Nalcor Energy – Lower Churchill Project

LCP ATMOSPHERIC ENVIRONMENTAL EFFECTS MONITORING PLAN

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1 PURPOSE

The purpose of this plan is to assess the Lower Churchill Hydroelectric Generation Project's (the Project) construction and operational activities identified in the EIS that have the potential to cause adverse environmental effects to the atmosphere through ambient air quality and greenhouse gas (GHG) emissions. This plan will propose the strategies for identification, management and monitoring of greenhouse gas, particulate and other air emissions for the Project.

The objectives for this Atmospheric EEMP are:

- To understand the sources and activities which contribute to the generation of GHGs;
- To create a framework for calculating emissions and identifying emissions reduction opportunities associated with the Project;
- To gather the information that will assist in the development of a management plan for the Operations Phase;
- To develop methods and recommendations to effectively reduce emissions associated with the Project.

2 SCOPE

This Atmospheric EEMP will address atmospheric characteristics of the Muskrat Falls Generation and Labrador Transmission Asset components during construction and operation. The mitigations will be applicable to all members of the Project Delivery Team (PDT) as encountered throughout their roles with the Project.

3 DEFINITIONS

Environmental Assessment: An evaluation of a project's potential environmental risks and effects before it is carried out and identification of ways to improve project design and implementation to prevent, minimize, mitigate, or compensate for adverse environmental effects and to enhance positive effects.

Environmental Management System: Part of an organization's management system used to develop and implement its environmental policy and manage its environmental aspects.

Environmental Protection Plan: Document outlining the specific mitigation measures, contingency plans and emergency response procedures to be implemented during the construction or operations of a facility.

Environmental Compliance Monitoring: Monitoring of Project activities to confirm compliance with regulatory requirements and commitments made through the EA process.

Follow-up Program: Studies or surveys designed and completed to verify the accuracy of the EA predictions and to determine the effectiveness of any measure taken to mitigate the adverse environmental effects of the Project.

Integrated Project Delivery Team: The integration of the Nalcor Energy and SNC Lavalin Inc. Teams.

4 ABBREVIATION AND ACRONYMS

AAQM	Ambient Air Quality Monitoring
CEAA	Canadian Environmental Assessment Act
CEM	Continuous Emissions Monitoring
CH_4	Methane
CO	Carbon monoxide
CO_2	Carbon dioxide
C-SEPP	Component-Specific Environmental Protection Plan
EA	Environmental Assessment
EF	Emission Factor
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EMS	Environmental Management System
EPP	Environmental Protection Plan
ERC	Environment and Regulatory Compliance
Gen	Generation
GHG	Greenhouse Gas (CO_2, CH_4, N_20)
IHA	International Hydropower Association
PDT	Integrated Project Delivery Team
JRP	Joint Review Panel
KI	Key Indicator
LCP	Lower Churchill Project

LTA	Labrador Transmission Asset
NAAQO	National Ambient Air Quality Objectives
NLDEC	Newfoundland and Labrador Division - Department of Environment and Conservation
N_2O	Nitrous oxide
NOx	Mono-nitrogen Oxides (NO, NO_2)
PEEMP	Protection and Environmental Effects Monitoring Plan
PM	Particulate Matter
UNESCO	United Nations Educational, Scientific and Cultural Organization
VEC	Valued Environmental Component
VOC	Volatile Organic Compound

5 REFERENCE DOCUMENTS

LCP-PT-MD-0000-EA-PL-0001-01	LCP Generation Environmental Assessment Commitment Management Plan
LCP-PT-ED-0000-EA-SY-0001-01	Environmental Impact Statement and Supporting Documentation for the Lower Churchill Hydroelectric Generation Project
LCP-PT-MD-0000-EV-PL-0011-01	Generation and Labrador Transmission Assets Environmental Protection Plan
LCP-PT-MD-0000-HS-PL-0001-01	Health and Safety Plan
LCP-PT-MD-0000-EV-PY-0002-01	LCP Anti-Idling Policy

6 PROJECT DESCRIPTION

6.1 MUSKRAT FALLS GENERATION PROJECT

The Muskrat Falls Generation Project (see Figure 6-1) will include the following sub-components which are broken down under the five principal areas of the development:

- 22 km of access roads, including upgrading and new construction, and temporary bridges;

- A 1,500 person accommodations complex (for the construction period); and
- A north roller compacted concrete overflow dam;
- A south rockfill dam;
- River diversion during construction via the spillway;
- 5 vertical gate spillway;
- Reservoir preparation and reservoir clearing;
- Replacement of fish and terrestrial habitat;
- North spur stabilization works;
- A close coupled intake and powerhouse, including:
- 4 intakes with gates and trash racks;
- 4 turbine/generator units at approximately 206 MW each with associated ancillary electrical/mechanical and protection/control equipment;
- 5 power transformers (includes 1 spare), located on the draft tube deck of the powerhouse; and
- 2 overhead cranes each rated at 450 Tonnes

Figure 6-1 Muskrat Falls Generating Facility

6.2 LABRADOR TRANSMISSION ASSET (LTA)

LTA consists of the ac transmission line system form Churchill Falls to Muskrat Falls (see Figure 6-2), specifically:

- Churchill Falls switchyard extension;
- Muskrat Falls switchyard;
- Transmission lines from Muskrat Falls to Churchill Falls: double-circuit 315 kV ac, 3 phase lines, double bundle conductor, Single circuit galvanized lattice steel guyed suspension and rigid angle towers; 247 km long;
- 735 kV Transmission Line at Churchill Falls interconnecting the existing and the new Churchill Falls switchyards; and
- Labrador Fibre Project (Nalcor's participation in Aliant led initiative).

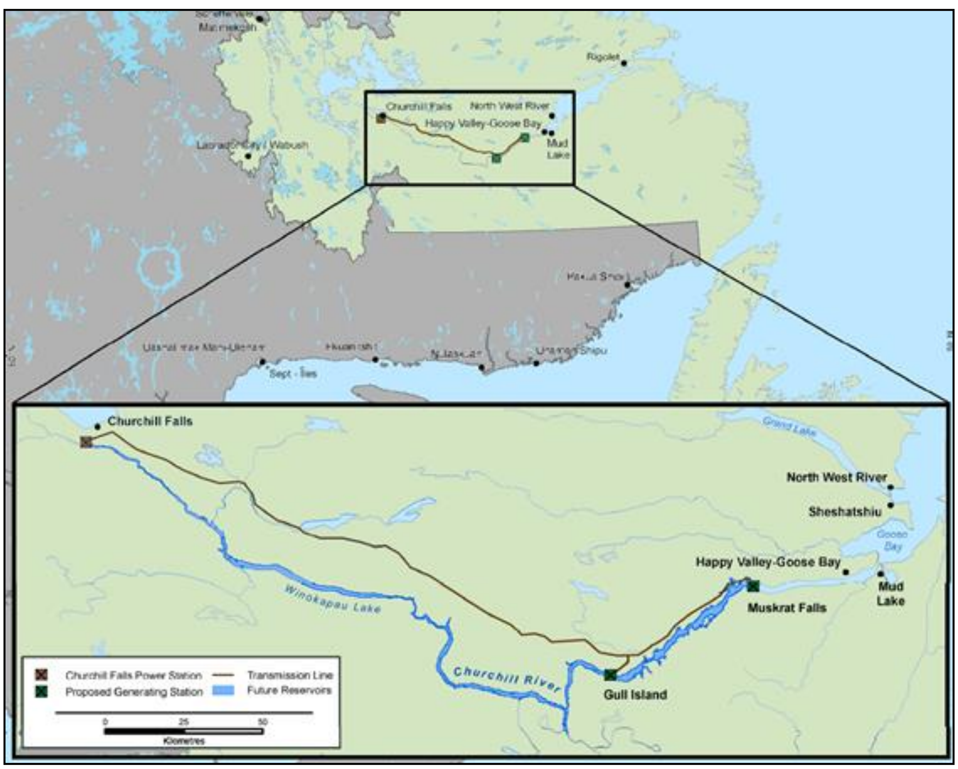

Figure 6-2 Labrador Transmission Assets

7 BACKGROUND

7.1 INTRODUCTION

The Muskrat Falls Generation Project will create a 59 km long reservoir, flooding 41 km^2 of land in the lower Churchill River valley. The environmental assessment of the Project, which included the Gull Island Project, identified the atmospheric environment as a Valued Environmental Component (VEC).

Overall, the Project itself will result in a net benefit from a climate and air quality perspective, by producing electricity with substantively lower emissions than other forms of electricity generation. The Lower Churchill agreement is a major part of Newfoundland and Labrador's strategy to reduce greenhouse gas (GHG) emissions from increased electricity demand and to offset GHG emissions from other sources. Once in operation, the Project is predicted to displace more than 16 megatonnes of carbon dioxide emissions annually.

7.2 POTENTIAL EFFECTS

Climate and Air Quality were selected as the two key indicators for the Atmospheric Environment VEC because of the potential for Project activities to release emissions that could affect both. In terms of climate, GHG emissions from Project activities have been identified as an important influence regarding climate change. In terms of air quality, emissions as a result of Project activities include particulate matter less than 10 microns (PM_{10}), particulate matter less than 2.5 microns ($PM_{2.5}$), sulfur dioxide (SO_2), mono-nitrogen oxides (NO_X), and volatile organic compounds (VOCs). The quality of the ambient air, including the ground-level concentrations of PM, PM_{10}, $PM_{2.5}$, SO_2, and NO_X, is important from both a biophysical and socioeconomic perspective.

Hydroelectric production was, until quite recently, considered for all practical purposes as relatively carbon neutral with close to zero-emissions (Hoffert et al., 1998; Victor, 1998), but it is now known that hydroelectric reservoirs do emit both carbon dioxide (CO_2) and methane (CH_4) gases during operation, with CO_2 making up the majority of emissions. Over time, reservoirs may come to resemble natural aquatic systems, all young reservoirs emit GHGs both through the mineralization of stored terrestrial carbon pools as well as through the permanent removal of natural carbon sinks such as forests and peatlands (Barros et al., 2011; Brothers et al., 2012; Roland et al., 2010).

The amount of GHGs released from flooded reservoirs is highly dependent on reservoir age, geographic location, and the nature and area of land flooded. Reservoirs at higher latitudes have been shown to release significantly less GHGs than those at lower latitudes in tropical regions (Barros et al., 2011). GHG emissions have been notably lower for deeper reservoirs as a function of colder water temperatures at depth with less microbial activity contributing to emissions (Brothers et al., 2012). Based on previous studies, the amount of GHGs emitted from a reservoir reach a peak at 3-6 times that of a natural lake approximately 1-5 years after construction and decrease nearer to baseline conditions approximately 10 years following impoundment (Teodoru et al., 2011; Tremblay et al., 2005b). Provided with the emission factors reported, (Table 7.1) it can be concluded that the hydroelectric energy is produced at emission factors orders of magnitude lower than thermal alternatives (Tremblay et al., 2005b). Particularly in the case of Muskrat Falls this is apparent, with a 126 km^2 reservoir (41 km^2 land to be inundated) producing close to 5 TW/h of power.

Over the last decade, there have been increasing efforts to understand the complex processes responsible for elevated levels of CO_2 and CH_4 emission that have been recorded following reservoir creation. This determination of GHG emissions from reservoirs is becoming more relevant both to ensure that methods of energy production are compared adequately and to evaluate facilities for CO_2 credits (Tremblay et al., 2005).

Table 7-1 Full Energy Chain Greenhouse Gas Emission Factors in g.CO_2.equiv./kWh(e).h-1 (modified from IAEA 1996).

Energy source	**Emission Factor* g CO_2 equiv./ kWh(e).h**
Coal (lignite and hard coal)	940 - 1340
Oil	690 - 890
Gas (natural and LNG)	650 - 770
Nuclear Power	8 - 27
Solar (photovoltaic)	81 - 260
Wind Power	16 - 120
Hydro Power	4 – 18
Boreal reservoirs (La Grande	~ 33
Average boreal reservoirs2	~ 15
Tropical reservoirs (Petit-Saut)3	~ 455 (gross) / ~ 327 (net)
Tropical reservoirs (Brazil)4	~ 6 to 2100 (average: ~160)

7.3 PREDICTED EFFECTS

Some of the activities associated with the Project will result in emissions of GHGs and air pollutants, as well as changing the landscape's carbon sequestration capacity. During construction, GHG will be emitted from the heavy equipment used during the construction of the Muskrat Falls Facility and the required transmission lines.

To predict GHG emissions, the fuel consumption of the equipment was estimated assuming the construction equipment operates 50 percent of the time at low to medium load. On this basis, and estimated fuel consumption, a conservative estimate of GHG emissions would be an approximate 300,000 tonnes of CO_2 emitted for the Project over the 5 year construction period (Minaskuat Inc. 2008b). The maximum total from the peak year of the Project construction period would represent approximately 3 percent of the total annual provincial GHG emissions. This amount, however, is relatively small by comparison to other sources of emissions in the Province.

It is anticipated that GHG emissions during operations from the waterways will continue at rates that are similar to baseline conditions during this period. It is also anticipated that any negative effects on air quality will be short term and reversible.

The chief sources of GHG emissions from the Muskrat falls reservoir area are likely to be CO_2 and CH_4 from the decay of organic materials on the flooded forest floor and mixing of nutrients from flooded vegetation in the water column. The breakdown of organic material is expected to be low, as compared to similar hydroelectric facilities due to the minimal drawdown value of 0.5 m. Results from recent long-term comprehensive studies based in Canadian boreal ecosystems suggest that once impounded, the reservoir will emit GHGs over the long-term at rates exceeding the carbon footprint of the pre-impoundment landscape (Teodoru et al., 2012). However, the integrated long-term carbon emissions per energy generation will remain far below the range of the natural-gas combined-cycle, which is considered the current industry standard. In addition, the GHG fluxes for the Churchill River and adjacent lakes were measured in 2006 (Bastien et al. 2007). The reported values indicate that GHG emissions from a mature reservoir at northern a latitude (Smallwood Reservoir) such as the future Muskrat Falls reservoir, are considered low in the context of national regulatory advice (CEA Agency 2003).

A discussion of the scenarios under which displacement of greenhouse gases may occur in various markets was provided in the Joint Review Panel Information Request responses, specifically, IR# JRP.7, IR# JRP.85, IR#JRP.7S and IR#JRP.85S. These responses provided a detailed comparative analysis of GHG displacement scenarios for possible electricity markets served and generation sources displaced, the GHG implications of the status quo (no Project) alternative, including both high and low GHG scenarios for the Island of Newfoundland.

Climate (GHG) and Air Quality, as discussed, are related to existing conditions, as well as the potential environmental effects of Project construction, and operation and maintenance. The information used to determine Project-related GHG and air pollutant emissions was obtained from engineering calculations, published literature and, where available, site-specific scientific studies related to other comparable hydroelectric facilities.

Regarding Air Quality, activities associated with site preparation (clearing, grubbing, and blasting), excavation for installation of the generation components, concrete production, transmission line clearing (right-of-way clearing), vehicle traffic onsite and quarrying and borrowing are expected to be the largest sources of air contaminant emissions for the Project. There is also the potential for fugitive emissions of PM (dust) from many of the construction activities including clearing, grading, blasting and quarrying. There will not be any burning of slash or other debris permitted during construction, and this will limit the adverse environmental effect on air quality.

7.4 MONITORING AND MITIGATION COMMITMENTS

In keeping with the responsibility to sustainable development, the Lower Churchill Project (LCP) has committed to the development of this Atmospheric Protection and Environmental Effects Monitoring Plan. This plan will outline the policies and mitigations that will be in place to minimize the negative effects to Climate and Air Quality and how the potential effects will be monitored. The Atmospheric PEEMP is one of the various key documents of the Environmental Management Plan, and part of the overall Environmental Management System (EMS).

8 REGULATORY COMPLIANCE

NL Reg. 18/12, also referred to as the *Lower Churchill Hydroelectric Generation Project Undertaking Order* releases the Project from environmental assessment and sets conditions for this release that LCP must meet. The release of the Project from environmental assessment under section 3 is subject to the following conditions:

(a) Nalcor Energy shall abide by all commitments made by it in the Environmental Impact Statement dated February 2009, and all the Environmental Impact Statement Additional Information Requests made by the Lower Churchill Hydroelectric Generation Project Environmental Assessment Panel and consequently submitted by Nalcor Energy, and the submissions made by Nalcor Energy during the panel hearings and, subsequent to the hearings, to the panel, unless one or more of the commitments, or a part of a commitment is specifically waived by the minister;

(e) Nalcor Energy shall prepare and abide by the requirements of environmental effects monitoring plans for all phases of the project, and those plans shall be submitted to and approved by the Minister of Environment and Conservation or the appropriate minister of the Crown before the commencement of an activity which is associated with or may affect one or more of the following matters:

(i) atmospheric

Submission of this EEMP satisfies the condition/requirement in NL Reg. 18/12 that Nalcor Energy prepare and submit to the Minister of Environment and Conservation or the appropriate minister of the Crown, an environmental effects monitoring plan for all phases of the project, before the commencement of an activity which is associated with or may affect the following matters:

(i) atmospheric

9 CONTRIBUTING SOURCES AND ACTIVITIES

9.1 CONSTRUCTION

9.1.1 Climate (GHG)

During construction, concrete production at the Muskrat Falls site, site water management, camp operations, quarrying and borrowing, impounding and transportation and road maintenance are expected to produce some GHG emissions. However, such emissions will occur only during construction and are not expected to be substantive.

Some interactions between the Project and Climate are of greater concern due to the magnitude of the associated GHG emissions relative to the overall Project. Other interactions are of concern due to public or regulatory concerns as expressed in federal or provincial policy or regulatory initiatives. These interactions include the GHG emissions from specific construction activities (e.g., fuel consumption of heavy equipment during upgrading and constructing site access roads, site preparation and construction of site buildings, excavation for and installation of generation components, transmission line construction, vehicular traffic on site and reservoir preparation).

When trees and vegetation are cleared for the transmission lines, reservoirs, and generating facilities, this results in a loss of the carbon sequestration potential for the region. With a decrease in CO_2-fixing vegetation, less CO_2 will be sequestered from the atmosphere in this region.

The GHG produced during construction will primary be from the combustion of fossil fuels. Table 8.1 indicates the expected activities releasing GHG throughout construction.

Table 9-1 Some Expected Sources of Produced GHG during construction

Core Emission	Source	GHG Produced
Direct		
Fuel Consumption (gasoline, diesel, jet fuel)	Owned/leased vehicles, heavy equipment, generators	CO_2, CH_4, N_2O
Shipping/Receiving	Propane tanks	CO_2, CH_4, N_2O
Indirect		
Purchased electricity (office spaces following power connection)	Facility lighting, process, HVAC	CO_2, CH_4, N_2O

9.1.2 Air Quality

Activities associated with site preparation (clearing, grubbing, and blasting), excavation for installation of the generation components, concrete production, proposed transmission line clearing (right-of-way clearing), vehicle traffic onsite and quarrying and borrowing will be the largest sources of air contaminant emissions for the Project. There is also the potential for fugitive emissions of PM (dust) from many of the construction activities including clearing, grading, blasting and quarrying.

9.1.2.1 Emissions from On-highway Transport of Equipment and Materials

Vehicle traffic volume estimates indicate the main commuter traffic between Happy Valley-Goose Bay and the site consists of transportation of the workers from the camps to the Project site and is planned to be limited to distances with travel times normally not exceeding 60 minutes. Therefore, the emission of air pollutants from vehicle traffic is expected to be low in comparison to the emissions from construction equipment. The on-highway transport emissions are low and will be spread out over a large area over several years, decreasing the likeliness to substantially affect Air Quality in the Assessment Area.

9.1.2.2 Emissions from Construction Equipment

The construction of the generation facility will require the excavation and movement of large quantities of earth materials. The preparation of the reservoirs will involve various types of equipment including feller bunchers, skidders, delimbers, and extractors when working in forest stands. The amount and type of equipment used will vary depending on the construction contractor and each of the construction activities.

In the assessment of potential environmental effects on Air Quality, existing information, experience and professional judgment were relied upon to establish whether the environmental effects are likely to result in frequent exceedance of the air quality standards. Overall, the total air pollutant emissions to the atmosphere on an annual basis during construction were estimated to be relatively low compared to the annual emissions from other sources in Newfoundland and Labrador (less than 2 percent). As air quality in Newfoundland and Labrador is considered good currently, and few other emission sources exist in the Assessment Area, a small increment is not expected to noticeably change ambient air quality. LCP will employ mitigation measures identified in the Generation and LTA EPP and Section 10 of this Plan to minimize the identified construction atmospheric effects.

9.1.2.3 Fugitive Dust Emissions

In addition to combustion gases, there is potential for fugitive dust emissions from several activities during construction. Fugitive dust is particulate matter that originates primarily from the movement of mobile equipment on unpaved surfaces, especially during dry and windy periods. These activities include site preparation (clearing, grubbing, blasting), excavation, quarrying and similar earth-moving activities. These activities are transient in nature and are dependent on many factors such as the moisture in the soil, the level of activity at a particular location, and meteorological conditions at the time. Any potential for dust generation would likely occur during periods of high winds or extreme dry periods. These episodes are expected to be of low frequency and short duration. Also, mitigations will be used to reduce fugitive dust. The emissions are therefore predicted to be nominal, and are expected to occur intermittently.

The concrete batch plants at the Muskrat Falls construction site will service various components of the Project including the powerhouse and spillway. The operation of each concrete batch plant has the potential to release fugitive emissions into the atmosphere.

These are primarily particulate matter associated with cement and aggregate material transfer.

9.2 OPERATION

9.3 CLIMATE (GHG)

During operation and maintenance of the Muskrat Falls Facility, the consumption of fossil fuels will be low. The stations will be operated remotely from St. John's, and most maintenance staff will commute from Happy Valley-Goose Bay to the facilities. The GHG emissions from the combustion of fossil fuel will be low in the context of national regulatory guidance during operation and maintenance (CEA Agency 2003).

However, there is potential for hydroelectric reservoirs to emit carbon dioxide (CO_2) and methane (CH_4) gases during operation.

GHG emissions from flooded lands can occur via the following pathways after flooding has occurred:

- molecular diffusion across the air-water interface for CO_2 and CH_4 (diffusive emissions);
- bubbles of CH_4 from the sediment through the water column (bubble emissions);
- emissions resulting from the water passing through a turbine or through the spillway and turbulence
- downstream (degassing emissions); and
- emissions from decay of flooded biomass

The Muskrat Falls reservoir is deep and narrow compared to other hydroelectric facilities of similar electrical output in Canada and elsewhere. The reservoir is also located at a northern latitude where cooler temperatures and ice formation slow the degradation of organic materials in the reservoirs and hasten their sequestration in the sediments. These factors will result in a low GHG emissions intensity (grams of CO_2e emitted per kilowatt-hour (kWh) of electricity generated or g CO_2e/kWh) for the overall Project.

It has been found that greenhouse N_2O emissions from flooded lands are considered to be low (IPCC 2006). Typically, N_2O emissions are substantive only where fertilizer nitrogen inputs are high, and because there is no agricultural activity being conducted within the boundaries of the watershed, the N_2O emissions are assumed to be negligible.

9.3.1 Air Quality

Emissions of air pollutants during operation and maintenance of the facilities are expected to originate only from vehicle traffic associated with commuting workers and from specific supplier and maintenance activities including inspection, maintenance and repairs along transmission line. These air pollutant emissions are expected to be very low and would not add any substantive loading to the atmosphere.

10 MITIGATIONS

Throughout construction and operations, a number of initiatives will be introduced to reduce the potential for adverse atmospheric environmental effects. These initiatives have been committed by the LCP to enforce during the phases of the LCP.

The following reduction initiatives will be implemented throughout the Construction and Operations phases, as outlined in the Generation/LTA EA commitments and the Generation and Labrador Transmission Assets Environmental Protection Plan (LCP-PT-MD-0000-EV-PL-0011-01).

Climate (GHG):

- Activities involving fuel combustion will comply with regulatory requirements for vehicle emissions and fuel quality. These measures will be established through appropriate leasing or purchasing agreements and maintenance schedules;
- Vehicles will be maintained and all equipment kept in good working order with mufflers regularly inspected and in compliance with federal emissions and efficiency standards;
- An anti-idling policy (LCP-PT-MD-0000-EV-PY-0002-01) has been implemented with respect to vehicle operation for all PDT members to reduce GHGs and particulate matter emissions (LCP-PT-MD-0000-EV-PY-0002-01);
- Burning of slash or debris will be prohibited. Burning debris releases stored carbon as CH_4 and also releases N_2O, both of which are more powerful GHGs than CO_2;
- In areas where work is concluded and access roads that may no longer be required – areas will be rehabilitated in accordance with the EPP to encourage the formation of natural conditions and carbon sequestration potential.

Air Quality:

- Enforced speed limits to limit dust on unpaved roads;
- Construction traffic will be monitored along with borrow pit activities to minimize dust issues;

- Dust control suppressants such as water and/or calcium chloride and magnesium chloride will be applied as necessary to reduce the amount of particulate matter in the local area on access roads;
- The burning of waste and other materials is prohibited on site, as harmful chemicals such as carbon monoxide (CO), Volatile Organic Compounds (VOCs), mono-nitrogen oxides (NO_x) as well as particulate matter can be released to the atmosphere.

11 MONITORING

Activities affecting Climate and Air Quality will be monitored throughout the construction, operation and maintenance phases of the LCP.

The DOEC-NL has impact assessment and approval requirements for generators of a certain size and duration of operation. The LCP will conduct air quality modelling as per this guidance document, to include in the submission of the annual GHG report.

11.1 MONITORING DURING CONSTRUCTION

Atmospheric effects from construction will be monitored through fuel tracking.

Quantification of emissions for Construction will be based on the Tier program of emissions calculations. All GHG activity data from the reporting of fuel consumption will be multiplied by a GHG emission factor. Fuel consumed by heavy equipment, diesel powered equipment and light duty vehicles will be included in the bulk consumption reporting to the LCP.

Fuel consumption reports will be made available to the appropriate regulator for informational purposes. If the emissions are determined to be above guidelines, adaptive management measures will be implemented.

11.1.1 GHG Emissions

There are currently no provincial or federal standards or guidelines for GHG concentrations in ambient air, nor are there any emission limits with respect to GHG releases from individual sources or sectors in place for Newfoundland and Labrador at this time. As such, the scope of this Project does not contain any aspects that are currently regulated for GHG emissions provincially or federally.

Calculation of emissions generated in the construction phase of the LCP will be completed through the reporting of fuel consumption by all site contractors. Reporting will be conducted on a monthly basis to the LCP team. These consumption totals will be used to calculate the CO_2 equivalent of GHG produced during the construction phase. To determine the emissions generated per month, the quantity of fuel consumed is multiplied by an emission factor for that fuel. The selection of Emission Factors (EF) is derived from the Emission Factors for Energy Mobile Combustion Sources (Environment Canada – GHG Emissions Quantification Guidance) (See Table 11-1)

Table 11-1 Emission Factors for Energy Mobile Combustion Sources

Mode	Emission Factor (g/L)		
	CO_2	**CH_4**	**N_2O**
Road Transport			
Gasoline Vehicles			
Light Duty Gasoline Trucks (LDGT)			
Tier 1	2289	0.24	0.58
Diesel Vehicles			
Light Duty Diesel Trucks (LDDT)	2663	0.068	0.21
Off-Road Transport			
Off Road Diesel	2663	0.15	1.1

The Greenhouse Gas Protocol has created a calculation tool available for industry use. Emission factors are set into a spreadsheet in which the user enters fuel consumption data. The WRI Transport Tool is an example of a calculation method for determining GHG emissions (See Appendix 1).

Following calculation of annual GHG emissions using the Greenhouse Gas Protocol, the LCP will create an annual report providing bulk fuel consumption of both diesel and gasoline from mobile and stationary sources. This report will be submitted annually to the Department of Environment and Conservation – Newfoundland and Labrador Division (DOEC-NL).

11.1.2 Air Quality

The relevant air contaminants selected as measureable parameters are PM, PM10, PM2.5, SO_2, and NO_X. The emissions and ambient concentrations of air pollutants are described in the Newfoundland and Labrador Regulation 39/04, Air Pollution Control Regulations (Government of Newfoundland and Labrador 2004, Internet site), Government of Canada's NAAQO, the Canada-Wide Standards and other recognized emission or ambient standards.

Emissions of VOC are estimated and compared to overall emissions from Newfoundland and Labrador. However, no relevant ambient standard or guideline for VOC exists.

To address air quality monitoring, this will be based on a complaint-driven process as the Project progresses. If warranted, an ambient air quality monitoring (AAQM) program will be developed and initiated as per Environmental Assessment commitments. Monitoring would be done as needed at the edge of buffer zones outside the Project's zone of influence.

11.1.3 MONITORING DURING OPERATIONS AND MAINTENANCE

The main area of interest of the Atmospheric EEMP is the GHG emission generating activities. These activities will also be tracked throughout the operation and maintenance phases of the LCP.

Research undertaken in Canadian Boreal reservoirs has shown consistently that very small GHG emissions are released (Tremblay et al., 2005b; Tremblay 2004a,b; Bastien et al., 2007), with baseline conditions generally seen no longer than 10 years following impoundment. Additionally, these studies have indicated that deployment of the equipment required to estimate GHG emissions is difficult from both a technical and safety perspective. The Churchill River itself is a major constraint to the effective mobilization of this equipment, further reducing the reliability. Therefore, a study to determine GHG flux for this Project is not appropriate.

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APPENDIX 1

Greenhouse Gas Protocol – Calculation Tool

The Greenhouse Gas Protocol Initiative
The foundation for sound and sustainable climate strategies

Total GHG Emissions, exclude Biofuel CO2 (metric tonnes CO2e)	0
Biofuel CO2 Emissions (metric tonnes)	0

Activity Data

Status	Source Description	Region	Mode of Transport	Scope	Type of Activity Data	Activity Data					
						Vehicle Type	Distance Travelled	Gross Weight	# of Passenger	Unit of Distance	Fuel Used

		Error Messages	GHG Emissions				
Fuel Amount	Unit of Fuel Amount		Fossil Fuel CO_2 (metric tonnes)	CH_4 (kilograms)	N_2O (kilograms)	Total GHG Emissions, exclude Biofuel CO_2 (metric tonnes CO_2e)	Biofuel CO_2 Emissions (metric tonnes)