks are not understated.

8.2 Screening of Groundwater and Surface Water Pathways

Uncertainty remains regarding the final characterization of Project-related effects on groundwater and surface water because environmental studies associated with reject-water discharge pathways and downstream receiving environments are still ongoing. These studies include hydrological assessments (including baseline sampling), surface water quality evaluations, and regulatory review of potential discharge options, all of which will inform the final understanding of how treated process water may interact with groundwater or surface water bodies near the Project.

Despite these uncertainties, several factors reduce the likelihood that additional information will change the HHRA conclusion.

- Pathway completeness: The HHRA identifies groundwater and surface water pathways as incomplete because the Project is not expected to introduce contaminants to these media at levels that could result in toxicologically-relevant human exposure. Reject-water constituents are non-volatile and are not associated with bioaccumulation.
- Controls and mitigation: The Project incorporates multiple management measures, including spill-prevention and containment systems, a stormwater management plan, and a formal groundwater monitoring program. These measures further limit the potential for chemical releases beyond natural groundwater variability.
- Water supply protection: Baseline well sampling within a 2-km radius and contingency commitments (temporary water supply, repair or replacement of affected wells) provide additional confidence that residential water quality will remain protected.

Overall, while the hydrogeological and surface-water studies are ongoing, the current understanding indicates that Project activities are not expected to contaminate groundwater or surface water at levels relevant to human health, and that outstanding uncertainty is unlikely to alter the conclusions of the HHRA.

8.3 Exposure Assumptions

Health Canada guidance highlights that assumptions about exposure frequency, duration, and receptor presence can be a major source of uncertainty and may lead to over- or under-estimation of risk.

In this HHRA:

- For screening purposes, receptors were assumed to be present over the relevant averaging periods (1-hour, 24-hour, and annual), even at locations within the pipeline corridor where human presence is expected to be infrequent and transient.
- Populations sensitive to NO_2 and $PM_{2.5}$ (e.g., children, elderly adults, individuals with asthma or cardiovascular disease) were assumed to potentially be present throughout the LAA, including undeveloped wetlands and forested areas, to uniformly apply TRVs that are protective of the most sensitive individuals.
- No distinction was made between indoor and outdoor concentrations; no infiltration factor was applied, so indoor exposure was assumed to be equal to outdoor ambient concentrations at each receptor location.

Health Canada indicates that such "exposure term of 1" assumptions (i.e., full-time contact) are acceptable in screening-level assessments but must be recognized as conservative. This conservatism was explicitly acknowledged in the interpretation of risk results as part of risk characterization. For example, residents and sensitive receptors are unlikely to spend substantial time in the pipeline corridor where maximum concentrations occur, and typical time indoors would further attenuate exposures.

These exposure assumptions intentionally bias the HHRA toward over-estimation of risk, thereby providing a conservative basis for comparison against health-based guidelines while acknowledging that actual exposures are likely lower.

8.4 Toxicity and Toxicity Reference Value-Related Uncertainty

Uncertainties are inherent in the development and application of TRVs, particularly for air pollutants such as NO_2 and $PM_{2.5}$. Health Canada (2023a) notes that TRVs are derived from epidemiological or toxicological studies designed around specific exposure patterns, and applying TRVs outside those conditions introduces uncertainty in the risk characterization process.

8.4.1 Nitrogen Dioxide

The TRVs for NO_2 are based on epidemiological evidence linking both short-term and long-term NO_2 exposure to respiratory morbidity, all-cause mortality, and other health effects. WHO and Health Canada assessments consistently conclude a linear concentration–response relationship with no clear population threshold. Despite strong epidemiological evidence, several TRV-related uncertainties remain.

- Limited Mechanistic and Toxicological Evidence - WHO (2021) notes that, unlike $PM_{2.5}$, NO_2 does not have a robust independent toxicological evidence base confirming mechanistic pathways at ambient concentrations. Specifically, WHO indicates that “there has been no separate, independent assessment of mechanistic, toxicological and clinical studies” for NO_2 within guideline development. This reliance on epidemiology introduces uncertainty in causal interpretation.
- Co-pollutant Confounding - In urban settings, NO_2 strongly co-varies with combustion-related pollutants (e.g., $PM_{2.5}$, black carbon, traffic emissions). WHO (2021) acknowledges that determining the independent health effects of NO_2 is challenging given the correlated mixture environment. As a result, TRVs may partly reflect the effects of associated co-pollutants.
- Applicability Across Exposure Patterns - Health Canada (2023a) highlights that TRVs derived from chronic or continuous-exposure studies may not perfectly reflect intermittent or short-duration exposure patterns relevant to project scenarios. This creates uncertainty when applying long-term NO_2 TRVs to populations experiencing irregular exposure patterns.
- Sensitivity at Low Concentrations - Because NO_2 is treated as a non-threshold pollutant, TRVs derived from epidemiological data assume that any incremental change contributes to risk. However, WHO (2021) notes that observational studies used to derive these functions carry inherent uncertainty regarding the precision of effect estimates, especially at low concentrations.

8.4.2 Fine Particulate Matter

The TRVs for $PM_{2.5}$ are grounded in a large body of epidemiological, toxicological, and controlled human exposure studies that collectively establish a causal relationship between $PM_{2.5}$ exposure and several key health outcomes, including all-cause mortality, cardiovascular and respiratory morbidity, and lung cancer. However, several sources of uncertainty exist.

- Complexity of $PM_{2.5}$ Composition and Mechanisms - $PM_{2.5}$ acts through non-specific biological mechanisms, such as oxidative stress and inflammation, which occur across multiple tissues. Health Canada (2022) notes that although several $PM_{2.5}$ components (e.g., elemental carbon, sulfates, nitrates) show similar associations with adverse health outcomes, no comprehensive conclusion can be drawn about the specific toxicity of individual $PM_{2.5}$ components. This creates uncertainty about how well a mass-based $PM_{2.5}$ TRV captures the toxicity of $PM_{2.5}$ from specific sources, including combustion-based emissions.

- Evidence at Very Low Concentrations - Canadian cohort studies demonstrate associations between long-term $PM_{2.5}$ exposure and mortality even at 3–6 µg/m³, below many regulatory benchmarks. Health Canada (2022) emphasizes a non-threshold linear concentration-response relationship but also notes that confidence intervals widen at the lowest concentrations. This introduces uncertainty in the precision of risk estimates at very low exposure levels, including around the WHO 5 µg/m³ guideline.
- Emerging Health Endpoints - Uncertainties remain regarding $PM_{2.5}$ impacts on reproductive, developmental, metabolic, and neurological outcomes. Health Canada (2022) characterizes these effects as “suggestive” or “inadequate” due to limited or inconsistent evidence. TRVs may therefore not fully capture all potential $PM_{2.5}$-related risks, especially for sensitive subpopulations.
- Population Variability - Health Canada identifies increased vulnerability among individuals with cardiovascular disease, diabetes, obesity, asthma, chronic obstructive pulmonary disease, and among children. TRVs derived from population-level data may not reflect the upper bound of susceptibility for these groups, representing another uncertainty.

8.4.3 Summary

Across both COPCs, uncertainties arise from:

- Incomplete mechanistic understanding (especially for NO_2)
- Reliance on epidemiological evidence and its inherent limitations
- Application of TRVs to exposure scenarios different from those in underlying studies
- Non-threshold assumptions that increase sensitivity to small exposure changes
- Limited data for emerging endpoints and highly sensitive subgroups

These uncertainties do not invalidate the TRVs; rather, they reflect the limitations inherent in current scientific understanding. As emphasized in Health Canada (2023a), acknowledging such uncertainties is essential to interpreting risk estimates and understanding the degree of confidence and conservatism in the assessment.

8.5 Inability of the HHRA Framework to Capture Potential Positive Health Effects

Health Canada’s HHRA guidance specifies that project-based HHRAs focus on evaluating the potential for increased chemical exposures arising from project emissions and do not assess broader system-level, regional, or socio-economic health determinants (Health Canada 2023a). As such, the HHRA framework applied herein is intentionally limited to characterizing Project-related incremental risk and cannot quantify potential positive health effects that may result from changes to the broader energy system or reductions in emissions occurring outside the LAA.

For this Project, NB Power estimates that operation of the facility could reduce reliance on higher-emitting generation sources, including a projected net reduction of up to 250,000 tonnes of CO_2 per year, of which 150,000 tonnes per year represents avoided coal-fired emissions. These regional-scale changes are expected to produce corresponding reductions in co-emitted criteria air contaminants (e.g., $PM_{2.5}$, NO_x, SO_2), all of which are associated with well-documented adverse health effects at the population level. The scientific literature summarized by Health Canada (2022) and the WHO (2021) demonstrates that ambient $PM_{2.5}$ and NO_2 are causal for premature mortality, cardiovascular and respiratory morbidity, and other population-level health burdens.

Therefore, reduction in emissions from displaced higher-emitting power generation would be expected to have positive human health implications at the regional scale. However, because the HHRA evaluates only direct Project contributions to local air quality (i.e., within the LAA) and does not incorporate avoided emissions or net regional air quality improvements, these health benefits cannot be quantified or reflected within the HHRA results.

This represents an inherent source of uncertainty: the HHRA may overstate the net health risk of the Project by focusing on localized, maximum modeled ground level concentrations while excluding system-level emissions reductions that would be expected to lower population exposure to harmful air pollutants regionally. While this does not affect the validity of HHRA results, which appropriately characterize incremental Project effects following Health Canada methodology, it does highlight a limitation of the HHRA framework in representing the Project's potential overall net health effect, which may be more favourable when regional avoided emissions are considered.

9 Determination of the Extent of the Effects and Risks

In accordance with Health Canada's guidance (Health Canada 2023a), the results of the assessment were reviewed to determine the extent of predicted human health effects and risks. Under this framework, COPCs with HQs exceeding an acceptable target value of 1.0 are carried forward for consideration of potential health effects, whereas COPCs with HQs below target values are considered to represent negligible risk and do not require further effects characterization.

For the Project, air inhalation was the only complete exposure pathway identified, with NO_2 and $PM_{2.5}$ retained as COPCs. Under planned operating conditions, which involve intermittent operation of the CTGs using natural gas as the primary fuel, quantitative risk characterization indicates that Project-related HQs for short-term and long-term inhalation exposure to NO_2 and $PM_{2.5}$ do not exceed the target value of 1.0, indicating that adverse health effects are not expected.

Although annual HQs for $PM_{2.5}$ slightly exceed 1.0, this result reflects existing baseline regional air quality conditions rather than Project-related emissions. The Project's incremental contribution to long-term $PM_{2.5}$ exposure is negligible and does not materially influence chronic exposure or risk for Residential, Recreational, or Indigenous receptors. Consistent with Health Canada guidance, it is therefore not necessary to further characterize health effects for these COPCs under planned operating conditions, as they represent negligible or minimal risk.

In the unlikely event of a natural gas supply interruption, the Project includes the capability to operate the CTGs using ULSD as a contingency measure. Conservative air dispersion modelling conducted for this contingency scenario indicates that predicted concentrations of NO_2 and $PM_{2.5}$ at human receptor locations are expected to meet applicable air quality guidelines. Given the low likelihood and low concentrations, the risk of adverse health effects is negligible.

The HHRA incorporates conservatism across emissions modelling, exposure assumptions, and toxicity information leading to overestimates rather than underestimates of Project-related exposures. However, the HHRA framework does not capture potential positive population-level health effects from reduced regional reliance on coal-fired electricity generation (which would be expected to reduce contaminant exposures at a regional level), meaning the assessment may overstate the Project's net effect on human health.

10 Recommendations

The findings of the HHRA indicate that predicted Project-related risks to human health are negligible to minimal, and the uncertainties identified in Section 8 do not necessitate additional human-health-specific follow-up.

Accordingly, the following recommendations are provided.

10.1 Air Quality Monitoring

Although no human-health-specific monitoring is required, routine air contaminant monitoring during operation is recommended to:

- confirm that mitigation measures are being implemented effectively; and
- verify that emission rates used in the air dispersion modeling are representative of actual operating conditions.

This monitoring aligns with the Project's air-quality commitments (Stantec 2025) and supports validation of the predictions made in the HHRA.

10.2 Verification of Groundwater and Surface Water Assumptions

The HHRA relied on conservative assumptions regarding groundwater and surface-water quality pending completion of the hydrogeological and surface-water assessments. To confirm the screening conclusions for these pathways, it is recommended that:

- groundwater quality assumptions be confirmed following completion of ongoing groundwater studies; and
- surface-water quality assumptions be verified once the receiving-environment assessments for the reject-water discharge options are complete.

Based on current understanding, no Project-related changes to groundwater or surface-water chemistry at levels relevant to human health are expected; therefore, no human-health follow-up monitoring is required at this time. Confirmation of assumptions is recommended strictly to validate screening decisions.

11 References

Health Canada. 2016. Human Health Risk Assessment for Ambient Nitrogen Dioxide.

Health Canada. 2022. Canadian Health Science Assessment for Fine Particulate Matter.

Health Canada. 2023a. Guidance for Evaluating Human Health Effects in Impact Assessment: Human Health Risk Assessment.

Health Canada. 2023b. Guidance for Evaluating Human Health Effects in Impact Assessment: Air Quality.

Health Canada. 2023c. Guidance for Evaluating Human Health Effects in Impact Assessment: Country Foods.

Health Canada. 2023d. Guidance for Evaluating Human Health Effects in Impact Assessment: Drinking and Recreational Water Quality.

New Brunswick Department of Environment and Local Government (NBDELG). 2023. Noise Complaint Guidelines. https://www2.gnb.ca/content/dam/gnb/Departments/env/pdf/Air-Lair/noise-complaint-response-guidelines.pdf.

PROENERGY Holding Company, Inc. (PROENERGY). 2025. Initial Project Description and Environmental Impact Assessment Registration for the Centre Village Renewables Integration and Grid Security Project. Submitted to the Impact Assessment Agency of Canada and New Brunswick Department of Environment and Local Government.

Stantec Consulting Ltd. (Stantec). 2025. Effects Assessment for the Centre Village Renewables Integration and Grid Security Synchronous Condensing/Generation Facility Project - Environmental Impact Assessment Registration Addendum #1."

World Health Organization (WHO). 2021. WHO Global aur quality guidelines. Particulate matter ($PM_{2.5}$ and PM_{10}), ozone, nitrogen dioxide, sulfur dioxide, and carbon monoxide.

Appendix A Modelling Results for Planned Operations

Air Modelling Results for Planned Operations

To estimate representative air concentrations for human exposure under planned operating conditions, the air dispersion modelling described in the *Centre Village Air Dispersion Modelling Study*[1] was repeated using natural-gas-only emission rates for the combustion turbine generators (CTGs) and the ozone limiting method approach for conversion of NO_x to NO_2.

A.1 Receptor Locations

In evaluating potential human health risks from changes in air quality, it is appropriate to focus on locations where people are most likely to be present and where Project-related changes in air quality would be greatest, such as areas closest to the emission sources. Residences located near the Project represent the most relevant receptor locations for assessing potential exposure, as they reflect places where individuals may experience both higher concentrations and longer durations of exposure. Five nearby residences were identified for this purpose, as summarized in **Table A-1**.

Table A-1 Receptor Locations

Receptor ID	Description	Coordinates	
		X (m)	Y (m)
1	Residence	400931.9	5100548
2	Residence	400816.7	5099690
3	Residence	400624.9	5099202
4	Residence	400635.4	5098780
5	Residence	400666.8	5098668

A.2 Predicted Ground-Level Concentrations

Two contaminants of potential concern were retained for quantitative assessment: nitrogen dioxide (NO_2) and fine particulate matter ($PM_{2.5}$). Predicted ground-level concentrations are made for each hour of the five-year period of the meteorological data (2020 to 2024) for the modelled scenario. For the location of the maximum-predicted ground-level concentration and each of the five residential receptors locations, the 99th percentile concentrations and annual average concentrations were calculated for each of the model years, and the highest of these are presented in **Table A-2**. For the 1-hour averaging periods, the highest 1-hour concentration over the five model years is provided.

[1] Stantec Consulting Ltd. 2025. Centre Village Renewables Integration and Grid Security Synchronous Condensing/Generation Facility – Environmental Impact Assessment Registration Addedum #1, Appendix A - Centre Village Air Dispersion Modelling Study. Final Report. Prepared for WattBridge Energy LLC. Dated June 13, 2025.

Table A-2 Modelled Ground-Level Concentrations for Planned Operations

Receptor Location	Contaminant	Averaging Period	Assessment Scenario		
			Baseline (μg/m³)	Project Alone (μg/m³)	Baseline + Project (μg/m³)
Maximum	NO_2	1-hour	7.67	96.8	104
Maximum	NO_2	24-hour *	5.78	12.2	18.0
Maximum	NO_2	Annual	3.55	0.34	3.9
Maximum	$PM_{2.5}$	24-hour *	8.87	6.32	15.2
Maximum	$PM_{2.5}$	Annual	5.55	0.20	5.75
1	NO_2	1-hour	7.67	19.2	26.9
1	NO_2	24-hour *	5.78	1.04	6.82
1	NO_2	Annual	3.55	0.02	3.57
1	$PM_{2.5}$	24-hour *	8.87	0.54	9.41
1	$PM_{2.5}$	Annual	5.55	0.01	5.56
2	NO_2	1-hour	7.67	22.6	30.2
2	NO_2	24-hour *	5.78	1.61	7.39
2	NO_2	Annual	3.55	0.03	3.58
2	$PM_{2.5}$	24-hour *	8.87	0.84	9.71
2	$PM_{2.5}$	Annual	5.55	0.01	5.56
3	NO_2	1-hour	7.67	17.9	25.6
3	NO_2	24-hour *	5.78	1.61	7.39
3	NO_2	Annual	3.55	0.02	3.57
3	$PM_{2.5}$	24-hour *	8.87	0.84	9.71
3	$PM_{2.5}$	Annual	5.55	0.01	5.56
4	NO_2	1-hour	7.67	19.5	27.1
4	NO_2	24-hour *	5.78	1.16	6.94
4	NO_2	Annual	3.55	0.02	3.57
4	$PM_{2.5}$	24-hour *	8.87	0.60	9.47
4	$PM_{2.5}$	Annual	5.55	0.01	5.56
5	NO_2	1-hour	7.67	17.0	24.6
5	NO_2	24-hour *	5.78	1.48	7.26
5	NO_2	Annual	3.55	0.02	3.57
5	$PM_{2.5}$	24-hour *	8.87	0.77	9.64
5	$PM_{2.5}$	Annual	5.55	0.01	5.56

Note:
* 99^{th} percentile (fourth highest 24-hour value of model year); highest of the five model years

A.3 Calculated Hazard Quotients for Planned Operations

Risk characterization is quantified by calculating the Hazard Quotient (HQ), which is the ratio of the modelled concentration to the toxicological reference value (TRV). The health-based inhalation exposure limits applied as TRVs in this HHRA are summarized in **Table A-3**.

Table A-3 Inhalation Exposure Limits Applied as Toxicological Reference Values

COPC	Exposure Period	Exposure Limit / TRV (μg/m^3) *
Nitrogen Dioxide (NO_2)	Acute (1-hour)	200
	Acute (24-hour)	25
	Chronic (Annual)	10
Fine Particulate Matter ($PM_{2.5}$)	Acute (24-hour)	15
	Chronic (Annual)	5

Notes:
* World Health Organization (WHO). 2021. WHO Global aur quality guidelines. Particulate matter (PM2.5 and PM10), ozone, nitrogen dioxide, sulfur dioxide, and carbon monoxide.

The modelled concentrations are presented in **Table A-2** and the TRVs presented in **Table A-3** were used to calculate the HQs presented in **Table A-4**.

Table A-4 Hazard Quotients (HQs) for Planned Operations

Receptor Location	Contaminant	Averaging Period	Assessment Scenario		
			Baseline	**Project Alone**	**Baseline + Project**
Maximum	NO_2	1-hour	0.04	0.5	0.5
Maximum	NO_2	24-hour*	0.2	0.5	0.7
Maximum	NO_2	Annual	0.4	0.03	0.4
Maximum	$PM_{2.5}$	24-hour*	0.6	0.4	1.0
Maximum	$PM_{2.5}$	Annual	**1.1**	0.04	**1.2**
1	NO_2	1-hour	0.04	0.1	0.1
1	NO_2	24-hour*	0.2	0.04	0.3
1	NO_2	Annual	0.4	0.002	0.4
1	$PM_{2.5}$	24-hour*	0.6	0.04	0.6
1	$PM_{2.5}$	Annual	**1.1**	0.002	**1.1**
2	NO_2	1-hour	0.04	0.1	0.2
2	NO_2	24-hour*	0.2	0.1	0.3
2	NO_2	Annual	0.4	0.002	0.4
2	$PM_{2.5}$	24-hour	0.6	0.1	0.6
2	$PM_{2.5}$	Annual	**1.1**	0.002	**1.1**
3	NO_2	1-hour	0.04	0.1	0.1
3	NO_2	24-hour	0.2	0.1	0.3
3	NO_2	Annual	0.4	0.002	0.4
3	$PM_{2.5}$	24-hour	0.6	0.1	0.6
3	$PM_{2.5}$	Annual	**1.1**	0.002	**1.1**
4	NO_2	1-hour	0.04	0.1	0.1
4	NO_2	24-hour	0.2	0.05	0.3
4	NO_2	Annual	0.4	0.002	0.4
4	$PM_{2.5}$	24-hour	0.6	0.04	0.6
4	$PM_{2.5}$	Annual	**1.1**	0.002	**1.1**
5	NO_2	1-hour	0.04	0.1	0.1
5	NO_2	24-hour	0.2	0.1	0.3
5	NO_2	Annual	0.4	0.002	0.4
5	$PM_{2.5}$	24-hour	0.6	0.1	0.6
5	$PM_{2.5}$	Annual	**1.1**	0.002	**1.1**

Notes:
Hazard Quotients (HQ) greater than 1.0 in **bold**