Questions and Comments

Innavik Hydroelectric Project
by the Pituvik Landholding Corporation

File 3215-10-005

December 2018

PROJECT TEAM

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TABLE OF CONTENTS

List of Tables

List of Appendices

GENERAL COMMENTS

This document includes a fourth series of questions and comments addressed to Pituvik Landholding Corporation as part of the review of the impact assessment for the Innavik Hydroelectric Project in Inukjuak.

After having analyzed all the information that was submitted to us, we find that the Developer has neglected to provide certain documents that it had undertaken to submit to the Quebec Ministry of Sustainable Development, Environment and the Fight against Climate Change (MELCC). MELCC expects the Developer to submit the requested documents and respond to the questions and comments below **no later than January 14, 2019**, i.e. approximately one week before the preparatory meeting with the Kativik Environmental Quality Commission (KEQC) in anticipation of the public consultations.

GENERAL CONTEXT

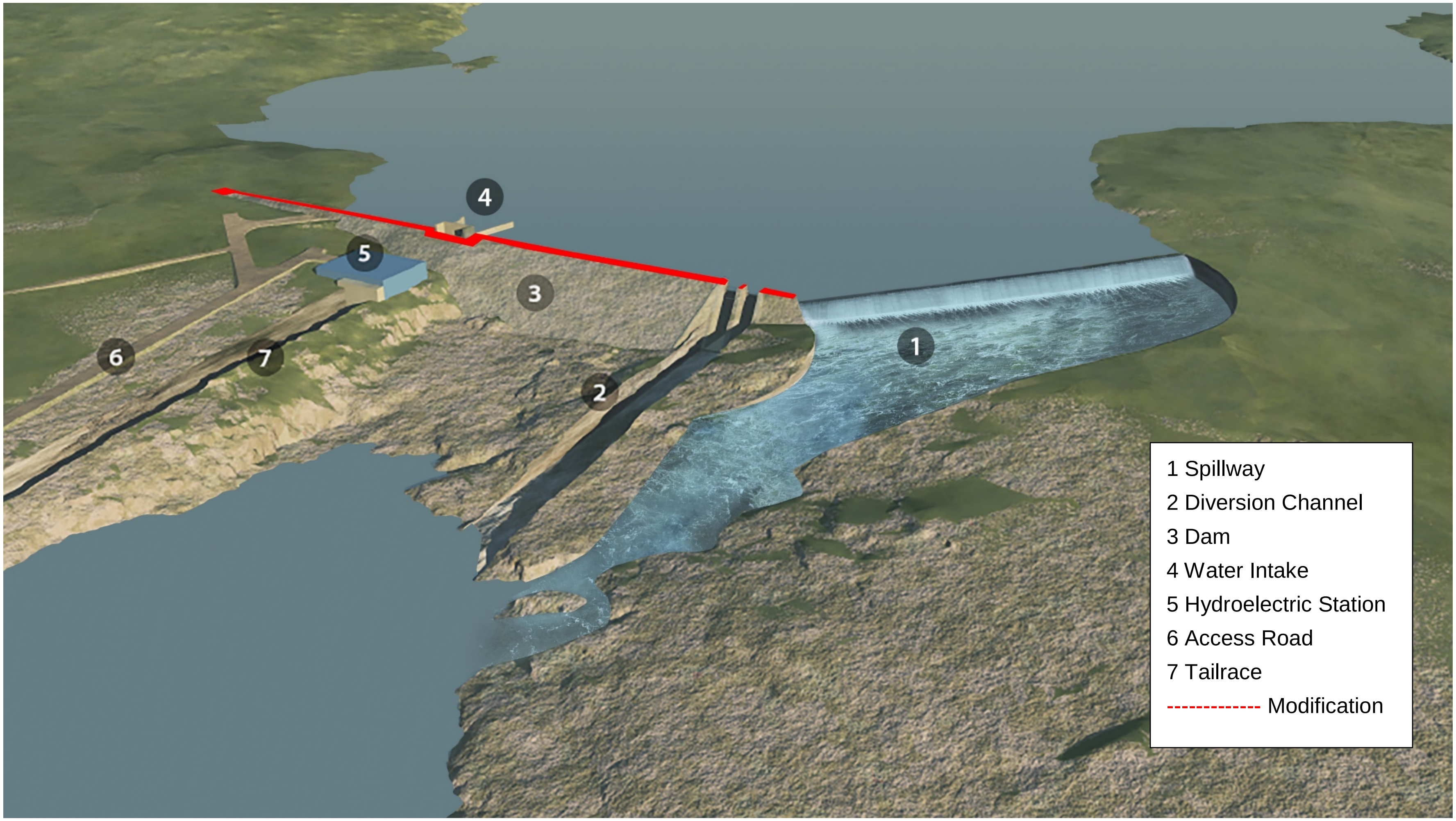
QC - 4.1. RQC3.2a.

The Developer indicates that it will ensure an appropriate freeboard by raising the dam to 47.3 m, i.e. 1 m higher than initially planned. However, this change will result in modifications to the dimensions of the dam. Thus, the length will be increased by less than 10 m on the right bank, and the maximum width across the entire height will be increased by less than 3 m. These changes will not have any impact on the forebay, the characteristics of which remain unchanged with a normal operating level of 44 m. The Developer indicates that the visual simulation of the dam will be updated.

a. **Likewise, the Developer shall submit the updated visual simulation of the dam.**

RQC - 4.1.

Updated visual simulation of the dam



FLOODING

QC - 4.2. RQC3-11a.

In response RQC3-11a in the third series of questions and comments, the Developer indicates that the fill scenario has not yet been decided. The Developer has mentioned that various scenarios were being studied in greater detail in order to determine which one would be the most appropriate from technical, economic and environmental perspectives.

a. The Developer shall indicate whether it has made a final decision regarding the fill scenario for the forebay. This scenario shall be presented at the public consultations held for the project.

RQC – 4.2.

The Developer has made a final decision regarding the fill scenario for the forebay. The forebay will be filled in 3.4 days.

SOCIAL ASPECTS

QC - 4.3. RQC3-15a.

The Developer indicates that it has scheduled meetings with representatives of the hunting, trapping and fishing community in Fall 2018, and that it plans to subsequently submit minutes of these meetings.

a. The Developer shall submit these meeting minutes.

RQC - 4.3.

Please find attached as Appendix 1 the minutes for the meeting held on September 20, 2018 in Inukjuak with the Inukjuak Hunting, Fishing and Trapping Association.

QC - 4.4. RQC3-16a.

In response RQC3-16a in the third series of questions and comments, the Developer indicates that it does not anticipate any adverse social impacts for the community related to the significant arrival of workers from outside the region.

a. The Commission considers that this project is of tremendous importance for the community of Inukjuak and requests that the Developer provide a rigorous assessment of the ensuing social impacts.

RQC – 4.4

The Developer is aware of the social issues and disturbances that will be triggered by the presence of the work site and the arrival of workers from outside the region. The Developer intends to implement a series of actions and measures throughout the project in order to prevent undesirable consequences as much as possible and mitigate any adverse impacts.

At the organizational level, measures will be implemented as early as Q1 2019 in order to fill as many positions as possible using local and regional resources and thereby limit the number of workers from outside the region. To this end, meetings will ensue starting in February and constant recruiting and training efforts will be continually undertaken until construction work begins. Also prior to the commencement of works, a social impact monitoring protocol (including behaviours that are inappropriate or that jeopardize social harmony) will be developed and a confidential mechanism will be put into place to handle grievances and problematic cases. These measures will be submitted to the Follow-up and Cooperation Committee, though specific cases will be handled in confidentiality. All these measures will be communicated to the community prior to the commencement of works, as will reminders issued at regular intervals throughout project construction.

During construction, in addition to the elements already mentioned in RQC3-16a and with the aforementioned clarification whereby the Follow-up and Cooperation Committee will not handle individual complaints, which will be treated confidentially (though a report will nevertheless be submitted to the Committee), a safety officer will be assigned to the camp in order to monitor workers’ comings and goings and ensure compliance with the established rules. In addition to the regular and constant monitoring of potential issues created by the presence of the construction site, an annual assessment will be prepared after each intensive season of construction in order to identify the necessary corrective measures for the following season. The existence of an annual pause in the construction schedule will provide the Developer the time it needs to implement corrective measures for the issues identified before resuming the intensive work schedule.

Lastly, the final year of construction will coincide with the implementation of a “landing” protocol, the object of which will be to ensure that construction draws to a close in the best conditions possible. This process entails assessing the impacts of construction on the social fabric of the community and its normal activities in collaboration with the Follow-up and Cooperation Committee and, once again, implementing measures that will facilitate a return to normal. The Developer firmly believes that this process must be initiated prior to the end of construction in order to ensure the commitment of all stakeholders.

In order to undertake all the aforementioned measures, the Developer will be able to enlist the services of expert consultants and mobilize other necessary resources.

EMERGENCY ACTION PLAN

QC - 4.5. RQC3.23c.

The Developer mentions that it plans to develop and submit a multi-injury evacuation plan that will be established in collaboration with the local authorities.

a. The Developer shall submit this plan.

RQC - 4.5. a.

The Multi-Injury Evacuation Plan is in the course of being developed. The Developer plans to meet notably with the Inuulitsivik CLSC in Inukjuak. The plan will be submitted prior to the start of the construction phase.

DRINKING WATER INTAKE

QC - 4.6. RQC3.25a. and d.

In QC3-25 a. and d. in the third series of questions and comments, the Developer was requested to provide further details on the temporary water intake installed upstream of the work to be carried out during the construction phase, in order to avoid any potential of drinking water contamination for the village of Inukjuak.

The Developer indicates a preliminary location for the temporary water intake and mentions that a temporary access road will be built while maximizing the use of existing roads and avoiding wetlands.

a. The Developer shall specify the locations of both the temporary water intake and the temporary access road. In the event this information is not yet available, the Developer shall indicate which options are currently being considered.

The Developer stipulates that water quality will be continually monitored during the construction period and that the frequency of analyses will be adjusted as a function of the level of risk and validated by the project team.

b. The Developer shall specify whether it will be responsible for water quality monitoring during the construction and operation periods. If this is not the case, the Developer shall specify who will be responsible for this monitoring.

RQC – 4.6.

a. As mentioned in RQC – 3.25 a., the preliminary location of the temporary water intake is indicated in the Project Infrastructure Map, which was attached as an insert to document . Since responses to the third series of questions were submitted to the Administrator on August 31, 2018, a meeting was held with the Inukjuak Hunting, Fishing and trapping Association (IHFTA) on September 20, 2018, and the latter mentioned the possibility of installing the temporary water intake not near the construction site, but rather in one of the lakes close to the village, i.e. Lake Tasiqu Tullipaaq. Telephone exchanges were held with KRG's head of drinking water infrastructure Mr. Aubrey C. Desroches and it was agreed that a meeting between the Developer, the contractor, the Northern Village and KRG would be organized in February 2019 in Inukjuak. The aim of this meeting is to properly understand the village's water distribution system (water sampling in the river and at reservoir outlets, disinfection, delivery schedule, etc.) for the village and to assess, amongst other things, the drinking water needs of the work camp, the location of the temporary water intake, potential contamination risks (sediment, oil, etc.) during construction and operation phases, and development of an emergency action plan to ensure that under no circumstances will drinking water quality be compromised and if a degradation were to be identified, that appropriate measures are put into place. Additionally, the guidelines of the drinking water monitoring program will be established in collaboration with the stakeholders in attendance. These guidelines will include the location where water samples will be taken, the sampling frequency, and the shipping of samples to the MELCC-accredited laboratory.

b. The Developer will be responsible for monitoring drinking water quality during the construction and operation phases. Samples will be collected prior to the commencement of construction in the river near the village's water intake and at a frequency that might be agreed to with the village and with KRG. However, the village will be responsible for the water distribution system and its quality, as necessary.

QC - 4.7. RQC3.26a.

The Developer indicates that the Kativik Regional Government (KRG) and the Quebec Ministry of Sustainable Development, Environment and the Fight against Climate Change (MELCC) will be directly involved in coordinating the temporary water intake work and the monitoring to be implemented.

a. The Developer shall specify in what capacity KRG and MELCC will be involved if a water quality issue were to arise.

b. The Developer shall indicate whether other organizations or ministries will be involved and specify the nature of their involvement.

RQC – 4.7.

a. Subsequent to the February 2019 meeting with representatives of the Northern Village, the contractor, Pituvik and KRG, the Developer will carry out water analyses at potential locations targeted for a temporary water intake. At the present time, the latter might be located upstream of the project as initially proposed, or at Lake Tasiqu Tullipaaq. A request for authorization under Article 22 of the *Environment Quality Act* will be submitted to MELCC in order to be able to use a second water intake. Water analyses shall be conducted beforehand to validate whether or not the water from the second drinking water intake requires additional treatment via the village's distribution system.

   The Northern Village is responsible for the water distribution system and for collecting water samples. KRG receives the analysis results and transfers them to the Nunavik Department of Public Health. In the event that a result does not comply with applicable standards, the laboratory shall promptly communicate with the village, KRG and the Director of Public Health. Subsequently, the village informs the users and takes the necessary measures to correct the situation.

   If a water quality problem were to arise following an incident occurring during construction of the hydroelectric plant, the Emergency Action Plan would be executed, and water would be drawn from the temporary water intake pre-approved by MELCC until the situation returns to normal.

b. The Developer will ensure that the Northern Village, KRG and MELCC are involved in managing the drinking water quality monitoring. Further details on the roles of each party will be discussed at next February's meeting.

GREENHOUSE GASES

QC - 4.8. RQC3.27a.

In response RQC3-27a of the third series of questions and comments, the Developer estimated greenhouse gas (GHG) emissions during the project's construction phase and established an annual average for the operation phase of the project. The Developer also presents the mitigation, monitoring and follow-up measures.

The Developer shall provide further details on greenhouse gases. More specifically, it should submit the following information:

a. Equations and data used: to facilitate the understanding of the results presented by the Developer, the source data and the equations used would need to be presented.
b. Emission results by GHG type: differentiate emissions for CO_2, CH_4, N_2O, SF_6, etc. To sum different GHG emissions of the project, the unit tonne of carbon

dioxide equivalent (tCO_2e) must be used while multiplying by the corresponding global warming potential.

c. Succinct calculation for sources considered negligible: it is possible to exclude sources deemed irrelevant as well as sources that, cumulatively, represent less than 3% of the project's total GHG emissions and that can consequently be considered negligible. However, for the latter, a rough quantification shall be made as a justification.

d. Frequency of inspection and the measures taken to identify leaks in high-voltage electrical equipment.

An explanatory document is presented in the appendix for the Developer's reference.

RQC - 4.8

a. Estimates for all GHG emissions have been recalculated using the references provided by MELCC (Appendix 2). The source data and calculations used are presented in Appendix 2. Thus, the estimate for all project-related GHG emissions would amount to 49,797 tonnes of carbon dioxide equivalent (hereafter, "tCO_2e") with an emissions estimate of 34,344 tCO_2e during the construction phase and an average of 386 tCO_2e/year during the operation phase considering a 40-year period (Table 1).

Tableau 1 - Summary of Greenhouse Gas (GHG) Emissions for the Innavik Project

Project Phase	Estimated Annual GHG Emissions [tCO_2e/year]	Number of Years	Estimated Total GHG Emissions [tCO_2e]
Construction	8,586	4	34,344
Operations	386	40	15,453
Total	-	-	49,797

In any case, annual emissions will be below the declaration threshold of 10,000 tCO_2e stipulated in the *Regulation respecting mandatory reporting of certain emissions of contaminants into the atmosphere* (c. Q-2, r. 15). The project is not an emitter under Article 2 of the *Regulation respecting a cap-and-trade system for greenhouse gas emission allowances* (c. Q-2, r. 46.1).

b. The emission results are presented by GHG type wherever applicable. The project's various GHG emissions are summed by multiplying the figures by the global warming potential for the corresponding GHG type.

c. Source data and the calculations used are presented in Appendix 2. Note that the project will not result in biogenic CO_2 emissions.

d. No insulating gas (PFC or SF6) leakages from high-voltage equipment is anticipated since the latter will be air-cooled and will not contain any of these gases. Electrical insulation will be made of solid material that is not likely to result in the emission of GHGs.

In conclusion, over the entire project life cycle (40 years), the Innavik plant will allow for a reduction in the order of 696,000 metric tonnes of CO_2 equivalent, while its construction will emit approximately 34,344 tCO_2e and its operation phase will emit 15,453 tCO_2e.

CLIMATE CHANGE

QC - 4.9. RQC3.28a.

In response RQC3-28a in the third series of questions and comments, the Developer stipulates that it will ensure that infrastructure design takes into account the effects of climate change. However, we would like to reiterate to the Developer the importance of ensuring that it takes into account changes in the hydrological regime under current and future climate scenarios when planning and operating its project.

In this regard, the Developer shall provide the following clarifications:

a. The Developer shall demonstrate that the anticipated impacts of climate change on the project and the receiving environment have been accounted for in the course of developing the project and assessing its impacts.

b. If relevant, the Developer shall demonstrate that its project design is adapted to the future climate.

RQC – 4.9.

a. The anticipated impacts of climate change on the project have been taken into account. The impact assessment predicts:

- A higher ambient temperature;
- An increase in precipitation and an ensuing increase in annual average flows potentially in the order of up to 10%;
- Early spring flooding;
- Greater winter flows;
- A decrease in snowfall;
- A decrease in ice cover.

Thus, if climate change were to result in greater winter flows and early spring flooding, the project would be able to better meet energy demand during those months of the year in which the supply-demand balance is more difficult to achieve.

b. Infrastructure design has taken the anticipated changes in the hydrological regime into account. Since the structures will be built on rock foundations, impacts on the project design is limited to the following points:

- Reduced ice cover resulting in lower ice forces on the structures and an increase in the volume of frazil ice below the ice cover;
- Higher ambient temperature resulting in a reduction in the annual volume of frazil ice generated upstream of the reservoir.

Explanatory Document - Appendix

Stationary combustion system:

In the context of a project, various types of fuels can be used in stationary combustion equipment to produce energy in the form of electricity, heat or steam. In order to calculate GHG emissions for stationary combustion systems, one must know the quantity of the various fuel types consumed for the combustion sources as well as the GHG emission factors of the fuels used.
GHG emissions for stationary combustion sources can be calculated using Equation 1 for each fuel type (i):

Equation 1. GHG emissions attributable to stationary combustion sources

$$\text{Émissions de gaz à effet de serre} = \sum_{i=1}^{i=n} \text{Quantité de combustible } i \text{ consommée} \times \text{Facteur d'émission}_i$$

This equation can be used for all fuel types as well as to estimate biogenic CO_2 emissions when using fuels other than fossil fuels, when applicable to a given project. For example, CO_2 emissions from the combustion of biomass, biogas, wood pellets, biofuels or mixed liquor are biogenic emissions.

Biogenic CO_2e emissions shall be presented separately in the results tables.

For GHG emission factors for different fuel types, please refer to Tables 1-1 through 1-8 of Quebec's *Regulation respecting mandatory reporting of certain emissions of contaminants into the atmosphere*.

Mobile combustion system:

The covered sources are all mobile equipment used at a facility or establishment for the on-site transportation or movement of substances, materials or products, and any other mobile equipment such as tractors, mobile cranes, log transfer equipment, mining machinery, graders, backhoes and bulldozers, and other mobile industrial equipment used during construction activities or operations of the project to be authorized.

Additionally, in the course of project operations, if the Developer is directly or indirectly (through sub-contractors) responsible for certain activities such as transporting raw materials, intermediate products or finished products and these activities are to take place within Quebec, then these emissions must also be quantified.

Emissions from mobile combustion activities are estimated for each fuel type using Equation 2 (i), which is essentially the same as the one described in the section on stationary combustion systems (Equation 1), but adapted to mobile sources:

Equation 2. GHG emissions attributable to the use of mobile equipment

$$\acute{E}missions\ de\ gaz\ \grave{a}\ effet\ de\ serre = \sum_{i=1}^{i=n} Quantit\acute{e}\ de\ carburant\ i\ consomm\acute{e}e\ \times Facteur\ d'\acute{e}mission_i$$

With regard to GHG fuel emission factors, please see Tables 4 and 5.

Table 1. Fuel Emission Factors [CO_2 equivalent]					
Liquid fuels	gCO_2/litre	gCH_4/litre	gN_2O/litre	gCO_2e/litre	Reference
Gasoline	2307	0.14	0.022	2317	*
Diesel fuels	2681	0.11	0.151	2729	*
Propane	1515	0.64	0.028	1539	*
Off-road vehicles, gasoline	2307	10.61	0.013	2576	*
Off-road vehicles, diesel	2681	0.073	0.022	2689	*
Natural gas-powered vehicles	1.9	0.009	0.00006	2.143	*, ***
Aviation gasoline (“avgas”)	2365	2.2	0.23	2489	*
Jet fuel	2560	0.029	0.071	2582	*
Diesel-powered trains	2681	0.15	1	2983	*
Gasoline-powered boats	2307	0.22	0.063	2331	*
Ships, diesel	2681	0.25	0.072	2709	*
Ships, light fuel	2753	0.26	0.073	2781	*
Ships, heavy fuel	3156	0.29	0.082	3188	*

Table 2. Biofuel Emission Factors [CO2 equivalent]				
Liquid biofuels	Biogenic emissions	Non-biogenic emissions		Reference
	Emission factor (gCO_2/litre)	Emission factor (gCH_4/litre)	Emission factor (gN_2O/litre)	
Ethanol (100 %)	1508	0.14	0.022	*
Biodiesel (100%)	2474	0.11	0.151	*
Gaseous biofuels	Biogenic emissions	Non-biogenic emissions		Reference
	Emission factor (gCO_2/m^3)	Emission factor (gCH_4/m^3)	Emission factor (gN_2O/m^3)	
Biogas	1887	0.037	0.033	**

* *National Inventory Report* (NIR) 1990-2016. Part II. Table A6-12 – *Emission Factors for Energy Mobile Combustion Sources*.

** NIR 1990-2016. Part II. Tables A6-1 and A6-2.

*** At standard temperature and pressure conditions.

As mentioned above, biogenic CO_2 emissions due to the use of biofuels, when applicable, must be presented separately in the results tables.

With regard to GHG emissions attributable to the use of off-road mobile equipment, the Developer also has the possibility of estimating fuel consumption using the BSFC factor[1], which represents the diesel consumption of equipment by horsepower and hour of use. This factor is expressed in pounds of diesel per horsepower-hour and can be determined from Tables A4, C1 and C2 of the document *Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling-Compression-Ignition in MOVES201X*, published in January 2018 by the United States Environmental Protection Agency (US EPA)[2].

- Calculation of indirect GHG emissions attributable to the use of electrical energy

Annual GHG emissions attributable to electricity consumption of the project can be determined using the annual electricity consumption and the GHG emission factor for electricity production in Quebec. Table A13-6 of the NIR published by Environment and Climate Change Canada (ECCC) presents the grams of CO_2 equivalent emitted per kilowatt-hour of electricity generated in Quebec.

1 Brake-Specific Fuel Consumption.
2 *https://cfpub.epa.gov/si/si_public_file_download.cfm?p_download_id=534575.*

- Calculation of GHG emissions attributable to the transportation of construction materials as well as excavation/backfill material

Emissions attributable to the transport of excavation/backfill material needed for project construction shall be calculated using the methodology presented in the section on mobile equipment.

- Calculation of GHG emissions attributable to the use of explosives

If explosives are used during project activities, GHG emissions attributable to their use can be calculated using Equation 3.[3]

Equation 3. GHG emissions attributable to the use of explosives

$$E_{CO2\_Exp} = \sum_{n=1}^{n=12} 3{,}664 \times (FFexp_n \times CC_n) \times 0{,}001$$

where:

E_{CO2_Exp} = Annual CO_2 emissions due to the consumption of fossil fuels used in explosives in tonnes per year;

$FFexp_n$ = Mass of fossil fuel contained in explosives used in Month n, expressed in kilograms of fuel;

CC_n = Average carbon content of fossil fuel used in explosive in Month n, expressed in kilograms of carbon per kilogram of fossil fuel;

n = Month;

3.664 = Ratio of molecular weight of CO_2 with respect to carbon;

0.001 = Conversion factor, kilograms to tonnes.

- Calculation of GHG emissions attributable to ecosystem flooding

Flooded lands are defined as water bodies that are regulated by humans for energy production, irrigation, navigation, recreation, etc., where this water control is the source of substantial changes in the water surface area. Regulated lakes and rivers where the primary, pre-flooded ecosystem was a natural lake or river are not considered flooded lands.

3 *A Guidance Document for Reporting Greenhouse Gas Emissions for Large Industry in Newfoundland and Labrador*. Government of Newfoundland and Labrador. Office of Climate Change. March 2017. http://www.exec.gov.nl.ca/exec/occ/greenhouse-gas-data/GHG_Reporting_Guidance_Document.pdf.

GHG emissions from flooded lands can mainly be generated in the following manners:

- Molecular diffusion between the air and water for CO_2, CH_4 and N_2O (diffusion emissions);
- CH_4 bubbles from sediment in the water column (bubbling emissions).

In cold regions, CO_2 and CH_4 accumulate under the ice and will be emitted during the spring thaw.

In its document *Report on Good Practice Guidance for Land use, Land-use Change and Forestry* [4], the IPCC proposes three methodological levels for estimating reservoir emissions, with an increasing degree of accuracy associated with the higher levels.

The methodology proposed to estimate GHG emissions attributable to the flooding of ecosystems is IPCC Level 1 methodology, which is a simplified method based on default emissions data and aggregate land area data. However, if it wishes to do so, the Developer of the project is free to use the Level 2 and 3 methods, which are more comprehensive and can include additional country-, province- or region-specific data.

- Calculation of GHG emissions attributable to fugitive sulphur hexafluoride and perfluorocarbons emissions

If electricity transmission and distribution equipment using sulphur hexafluoride (SF_6) or perfluorocarbons (PFC) is present in the project to be authorized, the emissions attributable to the operation of such equipment must be estimated.

When operating this kind of equipment, fugitive SF_6 or PFC emissions can arise in the course of or in relation to:

- Gas handling and transfer operations;
- Equipment operations;
- Mechanical breakdown of equipment.

Due to these fugitive emissions, it is sometimes necessary to refill or replenish equipment with SF_6 or PFCs to replace leaked gas and ensure that the equipment is in good working order. Consequently, these gases must be replenished, regardless of how they leaked. By measuring the quantity of gases added, an accurate estimate can be made of the quantity of gases released. This simple and accurate methodology cannot be used at the authorization stage of the project. For this reason, SF_6 or PFC emission estimation methods must be used.

[4]https://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf_files/GPG_LULUCF_FULL.pdf.

Consequently, in order to estimate fugitive SF_6 or PFC emissions, the Canadian Electricity Association[5] recommends using a simple quantification method based on emission factors, as shown in Equations 4 and 5.

Equation 4. Estimation of GHG emissions attributable to SF_6-containing equipment used for electricity transmission and distribution

$$E_{SF6} = (0{,}01 \times Cht_{SF6} + 0{,}7 \times ChiSF6_{EMR}) \times PRP_{SF6} \times 0{,}001$$

where:

E_{SF6} = GHG emissions attributable to the use of SF_6, expressed in tonnes of CO_2 equivalent per year;

Lt_{SF6} = Total SF_6 load in existing equipment during Year t, expressed in kilograms of SF_6 per year;

$LiSF6_{DE}$ = Initial SF_6 load in discarded equipment, expressed in kilograms of SF_6 per year;

GWP_{SF6} = Global warming potential of SF_6;

0.001 = Conversion factor, kilograms to tonnes.

Equation 5. Estimation of GHG emissions attributable to PFC-containing equipment used for electricity transmission and distribution

$$E_{PFC} = (0{,}01 \times Cht_{PFC} + 0{,}7 \times ChiPFC_{EMR}) \times PRP_{PFC} \times 0{,}001$$

where:

E_{PFC} = GHG emissions attributable to the use of PFCs, expressed in tonnes of CO_2 equivalent per year;

Lt_{PFC} = Total PFC load in existing equipment during Year t, expressed in kilograms of PFCs per year;

$LiPFC_{DE}$ = Initial PFC load in discarded equipment, expressed in kilograms of PFCs per year;

GWP_{PFC} = Global warming potential of PFCs;

0.001 = Conversion factor, kilograms to tonnes.

[5] Environment Canada. Canadian Electricity Association *Appendix A: Protocole d'estimation et de déclaration des émissions de SF_6 pour les services d'électricité* (version finale) (available in English as *SF6 emission estimation and reporting protocol for electric utilities: final version*). Page 32. http://publications.gc.ca/collections/collection_2013/ec/En4-229-2008-fra.pdf

Minutes of Meeting with the Inukjuak Hunting, Fishing and Trapping Association (IHFTA)

Thursday, September 20, 2018

Offices of the Pituvik Landholding Corporation, Inukjuak

10:00 a.m. to 2:00 p.m.

Attendees:

- Lazarusie Tukai, VP, IHFTA and board member of Pituvik
- Arthur Elijassiapik, board member, IHFTA
- Charlie Elijassiapik, board member, IHFTA
- Paulu Palliser, board member, IHFTA
- Eric Atagotaaluk, Pituvik
- Michael Kasudluak, Pituvik
- Sarah Lisa Kasudluak, Pituvik
- Jeanne Gaudreault, Innergex
- Matthieu Féret, PESCA Environnement

Meeting objective: to present the project as it currently stands and to take stock of the issues and concerns of the IHFTA.

The project was presented by Eric Atagotaaluk in Inuktitut with visual support (PowerPoint) in English.

Harvesting Activities in Vicinity of Project

Members of the IHFTA indicated on the project map the sectors used for hunting and fishing as well as the associated seasons:

- Ice fishing in early winter (as soon as ice conditions allow) on Lake Qattaakkuluup Tasinga and on the Inukjuak River at the mouth of the Sanirqamatik tributary (late November and December).
- Caribou hunting along the existing road. Hunters wait here for caribous crossing the river during their spring migration, especially in March, but sometimes later. Otherwise, the majority of caribous cross the Inukjuak River at Lake Qattaakkuluup Tasinga during their spring migration.
- Goose hunting along the Inukjuak River.

Concerns Regarding the Project's Impact on Their Activities

Hunters and fishers use the existing road to reach Lake Qattaakkuluup Tasinga. They wonder whether access will continue to be possible during the construction phase with the presence of borrow pits and heavy-vehicle traffic. To address this concern, Pituvik and Innergex will examine the possibility of creating a reserved lane within the right-of-way of the road to be upgraded in order to maintain safe and easy access for members of the community.

The installation of the bridge across the Inukjuak River represents a major benefit for IHFTA members. Even if certain areas may no longer be able to be used due to the project, the opening of this road will enhance the accessibility of a hitherto underexploited area with an abundance of berries, terrestrial fauna and fish. IHFTA members enquire about the work schedule and when the bridge will be installed. For them, the sooner the better. Ideally, the new route should allow an ATV to leave the right-of-way (no embankment, driving surface not much higher than adjacent ground). Eric Atagotaaluk and Jeanne Gaudreault will look into the possibility of installing the bridge as quickly as possible, i.e. Fall 2019.

Impoundment of the forebay would mean that there would no longer be an elevation differential between the latter and Lake Qattaakkuluup Tasinga. For IHFTA members, this would represent a major achievement. In fact, Lake Qattaakkuluup Tasinga is highly appreciated for fishing and hunting, but is far from the village and difficult to access, especially if transporting a watercraft. If no elevation differential is present following project build-out, fishermen will be able to set out from the forebay in their craft (less far, more accessible, more convenient).

Hunting activities along the access road (caribou, geese) could be suspended during the construction phase, especially if other areas are available on the left bank. Community members will be notified in order to avoid hunting in this sector, as it will not be possible to interrupt work for a specific period (the hunting season lasts several months).

Hunting and Fishing for Workers

Pituvik and IHFTA are open to the idea that workers be allowed to hunt or fish in the area during the construction phases, provided that the following stipulations are met:

- Hunting and fishing seasons must be respected.
- Workers must be in possession of a provincial licence and an authorization from Pituvik.
- Workers must be accompanied by an IHFTA member (guide), who would be hired to provide his or her services and material.

These services could generate additional local economic benefits.

Mercury Monitoring

IHFTA members asked whether monitoring could also be conducted in the lakes of the Inukjuak River watershed (e.g. Lake Tasiq Tullipaaq and Lake Qikirtalik).

IHFTA members are interested in participating in harvesting fish for the purpose of monitoring mercury levels. They will be permitted to catch and keep the fish frozen until the required sample size is reached. Some species are less abundant, notably touladi (lake trout). In this case, a smaller sample size will be required. It is understood that Lazarusie Tukai will be in charge of coordinating the work in collaboration with Eric and Jeanne once the protocol has been developed (quantities, location, sampling period, freezing procedure and shipment to laboratory in Kuujjuaq, etc.)

Compensation Plan for Loss of Fish Habitat

The Developer has undertaken to develop, in consultation with municipal stakeholders, a compensation plan for the modification of fish habitat. The IHFTA is therefore requested to provide its opinion. A list of potential projects will be presented to IHFTA and discussed with its members. Such projects may include habitat creation or habitat improvement initiatives. Eric Atagotaaluk also enquired whether raising fry and stocking the river could be an option. This possibility will be discussed with the relevant authorities (MFFP and DFO).

Temporary Water Intake

During the presentation, water quality monitoring was addressed, as was the Emergency Action Plan. Discussions ensued on the idea of installing a temporary water intake, not slightly upstream of the construction site, but rather in one of the lakes lying in proximity to the village. The Northern Village owns a portable pump in the event the permanent water intake fails. This option would be advantageous in the event that water is trucked in to the village. Further, according to Eric Atagotaaluk, the lake water is potable. Meetings are planned with the village and KRG.

Varia

Betsy is no longer involved in IHFTA. She has been replaced by the current mayor of Inukjuak, Mr. Paulossie Kasudluak.

Lazarusie Tukai has been designated as IHFTA’s contact person and representative to provide information, review and opine on compensation plans and monitoring programs, and sit on the Follow-up and Cooperation Committee.

CONSTRUCTION PHASE

Estimate of GHG emissions associated with producing aggregates

Parameter	Value/Quantity	Unit	Source
Quantity of diesel fuel consumed	53,302	litres	
GHG emission coefficient for diesel fuel	0.002729	tCO_2e / litre of diesel	Appendix provided by MELCC
GHG emissions associated with producing aggregates	**145**	**tCO_2e**	

Estimate of GHG emissions associated with excavating, loading and transporting aggregates

Parameter	Value/Quantity	Unit	Source
Volume of soil to be excavated and used as backfill	311,477	m^3	
GHG emission coefficient for soil excavating, loading and transporting activities	4	kg CO_2e / m^3 of soil	Greenhouse Gas Emissions Mitigation in Road Construction and Rehabilitation, Egis 2010
GHG emissions associated with excavating, loading and transporting aggregates	**1,246**	**tCO_2e**	

Estimate of GHG emissions associated with the use of explosives for excavating rock

Parameter	Value/Quantity	Unit	Source
Mass of explosives	190,000	kg of explosives / m^3 rock	
GHG emissions factor – Heavy ANFO	0.178	tonne CO_2 / tonne of explosives	AGO Factors and Methods Workbook, Australian Greenhouse Office, December 2006
GHG emissions associated with the use of explosives for excavating rock	**34**	**tCO_2e**	

Determination of difference between GHG emission factors associated with production of Portland cement present in concrete made in Canada and in China

Parameter	Value/Quantity	Unit	Source
GHG emissions associated with Portland cement production in Canada	0.532	tCO_2e / t Portland cement	Canada – National Inventory Report 1990-2016 – Part 2, Table A6-13
GHG emissions associated with Portland cement production in China	1.163	tCO_2e / t Portland cement	The Greenhouse Gas Emission from Portland Cement Concrete Pavement Construction in China, Int. J. Environ. Res. Public Health 2016, 13, 632
Difference between emission factors	(0.631)	tCO_2e / t Portland cement	
Mass of Portland cement used for concrete production	0.150	t Portland cement / m^3 concrete	
Difference between GHG emission factors associated with production of Portland cement present in concrete made in Canada and in China	(0.095)	tCO_2e cement / m^3 concrete	

Determination of GHG emission factor associated with producing, transporting and pouring concrete in the context of a work site in Canada

Parameter	Value/Quantity	Unit	Source
GHG emission factor – Production, transport and pouring of concrete in context of a construction site in China	1.345	tCO_2e / m^3 of concrete	Factor calculated using data presented in the following study that considers a Portland cement production process commonly used in China: The Greenhouse Gas Emission from Portland Cement Concrete Pavement Construction in China, Int. J. Environ. Res. Public Health 2016, 13, 632
Difference between GHG emission factors associated with production of Portland cement present in concrete made in Canada and in China	(0.095)	tCO_2e cement / m^3 concrete	
GHG emission factor – Production, transport and pouring of concrete in context of a construction site in Canada	**1.250**	**tCO_2e / m^3 concrete**	

GHG emissions associated with concrete production for the project

Parameter	Value/Quantity	Unit	Source
Volume of concrete used for project	9,659	m^3	
GHG emission factor – Production, transport and pouring of concrete in context of a construction site in Canada	1.250	tCO_2e / m^3 of concrete	
GHG emissions associated with concrete production for the project	**12,074**	**tCO_2e**	

GHG emissions associated with steel production

Parameter	Value/Quantity	Unit	Source
Reinforcing steel	1,256	t	According to a ratio of 0.13 t of reinforcing steel per m^3 of concrete
Steel piping	3	t	
Other components (structures, equipment, hardware)	100	t	
Mass of steel used	1,359	t	
GHG emission factor for steel production using basic oxide furnace (BOF)	2.8	tCO_2 / t steel produced	The Global Network for Climate Solutions fact sheets – Mitigating Iron and Steel Emissions – Columbia Climat Center – Earth Institute – Columbia University
GHG emissions associated with steel production	**3,804**	**tCO_2e**	

GHG emissions associated with air transport of passengers

Parameter	Value/Quantity	Unit	Source
Round-trip distance, Montréal-Inukjuak	1,500	km / return trip	
Number of passengers per return trip	10	passengers	
Number of return trips	300	return trips	3 return trips / week, 100 weeks between September 2019 and July 2022
GHG emission factor – Air transport of passengers	0.000145	tCO_2/km-passenger	Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the IPCC, Chapter 8. Brochure “CO_2 is in the air : Cinq mythes sur le rôle du transport aérien dans les changements climatiques”. Réseau Action Climat.
GHG emissions	**653**	**tCO_2e**	

GHG emissions associated with air transport of cargo (construction materials, fuel and provisions)

Parameter	Value/Quantity	Unit	Source
Average jet fuel consumption of cargo plane (Boeing 737 200C series) – return trip, Montréal-Inukjuak	75,000	litres	Example taken for indicative purposes from Air Inuit website, January 14, 2019
GHG emission factor for jet fuel	0.002582	tCO_2e/litre	Appendix provided by MELCC
Number of return trips	50	return trips	1 return trip / 2 weeks, 100 weeks between September 2019 and July 2022
GHG emissions	**9,683**	**tCO_2e**	

GHG emissions associated with cargo transport (material and equipment) by road to Wemindji maritime terminal

Parameter	Value/Quantity	Unit	Source
Estimated mass of cargo	6,119	t	
Carrying capacity of a truck	25	t / return trip	
Number of return trips	245	return trips	
Round-trip distance, Montréal-Wemindji	1,400	km / return trip	
Average fuel consumption	32	litres/100 km	
GHG emission factor for diesel fuel	0.002729	tCO_2e/litre	Appendix provided by MELCC
GHG emission factor per return trip	1.2	tCO_2e/return trip	
Number of return trips	245	return trips	
GHG emission factor per return trip	1.2	tCO_2e/return trip	
GHG emissions	**299**	**tCO_2e**	

GHG emissions associated with cargo transport (material and equipment) by sea from Wemindji to Inukjuak

Parameter	Value/Quantity	Unit	Source
GHG emission factor for heavy fuel oil	0.003188	tCO_2e / litre heavy fuel oil	Appendix provided by MELCC
Average fuel consumption	358	km-tonne cargo by ship / litre heavy fuel oil	Environmental and Social Impacts of Marine Transport In the Great Lakes-St. Lawrence Seaway Region, Research and Traffic Group, January 2013
Factor to represent the lower efficiency of a push barge vs. a heavy-tonnage vessel on the St. Lawrence Seaway	2		
Emission factor	0.000017810	tCO_2e / km-tonne cargo	
Round-trip distance, Wemindji-Inukjuak	675	km	
Number of return trips planned	12	return trips	3 return trips / summer for 4 years
Estimated mass of freight	6,119	t	
GHG emissions	**883**	**tCO_2e**	

Estimate of GHG emissions associated with the use of mobile equipment running on diesel

Equipment	Value/Quantity	Unit	Source
Nacelle, 85' high (SNORKEL AB 85RS)	10,746	litres	
Crawler bulldozer, STD 130 kW (CAT D6R-XL, JD 850 LT, Komatsu D65EX)	86,720	litres	
Off-road articulated truck, 40T (Komatsu HM400)	428,927	litres	
Compactor, 84" operated (HAMM 3412 & 3520)	11,465	litres	
Boom truck, 28T (24 tm)	3,380	litres	
Water truck, 12,000 l (NON-operated)	10,017	litres	
Water truck, 12,000 l (operated)	4,712	litres	
Tow truck, 45T (CRT, operated)	65,000	litres	
Vacuum truck, 10-wheel CRT	8,187	litres	
Dynamite truck	8,020	litres	
Air compressor, 375 cfm	157,857	litres	
Scissor lift (Cisolift)	600	litres	
Drill rig, Atlas-Copco	93,416	litres	
Grizzly	1,702	litres	
Hydraulic picker crane, 65T (Grove RT-650 & 760)	57,827	litres	
Hydraulic picker crane, 130T (Link Belt RTC-80130) for rock bolts	108,260	litres	
Grader, 185 kW (CAT 16H VHP & 14M, Volvo G990, Komatsu GD825A-2)	60,402	litres	
Concrete pump, Putzmeister 42m CRT	15,266	litres	
Skytrak 1042, CAT TL943, Merlot 80-14 GROS (operated) CRT	57,121	litres	
Diesel-powered welding machine (400A) on trailer with consumables	110,470	litres	
Total	**1,300,095**	**litres**	
GHG emission factor for diesel fuel	0.002729	tCO_2e/litre	Appendix provided by MELCC
GHG emissions generated by mobile equipment running on diesel	**3,548**	**tCO_2e**	

Estimate of GHG emissions associated with the use of mobile equipment running on automotive gasoline (unleaded)

Equipment	Value/Quantity	Unit	Source
Motorboat, 40 hp	1,725	litres	
Pickup truck	250	litres	
Pickup truck by the week	124,989	litres	
Total	**126,964**	**litres**	
GHG emission factor for unleaded gas	0.002317	tCO_2e/litre	Appendix provided by MELCC
GHG emissions generated by mobile equipment running on automotive gasoline (unleaded)	**294**	**tCO_2e**	

Estimate of GHG emissions associated with the use of stationary equipment running on diesel

Equipment	Value/Quantity	Unit	Source
Diesel generator (elect.), 100 kW	377,622	litres	
Screening machine on crawler tracks (Powerscreen 1800T)	45,123	litres	
Scissor lift (Cisolift)	4,000	litres	
Compactor, 54" non-operated (SuperPac 540C)	1,610	litres	
Total	**428,355**	**litres**	
CO_2 emission factor for diesel fuel	0.002663	tCO_2/litre	RMRCECA, Table 1-3
Global warming potential	1		IPCC – Fourth Assessment Report https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/quantification-guidance/global-warming-potentials.html
	1,141	**tCO_2e**	
CO_2 emission factor for diesel fuel	0.000000133	tCH_4/litre	RMRCECA, Table 1-3
Global warming potential	25		IPCC – Fourth Assessment Report https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/quantification-guidance/global-warming-potentials.html
	1	**tCO_2e**	
N_2O emission factor for diesel fuel	0.0000004	tN_2O/litre	RMRCECA, Table 1-3
Global warming potential	298	tN_2O	IPCC – Fourth Assessment Report https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/quantification-guidance/global-warming-potentials.html
	51	**tCO_2e**	
GHG emissions generated by stationary equipment running on diesel	**1,193**	**tCO_2e**	

Estimate of GHG emissions associated with the use of equipment running on heating oil

Equipment	Value/Quantity	Unit	Source
Diesel heater, FVO-400 (395,000 BTU)	173,200		
CO_2 emission factor for diesel fuel	0.002663	tCO_2/litre	RMRCECA, Table 1-3
Global warming potential	1		IPCC – Fourth Assessment Report https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/quantification-guidance/global-warming-potentials.html
	461	**tCO_2e**	
CO_2 emission factor for diesel fuel	0.000000133	tCH_4/litre	RMRCECA, Table 1-3
Global warming potential	25		IPCC – Fourth Assessment Report https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/quantification-guidance/global-warming-potentials.html
	1	**tCO_2e**	
N_2O emission factor for diesel fuel	0.0000004	tN_2O/litre	RMRCECA, Table 1-3
Global warming potential	298	tN_2O	IPCC – Fourth Assessment Report https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/quantification-guidance/global-warming-potentials.html
	21	**tCO_2e**	
GHG emissions generated by stationary equipment running on heating oil	**482**	**tCO_2e**	

Estimate of annual GHG emissions from incineration of domestic waste

Parameter	Value/Quantity	Unit	Source
Incinerated mixed paper, compostable material and green waste	0.15	t/day	
GHG emission factor for waste	0.0472	tCO_2e / t waste	Greenhouse gas calculator for waste management, Environment Canada 2005
Daily GHG emissions	0.00708	tCO_2e/day	
Duration of construction phase	852	days	May 1 to November 30 for 4 years
GHG emissions associated with incineration of domestic waste	**6**	**tCO_2e**	

OPERATION PHASE

Estimate of annual CO_2 emissions from submerged portion of reservoir

Parameter	Value/Quantity	Unit	Source
Emission factor for molecular diffusion	15.5	kg CO_2/ha/day	IPCC – Report on Good Practice Guidance for Land use, Land-use Change and Forestry, Table 3A3.5, 2003
Size of land area flooded	65	ha	
Duration of emissions	365	days / 10 years	CO_2 emissions will be limited to approximately 10 years after flooding. When the reservoir surface is frozen, CO_2 will accumulate under the ice and will be released during the spring thaw.
Annual emissions over the first 10 years of project operations	**368**	**tCO_2/year**	**For first 10 years**

Estimate of annual CH_4 emissions from submerged portion of reservoir

Parameter	Value/Quantity	Unit	Source
Emission factor for molecular diffusion	0.11	kg CH_4/ha/day	IPCC – Report on Good Practice Guidance for Land use, Land-use Change and Forestry, Table 3A3.5, 2003
Emission factor for gaseous emissions	0.29	kg CH_4/ha/day	
Emission factor for molecular diffusion and gaseous emissions	**0.4**	**kg CH_4/ha/day**	
Global warming potential for CH_4 – 100-year horizon	25	CO_2e	IPCC – Fourth Assessment Report https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/quantification-guidance/global-warming-potentials.html
Size of land area flooded	65	ha	
Number of days per year that GHG emissions will be generated	365	days/year	When the reservoir surface is frozen, CH_4 will accumulate under the ice and will be released during the spring thaw.
Annual emissions over 40 years of project operations	**237**	**tCO_2e/year**	

Estimate of annual N_2O emissions from submerged portion of reservoir

Parameter	Value/Quantity	Unit	Source
Emission factor for molecular diffusion	0.008	kg N_2O/ha/day	IPCC – Report on Good Practice Guidance for Land use, Land-use Change and Forestry, Table 3A3.5, 2003
Global warming potential for N_2O – 100-year horizon	298	CO_2e	IPCC – Fourth Assessment Report https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/quantification-guidance/global-warming-potentials.html
Size of land area flooded	65	ha	
Duration of emissions	365	days/year	When the reservoir surface is frozen, CH_4 will accumulate under the ice and will be released during the spring thaw.
Annual emissions over 40 years of project operations	**57**	**tCO_2e/year**	

Estimate of GHG emissions from submerged portion of reservoir

Parameter	Value/Quantity	Unit	Source
Annual CO_2 emissions for first 10 years of project operations	368	tCO_2e/year	---
Annual CH_4 emissions over 40 years of project operations	237	tCO_2e/year	---
Annual N_2O emissions over 40 years of project operations	57	tCO_2e/year	---
Annual GHG emissions over first 10 years of project operations	662	tCO_2e/year	---
Annual GHG emissions between Year 11 and Year 40 of project operations	294	tCO_2e/year	---
GHG emissions over duration of project operations (40 years)	**15,430**	**tCO_2e**	
Average annual GHG emissions	**386**	**tCO_2e/year**	

Estimate of GHG emissions from project’s annual electricity consumption

Parameter	Value/Quantity	Unit	Source
Annual electricity consumption	438,000	kWh/year	
GHG emission factor	1.3	gCO_2e/kWh	Canada – National Inventory Report 1990-2016 – Part 3 – Table A13-6 Electricity Generation and GHG Emission Details for Quebec
Over 40 years of project operations	**0.6**	**tCO_2e**	

CONCLUSION

Quantification of Greenhouse Gas Emissions for Construction Phase

GHG emission source associated with construction phase	**GHG Emissions [tCO_2e]**	**Resource for quantification**
Removal of vegetation	None	Little ground vegetation, Arctic tundra.
Production, excavation, loading, transport of aggregates, backfill	1,391	Appendix provided by MELCC Greenhouse Gas Emissions Mitigation in Road Construction and Rehabilitation, Egis, 2010
Use of explosives	34	AGO Factors and Methods Workbook, Australian Greenhouse Office, December 2006
Production, mixing, transport and pouring of concrete	12,074	Canada's Greenhouse Gas Inventory – Appendix C. The Greenhouse Gas Emission from Portland Cement Concrete Pavement Construction in China, International journal of Environmental Research and Public Health, 2016
Life cycle of construction materials	3,804	The Global Network for Climate Solutions fact sheets – Mitigating Iron and Steel Emissions – Columbia Climat Center – Earth Institute – Columbia University
Transport of construction materials, fuel, provisions and workers	11,517	Research and Traffic Group, Environmental and Social Impacts of Marine Transport In the Great Lakes-St. Lawrence Seaway Region, Summary, January 2013 Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the IPCC, Chapter 8 Brochure "CO_2 is in the air : Cinq mythes sur le rôle du transport aérien dans les changements climatiques". Réseau Action Climat.
Use of mobile equipment other than equipment intended for excavation/backfill and concrete preparation/transport/pouring	5,518	Regulation respecting mandatory reporting of certain emissions of contaminants into the atmosphere, Table 1-3 IPCC – Fourth Assessment Report https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/quantification-guidance/global-warming-potentials.html
Waste incineration	6	Determination of the Impact of Waste Management Activities on Greenhouse Gas Emissions: 2005 Update, Submitted to Environment Canada and Natural Resources Canada, ICF Consulting, 2005
Total	**34,344**	**tCO_2e,** over 4 years of construction
Annual average	**8,586**	**tCO_2e/year**

Quantification of Greenhouse Gas Emissions for Operation Phase

GHG emission source associated with operation phase	Average Annual GHG Emissions [tCO_2e]	Resource for quantification
Molecular diffusion and gaseous emissions – submerged part of reservoir	386	IPCC – Report on Good Practice Guidance for Land use, Land-use Change and Forestry, Table 3A3.5, 2003
Fugitive GHG emissions from high-voltage electrical equipment	-	High-voltage equipment will be air-cooled and will not contain any insulating gases such as PFC or SF6.
Project's annual electricity consumption	0.6	
Annual average	**386**	**tCO_2e/year**
Total	**15,453**	**tCO_2e** for 40 years of operation