

10. GREENHOUSE GASES

This section describes and summarizes an assessment of the effects of the Project on greenhouse gases. The assessment follows the general approach and concepts described in Section 5. The main steps in the assessment include:

- consideration of input from Indigenous communities, government representatives and agencies, other communities, property owners and people or groups interested in the Project during the ongoing consultation and engagement process;
- identification of information and data sources used in the assessment;
- identification and rationale for selection of criteria and indicators for greenhouse gases;
- establishment of temporal and spatial boundaries for the assessment of effects on these criteria;
- description of the existing environment to gain an understanding of baseline conditions for these criteria;
- identification and screening of effect pathways that could link Project activities to changes in these criteria;
- characterization of predicted net effects (after mitigation) of the Project on criteria (if required);
- assessment and determination of significance of cumulative effects from the Project and previous, existing and RFD's on criteria (if required);
- assessment of uncertainty in the effects predictions, indicating how uncertainties are addressed; and,
- identification of proposed monitoring or follow-up to confirm predictions and address uncertainty.

As outlined in Section 5.2.1, the assessment is structured around three assessment cases:

- Base Case;
- Project Case; and,
- Cumulative Effects Case.

10.1 Input from Consultation and Engagement

No issues pertaining to greenhouse gases have been raised during consultation and engagement for the Project. A detailed consultation and engagement record is provided in Appendices 2-III and 2-IX.

10.2 Information Sources

Information for the greenhouse gases baseline was collected from review of the *ECCC National Inventory Report 1990-2014: Greenhouse Gas Sources and Sinks in Canada* (ECCC 2016). A national inventory report is prepared and submitted annually to the United Nations Framework Convention on Climate Change (UNFCCC) to satisfy Canada's requirements under the convention to update, publish, and make available the national inventory of anthropogenic emissions by sources and removals by sinks. This report also includes the total Canada-wide (federal) greenhouse gas emissions from 2014, which is the most recent annual data set available, and presents annual greenhouse gas emissions by province and territory.

Ministry of the Environment and Climate Change (MOECC) greenhouse gas emissions reporting by facility data (MOECC 2016) and federal ECCC reported facility greenhouse gas data (ECCC 2015b) were also used to review sector-specific data. Ontario Regulation (O. Reg.) 452/09 governs the documentation and reporting of GHG emissions in Ontario. The *Guideline for Greenhouse Gas Emissions Reporting* (MOECC 2015; the O. Reg. 452/09 Guideline) provides the emission estimation methods that are required to be used under this reporting regulation. In Ontario, only stationary combustion is currently required to report under O. Reg. 452/09. The *Technical Guidance on Reporting Greenhouse Gas Emissions* (November 2015; ECCC 2015a) provides direction in determining if facilities are required to submit a greenhouse gas report to ECCC under the Greenhouse Gas Reporting Program. The Greenhouse Gas Reporting Program has not been used for construction projects.

For the purposes of the EA, sufficient information was deemed to be available from these references to assess the potential effects of the Project on greenhouse gases.

10.3 Criteria, Assessment Endpoints and Indicators

Criteria are components of the environment that are considered to have economic, social, biological, conservation, aesthetic or ethical value (Section 5.1). Greenhouse gases have been selected as the criterion because they have the potential to affect future climate as they contribute to the greenhouse effect by absorbing infrared radiation in the atmosphere, increasing temperature and changing weather patterns.

Assessment endpoints represent the key properties of a criterion that should be protected (Section 5.1). The assessment endpoint for the greenhouse gases criterion is maintenance of provincial and federal greenhouse gas emission levels.

Indicators represent attributes of the environment that can be used to characterize changes to criteria and the assessment endpoint in a meaningful way. Greenhouse gas emissions include the following compounds: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), sulphur hexafluoride (SF₆), perfluorocarbons (PFCs), and hydrofluorocarbons (HFCs). Consideration of these greenhouse gas emissions is required as part of the Ontario Provincial Greenhouse Gas Reporting Program under the Ontario *Greenhouse Gas Emissions Reporting* regulation (O. Reg. 452/09) and Canada's Greenhouse Gas Emissions Reporting Program (GHGRP) under the *Canadian Environmental Protection Act, 1999*. Of the greenhouse gases emissions requiring consideration, the Project is expected to emit CO₂, CH₄ and N₂O from the combustion of mobile equipment. The indicators for the greenhouse gases criterion are defined as follows:

- **Predicted CO₂ emissions:** CO₂ is a greenhouse gas that has a Global Warming Potential (GWP) of 1 under O. Reg. 452/09 (MOECC 2016).
- **Predicted CH₄ emissions:** CH₄ is a greenhouse gas that has a GWP of 21 under O. Reg. 452/09 (MOECC 2016).
- **Predicted N₂O emissions:** N₂O is a greenhouse gas that has a GWP of 310 under O. Reg. 452/09 (MOECC 2016).

The criterion, assessment endpoint and indicators selected for the assessment of Project effects on greenhouse gases, and the rationale for their selection, are provided in Table 10-1.

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Table 10-1: Greenhouse Gases Criteria, Indicators and Assessment Endpoint

Criteria	Rationale	Indicators	Assessment Endpoint
Greenhouse Gases	<ul style="list-style-type: none"> ■ Greenhouse gases contribute to climate change ■ Federal and provincial concerns with greenhouse gas emissions and climate change 	<ul style="list-style-type: none"> ■ Predicted greenhouse gas emissions of CO₂ ■ Predicted greenhouse gas emissions of N₂O ■ Predicted greenhouse gas emissions of CH₄ 	Maintenance of provincial and federal greenhouse gas emission levels

10.4 Assessment Boundaries

10.4.1 Temporal Boundaries

Development of the Project is planned to occur during two phases (Section 5.2.1):

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

The assessment of Project effects on greenhouse gases considers effects that occur during the construction phase as greenhouse gas emissions are considered to be largest during this phase of the Project. These periods are sufficient to capture the effects of the Project.

10.4.2 Spatial Boundaries

Spatial boundaries for the assessment are provided in Table 10-2.

Table 10-2: Greenhouse Gases Spatial Boundaries

Spatial Boundaries	Area (ha)	Description	Rationale
None	None	A spatial boundary for the assessment has not been defined because greenhouse gas emissions are by nature considered at the global scale. Regional and provincial greenhouse gas emissions are provided in this section for context.	

10.5 Description of the Existing Environment (Base Case)

This section provides a summary of the existing environment relevant to greenhouse gases as determined through desktop review.

10.5.1 Baseline Data Collection Methods

A desktop review was completed to identify baseline conditions. While greenhouse gas emissions are monitored at a federal scale by ECCC, they can also be quantified using published emission factors. For the purposes of this assessment, federal and provincial reported greenhouse gas emissions data were used to characterize existing greenhouse gas emissions at the federal and provincial levels using the ECCC *National Inventory Report 1990-2014: Greenhouse Gas Sources and Sinks in Canada* (2016).

10.5.2 Baseline Conditions

It is most appropriate to consider greenhouse gas emissions on a national or provincial scale. The primary sources of greenhouse gas emissions in Canada and Ontario are from anthropogenic sources that include the transportation sector (e.g., vehicles on 400 series highways in Ontario) and large industrial activities (e.g., manufacturing facilities) (ECCC 2016). Estimates of greenhouse gas emissions are expressed as million metric tonnes (Mt) of CO₂ equivalent (CO₂e), which are calculated based on the global warming potential for each gas relative to the global warming potential of CO₂.

The latest available national and provincial greenhouse gas data were used to describe current greenhouse gas emissions. The latest available data are from the 2014 reporting year. In 2014, approximately 732 Mt of CO₂e emissions were reported nationally. Ontario was accountable for 23% of these emissions. The national and provincial emissions reported in 2014 are summarized in Table 10-3 (ECCC 2016).

Table 10-3: Baseline Greenhouse Gas Emissions

Source(a)	Greenhouse Gas Emissions (Mt CO ₂ e)
Canada-wide 2014 GHG emissions	732
Ontario-wide 2014 GHG emissions	170

a) ECCC 2016 and MOECC 2016.

10.6 Project-Environment Interactions and Pathway Analysis

The linkages between Project components and activities and potential effects to greenhouse gases are identified and assessed through a pathway analysis (Section 5.4). Potential pathways for effects to greenhouse gases are presented in Table 10-4. Classification of effects pathways to greenhouse gases are also presented in Table 10-4, and detailed descriptions are provided in the subsequent sections.

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Table 10-4: Potential Effect Pathways for Effects to Greenhouse Gases

Project Component or Activity	Effect Pathway	Pathway Duration	Mitigation	Pathway Type
Project activities during the construction phase, including: <ul style="list-style-type: none"> ■ land clearing activities; ■ material handling and hauling; ■ vehicular exhaust; and, ■ reclamation of temporary access roads and staging areas. 	Greenhouse gas emissions from construction activities can result in changes in federal and provincial annual greenhouse gas emissions	Temporary, with effects limited to construction	<ul style="list-style-type: none"> ■ Where reasonable and practical, vehicles and equipment will be turned off when not in use, unless weather and/or safety conditions dictate the need for them to remain turned on and in a safe operating condition ■ The Contractor will keep equipment well-maintained to maximize fuel efficiency ■ Burning of slash will be subject to agreements with landowners, and to permits and approvals by appropriate regulatory agency (refer to Table 1-1) ■ Use multi-passenger vehicles to transport workers to site when possible 	Secondary

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10.6.1 Pathway Screening

10.6.1.1 No Pathway

No “no pathways” are predicted for net effects to greenhouse gases. Subsequently, there is no further discussion of no pathways.

10.6.1.2 Secondary Pathways

In some cases both a Project component or activity (i.e., source) and an effect pathway may exist, but the Project was assessed as resulting in a minor environmental change with a negligible net effect on greenhouse gases, resulting in a predicted secondary pathway. Project activities during the construction stage, such as land clearing activities, material handling and hauling, vehicular exhaust and reclamation of temporary access roads and staging areas are predicted to result in an effect pathway. This pathway, described in the following bullet, was assessed as secondary and was not carried through to the net effects assessment.

- **Greenhouse gas emissions from construction activities can result in changes in federal and provincial annual greenhouse gas emissions**

The primary sources of greenhouse gas emissions during the construction of the Project are off-road and on-road equipment. These emitted greenhouse gases are a by-product of fossil fuel combustion by engines. Potential effects associated with construction are anticipated to be minimal due to their short duration and intermittent frequency. A secondary screening assessment was completed to confirm potential effects.

It was assumed that, as a worst case, flagging and clearing, access road construction, staking, geotechnical investigations and foundation installation activities for the Project could occur at the same time. Corresponding equipment data for these activities provided by the Project construction team were used in combination with published emission factors from the Ontario Guideline for Greenhouse Gas Emissions Reporting (MOECC 2015) to calculate annual greenhouse gas emission totals.

A summary of the equipment data and emission factor references used for each source of emissions is provided in Table 10-5. Mitigation measures (Table 10-4) were assumed to be implemented. Vehicles were assumed to be operating for 10 hours, 21 days out of each month per year. This is a conservative assumption as not all equipment would likely be in operation for the full planned schedule (21 days per month, per year).

Table 10-5: Data Used for Emission Calculations

Emission Source	Equipment/Activity Data used in Emission Rate Calculations	Emission Factor Used in Emission Rate Calculations
Mobile equipment and vehicular exhausts	<ul style="list-style-type: none"> ■ Equipment type and quantity ■ Vehicle engine size ■ Equipment hours of operation 	<ul style="list-style-type: none"> ■ Diesel emission factors from Table 20-2 of the <i>Ontario Guideline for Greenhouse Gas Emissions Reporting</i> document (MOECC 2015) ■ Load factors from Table 9 of the <i>Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling</i> document (U.S. EPA 2010)

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The estimated annual greenhouse gas emissions from mobile equipment for the construction phase of the Project are summarized in Table 10-6. Construction phase greenhouse gas emissions are attributed to the operation of mobile equipment and likely represent an overestimate of the greenhouse gas emissions with the conservative assumptions (not all equipment would likely be in operation for the full planned schedule). The GWP used to calculate the annual total greenhouse gas emissions in CO₂e correspond to the GWPs from O. Reg. 452/09.

Table 10-6: Summary of Estimated Annual Greenhouse Gas Emissions during the Project Construction Phase

Source	Construction Annual Greenhouse Gas Emissions (tonnes/year)			Annual Total (tonnes/year)
	CO ₂	CH ₄	N ₂ O	CO ₂ e
Mobile Equipment	53,745.26	2.68	8.07	56,304.23

A comparison of the estimated annual overall greenhouse gas emission from the construction of the Project to the federal and provincial totals is provided in Table 10-7. The total estimated greenhouse gas emissions from the Project represent approximately 0.03% of the provincial total and less than 0.01% of the Canada-wide total. A comparison to the global greenhouse gas emissions total was not completed as greenhouse gas emissions from the Project represent a negligible fraction of global greenhouse gas emissions.

Table 10-7: Comparison of Estimated Greenhouse Gas Emissions from the Project to Ontario and Canadian Emission Totals

Source	Construction Phase Greenhouse Gas Emissions (CO ₂ e tonnes/year)
Project annual greenhouse gas emissions	56,304
Comparison to Canada-wide total	0.01%
Comparison to Ontario total	0.03%
Canada-wide 2014 greenhouse gas emissions	732,000,000
Ontario-wide 2014 greenhouse gas emissions	170,000,000

GHG = greenhouse gases; CO₂e = CO₂e = carbon dioxide equivalent; % = percent.

The Project is expected to have a negligible net effect on the criterion's assessment endpoint based on the comparison between the estimated annual emission to both the federal and provincial greenhouse gas emissions. Provincial and federal greenhouse gas emission levels are anticipated to be maintained. Therefore, the pathway is not expected to additively or synergistically contribute to effects of other past, previous or RFDs.

10.6.1.3 Primary Pathways

No primary effect pathways were identified for greenhouse gases. Subsequently, there is no further assessment or characterization of net effects, including determination of significance (Section 5.4.3).

10.7 Project Effects Assessment (Project Case)

No primary effect pathways were identified for greenhouse gases as a result of the Project (refer to Section 10.6.1). No further assessment or characterization of net effects, including determination of significance, is required.

10.8 Cumulative Effects Assessment (Cumulative Effects Case)

No primary effect pathways were identified for greenhouse gases as a result of the Project (refer to Section 10.6.1). Consequently, the greenhouse gases criterion is not carried forward for assessment of cumulative effects.

10.9 Prediction Confidence in the Assessment

The confidence in the effects assessment for greenhouse gases is moderate to high, considering that the mitigation described in the EPP (Appendix 4-II) is based on accepted and proven best management practices that are well-understood and have been applied to transmission line projects throughout North America. Uncertainty in the assessment has been further reduced by making conservative assumptions, planned implementation of known effective mitigation and monitoring measures, and available adaptive management measures to address unforeseen circumstances should they arise.

When considering greenhouse gas emissions from the Project, uncertainty was addressed through conservative assumptions regarding the operation of mobile equipment during the construction phase. Best management practices for mobile equipment include the regular maintenance of the equipment and practices to reduce the idling of mobile equipment. These measures will potentially reduce the emissions further below the conservative estimate, increasing confidence in the assessment.

10.10 Follow-up, Inspection and Monitoring Programs

No follow-up, inspection or monitoring programs will be required for greenhouse gases.

10.11 Information Passed on to Other Components

No results of the greenhouse gases assessment were forwarded to other components of the EA.

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