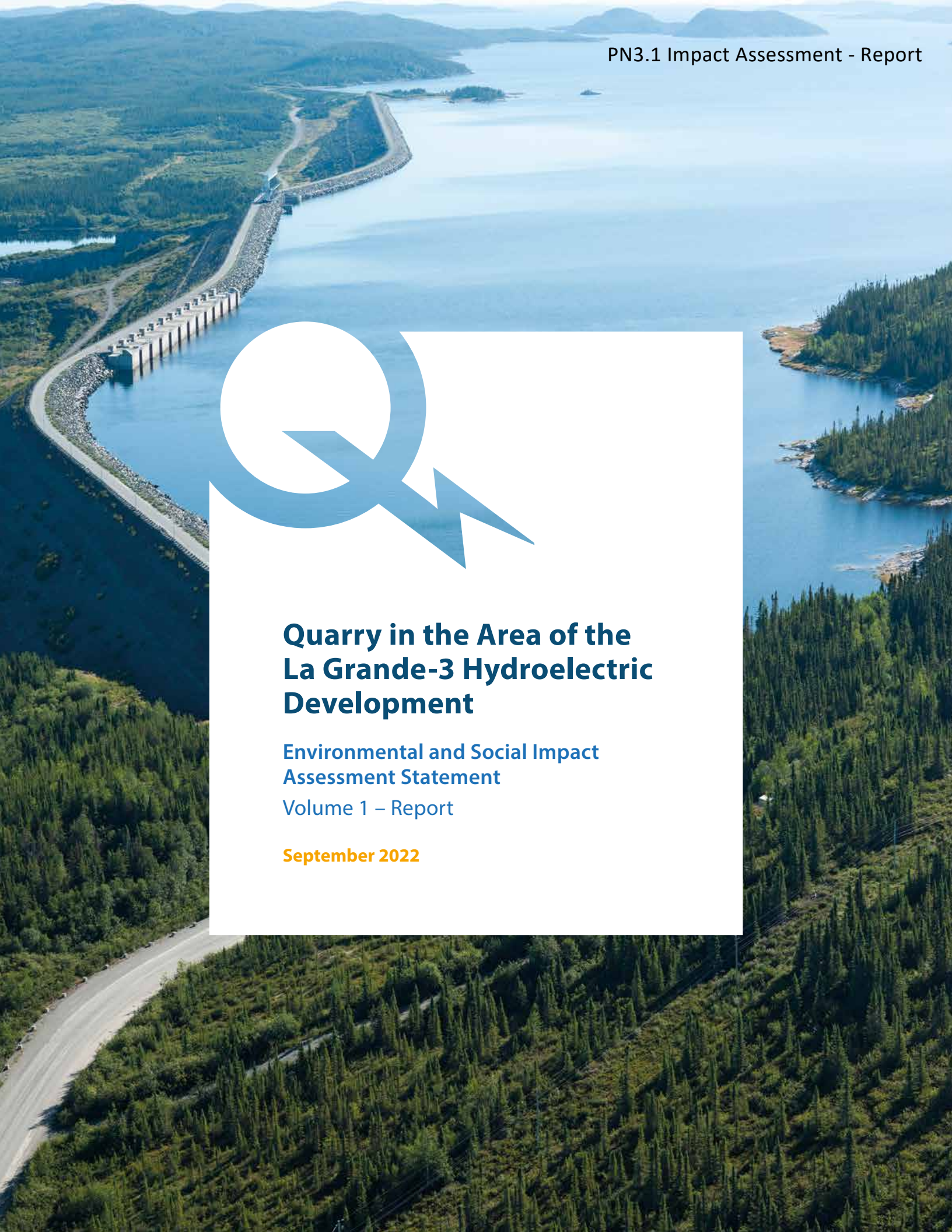

Quarry in the Area of the La Grande-3 Hydroelectric Development

Environmental and Social Impact Assessment Statement

Volume 1 – Report

September 2022

Produced by
Hydro-Québec

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Environmental and Social Impact Assessment Statement

Hydro-Québec
September 2022

This environmental impact statement (EIS) is being filed with the Ministère de l'Environnement et de la Lutte contre les changements climatiques *in accordance with the second paragraph of section 160 of the Environment Quality Act with a view to obtaining the necessary authorizations to carry out a project to create a quarry of more than 3 ha near the La Grande-3 hydroelectric development, located on the Eeyou Istchee Baie-James territory, south of the 55th parallel.*

This impact statement is made up of two volumes:

- Volume 1 – Report
- Volume 2 – Appendices

This study was conducted by Hydro-Québec
in collaboration with SNC-Lavalin.
The list of main contributors is provided in Appendix A, in Volume 2.

Summary

Rationale

As part of planning and long-term operability activities for the power generation and transmission structures in the La Grande-3 hydroelectric development area, Hydro-Québec has established a list of projects that will require considerable amounts of granular material. The estimated quantity required is 500,000 m^3. Since the potential in existing quarries and borrow pits located near La Grande-3 generating station is almost completely exhausted, Hydro-Québec intends to create a new quarry with operations beginning in 2024.

Project description

The new quarry will be located on the Eeyou Istchee Baie-James territory, or more precisely, at kilometre 7.2 on the road leading to La Grande-3 generating station. The proposed quarry will have a surface area of approximately 12.6 ha and will include different activity areas:

- Mining area with a floor set at a geodetic elevation of 262 m; the proposed configuration would provide output potential equivalent to an estimated 590,000 m^3 of MG-20 granular material.
- Storage area with an estimated capacity of 150,000 m^3 of MG-20 granular material, with a maximum pile height of 12 m.
- Service area for construction trailers, parking area for personal vehicles, maintenance area for heavy machinery, storage containers for equipment and tools, sanitary facilities and generators.
- Crushing and screening area.
- Three organic soil storage areas.

The explosive magazines, where detonators, dynamite and blasting agents are stored, will be located off-site.

The quarry is currently expected to produce at a rate that will provide the required aggregate for all projects in the La Grande-3 hydroelectric development area over a 20-year period (2024–2043).

Environmental impact assessment and public participation process

This project is subject to the environmental and social impact assessment and review procedure under chapter II, title II of the *Environment Quality Act* (EQA), since the quarry surface area will exceed 3 ha.

Within the framework of this impact assessment, Hydro-Québec implemented a consultation program that was mainly carried out virtually due to the pandemic. The various communication activities were held with the Eeyou Istchee James Bay Regional Government, the Council of the Cree Nation of Chisasibi, the Council of the Cree Nation of Wemindji, the Cree Trappers' Association (CTA), the CH40 trapline tallyman, and various mining exploration companies. In 2020 and 2021, Hydro-Québec sent written communications and held six meetings to present the project; a virtual open house was also organized with the Council of the Cree Nation of Chisasibi. Designed to gather concerns and comments about various aspects of the project, this process will continue during the detailed engineering, development and operation phases, in an effort ensure the project integrates as harmoniously as possible with the host communities.

Environmental impacts of the project

The quarry site was chosen with the objective of minimizing negative impacts on the environment and avoiding the areas most highly valued by the Cree community. Measures implemented at the project design stage include configuring the quarry to promote natural site drainage, while avoiding wetlands as much as possible. The project will, however, result in permanent loss of 1,630 m^2 of wetlands.

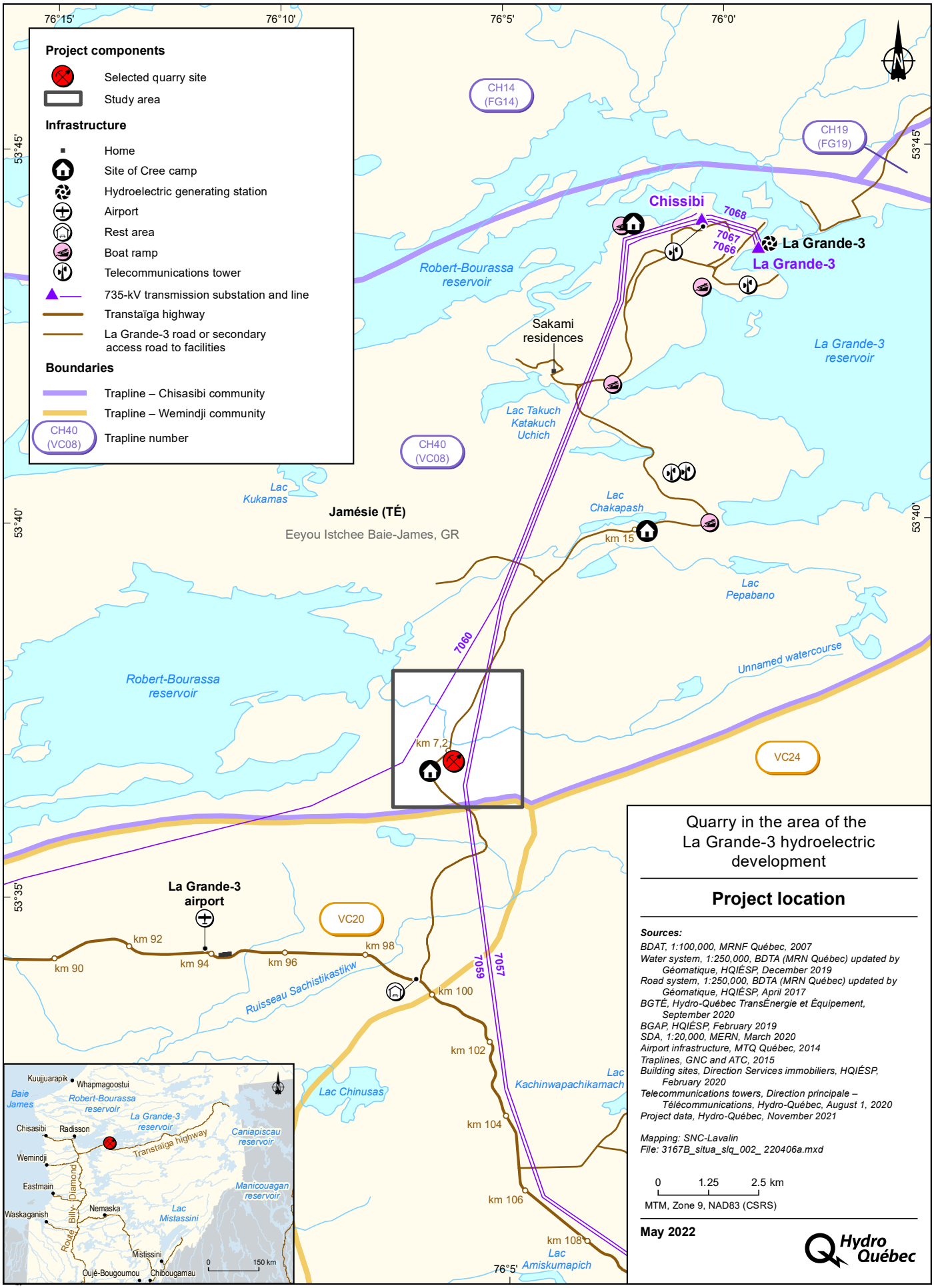
Although no public institution or dwelling, as defined in the *Regulation respecting sand pits and quarries*, is located within a 600-m radius of the quarry, one camp belonging to the CH40 trapline tallyman is located directly across from the project site (at kilometre 7 of the La Grande-3 road). To prevent the tallyman from being bothered by the nuisances associated with quarrying (noise, dust, increased road traffic) and as compensation for the inconvenience, a new camp will be built a distance away from the proposed quarry.

By implementing the mitigation measures planned for the project, all residual environmental impacts associated with developing, operating and ultimately closing the proposed quarry are of minor significance. Furthermore, the project will generate positive economic spinoffs for the Cree community during the development and operation phases. The various measures implemented by Hydro-Québec will maximize local spinoffs.

Cumulative effects were assessed based on three valued components: the quality of surface water, economic spinoffs for the Cree communities and Cree land use. Taking into account the cumulative effect of all past, current and future projects, activities and events, the relative share of the proposed quarry in the total cumulative effect is deemed to be low. Therefore, no additional mitigation measures or follow-up programs are required.

Project schedule and cost

Development and operation of the proposed quarry will begin in 2024, upon receipt of government approvals. The cost of the quarry project has yet to be determined, but based on the information available, it is currently estimated at $150 million to meet the needs of the activities planned over the next 20 years.



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A Biophysical and human environment

1 Introduction

1.1 Presentation of project proponent

Hydro-Québec's mission is to provide a reliable power supply and quality services adapted to its customers' needs—all at the lowest possible cost. In addition to core operations and facility development activities, the company markets system capacity and exports electricity on neighboring markets.

A key actor in the clean and renewable energy sector, Hydro-Québec will be called upon to contribute to the development of a green and sustainable economy. In accordance with the intentions of the Québec government set out in the *2030 Plan for a Green Economy (2030 PGE)*, the province's energy transition will rely on the massive electrification of a number of sectors, including transportation, buildings, industry and agriculture. Hydro-Québec expects that more than 100 TWh of additional electricity will be needed for Québec to reach its goal of becoming carbon neutral by 2050.

To meet these growing needs, Hydro-Québec will invest heavily in major generation and transmission development projects in the coming years. The implementation of the 2030 PGE will place higher demands on our facilities, many of which are already operating at full capacity or approaching the end of their useful life. Greater efforts will need to go into replacing or upgrading assets or increasing system capacity and robustness.

At the same time, Hydro-Québec will need to transition its power system to an increasingly diversified smart grid, integrating distributed energy resources, a greater number of variable energy sources and digital technologies that enable customers to play a larger role in energy exchanges.

To meet the major challenges of the energy transition while ensuring the long-term operability of its infrastructure, Hydro-Québec will invest an average of $5 billion per year between 2022 and 2026.

1.2 Legislative framework of the project

1.2.1 Environmental and social impact assessment and review procedure

Chapter II, title II of the *Environment Quality Act* (EQA) describes the environmental and social impact assessment and review procedure applicable to the Eeyou Istchee Baie-James territory located south of the 55th parallel. The development and subsequent operation of a quarry with an area of 3 ha or over are automatically subject to this procedure, pursuant to section 153 and paragraph (b) of Schedule A of the EQA.

To launch the applicable environmental and social impact assessment procedure, the proponent of a project that is subject to chapter II, title II of the EQA shall submit the preliminary project information to the Provincial Administrator of the *James Bay and Northern Québec Agreement* (JBNQA). In a directive, the *Ministère de l'Environnement et de la Lutte contre les changements climatiques* (MELCC) indicated the nature, scope and extent of the environmental and social impact assessment that must be carried out, after receiving relevant recommendations from the Environmental and Social Impact Evaluating Committee (COMEV). This directive presents a process aimed at providing the information necessary for the environmental and social impact assessment of the project proposed.

On September 16, 2020, Hydro-Québec submitted the preliminary project information to the Provincial Administrator of the JBNQA. On January 8, 2021, the MELCC sent the directive for preparing the impact statement to Hydro-Québec.

1.3 Government approvals

Hydro-Québec will be required to obtain the following approvals for developing and operating the quarry:

- Certificate of authorization under Section 164 of the EQA upon completion of the environmental and social impact assessment and review procedure set out in chapter II, title II of the EQA
- MELCC authorization under Section 22 of the EQA

Certain activities carried out within the framework of the project could also be subject to declaration of compliance or exemptions in accordance with the *Regulation respecting the regulatory scheme applying to activities on the basis of their environmental impact* (REAFIE).

After obtaining the above-mentioned authorizations, along with the relevant sector-related authorizations, Hydro-Québec undertakes to carry out the project in accordance with the conditions attached thereto.

Furthermore, as specified in the directive, the environmental and social impact assessment statement reports the findings of the proponent's environmental and social impact assessment. The statement must use scientific methods and satisfy the requirements of the MELCC and Environmental and Social Impact Review Committee (COMEX) regarding the project analysis and consultation with the public and relevant Indigenous communities. The purpose of the impact statement is to enable competent authorities to decide whether to authorize the project, taking into consideration the potential environmental and social impacts.

Associated developments, work or projects cited in Section 3.5 of this impact statement are not subject to the environmental and social impact assessment and review procedure. They are, however, mentioned in this impact statement to provide a better overall understanding of the project. As applicable, Hydro-Québec will see to it that any government approvals that may be required are obtained in a timely fashion.

1.4 Hydro-Québec's environmental policy

Hydro-Québec is committed to promoting the responsible use of resources and to ensuring sustainable development. Through its Our Environment policy, the company sets out its focus on sustainable development and describes its strategies for improving its environmental performance.

The Our Social Role policy sets out Hydro-Québec's commitment regarding its social role. The company defines itself as a responsible corporate citizen, committed to making an effective contribution to the economic, social and cultural success of the society in which it carries out its activities.

In addition, Hydro-Québec implements the following directives and procedures:

- Environmental Management Systems (DIR-07). This guidance document sets out the company's requirements regarding the implementation and maintenance of an environmental management system (EMS). It clarifies and completes the requirements of the international standard ISO 14000:1996.

- Requirements concerning the prevention and control of pollution and nuisances (DIR-22). This is a tool the company and its officers use to carry out the due diligence and strict environmental management required to prevent pollution and nuisances and minimize their effects.

- Procedure for accidental contaminant spills (PR-DPPSE-447-01). Under existing legislation and the Requirements concerning the prevention and control of pollution and nuisances, this guideline sets out rules and measures for mitigating the environmental impact of an accidental contaminant spill.

- Heritage and multiple uses of land and facilities (DIR-23). This directive sets out the rules to be followed and measures to be taken regarding heritage and multiple uses of land and facilities. Hydro-Québec ensures the protection and enhancement of its equipment, facilities and properties through means that may go beyond environmental impact management. The company incorporates the concept of multiple uses into the design of its new structures and facilities, and strives to ensure versatility in its rehabilitation projects and maintenance activities, while taking the host community's concerns into consideration.

Lastly, Hydro-Québec integrates Standard Environmental Clauses in all its requests for proposals (Hydro-Québec Innovation, équipement et services partagés et SEBJ, 2018), which establish mitigation measures for at-source reduction of the company's environmental impacts.

The Cahier des bonnes pratiques en environnement – Construction et réfection d'aménagements hydroélectriques [guide to good environmental practices for the construction and rehabilitation of hydroelectric developments] (Hydro-Québec, 2022) lists the recommended construction methods and mitigation measures for hydroelectric developments, including those associated with developing and operating pits and quarries.

2 Project context and justification

2.1 Project context

Within the context of its activities to ensure long-term operability of the power generation and transmission structures in the La Grande-3 development area, which is scheduled for completion between 2024 and 2043, Hydro-Québec expects to require considerable amounts of granular material.

This chapter therefore first justifies the need for the quarry project in the La Grande-3 development area and assesses its life span. The second part of the chapter details the steps taken by Hydro-Québec to identify sites capable of supplying the quality granular materials that rehabilitation of structures in that area will require over a 20-year period.

This environmental and social impact assessment statement covers only the project subject to the impact assessment and review procedure under the *Environment Quality Act*, which in this case is the development and operation of the proposed quarry of over 3 ha. Future activities requiring granular materials from this quarry will be subject to separate governmental approvals, where required under current regulations.

2.2 Project justification

The La Grande-3 development is located near the Grande Rivière, in the municipal territory of the Eeyou Istchee James Bay Regional Government. The development was built as part of the James Bay project phase I between 1973 and 1985. It can be accessed from the Transtaïga highway, which originates at kilometre 548 of Route Billy-Diamond. From the Transtaïga highway, other secondary roads under Hydro-Québec's responsibility service La Grande-3 generating station, the reservoir, the dikes, the residences and other facilities in the development.

The secondary road that leads to La Grande-3 generating station is about 30 km long and was built in the mid-1970s. It connects to the Transtaïga highway near kilometre 100. A branch at chaining 22+500 of the La Grande-3 road leads to the Sakami residences about 1 km away.

These secondary roads have not undergone any major work since they were built. Over the next two decades, traffic on these roads will increase significantly as a result of the various long-term operability projects that will require transporting heavy loads. In recent years, Hydro-Québec has conducted various studies to determine the condition of its road network (roads, bridges and culverts, vegetation, ditches, traffic signs, guardrails and lighting systems).

These studies revealed that all 30 km of the La Grande-3 road along with the road leading to the Sakami residences need to be completely rehabilitated, including replacement or addition of culverts, guardrails and road signs.

Rehabilitation of the La Grande-3 road, scheduled for 2024 and 2025, is the primary trigger for requiring a significant supply of granular materials in the area. This project alone will require approximately one-third of the total quantity of granular materials needed in the La Grande-3 development area over a 20-year period. Other planned maintenance activities that will require considerable amounts of granular material include:

- resurfacing the Transtaïga highway
- maintenance work on various infrastructure at the La Grande-3 airport
- resurfacing secondary roads, including replacement of bridges and culverts
- repair and maintenance work on various structures (dikes, dams, residences, etc.)

Hydro-Québec estimates that the quantity of crushed granular material required over a 20-year period to complete these projects in the La Grande-3 development will be approximately 500,000 m^3.

3 Project description

3.1 Analysis of potential quarry sites

3.1.1 Potential sites

The search for quarry sites began by inventorying the residual quantities of rock in existing quarries and borrow pits located near La Grande-3 generating station. This inventory revealed that the available quantities of rock still in place and able to be processed into aggregate was insufficient to meet future needs in the area, and that the potential of these sites was almost fully depleted (GHD, 2018).

Potential new quarry sites were surveyed in 2018 using geologic maps from the Ministère de l'Énergie et des Ressources naturelles (MERN) and aerial photographs (GHD, 2018). Geological maps indicated the presence of granitic rock in the central and southern areas of the La Grande-3 road, from kilometre 6 to TA-26 dike near kilometre 16. South of this area with granitic rock is land that is mostly covered with sediment (fine sand), whereas north of it is metasedimentary rock that tends to fragment into bladed particles and frequently contains sulphides, such as pyrite and pyrrhotite, which are unsuitable for fill materials and concrete aggregates. The search for potential sites therefore focused in granitic rock areas (central and southern), where field investigations took place on certain hills (IOS, 2019).

Four potential sites were found to be viable, so studies were conducted (see Map 3-1). All of them are located near 735-kV transmission lines, which is a constraint to consider where quarrying by drilling and blasting is planned, given the risks of flyrock and vibration from blasting. This constraint cannot be completely mitigated since the transmission lines are located near the La Grande-3 road throughout most of the central and southern areas where granitic rock is present. Moving a significant distance from the La Grande-3 road would require building an access road through bedrock with variable topography, which would increase development and operating costs significantly, in addition to causing additional environmental impacts.

3.1.2 Analysis of potential sites

Potential sites were analyzed according to the quarry site selection criteria below:

- Be located in an area composed of granitic rocks (avoiding metasedimentary rock)
- Be in a relatively central location along the La Grande-3 road to minimize hauling distance while resurfacing this road
- Ensure a safe distance (estimated at a minimum of 150 m) can be maintained between the extraction area and the 735-kV transmission lines
- Be located near the La Grande-3 road to minimize environmental impacts and costs associated with building the access road to the proposed quarry

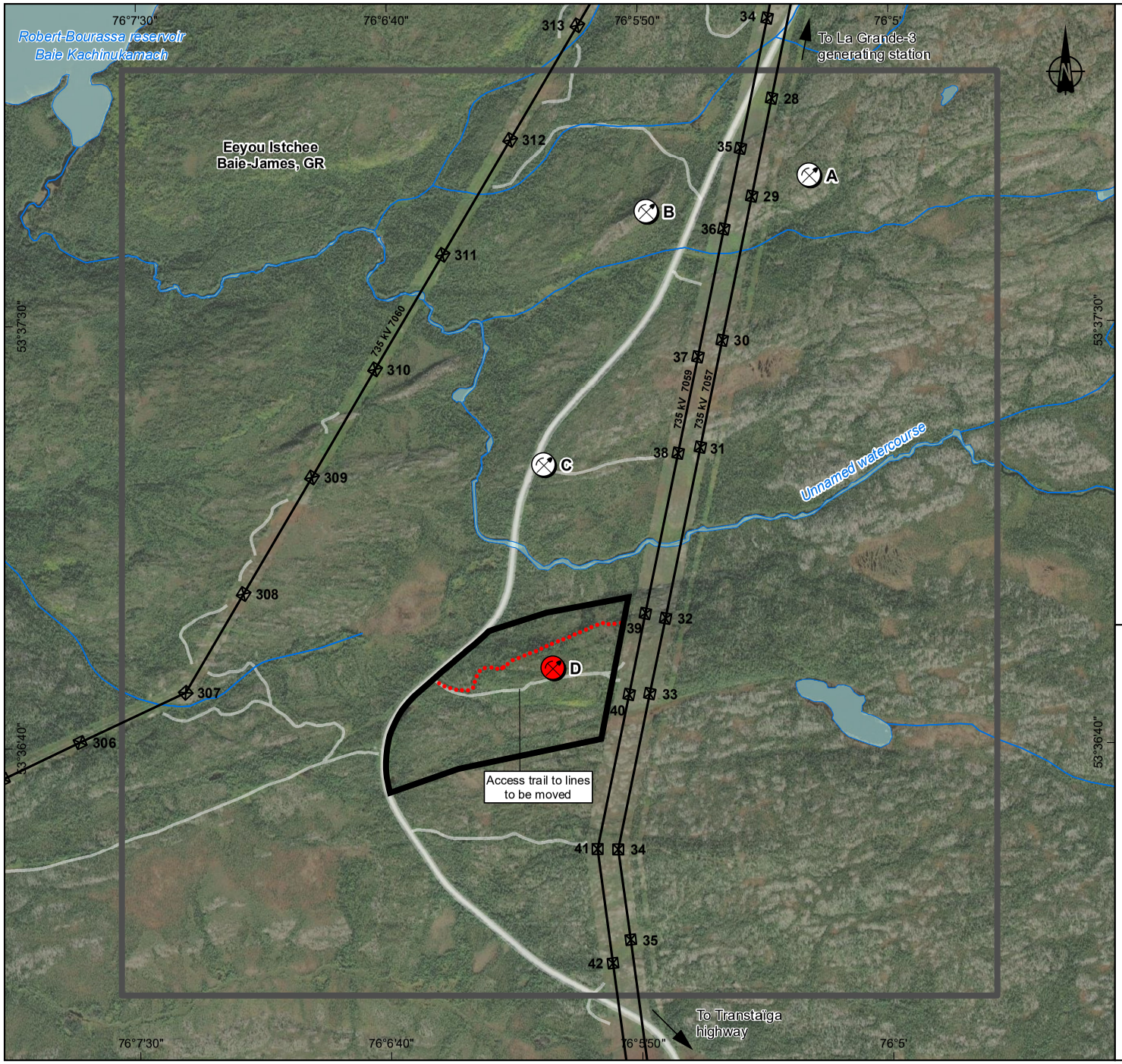
- Be located at an adequate distance from surrounding dwellings
- Be located at a high point, to facilitate drainage and prevent dewatering of the extraction area, while avoiding areas with extremely steep topography
- Ensure a buffer zone can be maintained around the quarry
- Avoid the Cree community's areas of intensive use for hunting, fishing, trapping and gathering
- Have characteristics that consider the data and concerns raised in community consultations
- Avoid intersecting areas that the Cree community values for cultural or other reasons
- Be far from waterways
- Encroach as little as possible on wetlands and aquatic environments
- Avoid special-status wildlife species habitats

Table 3-1 summarizes the four potential sites identified in 2018–2019 (GHD, 2019).

Table 3-1: Key characteristics of the four potential quarry sites

Potential site [a]	Location UTM Nad27 F18	Primary characteristics
Site A	428,068 m E 5,942,890 m N At km 9.1 on the La Grande-3 road	Extraction area of approximately 50,900 m^2 Located east of two 735-kV transmission lines (circuits 7057 and 7059) Rock with a very high composition of quartz (40%), very highly abrasive Lineaments oriented at N270 present Very rugged topography on the western slope; likelihood of creating a high quarry face very quickly. Access road would be complex and costly to build (variable rock and topography) Plateau with a considerable surface area south of the hill Little deforestation and stripping required
Site B	427,468 m E 5,942,769 m N At km 8.9 on the La Grande-3 road	Narrow hill with small operating surface area Located west of the La Grande-3 road Rock composed of altered gabbro, not favorable for a quarry
Site C	427,074 m E 5,941,850 m N At km 7.9 on the La Grande-3 road	Extraction area of approximately 65,900 m^2 Adjacent to the La Grande-3 road, on the east side Rock composed of granite containing a large proportion of quartz; highly abrasive In the immediate vicinity of the La Grande-3 road (would involve detouring and re-profiling the road at that location)
Site D	426,8344 m E 5,941,041 m N At km 7.2 on the La Grande-3 road	Dome-shaped rock of about 56,500 m^2. Located between the La Grande-3 road and two 735-kV transmission lines (circuits 7057 and 7059) Rock of mineralogical composition and texture most favorable for quarrying among all potential sites Relatively restricted space for starting point Significant amount of clearing and stripping required, especially on the north side of the site Trapping camp, used by the Cree community of Chisasibi, located west of the La Grande-3 road. ATV trail connecting the La Grande-3 road to the 735-kV power line right-of-way.

a. Cross-reference with GHD study (2019): Site A = Site 5; Site B = altered gabbro; Site C = granite; Site D = Site 2.



Project components

- Site studied
- Site selected
- Study area
- Biophysical environment inventory area
- Access trail to lines

Physical environment

- Lake or river
- Perennial watercourse

Infrastructure

- La Grande-3 road
- Access trail to lines
- Power transmission line and tower

Quarry in the area of
the La Grande-3
hydroelectric development

Potential sites studied

Sources:

Ortho-image (GeoEye-1), resolution 50 cm © ESRI, 2018
Ortho-image (WorldView-2), resolution 46 cm © ESRI, 2019
Adresses Québec réseau+, MERN Québec, September 1, 2020
Géobase du réseau hydrographique du Québec (GRHQ), MERN Québec
BGTÉ, Hydro-Québec TransÉnergie et Équipement, September 2020
Project data, Hydro-Québec, November 2021

Mapping: SNC-Lavalin
File: 3167B_eic3_1_slq_012_sitepot_220406a.mxd

0 210 420 m
MTM, Zone 9, NAD83 (CSRS)

Map 3-1

May 2022

Hydro Québec

3.1.3 Site selected

Based on field investigations, consultation of lidar topography, and petrographic sampling and analysis of thin polished sections, Site D was recommended (GHD, 2019). Qualification of intrinsic rock properties through coring and laboratory testing was then carried out, and no contraindications were raised (GHD, 2020).

The selected site meets most of Hydro-Québec's technical and environmental criteria. Its primary advantages are the morphology of the land that favors quarry development (rock hill rising above surrounding land), the topography of the land that will allow to develop accesses to different quarry levels, the possibility of developing a large storage area on the southwestern side of the hill (despite the wetlands inventoried later), and the high potential for long-term production (several operating floors).

However, the site is located near a camp belonging to a tallyman from the Cree community of Chisasibi. For that reason and beginning with the draft design stage, Hydro-Québec has carried out targeted consultations on the CH40 trapline tallyman's use of the territory (see Chapter 4).

3.2 Description of the selected project

The following description of the various areas in the proposed quarry represents the current status of engineering progress. It is detailed in order to take into account the primary environmental issues, which is a critical step in the decision-making process. Possible modifications arising from the detailed engineering phase will be specified and implemented as necessary when sector-related requests for authorization are submitted to the competent authorities.

3.2.1 Extraction area

The extraction area is located in a positive relief with a morphology in line with the preferred approximate east-west axis. The hill formed by this positive relief peaks at a geodetic elevation of 290 m at the right-of-way of two power lines (circuits 7059 and 7057). In the extraction area, the ground elevation varies between 262 m and 283 m above mean sea level.

The extraction area is located between 150 and 400 m from the La Grande-3 road. Its southern slope is relatively steep, varying between 35° and 40°. A wetland complex borders the foot of the slope at a geodetic elevation of 260 m.

The northern slope of the extraction area is less steep, ranging from 22° to 26° from horizontal. Furthermore, wetlands are more rare on this site. A single isolated wetland was identified approximately 70 m from the northern boundary of the extraction area, at an elevation of 239 m.

The extraction area was designed and delineated according to its physical characteristics, as well as the environmental, technical and health and safety constraints listed below.

1. In order to maximize the extraction potential while protecting the wetland complex at the foot of the southern slope, the lower quarry floor was set at a geodetic elevation of 262 m, which is 2 m above the geodetic level of the wetland, to avoid the risk of draining these areas.
2. The maximum height of the quarry benches was set at 10 m to meet safety requirements associated with the stability of rock walls. Thus, the first floor will be mined at a geodetic elevation of 272 m, and the second at an elevation of 262 m.
3. The rock will be excavated by drilling and blasting benches 10 m in height. For safety, horizontal terraces of at least 10 m wide will be left in place next to any final face height that is more than 10 m in height.
4. The northern boundary of the extraction area meets the natural elevation of the rock at 262 m.
5. The eastern boundary of the extraction area was set at 150 m from the right-of-way of the transmission lines (circuits 7059 and 7057) in order to minimize ground vibrations near the towers during blasting; in so doing, the integrity of these electricity transmission infrastructures will be preserved. Maintaining this distance, combined with a blasting strategy that directs the shots to the north-northwest, will also eliminate the risk of flyrock impacting the transmission infrastructure.
6. On the south side, the boundary of the extraction area was established according to the estimated topography of the rock. The southern boundary of the extraction area was established to avoid the steep slope north of the wetland complex. Driving machinery on such a slope would result in significant health and safety risks.
7. The western boundary of the extraction area was established to maintain a minimum cut height at all locations of 5 m in relation to the second quarry floor at the 262-m elevation. This consideration increases the proportion of rock that can be used to produce granular material after blasting, since the proportion of oversize boulder loss is decreased. The point where machinery will access the roadways for both planned operating floors is on the northwestern boundary of the extraction area (at elevations of 272 m and 262 m).
8. To protect the wetlands identified south of the rocky hill as well as the 735-kV transmission lines, the proposed quarry layout will have an opening on the north slope. Thus, blasting will be directed toward the north-northwest, which decreases the risk of accidental projection of flyrock into the wetland complex and transmission infrastructure.

With this extraction area configuration, the final quarry floor at 262 m will provide an estimated granular material production potential equivalent to 590,000 m^3 of MG-20 granular material.

3.2.2 Other developments required for quarry operations

In addition to the extraction area described above, several other developments are planned for the proposed quarry operations. These developments are as follows:

- Storage area
- Service area
- Crushing area
- Quarry access road
- Access road to the 272-m quarry floor
- Access road to the 262-m quarry floor
- Organic soil storage areas

The following subsections provide a brief overview each development.

3.2.2.1 Storage area

The following criteria were used for establishing the storage area location. Requirements for the area selected:

- Avoid or minimize encroachment on wetlands
- Allow for a strip of forest to be maintained between it and the road to mitigate visual impact
- Be sufficiently large and flat to allow approximately 150,000 m^3 of blasted or crushed material to be stored in several separate piles, since more than one size of aggregate may be produced or more than one pile of the same size of aggregate may be required for safety (stability) or stockpile property-related reasons
- Be an area where no rock needs to be blasted for the initial levelling works
- Be relatively close to the extraction area
- Comply with distances from the road, as stipulated in the *Regulation respecting sand pits and quarries*

Based on these considerations, the proposed storage area will be positioned approximately 550 m southwest of the extraction area. It has a total potential development area of about 35,000 m^2.

Within the natural environment inventory area, this was the only area that met most of the pre-established criteria. Developing the storage area in this location will result in losing 1,630 m^2 of open ombrotrophic peatland. Wetlands are also present to the north, east and south of the storage area. The proposed area was delineated to maintain a minimum 30-m buffer zone from the wetlands.

The natural terrain has low slopes in this area, generally less than 10%. The central part of the storage area is the highest point, with an elevation of 258 m. The low point of the storage area, in the northern section, is at an elevation of 248 m. Thin overburden is predominant in the storage area, particularly in the central portion.

To flatten the topography of the area after the overburden is removed to the bedrock, the first phase will consist in backfilling a platform using crushed rock from the quarry. The next phase will consist in backfilling around the perimeter of the storage area to create an infrastructure that will accommodate heavy vehicle traffic. This infrastructure will gradually be extended up to the central section of the storage area, so vehicles can reach the stockpiles of crushed rock produced at the quarry.

In addition to allowing for traffic around the perimeter and stockpiling of aggregates, the storage area could also possibly accommodate crushing equipment and a weigh station while the quarry is operational. However, in producing the first 160,000 m^3 of aggregates required to rehab the La Grande-3 road, most of the crushing operations will take place in the extraction area.

It is estimated that the storage area will be able to hold 150,000 m^3 of MG-20 granular material, with piles approximately 12 m high. The storage capacity may vary during the life cycle of the quarry, depending on what activities take place and what equipment is stored there (e.g., relocation of crushing activities to this area, installation of a weigh station, reconfiguration of access roads).

3.2.2.2 Service area

The service area, adjacent to the quarry access road and located approximately 60 m from the La Grande-3 road, will accommodate the construction site trailers, a parking lot for personal vehicles, the sanitary facilities, the generators, the maintenance area for heavy machinery and the storage containers for equipment and tools. This area will also be used to install above-ground fuel tanks for refueling construction equipment, if the successful contractors do not use their own tanker trucks for this purpose.

Currently, the plan is for this area to be developed at a geodetic elevation of 252 m. The current ground elevation varies between 247 and 252 m. Up to 5 m of backfill will be added to level it.

Drilling in this area revealed an organic cover varying between 7 and 21 cm thick on top of a thin till layer on the bedrock, which varies between 0.14 and 1.20 m in thickness.

3.2.2.3 Crushing area

The crushing area will initially be located inside the 272-m extraction area, at the end of the road that leads to it, where the ground topography is relatively flat at a geodetic

elevation of 272.5 m. The crushing will then be moved farther into the extraction area, depending on the blasting phases. As stipulated in Section 3.2.2.1, the crushing area could also be relocated to the storage area, most notably after the La Grande-3 road rehabilitation is complete, during the phase when the 262-m portion of the proposed quarry is under operation.

3.2.2.4 Quarry access road

The quarry access road will start near the middle of a straight section of the La Grande-3 road, to ensure the best possible visibility for the drivers of vehicles leaving the quarry and for those traveling on the road. The area around the quarry access road and La Grande-3 road intersection will be cleared to maximize visibility. Building the access road in this location also has the advantage of minimizing the impact on any occupants of the Cree camp located about 300 m away.

A manual security gate will be installed at the entrance to the access road so that only authorized personnel can access the quarry. The access road, which will be 10 m wide and about 450 m long, will feature two lanes wide enough for standard dump trucks and will connect the La Grande-3 road to the service area and the storage area. The last 150 m of the road will be adjacent to the 272-m quarry floor access road (see next section). This section will be reserved exclusively for oversized mining trucks. The roads will be separated by oversize boulders.

The organic soil layer will be removed prior to road construction. Access roads will then be regraded and, if necessary, backfilled to create road surfaces that are appropriate for their intended use.

3.2.2.5 272-m quarry floor access road

This access road will connect the storage area to the first floor of the extraction area at an elevation of 272 m. It will be approximately 450 m long and 13 m wide. It will be used exclusively by oversized mining trucks to transport blasted and crushed materials inside the quarry.

Its profile will vary between geodetic elevations of 252 and 272 m, with a grade of less than 10%.

3.2.2.6 262-m quarry floor access road

The 262-m quarry floor access road will be approximately 75 m long and will begin at the 272-m quarry floor access road. With the same functionality of the first road, the new access road will become the main route to the extraction area when quarry operations reach the second level, at elevations between 272 and 262 m. At that point, the last segment of the 272-m quarry floor access road will no longer be used.

3.2.2.7 Organic soil storage areas

The organic soil storage areas will be used as needed to store topsoil stripped from the extraction area, storage area, service area and roads. Any logs from land clearing that are not claimed by the Cree community will also be stored in these locations.

Three areas were selected for storing organic soils. They were chosen for their proximity to the large areas to be stripped and the topography of the site. The first area will be located on the northern edge of the extraction area, which is also the lowest point in this area. The second organic soil storage area is located to the south of the storage area, and the third is on the northern edge of the service area. The last two locations have little potential for other uses.

3.2.2.8 Culverts

In developing the proposed quarry, a total of three culverts are planned for managing runoff.

Culvert P1 will be installed as soon as work begins, in the ditch of the La Grand-3 road, where the intersection with the quarry access road will be. It will be approximately 26 m in length. Considering this is one of the first steps for opening the proposed quarry, the infrastructure backfill needed to install this culvert will be granular material from a borrow pit outside the quarry.

Culvert P2 will also be installed in the early stages of the proposed quarry, once the access road from the quarry entrance to the extraction area has been built. This culvert will ensure that drainage water from the eastern slope of the quarry (±7,500-m^2 watershed) will flow northward after the access road is built. More specifically, part of the drainage system will consist of a ditch, where accumulated water will be channeled to a culvert, and drained to the north, where topographical levels are lower. The backfill material used to install this culvert will also come from a borrow pit.

The third culvert (P3) will be installed beneath the segment of the access road that leads to the storage area at the lowest topographic point. The invert of this culvert, which will be approximately 34 m long, will be positioned at the existing ground elevation, which will help to balance the water level in this area where there are wetlands on both sides of the road.

3.2.3 Temporary construction site facilities

During the extraction and crushing phases while the quarry is under development, and when the quarry is closed, the temporary construction site facilities will be in the service area. Outside of these periods, most of the temporary facilities will be dismantled or demobilized.

No potable water supply or wastewater treatment systems are planned for the proposed quarry site. Drinking water will come from bottled water and washroom facilities will be dry toilets. If, for some unforeseen reason, these systems are required, necessary authorizations will be obtained.

The site will not be connected to the electrical distribution system, since there are no distribution lines (≤25 kV) in the area where the proposed quarry will be located. Generators with a total capacity of less than 3,000 kW will power the facilities.

Moistening materials during crushing operations may be considered to reduce dust emissions. Water will be supplied by tankers filled at off-site locations, if necessary. The amount of water required to minimize dust emissions is estimated at less than 75 m^3 per day.

Explosive magazines, where detonators, dynamite and blasting agents are stored, will be located off-site, outside the study area. Their locations had not yet been confirmed when this impact statement was written. The most likely storage scenarios at this time are existing powder magazine storage facilities at other quarries in the area.

3.2.4 Stages of quarry development and granular material production as part of the La Grande-3 road rehabilitation

At this time, it is intended that the quarry, as well as the various areas and roads required, will be developed by the same general contractor awarded the contract to execute Phase 1 of producing the estimated 160,000 m^3 of granular material. Land clearing activities may be awarded to the same general contractor or to a different contractor. Development of the quarry and production of this volume of aggregate will overlap and take place over a period of six to nine months, between the spring of 2024 and the summer of 2025.

The first stage of the work will consist of clearing all the areas where development is planned. A total surface area of approximately 126,000 m^2 (12.6 ha) will be cleared. Land will be cleared by machines. The harvested timber will first be offered to the tallyman who occupies the camp located near the quarry, and to his family. The volume of timber the tallyman does not claim will be bucked or chipped and stockpiled in the organic soil storage areas. Woody debris will be chipped or burned. Burning will be kept to a minimum and will meet the terms agreed upon with the Société de protection des forêts contre le feu (SOPFEU).

Temporary access will be constructed when operations start on the 272-m quarry floor. This will allow the drills and heavy equipment (see Table 3-2) to be moved to the top of the rocky hill to begin stripping organic soils and overburden, and to begin drilling and blasting the 272-m quarry floor. Two of the three planned culverts will also be installed at this stage.

Table 3-2: Heavy machinery planned for work area construction and aggregate production within the context of the La Grande-3 road rehabilitation

Type of equipment	Number
Brush cutter	2
Drill	2
Excavator	2
Loader	2
Oversized mining truck	2
Bulldozer	2
Crushing and screening unit	1

Since no aggregate will be available on site until drilling and blasting in the extraction area has begun, some granular material from borrow pits may be required at this stage.

Once drilling and crushing activities have begun, all granular materials required to construct the extraction, service and storage areas and the access roads will come from the extraction area.

Work to develop the extraction area and produce granular material (MG-20) will be carried out according to a schedule designed to meet the immediate project needs. Therefore, it should be expected that some sections of the storage and service areas will not be fully developed when aggregate production begins, and that they will be completed as the volumes required to rehabilitate the La Grande-3 road are produced.

Most of the aggregates produced will consist of MG-20 granular material, which will not require washing. However, it is possible that Hydro-Québec will need certain materials with a specific particle size; if that is the case, those materials would require washing to remove a fine residual fraction after screening. These washing operations would be carried out in a manner that encourages water infiltration into the soil rather than runoff, thereby minimizing the risk of suspended solids being added to the surrounding wetlands. Where necessary, water runoff filtration and management measures will be implemented upstream from sensitive receptors. Aggregates will be washed in the extraction area or storage area.

3.2.5 Quarry operation

The quarry is currently expected to produce at a rate that will provide the required aggregate for all upcoming activities in the La Grande-3 hydroelectric development area over a 20-year period (2024–2043). Table 3-3 below details each of these activities, as currently planned, and provides an estimated volume of granular material that will be required. A more precise and updated schedule will be provided in the sector-related authorizations required for each activity.

Table 3-3: Estimated volume of granular materials required per activity planned in the La Grande-3 development

Activity planned in the La Grande-3 development	Approximate volume of granular material required
1. La Grande-3 road rehabilitation	160,000 m^3
2. Resurfacing of the Transtaïga highway	120,000 m^3
3. Resurfacing of secondary roads, including culvert replacement	110,000 m^3
4. Maintenance at the La Grande-3 airport	50,000 m^3
5. Various civil engineering projects at the Sakami residences and La Grande-3 generating station	20,000 m^3
6. Maintenance of civil engineering structures (dikes, reservoirs, dams, etc.)	20,000 m^3

Note: The number of activities and estimated granular material volumes required were based on preliminary engineering data and may vary after the detailed engineering stage or as requirements change. Volumes may be specified in sector-related authorizations, as required.

Typically, each rock extraction and crushing phase will take place over a period ranging from weeks to months. Phases will be spaced several months to several years apart, during which time granular material requirements will be met by sourcing from the volumes stockpiled in the storage area. Extraction and crushing will be resumed when stockpiled reserves begin to near depletion or when one or more of the activities listed in Table 3-3 take place. Thus, one extraction and crushing phase may be able to meet the cumulative needs of several activities.

3.2.6 Quarry closure

Topsoil thickness is generally thin in this area. Apart from the wetlands, the soundings carried out during the draft design stage show thicknesses that vary from 0 to 30 cm, depending on the area. Thus, the quantities that can be retained after clearing and stripping the various quarry development areas will be relatively small. Furthermore, considering quarry operations are planned over 20 years, it is likely that, by the time the site is restored, the vegetation will have regenerated on the organic soil stockpiles formed as a result of the stripping. The benefit of reusing these organic soils and spreading them on the various quarry floors will be evaluated at the end of quarry operations, prior to restoration.

The following subsections describe the restoration activities planned for each quarry development.

3.2.6.1 Extraction and storage areas

The slopes of the eastern and southern rock faces in the extraction area will be smoothed and stabilized, either by excavating the rock forming the horizontal terraces or by backfilling with rock or granular material.

Where applicable, materials used for backfilling will come from:

- Excavating the infrastructure backfill put in place when the storage area was developed, which will also restore the original topographic profile of the storage area.
- Dismantling the segment of access road between the service area and storage area.
- Reducing the width of the segment of access road between the La Grande-3 road and the extraction area.
- Residual oversize boulders generated during the life cycle of the quarry.
- Importing soil or compost from other Hydro-Québec facilities in the area, if necessary. The environmental quality of reused soils will meet the requirements stipulated in chapter VIII of the *Regulation respecting sand pits and quarries* (concentrations below the standards stipulated in Schedule I of the *Land Protection and Rehabilitation Regulation*).

Once the excavation and backfill work is complete, the extraction and storage areas, along with the dismantled road segments, will be seeded and trees will be planted. If necessary, areas to re-vegetate will be scarified to loosen the soil. Climate-appropriate seed mixtures requiring little organic matter will be used. The same properties will be sought for shrub and tree species to be planted (e.g., jack pine, mountain alder, black spruce).

3.2.6.2 Service area

Due to the limited amount of backfill required for the service area, it will not be excavated when the quarry closes. Existing road equipment (bollards, oversize boulders, signs) will be removed before the surface is graded.

The service area will be seeded and planted in the same manner as the extraction and storage areas, except for the area occupied by the access road.

3.2.6.3 Quarry access road

The access road to the extraction area will be left in place to allow Hydro-Québec maintenance crews to access to the power line rights-of-way.

The access road segment between the service area and storage area will be dismantled to the original ground profile, i.e. what it was before the quarry was developed.

3.2.6.4 272-m quarry floor access road

Since, when the proposed quarry is closed, operation will have reached the 262-m level, the access road to the 272-m quarry floor will no longer be required and will be rehabilitated according to the same terms and conditions as the extraction area.

3.2.6.5 262-m quarry floor access road

Just as with the quarry access road, the 262-m quarry floor access road will be preserved to allow access to the Hydro-Québec power line rights-of-way.

3.2.6.6 Culverts

Culverts P1 and P2 will be preserved in place to maintain the surface water system. Culvert P3 will no longer be required after the dismantling of the road segment beneath which it is installed, so it will be dismantled as well.

3.2.7 Labor

The number of workers required during development of the proposed quarry and during the operating phase will average from 15 to 20 people. The workforce will come from different regions of Québec, depending on the contractor selected.

The work schedule at the work site is 10 hours per day, 7 days per week, Monday to Sunday.

The following categories of workers are likely to be required:

- Brush cutter operators
- Backhoe operators
- Drillers and drill helpers
- Excavator operators
- Loader operators
- Oversized mining truck operators
- Bulldozer operators
- Mechanics
- Explosive experts
- Crushing and screening unit operators
- Surveyors
- Quality managers
- Construction site managers (superintendents, foremen, project managers, etc.)

3.3 Schedule

Development and operation of the proposed quarry to rehabilitate the La Grande-3 road will overlap and extend over a period of six to nine months, between the spring of 2024 and the summer of 2025 (see Table 3-4). The project schedule below may be updated when sector-related authorizations are submitted.

Table 3-4: Proposed quarry project schedule

Step	Target period [a]
Government approvals	Summer 2022 to summer 2023
Sector-related authorizations and request for proposals	Summer 2023 to winter 2024
Development	Spring 2024
Operation for the La Grande-3 road rehabilitation	Between spring 2024 and fall 2025b
Operation for subsequent activities	Post-2025
Site restoration	In the year after quarry operation ends

a. The granular material production schedule could be adapted to the project completion schedule for which they are produced.

b. Rehabilitation work on the La Grande-3 road (Phase 1 of quarry operation) is currently scheduled to take place between the summer of 2024 and the fall of 2025.

3.4 Project costs and regional economic spinoffs

3.4.1 Project costs

Based on the information currently available, the overall cost of the quarry development project and its operation to meet the needs of the activities planned for the next 20 years in the La Grande-3 development area is approximately $150 million.

3.4.2 Regional economic spinoffs

Hydro-Québec sees its projects as an opportunity to participate in the economic development of host communities. In conjunction with community stakeholders and in compliance with corporate procedures, Hydro-Québec will maximize the economic spinoffs of the project in the Eeyou Istchee Baie-James territory.

Direct economic spinoffs include work being awarded to contractors and job creation. Indirect economic benefits are associated with the purchase of goods and services from local and regional suppliers, subcontracting, acquisition of materials, and worker and consumer spending by suppliers.

The indirect economic spinoffs anticipated in the La Grande-3 development area will be minimal, given the absence of businesses and the fact that the workers required for the project will be housed and fed in the Sakami residences. Spinoff could be more significant in regional communities along the routes workers use to travel to the La Grande-3 development area.

As it does for all its major projects, Hydro-Québec is committed to implementing a variety of measures that promote the regional economic spinoffs of the project. To that end, Hydro-Québec will work closely with regional economic organization representatives and with the Cree Nations affected by the project to establish ways for regional businesses and workers to find business and employment opportunities among the many available, including subcontracting by contractors who will be awarded the clearing, construction and granular material production contracts through the request for proposals process.

3.5 Related work

3.5.1 Modification of the ATV access trail to the 735-kV power line right-of-way

Development of the proposed quarry will require modification of an all-terrain vehicle (ATV) trail that Hydro-Québec uses to conduct annual inspections of the 735-kV power lines (circuits 7057 and 7059). The existing trail connects the La Grande-3 road to the power line right-of-way in a more or less straight line running through the proposed extraction area.

As illustrated on Map 5-2, the proposed ATV trail will follow the quarry access road and then run along the northern edge of the extraction area, inside the 10 m strip of land that will be cleared around the perimeter of the extraction area. From the eastern edge of the extraction area, the trail will run through approximately 75 m of woods before reaching the power line right-of-way (circuits 7057 and 7059). In accordance with the *Guide d'aménagement et d'entretien de sentiers de quad* relating to one-way trails and published by the Fédération québécoise des clubs quads (FQCQ, 2021), the ATV trail right-of-way in this wooded segment will be no more than 6.7 m. The actual trail width will be approximately 4 m; therefore modifying the ATV trail route will require clearing an additional 750 m^2. A permit in accordance with the *Regulation respecting the sustainable development of forests in the domain of the State* (RSDFDS) will be obtained for that operation. Earthwork will also be done to create a flat driving surface. Local soil and granular materials on the trail and at the quarry site will be used to grade. The proposed ATV trail will not cross any bodies of water or wetlands.

3.5.2 Storage of fuel and hazardous materials

No permanent fuel or hazardous material storage equipment will be installed on the site.

During quarry opening and while granular materials for resurfacing the La Grande-3 road are being produced, temporary facilities will be set up to store fuel and hazardous materials. These temporary facilities will be removed from the site when the contractor demobilizes the construction site.

Dedicated fuel and hazardous material storage space will be set up in the service area (see Map 5-2). Since handling this type of product induces increased risk of accidental spills that could alter soil, surface water or groundwater quality, not to mention the risk to the health and safety of workers that it poses, Hydro-Québec will implement various mitigation measures. These primarily involve safe storage methods, maintaining storage equipment in good condition, outlining a procedure to follow in case of accidental spills, and stipulating the preventive actions to implement to reduce risks of contamination, as well as those related to the health and safety of workers. Hydro-Québec will conduct these activities in compliance with all applicable regulations.

The preventive measures that Hydro-Québec intends to implement does not completely eliminate the risk of contamination. For that reason, an environmental characterization will be conducted in the fuel and hazardous materials storage areas when the quarry development work and aggregate production activities for the La Grande-3 road rehabilitation is complete, in order to verify whether the environmental quality of the soils was altered during fuel and hazardous materials handling and storage operations. Storage areas will undergo environmental rehabilitation as needed, to ensure the environmental quality of the soil is equivalent to what it was before the quarry was developed.

4 Public participation

4.1 Objective of the public consultation and information process

Hydro-Québec implements a public participation process for every project. This process covers every phase, from draft design, up to filing of the environmental and social impact assessment statement with the Ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC). The purpose of public participation is to enable the local communities to contribute to the technical and environmental assessment process in order to ensure that the new facilities integrate into the host environment as seamlessly as possible. It also establishes a line of communication with the host communities, which is maintained throughout the project, even after the assessment statement is filed.

The public participation process associated with the project to open a quarry of more than 3 ha was designed to:

- inform the public of the technical, environmental and economic aspects of the project
- consult the public in the study area
- gather all concerns and comments from the affected stakeholders in order to incorporate them into the project

Written communications and minutes from key meetings held as part of the public information and consultation processes are included in Appendix B.

It should also be noted that targeted consultations regarding land use by the CH40 trapline tallyman were conducted. These consultations were carried out simultaneously with a land use inventory. The results are reported in Section 4.3 and Section 4.5.

4.2 Host environment and targeted public

With an area of 10.86 km^2, the study area is located in the Nord-du-Québec administrative region (10) and is part of the Eeyou Istchee Baie-James territory, located south of the 55th parallel. It is entirely located on Category III land and crosses Chisasibi and Wemindji Cree Nations' trapping territories (see Section 5.5.1.1):

- Chisasibi Cree Nation trapping territory
- Wemindji Cree Nation trapping territory

The territory is also occupied by Hydro-Québec, mining companies and outdoor enthusiasts.

Thus, the individuals and groups targeted for the public participation program are related to the following entities and organizations:

- Eeyou Istchee James Bay Regional Government (EIJBRG)
- Council of the Cree Nation of Chisasibi
- Cree Trappers' Association (CTA)
- CH40 trapline tallyman
- Council of the Cree Nation of Wemindji
- Mining exploration companies with mining claims in the study area

The public informed and met with and the concerns expressed are listed in the following sections, summarizing each step of the information and consultation process.

4.3 Presentation of Hydro-Québec's consultation and information activities

This public participation process was the opportunity to hold numerous meetings and information activities throughout the technical and environmental assessment phases of the project. The meetings were primarily held virtually to facilitate discussions in the midst of the pandemic.

This process allowed Hydro-Québec to present and describe the quarry project to elected officials and managers of municipalities and band councils, community representatives, association members and land users. These stakeholders all had the opportunity to submit their comments and concerns about the project and have their questions answered.

The information and consultation process with the various stakeholders will continue even after this report is published, in order to optimize project integration in the host communities during the detailed engineering, development and operation phases of the proposed quarry.

4.3.1 Written communications

In September 2020, Hydro-Québec undertook an information-consultation process with the Council of the Cree Nation of Chisasibi, the CH40 trapline tallyman and the EIJBRG. A meeting was also held with two mining companies, within the framework of this process.

The information and consultation process included the following activities:

- Letter sent to the Chief of the Council of the Cree Nation of Chisasibi, Daisy House, informing her of Hydro-Québec's intention to open and operate a quarry in the vicinity of its La Grande-3 facilities.
  - Letter dated September 18, 2020, from Marc Tremblay, Project Manager at Hydro-Québec, to Daisy House, Chief of the Council of the Cree Nation of Chisasibi, including a map of the location of the quarry under study.
- Letter sent to the Chief of the Council of the Cree Nation of Wemindji, Christina Gilpin, informing her of Hydro-Québec's intention to open and operate a quarry in the vicinity of its La Grande-3 facilities.
  - Email sent to Chief Gilpin on March 8, 2021.
- Written communication to the EIJBRG sent on September 13, 2021.
  - Information about the progress status of the project; no response or request to date.
- Written communications to mining companies with claims on the proposed quarry site sent on May 5 and 6, 2021.
  - Informational emails sent to request a meeting to discuss potential occupancy issues.

Copies of these communications are included in Appendix B.

4.3.2 Meetings

Six meetings were held with various affected stakeholders during the project presentation phase (see Table 4-1). These were conducted virtually between February and October 2021 due to the pandemic. Hydro-Québec project team members used various communication tools to support these discussions, including maps produced from orthophotographs of the area and a dynamic map of the study area.

In collaboration with the Council of the Cree Nation of Chisasibi, a virtual open house was also held on May 26, 2021, giving all members of the Chisasibi Cree Trappers' Association (CTA) an opportunity to learn more about the project and voice their concerns. The Chisasibi Cree Trappers' Association advertised the activity. The absence of participants at the event is likely related to the community's lack of concern about the project.

Table 4-1: Meeting schedule

Date and location	Participants	Subject of the meetings
February 15, 2021 – Virtual meeting Project presentation Duration: 2 hours	Council of the Cree Nation of Chisasibi Daisy House, Chief Paula Napash, Deputy Chief Fawn Iserhoff, General Secretary Jason Bullfrog, CTA Coordinator Reggie Bearskin, CTA Regional Coordinator Sheree House, Land and Environment Officer Mabel Bearskin, Councillor Christina Kitty, Councillor Archie Moar, Councillor Janie Moar, Administrative Assistant Tommy Sam, Councillor Mark Wadden, Councillor Hydro-Québec Simon Langlois, Project Manager – Environment Carine Durocher, Advisor – Environment Stéphane Rodrigue, Project Engineer Josée Rousseau, Advisor – Indigenous Relations	Visual presentation and meeting minutes, validated by Council members Purpose of the presentation: • Present the project and rationale • Present the required environmental studies • Present the communication steps • Collect the community's comments and concerns about the project • Organize the virtual meeting with the CH40 trapline tallyman
March 12, 2021 – Virtual meeting Land use inventory planning Duration: 2 hours	Cree Nation of Chisasibi Jason Bullfrog, CTA Coordinator Reggie Bearskin, CTA Regional Coordinator Sheree House, Land and Environment Officer Hydro-Québec Carine Durocher, Advisor – Environment Josée Rousseau, Advisor – Indigenous Relations	Comments about methodological approach, consent form and assessment questionnaire
May 26, 2021 – Virtual open house Anticipated duration: 2 hours	Cree Nation of Chisasibi Sheree House, Land and Environment Officer Hydro-Québec Simon Langlois, Project Manager – Environment Carine Durocher, Advisor – Environment	No one other than the organizers attended this meeting
May 27, 2021 – Virtual meeting Interview about land use Duration: 3 hours	Cree Nation of Chisasibi [redacted] Tallyman Jason Bullfrog, CTA Adrian Chiskamish, CTA Sheree House, Land and Environment Officer Christopher Herodier, guest of Hydro-Québec Simon Langlois, Project Manager – Environment Carine Durocher, Advisor – Environment SNC-Lavalin Firm Eugénie Morasse Lapointe, Cartographer Stéphanie Cotnoir, Specialist – Human Environment	Purpose of the meeting: • Present the project • Inventory land use • Present anticipated impacts, requests and concerns about the project

Table 4-1: Meeting schedule (*cont.*)

Date and location	Participants	Subject of the meetings
September 8, 2021 – Virtual meeting Duration: 30 minutes	Osisko Gold Royalties Ltd. Guy Desharnais, Vice-President – Project Evaluation Hydro-Québec Simon Langlois, Project Manager – Environment Patrick Compartino, Advisor – Community Relations	Presentation of the quarry project, scope and timeline Request for validation of potential land use conflicts based on activities Osisko and Hydro-Québec have planned for the proposed quarry sector
October 19, 2021 – Virtual meeting Duration: 2 hours	Cree Nation of Chisasibi Daisy House, Chief Paula Napash, Deputy Chief Fawn Iserhoff, General Secretary Jason Bullfrog, CTA Coordinator Sheree House, Land and Environment Officer Natasha Bates, Councillor Mabel Bearskin, Councillor Charlotte Kanatewat Moar, Councillor Christina Kitty, Councillor Archie Moar, Councillor Tommy Sam, Councillor Thomas Shem, Councillor Mark Wadden, Councillor	Purpose of the meeting: • Update Council members about the project • Present project progress status • Summarize completed and upcoming environmental inventories • Summarize actions Hydro-Québec implemented to address the views and concerns expressed at the meetings held on February 15, 2021, with the Council of the Cree Nation of Chisasibi and on May 27, 2021, with the tallyman
October 28, 2021 – Virtual meeting Duration: 30 minutes	Osisko Gold Royalties Ltd. Guy Desharnais, Vice-President – Project Evaluation André Lebel, Vice-President – Legal Affairs Linda Darby, Mineral Title Manager Hydro-Québec Simon Langlois, Project Manager – Environment Geneviève Tétreault, Advisor – Government Approvals	Confirm absence of conflicts between Osisko and Hydro-Québec's activities in the proposed quarry sector Confirm mining claims do not need to be assigned or transferred

Meetings with Osisko Gold Royalties and Azimut Exploration Inc.

Hydro-Québec wished to inform quarry project claim holders and consult them about potential exploration or development projects on these properties.

In May 2021, Hydro-Québec emailed two mining companies holding claims on the proposed quarry site: Osisko Gold Royalties and Azimut Exploration Inc. The purpose was to inform quarry project claim holders and consult them about potential exploration or development projects on these properties. Despite several reminders, no response was received from Azimut Exploration Inc. However, two virtual meetings were held with Osisko Gold Royalties on September 8 and October 28, 2021 (see Table 4-1). Upon conclusion of these meetings, Osisko Gold Royalties confirmed to Hydro-Québec that the claims are not a priority, that no exploration or mining projects are planned in the short- or long-term, and that Hydro-Québec's quarry operations at this location would not affect their activities.

4.4 The public's concerns and questions

Overall, those met received the project well; they understood the project rationale and technical details, and considered the public information and consultation process to be adequate and complete.

Meetings with the community of Chisasibi brought out the following concerns:

- Sufficient involvement by the tallyman and other Cree users of the land

  Chisasibi Council representatives would like Hydro-Québec to take into account the concerns already expressed by Chisasibi trappers in a recent consultation held by CTA regarding recent development projects on the territory, including other quarry projects. In order to avoid negative impacts on traditional Cree activities on trapline CH40, they would like Hydro-Québec representatives to meet with the tallyman and land users so they can express their needs to be able to continue using the territory, and find out what solutions will be proposed to meet these needs.

- Application of appropriate land use inventory ethics

  The Council of the Cree Nation of Chisasibi would like for copies of the land use inventory report to be submitted to the community, and for the interview guide to be validated to confirm that it is appropriate for the Cree context.

- Preservation of the quality of water resources for consumption

  The Council of the Cree Nation emphasized that the availability of natural water sources is important to trappers operating on lands far from the community. They want to ensure that the project will not affect the water sources used by families in the area.

- Potential impact on a camp located near the proposed quarry

  Representatives of the Council of the Cree Nation are concerned that quarry operations will potentially impact the activities of the family who uses that camp. It is important to understand why this camp was set up in this location and to know what resources are available in the surroundings, so that appropriate measures can be taken to avoid impacts on this camp. Quarry development and operations also raise concerns about nuisances (noise and dust) and the safety of land users due to increased trucking activities.

- Recovery of timber for CH40 trapline users

  The Council of the Cree Nation mentions that it would be desirable for the timber generated by land clearing activities be offered to the families using the trapline.

The tallyman had few concerns about the project, as long as mitigation measures are applied to ensure that nuisances associated with quarry operations would not affect his camp. He mentioned that he has a camp near the proposed quarry site and expressed his expectation in terms of economic spinoffs for him and his family, given his experience working in the mining industry.

4.5 Incorporation of stakeholders' concerns into the project

This section explains the mitigation measures Hydro-Québec implemented to take into account the stakeholders' concerns listed in the previous section when conducting this impact assessment and planning the project. The results of these mitigation measures are stipulated in Chapter 6.

- Cree user involvement

  Hydro-Québec conducted an interview with the CH40 trapline tallyman to document his land use. The interview method as well as the possibility of meeting other land users were discussed with CTA representatives and the Council of the Cree Nation of Chisasibi. The main concerns that the tallyman expressed related to the economic spinoffs and nuisances (noise, dust) caused by quarry development and operation.

- Using appropriate land use inventory ethics

  The consent form was reviewed at a meeting with CTA and Council of the Cree Nation of Chisasibi representatives, and also commented on by the Chief and Deputy Chief of the Council. The online interview method was also discussed with CTA and Council of the Cree Nation of Chisasibi representatives. The land use interview report was sent to the tallyman for validation. The final report will be sent to the tallyman and community representatives.

- Preservation of the quality of water resources

  The water sources used by the tallyman and his family who use the Cree camp located near the proposed quarry were inventoried in an interview with the tallyman himself. None of these sources are located in the vicinity of the proposed quarry; they are located more than 8 km away.

- Potential impact on a camp located near the quarry

  Hydro-Québec plans to implement measures to ensure users of the camp located near the proposed quarry are not affected by nuisances related to quarry operations. One of these measures is the construction of a new camp on the trapline. A site visit will be scheduled to select the site for the new camp, when the health situation allows it. The tallyman will also have the opportunity to indicate whether he wishes to keep his camp near the proposed quarry; if not, he will have the option of choosing where he would like to relocate, depending on the quarry development and operation periods. Hydro-Québec will also implement speed reduction measures and signage around the quarry entrance during intense granular material hauling from the quarry to ensure public and worker safety.

- Recovery of timber for CH40 trapline users

  Hydro-Québec will consult with the CH40 trapline tallyman whether he or other trapline users wish to recover wood cut during land clearing and, if so, in what quantity. Hydro-Québec will make the wood available to the families involved.

- Local economic spinoffs

  Hydro-Québec plans to implement measures to help generate local economic spinoffs.

4.6 Other information and communication activities

As previously mentioned, Hydro-Québec will meet with the CH40 trapline tallyman as soon as the health situation permits.

The objectives of this meeting will be to:

- analyze the options available to the tallyman for the location of his new camp
- present the landscape assessment to the tallyman, according to the quarry site selected, and take into consideration his and his family's concerns regarding how the project will impact the landscape
- validate his needs in terms of the timber that could be made available to him

Hydro-Québec will also regularly update the Council of the Cree Nation of Chisasibi and EIJBRG of major project milestones throughout execution.

An Info-project line will allow anyone with questions or concerns about the project to contact Hydro-Québec. The Info-project line number will be posted at the entrance to the proposed quarry access road.

4.7 Conclusion

At the conclusion of this environmental and social impact assessment, the discussions and meetings with the members of the Council of the Cree Nation of Chisasibi, the CH40 trapline tallyman and the EIJBRG demonstrated that the stakeholders have few remaining concerns about the project.

Hydro-Québec will factor the results of the public information and consultation process into the project. Any significant changes will be communicated to the relevant stakeholders. Further informational meetings and discussions will be held at the detailed engineering stage, as well as during the development and operation stages, if the required project approvals are obtained.

5 Description of the environment

5.1 Study area

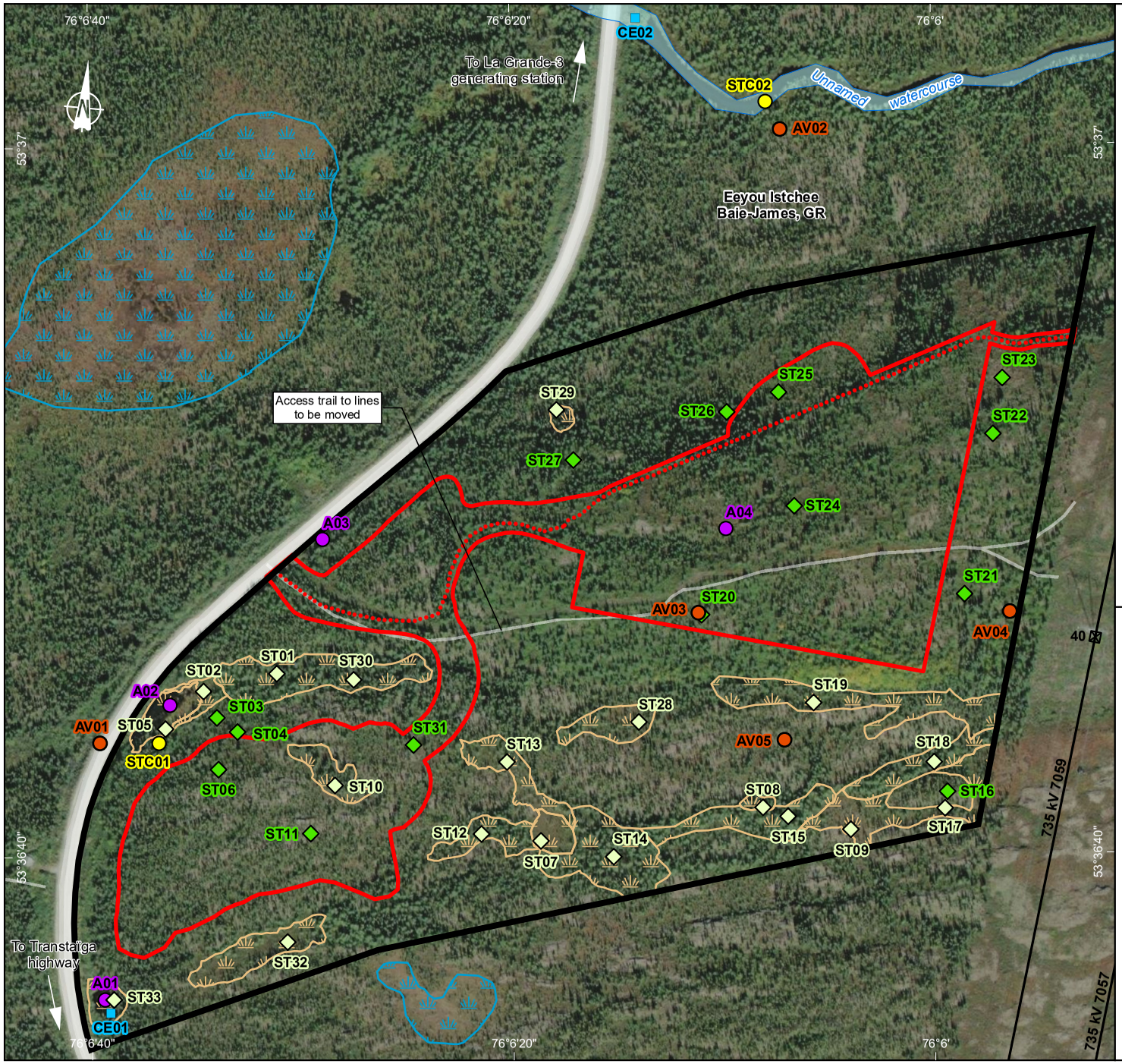
5.1.1 Location and size of the study area

The proposed quarry project study area covers a surface area of 10.86 km^2 (1,086 ha). (See Map A, in pocket.) It is located in the Nord-du-Québec administrative region, more specifically in the Eeyou Istchee Baie-James territory. It does not intersect any Jamesian municipalities or communities, nor any Cree villages or reserve land. It is approximately 15 km southwest of La Grande-3 hydroelectric development and 185 km east of the village of Chisasibi.

The study area was selected to encompass the various elements of the physical and human environments likely to be affected by the project. These are described in general terms in the impact study.

5.1.2 Biophysical environment inventory area

A biophysical environment inventory area, restricted to the study area, encompasses the components of the natural environment most directly affected by the project. Covering an area of 0.355 km^2 (35.5 ha), this biophysical environment inventory area is bounded on the west by the La Grande-3 road and on the east by two 735-kV power transmission lines (circuits 7057 and 7059; see Map 5-1). The biophysical environment inventories (wetlands and aquatic environments, flora, fauna, water and sediment) were primarily carried out within this area. However, three sampling stations were set up outside the inventory area to obtain certain information relating to birds, bats and quality of surface water in a stream located north of the inventory area.



Wildlife

- AV01 — Avian wildlife point count station
- A01 — Amphibian inventory station
- STC01 — Bat inventory station

Vegetation

- ST01 — Wetland characterization station
- ST03 — Terrestrial land characterization station
- Characterized wetland
- Photo-interpreted wetland

Watercourse

- CE01 — Surface water and sediment sampling station
- Perennial watercourse

Infrastructure

- La Grande-3 road
- Access trail to lines
- Transmission line and tower

Project components

- Quarry (deforestation)
- Biophysical environment inventory area
- Access trail to lines

Quarry in the area of the La Grande-3 hydroelectric development

Inventory stations

Sources:

Ortho-image (GeoEye-1), resolution 50 cm © ESRI, 2018
Ortho-image (WorldView-2), resolution 46 cm © ESRI, 2019
Adresses Québec réseau+, MERN Québec, September 1, 2020
Géobase du réseau hydrographique du Québec (GRHQ), MERN Québec
BGTÉ, Hydro-Québec TransÉnergie et Équipement, September 2020
Project data, Hydro-Québec, November 2021

Mapping and inventory: SNC-Lavalin
File: 3167B_eic5_1_slq_005_stamilieu_220406a.mxd

0 50 100 m
MTM, Zone 9, NAD83 (CSRS)

Map 5-1

May 2022

Hydro Québec

5.2 Methodology

The description of the environment is based on various sources of information from different bodies and departments including:

- Base de données topographiques et administratives (BDTA)
- Centre de données sur le patrimoine naturel du Québec (CDPNQ)
- Hydro-Québec
- Ministère de la Culture et des Communications (MCC)
- Ministère de l'Énergie et des Ressources naturelles (MERN)
- Ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC)
- Ministère des Forêts, de la Faune et des Parcs (MFFP)
- Environment and Climate Change Canada (ECCC)
- Eeyou Istchee James Bay Regional Government (EIJBRG)

The information was analyzed to determine whether there were sensitive features present that could be affected by the project activities.

Then, field inventories were conducted in 2020 and 2021 to learn more, establish which elements were sensitive and analyze impacts. Fauna and flora inventories were carried out within the biophysical environment inventory area, while the social and landscape components were analyzed for the entire study area. The specific methodologies and protocols used for fauna and flora inventories are stipulated in the relevant sections.

5.3 Physical environment

5.3.1 Climate

The study area is characterized by a cold, subarctic climate, a short growing season and moderate precipitation (Li et al., 2019).

A weather station is located at the Grande Rivière airport, more than 100 km west of the study area and at the same latitude as the study area. According to weather data recorded at the La Grande Rivière A weather station, the average daily temperature ranges from −23.2°C in January to 14.2°C in July. Mean annual precipitation is 697.2 mm, of which 453.8 cm is in the form of snow and 261.3 mm is in the form of rain (Government of Canada, 2020).

Prevailing winds are mainly from the west, except in the fall when they are from the south. Wind speeds in the region are relatively constant, ranging from 13.6 to 15.9 km/h, with a recorded mean wind speed of 14.5 km/h (Government of Canada, 2020).

5.3.2 Air quality

There is no government air quality monitoring station near the study area. Air quality is considered good, mainly because of the distance from major urban or industrialized areas.

5.3.3 Topography, geology, geomorphology and surface deposits

The study area is part of the hills of the Grande Rivière natural province. Bordering Hudson Bay and James Bay, this province consists of rolling plains with numerous scattered barren, rocky surfaces. The eastern portion is characterized by mounds and low, very close hills. Elevations range from sea level on the shores of the bays to 600 m at the base of the Otish Mountains in the southeastern tip of the province (Li et al., 2019). In the study area, elevations range from 190 to 290 m. More locally, the topography of the site selected to develop the quarry has elevations ranging from 239 to 278 m, with steep slopes in some areas. The location selected is also slightly inclined toward the La Grande-3 road.

The study area is located in the Superior geological province, which covers the central portion of the Canadian Shield. The Superior Province is largely composed of Neoarchean rocks, some of which are the oldest on Earth. The La Grande subprovince where the project is located is characterized by volcanic-plutonic rock with an east-west oriented regional structural grain (MERN, 2020*c*). Bands of volcanic rock (basalt) border Grande Rivière (Li et al., 2019). Surface deposits in the study area consist primarily of bedrock outcrops and deep-water glacial lake facies deposits (MFFP, 2016).

The site where the quarry will be located is composed of bedrock with rock outcrops; the plant cover varies. Surface materials consist of a till deposit composed of a sandy silty matrix, with a variable proportion of gravel (GHD, 2020). The surface is generally composed of a layer of mainly fibrous peat, averaging 26 cm thick in the geotechnical soundings performed in the extraction area.

5.3.4 Soil quality

SNC-Lavalin completed Phase I of the environmental site assessment on the site selected for developing the new quarry (2020). The results of this assessment do not indicate any risk or evidence of contamination from current or past anthropic activities. No contaminated land was identified on the site or in its immediate surroundings.

Based on the information collected during this assessment, a Phase II environmental site assessment is not recommended.

5.3.5 Hydrography and drainage

The study area is part of the Grande Rivière watershed (level 1) located in the James Bay and Hudson Bay hydrographic region (09). Most of the study area is located in the Grande Rivière watershed, while a small area of the Rivière Sakami watershed covers the southeast corner of the study area (see Map A, in pocket; MERN, 2020*d*).

The main watercourse in the study area is an unnamed river that flows westward into Robert-Bourassa reservoir located near the northwest boundary of the study area. Two small lakes, also unnamed, are located in the northeast (0.2 ha) and southeast (3.7 ha) of the study area. The closest lake to the proposed quarry site, which has an area of 3.7 ha, is approximately 750 m east of the proposed site, on the slope opposite to the one where the quarry will be developed.

In addition to these river system elements, a network of permanent and indeterminate watercourses drain the study area primarily in a westerly direction, toward Robert-Bourassa reservoir (see Map A, in pocket).

More precisely, the northern portion of the selected quarry site drains to the north and northwest (toward the unnamed watercourse), while the southern portion drains to the south, into the general westward drainage flow of the area. No watercourses were observed on the selected quarry site.

5.3.6 Surface water quality

5.3.6.1 Methodology

The methodology for this characterization is based primarily on the recommendations of the *Guide de caractérisation physicochimique de l'état initial du milieu aquatique avant l'implantation d'un projet industriel* (MDDELCC, 2017).

Surface water characterization was performed from two sampling stations. Map 5-2 shows their locations.

The first, named CE01, is located in one of the small marshes southwest of the proposed quarry site. This station is just over 300 m from the quarry site boundary. The second, named CE02, is located in the unnamed watercourse that runs approximately 250 m north of the proposed quarry site boundary.

Laboratory analyses were conducted for the parameters stipulated in Table 5-1. Analyses revealed that the total extractable metals were analyzed at trace levels.

Table 5-1: Surface water analysis parameters

Basic physical chemistry and nutrients		
Alkalinity	Conductivity (*in situ*)	pH (*in situ*)
Ammonia nitrogen	Total cyanides	Total phosphorus (traces)
Total nitrogen	Suspended solids	Total dissolved solids
Dissolved organic carbon	Nitrates-nitrites (N)	Turbidity
Fecal coliforms	Dissolved oxygen *(in situ*)	Hardness
Major ions		
Bromides (Br)	Fluoride (F)	Sodium (Na)
Calcium (Ca)	Magnesium (Mg)	Sulphates (SO_4)
Chlorides (Cl)	Potassium (K)	
Total extractable trace metals		
Aluminum (Al)	Cadmium (Cd)	Molybdenum (Mo)
Antimony (Sb)	Chromium (Cr)	Nickel (Ni)
Silver (Ag)	Cobalt (Co)	Lead (Pb)
Arsenic (As)	Copper (Cu)	Selenium (Se)
Barium (Ba)	Iron (Fe)	Strontium (Sr)
Beryllium (Be)	Manganese (Mn)	Vanadium (V)
Boron (B)	Mercury (Hg)	Zinc (Zn)

Samples were taken in accordance with the general recommendations of the following guides:

- *Suivi de la qualité des rivières et petits cours d'eau* (Hébert et Légaré, 2000)
- *Modes de conservation pour l'échantillonnage des eaux de surface* (Centre d'expertise en analyse environnementale du Québec [CEAEQ], 2012)
- *Guide d'échantillonnage à des fins d'analyses environnementales. Cahier 1 – Généralités* (MDDEP, 2008).

Special kits prepared by the laboratory were used for trace metals. Sampling for these parameters met the requirements of the following guide:

- *Protocole d'échantillonnage de l'eau de surface pour l'analyse des métaux en traces* (MDDELCC, 2014).

In situ measurements were taken using a multiparameter probe. Parameters measured on site included dissolved oxygen, pH and electrical conductivity. The probe was pre-calibrated according to the manufacturer's instructions.

In order to cover the variation in surface water quality throughout the year, three sampling campaigns were conducted during the ice-free season, i.e. during the months of:

- November 2020
- May 2021, and
- July 2021

A quality assurance and control program was established to verify the validity of the results obtained. To verify the accuracy of the analysis results, duplicate samples were collected and analyzed for all parameters at one of the two stations (50% of surface water samples).

Field and trip blanks were also included with each sampling campaign. Field blanks are used to verify for contamination during sampling, while trip blanks are used to verify contamination during sample transport. The blanks were prepared by the laboratory and only the field blank was opened at the site during sampling.

This quality control program is in addition to the laboratory quality assurance program, which includes analyzing laboratory duplicates, fortified samples and laboratory blanks.

5.3.6.2 Surface water quality criteria

Measured concentrations were compared to provincial criteria for the protection of aquatic life relating to chronic toxicity (MELCC 2021*a*) and the Canadian Council of Ministers of the Environment's water quality guidelines for the protection of aquatic life (CCME 2021).

5.3.6.3 Results

Tables 5-2 through 5-4 present the results for the three sampling campaigns. The parameters analyzed generally meet all MELCC and CCME criteria. A significant number of the parameters were also below the detection limits reported by the laboratory. The chemical analysis certificates are included in Appendix C.

pH and alkalinity

The pH values for most measurements were close to neutral. The values measured are within the range (6.5–9) established for the protection of aquatic life, with the exception of one value of 5.7 at station CE01 during the May 2021 campaign.

Alkalinity is an indicator of the neutralizing capacity of water. Since the measured concentrations are less than 10 mg of $CaCO_3$/L at station CE01 and less than 4 mg/L at station CE02, the alkalinity of the water can be described as low. These waters therefore have a limited neutralization capacity and are sensitive to changes in pH, especially acidification.

Suspended solids and turbidity

The measurement of suspended solids provide an indication of the presence of biotic or abiotic particles suspended in the water. Turbidity is a similar measurement, but can also be caused by certain materials dissolved in the water. The measurements taken indicated higher values during the May 2021 campaign due to spring runoff.

With turbidity values that were always less than or equal to 4 NTU (nephelometric turbidity unit) and suspended solids concentrations always less than or equal to 12 mg/L, the waters contain few suspended particles and can be described as clear (waters are described as clear when suspended solids concentration is less than 25 mg/L).

Conductivity, hardness and major ions

Conductivity and hardness are general parameters representative of salt content. Measurements of these parameters indicated very soft and low-mineralized water. Levels at station CE01 were higher than those at station CE02.

Chlorides, fluorides and sulfates were at very low concentrations or below water quality criteria.

Phosphorus and nitrogen

Total phosphorus concentrations were all below the MELCC criterion of 30 µg/L to prevent excessive algae and aquatic plant growth in streams. Maximum concentrations measured were approximately 10 µg/L, which is characteristic of oligotrophic and low-productivity environments.

Ammonia nitrogen and nitrate concentrations measured in the water were well below water quality criteria. Nitrites were below the analytical method detection limits. Nitrate ion (NO_3-) is the main form of inorganic nitrogen found in natural waters and is the final stage in nitrogen oxidation. Nitrite ion (NO_2-) is easily oxidized to nitrate ions and, for this reason, is rarely found in significant concentrations in natural waters.

Metals

The water sampled showed very few water quality criteria overruns and that measured concentrations were below detection limits for several parameters. The observed overruns were for iron, aluminum, lead and, to a lesser extent, copper.

Aluminum and iron consistently exceeded CCME criteria at both stations. However, MELCC criteria were still met. Aluminum and iron overruns are common in Québec.

Lead exceeded the MELCC criterion at station CE02, but not at station CE01. However, lead concentrations at both stations met CCME criteria. Low water hardness at station CE02 imposes a very strict quality criterion for lead, which explains why it was exceeded.

Copper concentrations exceeded MELCC and CCME quality criteria once—at station CE01 in the July 2021 survey.

Fecal coliforms

For fecal coliform, zero or low concentrations were detected (1–2 CFU/100 mL) in the September 2020 and May 2021 campaigns. In contrast, levels were quite significant in the July 2021 campaign (17–18 and >60 CFU/100 mL). Since the values were very low during the previous campaigns, it is possible that these results correspond to an occasional episode of animal droppings.

For comparison, the *Regulation respecting the quality of drinking water* sets the threshold at 20 CFU/100 mL for raw water intended for drinking water supply when this water is exempt from filtration treatment.

Table 5-2: Surface water quality – September 2020

Parameter	Unit	Detection limit	Station CE01	Criterion		Station CE02	Criterion		CE02 – Duplicate	Criterion	
				MELCC	CCME		MELCC	CCME		MELCC	CCME
Basic physical chemistry and nutrients											
Total alkalinity (in $CaCO_3$)	mg/L	1	7.7	NCI	NCI	2.1	NCI	NCI	1.7	NCI	NCI
Ammonia nitrogen	mg/L	0.05	<0.020	1.4[a]	1.54[a]	<0.020	1.4[a]	1.54[a]	<0.020	1.4[a]	1.54[a]
Total Kjeldahl nitrogen (TKN)	mg/L	0.4	<0.40	NCI	NCI	<0.40	NCI	NCI	<0.40	NCI	NCI
Dissolved organic carbon (DOC)	mg/L	0.5	17	NCI	NCI	15	NCI	NCI	15	NCI	NCI
Total hardness (in $CaCO_3$)	mg/L	1	13	NCI	NCI	6.4	NCI	NCI	5.9	NCI	NCI
Suspended solids (SS)	mg/L	2	2	NCI	NCI	2	NCI	NCI	<2	NCI	NCI
Nitrates	mg/L	0.02	0.036	3	13	<0.020	3	13	<0.020	3	13
Nitrites	mg/L	0.02	<0.020	0.02[b]	0.06	<0.020	0.02[b]	0.06	<0.020	0.02[b]	0.06
Dissolved oxygen *(in situ)*	%	0	N/A	NCI	NCI	N/A	NCI	NCI	N/A	NCI	NCI
pH (*in situ*)	pH	N.A.	N/A	6.5-9	6.5-9	N/A	6.5-9	6.5-9	N/A	6.5-9	6.5-9
Total phosphorus	µg/L	0.6	4.2	30	10[c]	8.1	30	10[c]	N/A	30	10[c]
Total dissolved solids	mg/L	10	65	NCI	NCI	52	NCI	NCI	49	NCI	NCI
Turbidity	NTU	0.1	0.27	NCI	NCI	1.9	NCI	NCI	1.9	NCI	NCI
Major ions											
Bromide (Br)	mg/L	0.1	<0.10	NCI	NCI	<0.10	NCI	NCI	<0.10	NCI	NCI
Calcium (Ca)	mg/L	0.5	4.2	NCI	NCI	2.0	NCI	NCI	1.8	NCI	NCI
Chlorides (Cl)	mg/L	0.05	0.40	230	120	0.40	230	120	0.39	230	120
Fluoride (F)	mg/L	0.1	<0.10	0.2	0.12	<0.10	0.2	0.12	<0.10	0.2	0.12
Magnesium (Mg)	mg/L	0.1	0.52	NCI	NCI	0.35	NCI	NCI	0.35	NCI	NCI
Potassium (K)	mg/L	0.5	<0.5	NCI	NCI	<0.5	NCI	NCI	<0.5	NCI	NCI
Sodium (Na)	mg/L	0.5	0.66	NCI	NCI	0.66	NCI	NCI	0.67	NCI	NCI

Table 5-2: Surface water quality – September 2020 (*Cont.*)

Parameter	Unit	Detection limit	Station CE01	Criterion		Station CE02	Criterion		CE02 – Duplicate	Criterion	
				MELCC	CCME		MELCC	CCME		MELCC	CCME
Major ions (*cont.*)											
Sulphates (SO_4)	mg/L	0.5	<0.50	500[d]	NCI	<0.50	500[d]	NCI	<0.50	500[d]	NCI
Conductivity	mS/cm	0.001	0.024	NCI	NCI	0.012	NCI	NCI	0.012	NCI	NCI
Total extractable metals											
Aluminum (Al)	µg/L	5	270	410[e]	100[f]	330	410[e]	100[f]	370	410[e]	100[f]
Antimony (Sb)	µg/L	0.005	0.042	240	NCI	0.027	240	NCI	0.022	240	NCI
Silver (Ag)	µg/L	0.003	<0.0030	0.1	0.25	<0.0030	0.1	0.25	<0.0030	0.1	0.25
Arsenic (As)	µg/L	0.08	0.19	150	5	0.22	150	5	0.23	150	5
Barium (Ba)	µg/L	0.03	8.3	50[g]	NCI	4.4	23[g]	NCI	4.5	21[g]	NCI
Beryllium (Be)	µg/L	0.01	<0.010	0.21[g]	NCI	0.011	0.065[g]	NCI	0.013	0.057[g]	NCI
Boron (B)	µg/L	0.3	0.98	5,000	1,500	1.9	5,000	1,500	1.7	5,000	1,500
Cadmium (Cd)	µg/L	0.006	<0.0060	0.060[g]	0.04 [g]	0.0074	0.035[g]	0.04 [g]	<0.0060	0.033[g]	0.04[g]
Chromium (Cr)	µg/L	0.04	0.54	16[g,h]	8.9[h]	0.53	9.1[g,h]	8.9[h]	0.52	8.5[g,h]	8.9[h]
Cobalt (Co)	µg/L	0.008	0.068	100	NCI	0.25	100	NCI	0.27	100	NCI
Copper (Cu)	µg/L	0.05	0.38	1.6[g]	2[g]	0.36	0.89[g]	2[g]	0.35	0.83[g]	2[g]
Iron (Fe)	µg/L	0.5	360	NCI	300	410	NCI	300	450	NCI	300
With correction factor[k]			180	1,300	NCI	205	1,300	NCI	225	1,300	NCI
Manganese (Mn)	µg/L	0.03	19	320[g]	210[i]	10	172 [g]	210[i]	11	160[g]	210[i]
Mercury (Hg)	µg/L	0.1	<0.10	0.91	0.026	<0.10	0.91	0.026	<0.10	0.91	0.026
Molybdenum (Mo)	µg/L	0.01	0.011	3,200	73	<0.010	3,200	73	<0.010	3,200	73
Nickel (Ni)	µg/L	0.03	0.27	9.3[g]	25[g]	0.26	5.1[g]	25[g]	0.41	4.7[g]	25[g]

Table 5-2: Surface water quality – September 2020 (*Cont.*)

Parameter	Unit	Detection limit	Station CE01	Criterion		Station CE02	Criterion		CE02 – Duplicate	Criterion	
				MELCC	CCME		MELCC	CCME		MELCC	CCME
Total extractable metals (*Cont.*)											
Lead (Pb)	µg/L	0.01	0.027	0.24[g]	1[g]	**0.17**	0.10[g]	1[g]	**0.17**	0.087[g]	1[g]
Selenium (Se)	µg/L	0.05	0.062	5	1	<0.050	5	1	<0.050	5	1
Strontium (Sr)	µg/L	0.04	11	21,000	NCI	7.3	21,000	NCI	7.2	21,000	NCI
Uranium (U)	µg/L	0.001	0.064	14	15	0.056	14	15	0.058	14	15
Vanadium (V)	µg/L	0.05	0.12	12	NCI	0.39	12	NCI	0.48	12	NCI
Zinc (Zn)	µg/L	0.5	1.3	21[g]	6[j]	1.3	11[g]	6[j]	1.3	11[g]	6[j]
Microbiology											
Fecal coliforms	UFC/100 mL	0	0	NCI	NCI	1	NCI	NCI	2	NCI	NCI

NCI: No criteria identified.

N/A: Not available.

N.A.: Not applicable.

a. For water temperature below 20°C with pH less than 7.5.
b. For chloride concentration less than 2 mg/L.
c. For an oligotrophic environment.
d. For hardness less than 100 mg/L and chloride concentration less than 5 mg/L.
e. For hardness of 10 mg/L, DOC concentration of greater than 12 mg/L and pH greater than 6.5.
f. For pH greater than 6.5.
g. According to the MELCC or CCME, the quality criteria to be met are based on water hardness, expressed in mg of $CaCO_3$/L.
h. For trivalent chromium (for hexavalent chromium: 11 µg/L according to the MELCC and 1 µg/L according to the CCME).
i. For hardness of 10 mg/L and pH greater than 6.5.
j. For hardness of 6.15 mg/L, DOC concentration of greater than 15 mg/L and pH greater than 6.5.
k. A correction factor of 0.5 is used on surface water data with suspended solids concentration less than 10 mg/L.

An underlined value indicates that the Canadian Council of Ministers of the Environment (CCME) guidelines for long-term exposure was exceeded.

A value in **bold** indicates that the MELCC criterion for the protection of aquatic life relating to chronic toxicity was exceeded.

Table 5-3: Quality of surface water – May 2021

Parameter	Unit	Detection limit	Station CE01	Criterion		Station CE02	Criterion		CE02 – Duplicate	Criteria	
				MELCC	CCME		MELCC	CCME		MELCC	CCME
Basic physical chemistry and nutrients											
Total alkalinity (in $CaCO_3$)	mg/L	1	5.4	NCI	NCI	2.0	NCI	NCI	2.1	NCI	NCI
Ammonia nitrogen	mg/L	0.05	0.076	1.4[a]	1.54[a]	<0.02	1.4[a]	1.54[a]	0.047	1.4[a]	1.54[a]
Total Kjeldahl nitrogen (TKN)	mg/L	0.4	<0.40	NCI	NCI	<0.40	NCI	NCI	<0.40	NCI	NCI
Dissolved organic carbon (DOC)	mg/L	0.5	11	NCI	NCI	8.4	NCI	NCI	8.5	NCI	NCI
Total hardness (in $CaCO_3$)	mg/L	1	9.4	NCI	NCI	5.0	NCI	NCI	6.2	NCI	NCI
Suspended solids (SS)	mg/L	2	6	NCI	NCI	9	NCI	NCI	12	NCI	NCI
Nitrates	mg/L	0.02	0.051	3	13	<0.020	3	13	<0.020	3	13
Nitrites	mg/L	0.02	<0.020	0.02[b]	0.06	<0.020	0.02[b]	0.06	<0.020	0.02[b]	0.06
Dissolved oxygen *(in situ)*	%	0	96	NCI	NCI	98	NCI	NCI	N/A	NCI	NCI
pH (*in situ*)	pH	N.A.	**5.7**	6.5-9	6.5-9	6.9	6.5-9	6.5-9	N/A	6.5-9	6.5-9
Total phosphorus	µg/L	0.6	4.2	30	10[c]	11.8	30	10[c]	N/A	30	10[c]
Total dissolved solids	mg/L	10	34	NCI	NCI	27	NCI	NCI	25	NCI	NCI
Turbidity	NTU	0.1	0.32	NCI	NCI	3.7	NCI	NCI	3.6	NCI	NCI
Major ions											
Bromide (Br)	mg/L	0.1	<0.10	NCI	NCI	<0.10	NCI	NCI	<0.10	NCI	NCI
Calcium (Ca)	mg/L	0.5	3.2	NCI	NCI	1.5	NCI	NCI	1.9	NCI	NCI
Chlorides (Cl)	mg/L	0.05	0.23	230	120	0.32	230	120	0.33	230	120
Fluoride (F)	mg/L	0.1	<0.10	0.2	0.12	<0.10	0.2	0.12	<0.10	0.2	0.12
Magnesium (Mg)	mg/L	0.1	0.38	NCI	NCI	0.30	NCI	NCI	0.36	NCI	NCI
Potassium (K)	mg/L	0.5	<0.5	NCI	NCI	<0.5	NCI	NCI	<0.5	NCI	NCI
Sodium (Na)	mg/L	0.5	0.69	NCI	NCI	0.75	NCI	NCI	0.86	NCI	NCI
Sulphates (SO4)	mg/L	0.5	<0.50	500[d]	NCI	<0.50	500[d]	NCI	<0.50	500[d]	NCI
Conductivity	mS/cm	0.001	0.018	NCI	NCI	0.0098	NCI	NCI	0.0098	NCI	NCI

Table 5-3: Quality of surface water – May 2021 (*Cont.*)

Parameter	Unit	Detection limit	Station CE01	Criterion		Station CE02	Criterion		CE02 – Duplicate	Criteria	
				MELCC	CCME		MELCC	CCME		MELCC	CCME
Total extractable metals											
Aluminum (Al)	µg/L	5	200	410[e]	100[f]	300	410[e]	100[f]	300	410[e]	100[f]
Antimony (Sb)	µg/L	0.005	0.049	240	NCI	0.027	240	NCI	0.027	240	NCI
Silver (Ag)	µg/L	0.003	<0.0030	0.1	0.25	<0.0030	0.1	0.25	<0.0030	0.1	0.25
Arsenic (As)	µg/L	0.08	0.17	150	5	0.16	150	5	0.15	150	5
Barium (Ba)	µg/L	0.03	5.4	35[g]	NCI	3.5	18[g]	NCI	3.8	23[g]	NCI
Beryllium (Be)	µg/L	0.01	<0.010	0.12[g]	NCI	0.01	0.043[g]	NCI	<0.010	0.062[g]	NCI
Boron (B)	µg/L	0.3	1.2	5,000	1,500	1.7	5,000	1,500	1.8	5,000	1,500
Cadmium (Cd)	µg/L	0.006	0.0072	0.047[g]	0.04[g]	0.0071	0.029[g]	0.04[g]	0.007	0.034[g]	0.04[g]
Chromium (Cr)	µg/L	0.04	0.55	12[g,h]	8.9[h]	0.71	7.4[g,h]	8.9[h]	0.68	8.8[g,h]	8.9[h]
Cobalt (Co)	µg/L	0.008	0.087	100	NCI	0.13	100	NCI	0.13	100	NCI
Copper (Cu)	µg/L	0.05	0.89	1.2[g]	2[g]	0.49	0.72[g]	2[g]	0.52	0.87[g]	2[g]
Iron (Fe)	µg/L	0.5	240	NCI	300	310	NCI	300	320	NCI	300
With correction factor[k]			120	1,300	NCI	155	1,300	NCI	160	1,300	NCI
Manganese (Mn)	µg/L	0.03	13	241[g]	210[i]	4.5	13[g]	210[i]	4.5	168[g]	210[i]
Mercury (Hg)	µg/L	0.1	<0.10	0.91	0.026	<0.10	0.91	0.026	<0.10	0.91	0.026
Molybdenum (Mo)	µg/L	0.01	0.019	3,200	73	0.035	3,200	73	0.035	3,200	73
Nickel (Ni)	µg/L	0.03	0.4	7.1[g]	25[g]	0.4	4.1[g]	25[g]	0.39	5.0[g]	25[g]
Lead (Pb)	µg/L	0.01	0.093	0.16[g]	1[g]	**0.12**	0.070[g]	1[g]	**0.13**	0.092[g]	1[g]
Selenium (Se)	µg/L	0.05	<0.050	5	1	<0.050	5	1	<0.050	5	1
Strontium (Sr)	µg/L	0.04	6.8	21,000	NCI	5.7	21,000	NCI	5.7	21,000	NCI
Uranium (U)	µg/L	0.001	0.06	14	15	0.05	14	15	0.054	14	15

Table 5-3: Quality of surface water – May 2021 (*Cont.*)

Parameter	Unit	Detection limit	Station CE01	Criterion		Station CE02	Criterion		CE02 – Duplicate	Criteria	
				MELCC	CCME		MELCC	CCME		MELCC	CCME
Total extractable metals (*cont.*)											
Vanadium (V)	µg/L	0.05	0.26	12	NCI	0.56	12	NCI	0.56	12	NCI
Zinc (Zn)	µg/L	0.5	3.3	16[g]	6[j]	1.5	9.5[g]	6[j]	1.4	11[g]	6[j]
Microbiology											
Fecal coliforms	UFC/100 mL	0	0	NCI	NCI	1	NCI	NCI	0	NCI	NCI

NCI: No criteria identified.

N/A: Not available.

N.A.: Not applicable.

a. For water temperature below 20°C and pH less than 7.5.
b. For chloride concentration less than 2 mg/L.
c. For an oligotrophic environment.
d. For hardness less than 100 mg/L and chloride concentration less than 5 mg/L.
e. For hardness of 10 mg/L, DOC concentration of greater than 12 mg/L and pH greater than 6.5.
f. For pH greater than 6.5.
g. According to the MELCC or CCME, the quality criteria to be met are based on water hardness, expressed in mg of $CaCO_3$/L.
h. For trivalent chromium (for hexavalent chromium: 11 µg/L according to the MELCC and 1 µg/L according to the CCME).
i. For hardness of 10 mg/L and pH greater than 6.5.
j. For hardness of 6.15 mg/L, DOC concentration of greater than 15 mg/L and pH greater than 6.5.
k. A correction factor of 0.5 is used on surface water data with suspended solids concentration less than 10 mg/L.

An underlined value indicates that the Canadian Council of Ministers of the Environment (CCME) guidelines for long-term exposure were exceeded.

A value in **bold** indicates that the MELCC chronic toxicity criterion for the protection of aquatic life was exceeded.

Table 5-4: Quality of surface water – July 2021

Parameter	Unit	Detection limit	Station CE01	Criterion		Station CE02	Criterion		CE02 – Duplicate	Criterion	
				MELCC	CCME		MELCC	CCME		MELCC	CCME
Basic physical chemistry and nutrients											
Total alkalinity (in $CaCO_3$)	mg/L	1	9.2	NCI	NCI	3.2	NCI	NCI	3.0	NCI	NCI
Ammonia nitrogen	mg/L	0.02	<0.02	1.4[a]	1.54[a]	<0.02	1.4[a]	1.54[a]	<0.02	1.4[a]	1.54[a]
Total Kjeldahl nitrogen (TKN)	mg/L	0.4	<0.40	NCI	NCI	<0.40	NCI	NCI	<0.40	NCI	NCI
Dissolved organic carbon	mg/L	0.5	13	NCI	NCI	10	NCI	NCI	10	NCI	NCI
Total hardness (in $CaCO_3$)	mg/L	1	11	NCI	NCI	5.3	NCI	NCI	5.1	NCI	NCI
Suspended solids (SS)	mg/L	2	4	NCI	NCI	2	NCI	NCI	2	NCI	NCI
Nitrates	mg/L	0.02	0.035	3	13	0.02	3	13	0.11	3	13
Nitrites	mg/L	0.02	<0.020	0.02[b]	0.06	<0.020	0.02[b]	0.06	<0.020	0.02[b]	0.06
Dissolved oxygen *(in situ)*	%	0	62	NCI	NCI	79	NCI	NCI	N/A	NCI	NCI
pH (*in situ*)	pH	N.A.	7.8	6.5-9	6.5-9	6.9	6.5-9	6.5-9	N/A	6.5-9	6.5-9
Total phosphorus	µg/L	2	13	30	10[c]	8.5	30	10[c]	8.6	30	10[c]
Total dissolved solids	mg/L	10	46	NCI	NCI	25	NCI	NCI	22	NCI	NCI
Turbidity	NTU	0.1	0.63	NCI	NCI	2.5	NCI	NCI	<0.10	NCI	NCI
Major ions											
Bromide (Br)	mg/L	0.1	<0.10	NCI	NCI	<0.10	NCI	NCI	<0.10	NCI	NCI
Calcium (Ca)	mg/L	0.5	3.8	NCI	NCI	1.7	NCI	NCI	1.6	NCI	NCI
Chlorides (Cl)	mg/L	0.05	0.26	230	120	0.41	230	120	0.41	230	120
Fluoride (F)	mg/L	0.1	<0.10	0.2	0.12	<0.10	0.2	0.12	<0.10	0.2	0.12
Magnesium (Mg)	mg/L	0.1	0.44	NCI	NCI	0.28	NCI	NCI	0.27	NCI	NCI
Potassium (K)	mg/L	0.5	<0.5	NCI	NCI	<0.5	NCI	NCI	<0.5	NCI	NCI
Sodium (Na)	mg/L	0.5	0.85	NCI	NCI	0.86	NCI	NCI	0.83	NCI	NCI

Table 5-4: Quality of surface water – July 2021 (*cont.*)

Parameter	Unit	Detection limit	Station CE01	Criterion		Station CE02	Criterion		CE02 – Duplicate	Criterion	
				MELCC	CCME		MELCC	CCME		MELCC	CCME
Major ions (*cont.*)											
Sulphates (SO_4)	mg/L	0.5	<0.50	500[d]	NCI	<0.50	500[d]	NCI	<0.50	500[d]	NCI
Conductivity	mS/cm	0.001	0.026	NCI	NCI	0.013	NCI	NCI	0.012	NCI	NCI
Total extractable metals											
Aluminum (Al)	µg/L	5	180	410[e]	100[f]	270	410[e]	100[f]	290	410[e]	100[f]
Antimony (Sb)	µg/L	0.005	0.097	240	NCI	0.026	240	NCI	0.028	240	NCI
Silver (Ag)	µg/L	0.003	<0.0030	0.1	0.25	<0.0030	0.1	0.25	<0.0030	0.1	0.25
Arsenic (As)	µg/L	0.08	0.18	150	5	0.18	150	5	0.21	150	5
Barium (Ba)	µg/L	0.03	6.9	41[g]	NCI	3.6	19[g]	NCI	3.8	19[g]	NCI
Beryllium (Be)	µg/L	0.01	<0.010	0.16[g]	NCI	<0.010	0.047[g]	NCI	<0.010	0.044[g]	NCI
Boron (B)	µg/L	0.3	1.4	5,000	1,500	2.3	5,000	1,500	2.7	5,000	1,500
Cadmium (Cd)	µg/L	0.006	0.0078	0.053[g]	0.04[g]	<0.0060	0.031[g]	0.04[g]	0.006	0.030[g]	0.04[g]
Chromium (Cr)	µg/L	0.04	0.44	14[g,h]	8.9[h]	0.66	7.8[g,h]	8.9[h]	0.57	7.5[g,h]	8.9[h]
Cobalt (Co)	µg/L	0.008	0.088	100	NCI	0.11	100	NCI	0.12	100	NCI
Copper (Cu)	µg/L	0.05	**5.6**	1.4[g]	2[g]	0.22	0.76[g]	2[g]	0.24	0.73[g]	2[g]
Iron (Fe)	µg/L	0.5	260	NCI	300	270	NCI	300	290	NCI	300
With correction factor[k]			130	1,300	NCI	135	1,300	NCI	145	1,300	NCI
Manganese (Mn)	µg/L	0.03	33	277[g]	210[i]	3.7	146[g]	210[i]	3.9	141[g]	210[i]
Mercury (Hg)	µg/L	0.1	<0.10	0.91	0.026	<0.10	0.91	0.026	<0.10	0.91	0.026
Molybdenum (Mo)	µg/L	0.01	0.05	3,200	73	0.062	3,200	73	0.053	3,200	73
Nickel (Ni)	µg/L	0.03	0.34	8.1[g]	25[g]	0.46	4.3[g]	25[g]	0.32	4.2[g]	25[g]
Lead (Pb)	µg/L	0.01	0.098	0.19[g]	1[g]	**0.11**	0.076[g]	1[g]	**0.12**	0.072[g]	1[g]

Table 5-4: Quality of surface water – July 2021 (*cont.*)

Parameter	Unit	Detection limit	Station CE01	Criterion		Station CE02	Criterion		CE02 – Duplicate	Criterion	
				MELCC	CCME		MELCC	CCME		MELCC	CCME
Total extractable metals (*cont.*)											
Selenium (Se)	µg/L	0.05	<0.050	5	1	<0.050	5	1	<0.050	5	1
Strontium (Sr)	µg/L	0.04	9.9	21,000	NCI	7	21,000	NCI	7.4	21,000	NCI
Uranium (U)	µg/L	0.001	0.073	14	15	0.059	14	15	0.063	14	15
Vanadium (V)	µg/L	0.05	0.21	12	NCI	0.42	12	NCI	0.44	12	NCI
Zinc (Zn)	µg/L	0.5	1.3	18[g]	6[j]	1.1	9.9[g]	6[j]	1.2	9.6[g]	6[j]
Microbiology											
Fecal coliforms	UFC/100 mL	0	>60	NCI	NCI	18	NCI	NCI	17	NCI	NCI

NCI: No criteria identified.

N.A.: Not applicable.

a. For water temperature below 20°C with pH less than 7.5.
b. For a chloride concentration less than 2 mg/L.
c. For an oligotrophic environment.
d. For hardness less than 100 mg/L and chloride concentration less than 5 mg/L.
e. For hardness of 10 mg/L, DOC concentration of >12 mg/L and pH >6.5.
f. For pH greater than 6.5.
g. According to the MELCC or CCME, the quality criteria to be met are based on water hardness, expressed in mg $CaCO_3$/L.
h. For trivalent chromium (for hexavalent chromium: 11 µg/L according to the MELCC and 1 µg/L according to the CCME).
i. For hardness of 10 mg/L and pH greater than 6.5.
j. For hardness of 6.15 mg/L, DOC concentration of greater than 15 mg/L and pH greater than 6.5.
k. A correction factor of 0.5 is used on surface water data with suspended solids concentration less than 10 mg/L.

An underlined value indicates that the Canadian Council of Ministers of the Environment (CCME) guidelines for long-term exposure were exceeded.

A value in **bold** indicates that the MELCC chronic toxicity criterion for the protection of aquatic life was exceeded.

5.3.6.4 Quality control

Duplicate samples

Results from the surface water duplicate samples were compared to those from their respective stations. Overall, the differences were generally less than 10%. Only a few values were above 20%, namely:

- September 2020 campaign: nickel (44% difference)
- May 2021 campaign: ammonia nitrogen (80% difference), SS (28% difference) and calcium (23% difference)
- July 2021 campaign: nitrates (138% difference) and nickel (36% difference)

These differences of more than 20% involve about 6% of the measurements taken. None of these differences affect measurements that exceeded the selected comparison criteria.

Field and trip blanks

Most field blank concentrations were below laboratory analysis detection limits. Only two measurements were above these detection limits, namely:

- September 2020 campaign: ammonia nitrogen (5 times above the 0.02 mg/L limit) and total dissolved solids (1.9 times above the 10 mg/L limit)

Three trip blanks showed concentrations above laboratory analysis detection limits.

- September 2020 campaign: ammonia nitrogen (13 times above the 0.02 mg/L limit) and total dissolved solids (1.3 times above the 10 mg/L limit)
- July 2021 campaign: barium (1.4 times above the 0.03 µg/L limit), cobalt (1.4 times above the 0.008 µg/L limit), iron (2 times above the 0.5 µg/L limit) and zinc (26 times above the 0.5 µg/L limit)

In September 2020, anomalies found in both the field and trip blanks for ammonia nitrogen and total dissolved solids suggest that analytical procedures were at fault.

The values detected in the blanks only pertain to a few parameters. They do not involve water quality criteria parameters that were exceeded. Quality control demonstrates that the reported analysis results were valid and can be confidently used.

5.3.7 Sediment quality

5.3.7.1 Methodology

Sediment characterization was carried out at the same sampling stations as for surface water, i.e., stations CE01 and CE02 (see Map 5-1), in a single sampling campaign conducted in July 2021.

The list of parameters analyzed for sediment is included in Table 5-5. For metals, the analysis was performed on the total extractable fraction. The detection limits for laboratory analysis were specified to be below the first quality criteria threshold used in contamination prevention, i.e., the rare effect concentration (Environment Canada and MDDEP, 2008).

Sampling was conducted in accordance with the recommendations stipulated in the *Guide de caractérisation physico-chimique et toxicologique des sédiments* (MDDELCC and ECCC, 2016). Sediments were collected using a small Eckman bucket. Sediment was collected from the center of the sample to avoid potential contamination from contact with the sides of the bucket.

Table 5-5: List of sediment analysis parameters

Total extractable metals and organic parameters		
Aluminum (Al)	Tin (Sn)	Sodium (Na)
Antimony (Sb)	Iron (Fe)	Strontium (Sr)
Silver (Ag)	Lithium (Li)	Thorium (Th)
Arsenic (As)	Magnesium (Mg)	Vanadium (V)
Barium (Ba)	Manganese (Mn)	Zinc (Zn)
Beryllium (Be)	Mercury (Hg)	Petroleum hydrocarbons
Boron (B)	Molybdenum (Mo)	pH
Cadmium (Cd)	Nickel (Ni)	Total organic carbon
Calcium (Ca)	Total phosphorus	Total sulphur (S)
Chromium (Cr)	Lead (Pb)	Particle size
Cobalt (Co)	Potassium (K)	Percentage of humidity
Copper (Cu)	Selenium (Se)	

5.3.7.2 Sediment quality criteria

Analysis results were compared to the sediment quality criteria for Québec (Environment Canada and MDDEP, 2008). These criteria are used to assess the extent of potential contamination and give direction for appropriate sediment management. Five baseline concentrations were established for several contaminants; four of these baseline concentrations were selected for comparison. Those concentrations are defined below.

- Rare effect concentration (REC): concentration below which no effect is anticipated. The observed concentrations are generally comparable to natural concentrations.
- Threshold effect concentration (TEC): when concentrations are at or below the TEC, the likelihood of the sediment having an impact on the environment is considered low.
- Occasional effect concentration (OEC): concentration at which adverse effects are expected in several benthic species.
- Probable effect concentration (PEC): concentration at which adverse effects are probable in several benthic species.

The rare effect concentration (REC) and threshold effect concentration (TEC) are the two benchmarks for contamination prevention.

5.3.7.3 Results

Table 5-6 presents the results obtained during the sediment sampling campaign. The chemical analysis and particle size certificates are included in Appendix C.

Overall, the sediments analyzed were of good quality. The pH was slightly acidic with values of 6.09 and 6.54. The sediments contained a small amount of organic matter. Low levels of petroleum hydrocarbons were measured at station CE01, located near the La Grande-3 road. Lastly, the values measured at station CE01 were often higher compared to those at station CE02.

For most metals, concentrations were below the REC (rare effect concentration) limit, except for chromium and arsenic. Chromium concentration was slightly higher than the REC at station CE02 and slightly higher than the TEC (threshold effect concentration) at station CE01. In contrast, the arsenic concentration was significantly elevated at station CE02, which is equivalent to the PEC (probable effect concentration). However, this high arsenic value was not observable at station CE01.

As for particle size, the analysis shows that the sediments at station CE02 are composed primarily of sand (55%), but at station CE01, where the water is more stagnant, they are composed of finer materials (silt and clay with a proportion of 73%; see Table 5-7).

Table 5-6: Sediment quality

Parameter	Unit	LD[a]	REC[b]	TEC[c]	OEC[d]	PEC[e]	Station CE01	Station CE02
Extractable metals								
Aluminum (Al)	mg/kg	20	N.A.	N.A.	N.A.	N.A.	8,600	5,400
Antimony (Sb)	mg/kg	2	N.A.	N.A.	N.A.	N.A.	10	6.4
Silver (Ag)	mg/kg	2	N.A.	N.A.	N.A.	N.A.	<2	<2
Arsenic (As)	mg/kg	2	4.1	5.9	7.6	17	3	17[e]
Barium (Ba)	mg/kg	5	N.A.	N.A.	N.A.	N.A.	69	32
Beryllium (Be)	mg/kg	0.5	N.A.	N.A.	N.A.	N.A.	<0.5	<0.5
Boron (B)	mg/kg	5	N.A.	N.A.	N.A.	N.A.	<5	<5
Cadmium (Cd)	mg/kg	0.1	0.33	0.6	1.7	3.5	0.17	<0.1
Calcium (Ca)	mg/kg	30	N.A.	N.A.	N.A.	N.A.	3,800	3,100
Chromium (Cr)	mg/kg	2	25	37	57	90	41[c]	26[b]
Copper (Cu)	mg/kg	1	22	36	63	200	17	9.7
Cobalt (Co)	mg/kg	2	N.A.	N.A.	N.A.	N.A.	6.7	6.4
Tin (Sn)	mg/kg	5	N.A.	N.A.	N.A.	N.A.	<5	<5
Iron (Fe)	mg/kg	10	N.A.	N.A.	N.A.	N.A.	17,000	13,000
Lithium (Li)	mg/kg	10	N.A.	N.A.	N.A.	N.A.	19	13
Magnesium (Mg)	mg/kg	10	N.A.	N.A.	N.A.	N.A.	4,900	3,400
Manganese (Mn)	mg/kg	2	N.A.	N.A.	N.A.	N.A.	650	130
Molybdenum (Mo)	mg/kg	2	N.A.	N.A.	N.A.	N.A.	<2	<2
Nickel (Ni)	mg/kg	1	N.A.	N.A.	N.A.	N.A.	16	13
Mercury (Hg)	mg/kg	0.05	0.094	0.17	0.25	0.49	0.075	<0.05
Potassium (K)	mg/kg	50	N.A.	N.A.	N.A.	N.A.	810	1000
Lead (Pb)	mg/kg	5	25	35	52	91	11	5.3
Selenium (Se)	mg/kg	1	N.A.	N.A.	N.A.	N.A.	<1	<1
Sodium (Na)	mg/kg	10	N.A.	N.A.	N.A.	N.A.	140	180
Strontium (Sr)	mg/kg	10	N.A.	N.A.	N.A.	N.A.	15	15
Thorium (Th)	mg/kg	5	N.A.	N.A.	N.A.	N.A.	<5	5.9
Vanadium (V)	mg/kg	5	N.A.	N.A.	N.A.	N.A.	27	22
Zinc (Zn)	mg/kg	5	80	120	170	310	42	31

Table 5-6: Sediment quality (*cont.)*

Parameter	Unit	LD[a]	REC[b]	TEC[c]	OEC[d]	PEC[e]	Station CE01	Station CE02
Other								
Total organic carbon (titration)	% (g/g)	0.1	N.A.	N.A.	N.A.	N.A.	6	4.9
Petroleum hydrocarbons (C_{10}-C_{50})	mg/kg	100	N.A.	N.A.	N.A.	N.A.	290	<100
pH	pH	N.A.	N.A.	N.A.	N.A.	N.A.	6.09	6.54
Total phosphorus	mg/kg	20	N.A.	N.A.	N.A.	N.A.	450	310
Sulphur (S)	mg/kg	100	N.A.	N.A.	N.A.	N.A.	1,200	290
Moisture	%	N.A.	N.A.	N.A.	N.A.	N.A.	66	72

N.A.: Not applicable

a. DL: detection limit
b. REC: rare effect concentration
c. TEC: threshold effect concentration
d. OEC: occasional effect concentration
e. PEC: probable effect concentration

Source: EC and MDDEP, 2008.

Table 5-7: Sediment particle size

Parameter	Unit	Station CE01	Station CE02
Gravel (>2 mm)	%	<0.1	15
Sand (0.06–2 mm)	%	27	55
Silt (0.004–0.06 mm)	%	43	20
Clay (<0.004 mm)	%	30	10

5.4 Biological environment

5.4.1 Vegetation

The study area belongs to the black spruce-moss bioclimatic domain (MFFP, 2019). The landscape in this domain is rather monotonous due to the low variability in relief and predominance of black spruce *(Picea mariana*), whether on dry, mesic or wet soils. In the black spruce-lichen domain, few tree species are observed and most are not abundant, except for black spruce and jack pine *(Pinus banksiana*). According to Open Forest mapping data (MFFP, n.d.), no forest fires have occurred in the study area.

Typical black spruce-lichen is an open forest. The forest floor features small shrubs such as blueberry *(Vaccinium* sp.), Labrador tea *(Rhododendron groenlandicum*), kalmia *(Kalmia* sp.) and dwarf birch *(Betula glandulosa*). However, the characteristic feature of the black spruce-lichen forest is complete ground cover with several species of caribou lichens *(Cladonia mitis*, *C. rangiferina*, *C. stellaris*; Gagnon, 2004).

According to information from the ecoforestry map of northern Québec (MFFP, 2018), maps of potential wetlands in Québec (MELCC, 2020*a*), and the photointerpretation conducted within the framework of this assessment, the main plant groups in this study area, with a total area of 1,085.8 ha, consist of 484.2 ha (44.6%) of open coniferous forest with moss, 286.5 ha (26.4%) of open coniferous forest with lichen and moss, 75.8 ha (7.0%) of open coniferous forest with shrubs and 61.6 ha (5.7%) of open coniferous forest with lichen. Wetlands and water bodies (lakes and rivers) occupy 68.9 ha (6.3%) and 8.6 ha (0.8%) of the study area respectively. It should be noted, however, that the consulted databases do not take into consideration any wetlands less than 4 ha in size. Thus, small area wetlands are not included in these values. This level of detail can only be achieved by conducting field inventories, which was done in the inventory area. Lastly, anthropogenic environments, consisting of the power line rights-of-way and the La Grande-3 road, represent a total area of 100.2 ha (9.2%). It should also be noted that disturbances related to drilling activities were observed at the quarry site when it was visited. These disturbances consisted primarily of a few cut trees and ground rutting. Despite these disturbances, the site remains natural (revegetation, debris left on the ground providing shelter for wildlife, etc.), and therefore these disturbances were not considered in the total anthropogenic environment area. Tables 5-8 and 5-9 present the surface areas for these environments as well as their proportion in the study area and biophysical environment inventory area.

Table 5-8: Types of environment in the study area, surface areas and proportions

Type of environment	Surface area (ha)	Proportion (%)
Open coniferous forest with moss	484.2	44.6
Open coniferous forest with lichen and moss	286.5	26.4
Open coniferous forest with shrubs	75.8	7.0
Open coniferous forest with lichen	61.6	5.7
Wetland	68.9	6.3
Body of water	8.6	0.8
Anthropogenic environment	100.2	9.2
Total	**1,085.8**	**100.0**

Table 5-9: Types of environment in the biophysical environment inventory area; surface areas and proportions

Type of environment	Surface area (ha)	Proportion (%)
Anthropogenic environment (road)	0.1	0.2
Open coniferous forest with moss	28.4	77.8
Open coniferous forest with shrubs	3.9	10.7
Wetland	4.1	11.3
Total	**36.5**	**100.0**

5.4.1.1 Wetlands

Wetlands in the study area were identified using the map of potential wetlands in Québec (MELCC, 2020*a*) and the *Ecological mapping of the vegetation of northern Québec* (MFFP, 2018). A photointerpretation analysis of 2018 and 2019 orthophotographs, with resolutions of 0.46 m and 0.50 m per pixel, respectively, completed the overview of wetlands in the study area. A photointerpretation of a mosaic of orthophotographs from a drone survey was then performed for the inventory area, at the same time as the site characterization. It should be noted that at these latitudes, it is difficult to use photointerpretation alone to distinguish between forested wetlands and terrestrial environments. Field validation is required. Therefore, a characterization was conducted on the biophysical environment inventory area in July 2021.

The total area of wetlands in the extended study area is 68.9 ha, or 6.3% of the area. Three classes of wetlands were identified as a result of the analysis and site visit: bog (66.7 ha), swamp (1.7 ha) and marsh (0.5 ha). Table 5-10 presents the breakdown of categories of wetlands and details of the types of swamps and bogs encountered in the study area.

Table 5-10: Categories of wetlands in the study area, surface areas and proportions

Category of wetland	Surface area (ha)	Proportion (%)
Marsh	0.5	<0.1
Swamps	1.7	0.2
Treed swamp	*0.8*	*<0.1*
Shrub swamp	*0.9*	*0.1*
Peat bog	66.7	6.1
Treed bog	*34.6*	*3.2*
Open bog	*20.4*	*1.9*
Open fen	*11.7*	*1.1*
Total	**68.9**	**6.3**

5.4.1.1.1 Wetland characterization

The study area is located outside the area covered in the guide entitled, *Identification et délimitation des milieux humides du Québec méridional*[1] [Identification and delineation of wetlands in southern Québec], which outlines the method for characterizing wetlands located south of the 49th parallel. To meet the requirements of the present quarry project, a method better adapted to species from more northern environments was developed, primarily pertaining to the water status of certain species that are dominant at these latitudes, but that are not linked to the wet nature of a site (e.g., black spruce). The MELCC, in correspondence addressed to Hydro-Québec (see Appendix D), sent a list of revised water statuses for species spread out north of the 49th parallel, and gave approval for its use. This list will be used in new methodology under development that will be used to characterize wetlands and water bodies in northern conditions. It was used to characterize wetlands for this project. New species statuses, taken from the MELCC list, are indicated in the wetland characterization sheets (see Appendix E).

An area of 4.1 ha of wetland was mapped and characterized on the field within the biophysical environment inventory area (see Table 5-11). Just as in the study area, bogs are the most abundant (2.2 ha) of the three types of wetland in the inventory area, followed by shrub swamps (0.9 ha), tree swamps (0.8 ha), and finally marshes (0.2 ha). Seven wetlands were characterized, two of which are complexes composed of different wetland classes (MH01 and MH07, see Map 5-2). Table 5-12 details the wetlands that were characterized and associated characterization stations; information is also found on maps 5-1 and 5-2 and Map A, in the pocket.

Table 5-11: Types of wetland in the biophysical environment inventory area; surface areas and proportions

Type of wetland	Surface area (ha)	Proportion (%)
Marsh	0.2	0.4
Swamps	1.7	4.7
Treed swamp	*0.8*	*2.3*
Shrub swamp	*0.9*	*2.4*
Peat bog	2.2	6.1
Treed bog	*0.8*	*2.2*
Open bog	*1.3*	*3.7*
Open fen	*0.1*	*0.3*
Total	**4.1**	**11.3**

1. BAZOGE, A., D. LACHANCE and C. VILLENEUVE. 2015. *Identification et délimitation des milieux humides du Québec méridional*. Québec, ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques. 64 p. et ann.2. ROBERT, M. M.-H. HACHEY, D. LEPAGE and A. R. COUTURIER (dir.) 2019. *Second Atlas of Breeding Birds of Southern Québec*. Montréal, Regroupement QuébecOiseaux, Canadian Wildlife Service and Bird Studies Canada, 694 pages.3. BP: before present, which is a dating indication based on the number of years elapsed from a constant reference point set by convention at 1950 A.D.

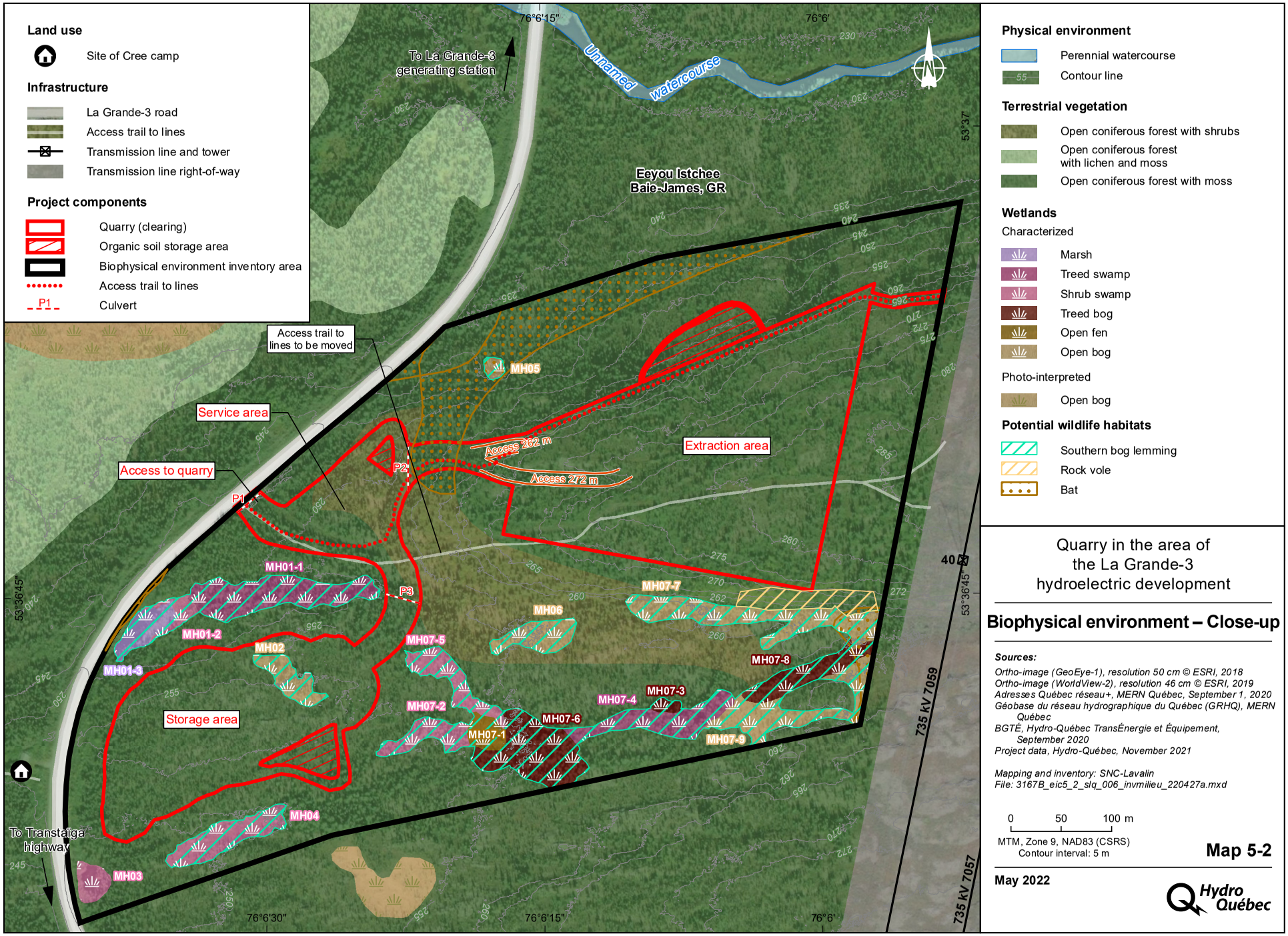


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Table 5-12: Wetlands characterized in the biophysical environment inventory area

Complex	Wetland	Type of wetland	Characterization station	Area (m^2) of wetland	Area (m^2) of the complex
MH01	MH01-1	Treed swamp	ST01 and ST30	5,113	7,449
	MH01-2	Shrub swamp	ST02	697	
	MH01-3	Marsh	ST05	1,639	
	MH02	Open bog	ST10	1,631	
	MH03	Shrub swamp	ST33	1,074	
	MH04	Shrub swamp	ST32	2,912	
	MH05	Open bog	ST29	368	
	MH06	Open bog	ST28	1,883	
MH07	MH07-1	Open fen	ST07	1,094	25,799
	MH07-2	Shrub swamp	ST12	1,813	
	MH07-3	Treed bog	ST08	334	
	MH07-4	Treed swamp	ST15	3,256	
	MH07-5	Shrub swamp	ST13	2,203	
	MH07-6	Treed bog	ST14	5,005	
	MH07-7	Open bog	ST19	5,498	
	MH07-8	Treed bog	ST18	2,515	
	MH07-9	Open bog	ST09 and ST17	4,081	

As illustrated on Map 5-2, nearly all of the observed wetlands are located in the southern half of the inventory area, in depressions surrounded by rocky plateaus. Only one wetland (MH05) was identified in the northern portion of the inventory area, where the topography consists of a rather steep and continuous slope. This wetland is located at the bottom of the slope, near the edge of the inventory area.

Most of the mapped and characterized wetlands correspond to open and treed bogs (nine stations). The main tree species observed are black spruce, tamarack *(Larix laricina*) and jack pine, while shrub species include Labrador tea, leatherleaf *(Chamaedaphne calyculata*), speckled alder *(Alnus incana* ssp. *rugosa*), dwarf birch *(Betula pumila*), and blueberry *(Vaccinium angustifolium; V. myrtilloïdes*). Herbaceous species are not very abundant or diversified due to the dominant shrub layer. Also of note are the following species: three-fruited sedge *(Carex trisperma*), Magellan's sedge *(Carex magellanica*), cloud berry *(Rubus chamaemorus*), sphagnum moss *(Sphagnum* sp.*),* moss (Moss sp.) and lichen (Lichen sp.). The thickness of organic matter measured varies from 35 cm to over 100 cm. Drainage is rated as poor and the main hydrological indicator observed is water saturation in the first 30 centimetres.

The observed open fen (MH07-1; ST07) does not have any tree species. Shrub species are quite diversified, and include sweet gale *(Myrica gale*), dwarf birch, tamarack, black spruce, shrubby cinquefoil *(Dasiphora fruticosa*), common cranberry *(Vaccinium oxycoccos*), and bog laurel *(Kalmia polifolia*). Herbaceous species are also more prominent than in ombrotrophic bogs (number and cover), most particularly alpine bulrush *(Tricophorum alpinum*), rough cottongrass*(Eriophorum tenellum*), three-leaved Solomon's seal *(Maianthemum trifolium*), bog goldenrod *(Solidago uliginosa*), and sphagnum moss. Drainage is described as very poor, and a thickness of 60 cm of organic matter was measured. The soil is saturated with water and ponds are present on the surface.

Whether arboreal or shrubby (eight stations), the swamps characterized were quite similar in terms of species observed. Those species were, primarily: black spruce, tamarack, and jack pine in the tree layer, and speckled alder, Labrador tea, blueberry, slender willow *(Salix petiolaris*), dwarf birch, and leatherleaf in the shrub layer. Herbaceous species are sparse, however three-leaved Solomon's seal, cloud berry, horsetail *(Equisetum sylvaticum; E. pratense*), bunchberry *(Cornus canadensis*) and loose-flowered alpine sedge *(Carex rariflora*) were noted. Mosses and sphagnum mosses are also generally abundant. Drainage varies from imperfect to very poor, while the soil is generally silt loam or silty clay in texture. Hydrological indicators are variable depending on the environment, with the most commonly observed being soil saturated with water and a shallow root system. It should also be noted that wetland MH03 (ST33) corresponds to a riparian shrub swamp surrounding a portion of more or less stagnant water located along the La Grande-3 road.

Only one marsh was observed and characterized in the inventory area. This is wetland MH01-3 (ST05), which is adjacent to a small body of water. Like shrub swamp MH03, this environment is affected by surface runoff and the La Grande-3 road ditch. There are primarily a few speckled alder and leatherleaf in the surroundings. Herbaceous species include three-leaved Solomon's seal, sedges *(Carex magellanica; C. canescens* ssp. *canescens; C. brunnescens* ssp. *brunnescens; C. trisprema*), tussock cottongrass *(Eriophorum vaginatum*), small bur-reed *(Sparganium natans*), and a significant cover of sphagnum moss. Drainage is very poor and the soil is a clay loam.

5.4.1.1.2 Characterization of terrestrial environments

The inventory area has a rather irregular topography. Numerous rocky headlands (sparsely vegetated) are found in the southern half of the inventory area, while the center features an elevated crest. The northern half is located on a hillside with a steep slope. Characterization stations were installed to document these areas (see Appendix E). It appears that leatherleaf remains ubiquitous in the surface rock outcrop areas (<20 cm), as well as other areas with soils generally composed of loam, sand and gravel, and in areas where drainage varies from good to imperfect. Indeed, this species, with a water status maintained at "obligate wetland species" on the revised northern status list (north of the 49th parallel) sent by the MELCC, was observed in both wetland and terrestrial environments. Based on field observations (soil type, drainage class,

dominant species not indicative of wetlands, lack of hydrological indicator and hydromorphic soil, steep slope with rocky outcrops on the surface, etc.), some sectors of the inventory area were considered terrestrial despite the abundance of leatherleaf.

5.4.1.2 Aquatic environments

As mentioned in Section 5.3.5, the aquatic environment of the study area includes an unnamed stream that flows westward into Robert-Bourassa reservoir, located on the northwestern edge, as well as two small lakes located northeast and southeast of the study area. A network of permanent and indeterminate streams drain the study area primarily northward to the unnamed stream and westward to Kachinukamach bay (Robert-Bourassa reservoir; see Map A, in pocket).

A reconnaissance visit in September 2020 showed that the river system was almost non-existent in the biophysical environment inventory area. Surface runoff and ditch water along the La Grande-3 road were found in two wetlands, namely riparian marsh MH01-3 and riparian shrub swamp MH03; the respective runoffs use culverts to run beneath the La Grande-3 road toward Robert-Bourassa reservoir. No streams were observed. Surface runoff is occasionally visible, but never in a distinct channel; it can mostly be attributed to natural runoff generated by the sometimes steep and uneven topography in the area.

5.4.1.3 Ecological functions of wetlands and aquatic environments

Wetlands have various ecological functions. According to the *Act to affirm the collective nature of water resources and to promote better governance of water and associated environments*, wetlands and aquatic environments have six major ecological functions:

"(1) acting as a pollution filter, controlling erosion and retaining sediments by, among other things, preventing and reducing surface water and groundwater pollution and sediment input;

(2) acting as a regulator of water levels by retaining meteoric water and meltwater and allowing part of it to evaporate, thereby reducing the risk of flooding and erosion and promoting groundwater recharge;

(3) conserving the biological diversity that enables the environments and ecosystems to provide living species with habitat in which to feed, find cover and reproduce;

(4) acting as a sun screen and natural wind-shield by maintaining vegetation, which prevents excessive warming of water and protects soils and crops from wind damage;

(5) sequestering carbon and mitigating the impacts of climate change; and

(6) protecting the quality of the landscape by preserving the natural character of a site and the attributes of the countryside associated with it, thus enhancing the value of adjacent land."

Depending on their classes and characteristics, the characterized wetlands perform some ecological functions more than others. Most of the wetlands characterized are peatlands; their primary ecological functions are water filtration, water level regulation and conservation of biological diversity. Peatlands are also known for sequestering carbon. Treed bogs can also act as natural sunscreens and windbreaks. Swamps filter water, regulate water levels and help conserve biological diversity. The shrub and tree layers act as natural sunscreens and windbreaks. Lastly, the primary ecological functions of swamps are to filter water, regulate water levels and help conserve biological diversity.

5.4.1.4 Special-status plant species

A request for information was submitted to the Centre de données sur le patrimoine naturel du Québec (CDPNQ) to verify the presence of any plant species that are threatened, vulnerable or likely to be so designated (PSTVL) in the study area. An analysis of the habitat potential for PSTVL was also conducted using *Les plantes vasculaires en situation précaire au Québec* (Tardif et al., 2016), as well as volumes 1, 2 and 3 of *La Flore nordique du Québec et du Labrador* (Payette et al., 2013, 2015 and 2018).

According to data from the CDPNQ, there are no known occurrences of PSTVL in the study area. However, the analysis of the habitat potential for vascular species showed that the area may have habitat potential for four other special-status plant species. Table 5-13 lists these species along with a description of their preferred habitats.

Table 5-13: Special-status plant species potentially present in the study area

Species		Species status in Québec [a]	Habitat [a]	Best observation period
Common name	Scientific name			
Ojibway waterwort	*Elatine ojibwayensis*	Species likely to be designated threatened or vulnerable	Palustrine environments (sandy shores, marshes); present in sunny places only, on wet substrate, no pH affinity.	Summer
Northern twayblade	*Neottia borealis*	Species likely to be designated threatened or vulnerable	Palustrine environments (bogs and treed bogs); prefers sunny locations, but tolerates shade, on moist, acidic substrate.	Late spring-early summer
Siberian polypody	*Polypodium sibiricum*	Species likely to be designated threatened or vulnerable	Terrestrial environments (rocky outcrops and cliffs), found in sunny locations only, on dry substrate, no pH affinity.	Summer
McCall willow	*Salix maccalliana*	Species likely to be designated threatened or vulnerable	Palustrine environments (rocky and gravelly shores, swamps, treed bogs, treed fens); prefers sunny locations but tolerates shade, on moist substrate, no pH affinity.	Summer

a. Tardif et al., 2016.

The inventory conducted in 2021 in the habitats described in Table 5-13 found that these species were not present in the biophysical environment inventory area.

5.4.1.5 Non-native invasive plant species

The MELCC SENTINEL tool (2020*b*) was consulted and no non-native invasive plant species (NNIS) are listed in the study area. Special attention was paid during a site visit in July 2021. No NNIS were identified in the inventory area.

5.4.2 Wildlife

5.4.2.1 Terrestrial mammals

No specific field inventories were conducted to validate the presence or abundance of terrestrial mammal species. For all species except caribou, the information presented is derived solely from general literature (Desrosiers et al. 2002; Feldhamer et al. 2003; Naughton 2012), hunting and trapping statistics (MFFP 2021*a*), and incidental field observations during biological environment inventories. For caribou, the information presented is derived from an aerial survey of woodland caribou conducted in the La Grande area (Szor and Gingras, 2020), telemetry data of migratory caribou wearing MFFP radio collars, analyses of woodland caribou habitat quality, and scientific literature (Couturier et al., 2010; Taillon et al. 2016).

Thirty-nine (39) species of terrestrial mammals potentially frequent the study area (see Table 5-14). Of those, five are special-status species: the least weasel, the rock vole, the southern bog lemming, the wolverine and the forest-dwelling woodland caribou. However, CDPNQ does not report any of these species in or near the study area (MFFP, 2020*a*). The migratory woodland caribou (Leaf River Herd) is also a species of special interest because of its importance to the Crees and the decline of migratory caribou populations in northern Québec in recent years.

All species presented in Table 5-14 are also likely to use habitats in the biophysical environment inventory area. Terrestrial species are likely to frequent the bogs and open coniferous forests, while aquatic and semi-aquatic species (Canadian beaver, river otter, American mink and muskrat) could potentially use riparian marsh MH01-3 and riparian shrub swamp MH03. Red fox tracks, snowshoe hare droppings and red squirrel calls were noted in the biophysical environment inventory area during the biological environment inventories.

Table 5-14: Land mammal species likely to frequent the study area

Species		Species status in Québec [a]	Species status in Canada [b]
Common name	**Scientific name**		
Least weasel	*Mustela nivalis*	Species likely to be designated threatened or vulnerable	–
Muskox	*Ovibos moschatus*	–	–
Southern red-backed vole	*Myodes gapperi*	–	–
Meadow vole	*Microtus pennsylvanicus*	–	–
Rock vole	*Microtus chrotorrhinus*	Species likely to be designated threatened or vulnerable	
Northern bog lemming	*Synaptomys borealis*	–	–
Southern bog lemming	*Synaptomys cooperi*	Species likely to be designated threatened or vulnerable	–
Wolverine	*Gulo gulo*	Threatened	At risk
Forest-dwelling woodland caribou	*Rangifer tarandus caribou*	Vulnerable	Threatened (boreal population)
Migratory woodland caribou	*Rangifer tarandus caribou*	–	None at present, but the eastern migratory population is under consideration for addition to Schedule 1
Canadian beaver	*Castor canadensis*	–	–
Star-nosed mole	*Condylura cristata*	–	–
Coyote	*Canis latrans*	–	–
Red squirrel	*Tamiasciurus hudsonicus*	–	–
Northern flying squirrel	*Glaucomys sabrinus*	–	–
Northern short-tailed shrew	*Blarina brevicauda*	–	–
Ermine	*Mustela erminea*	–	–
Ungava lemming	*Dicrostonyx hudsonius*	–	–
Arctic hare	*Lepus arcticus*	–	–
Snowshoe hare	*Lepus americanus*	–	–
Gray wolf	*Canis lupus*	–	–
River otter	*Lontra canadensis*	–	–
Canada lynx	*Lynx canadensis*	–	–
Woodchuck	*Marmota monax*	–	–
American marten	*Martes Americana*	–	–

Table 5-14: Terrestrial mammal species likely to frequent the extended study area (*cont.*)

Species		Species status in Québec [a]	Species status in Canada [b]
Common name	**Scientific name**		
Arctic shrew	*Sorex arcticus*	–	–
Masked shrew	*Sorex cinereus*	–	–
American water shrew	*Sorex palustris*	–	–
Pygmy shrew	*Sorex hoyi*	–	–
Moose	*Alces alces*	–	–
Black bear	*Ursus americanus*	–	–
Fisher	*Martes pennanti*	–	–
Heather vole	*Phenacomys ungava*	–	–
American porcupine	*Erethizon dorsatum*	–	–
Muskrat	*Ondatra zibethicus*	–	–
Arctic fox	*Vulpes lagopus*	–	–
Red fox	*Vulpes vulpes*	–	–
Meadow jumping mouse	*Zapus hudsonius*	–	–
Deer mouse	*Peromyscus maniculatus*	–	–
American mink	*Neovison vison*	–	–

a. Designation under sections 1 and 2 of the *Regulation respecting threatened or vulnerable wildlife species and their habitats* (chapter E-12.01, r. 2).

b. Designation under the *Species at Risk Act.*

Sources: Desrosiers et al., 2002; Feldhamer et al., 2003; MFFP, 2021*a*; Naughton, 2012.

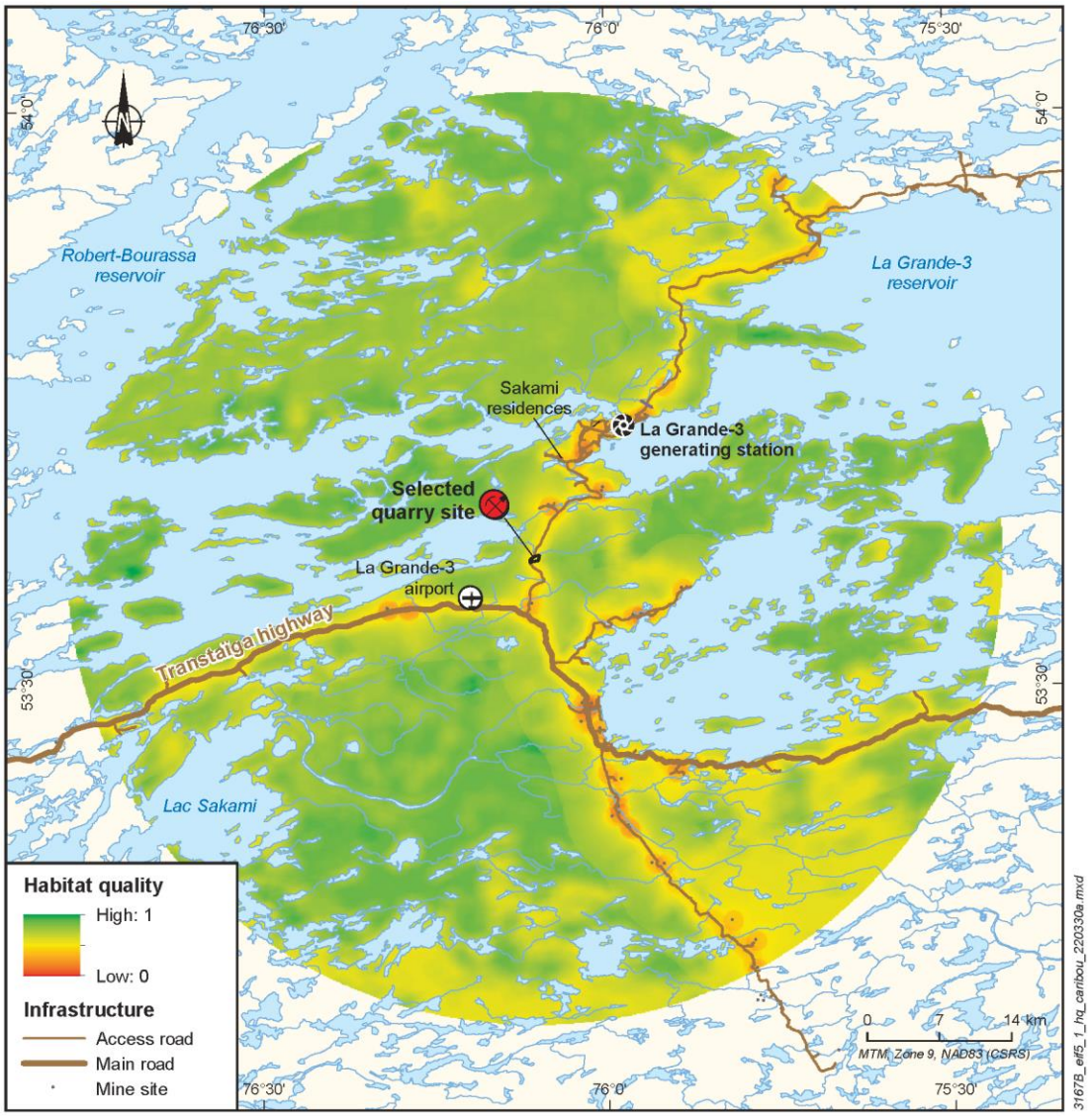
Forest-dwelling woodland caribou

Woodland caribou has been listed as threatened in Canada under the *Species at Risk Act* since June 2003 and designated as vulnerable in Québec since February 2005 under the *Act respecting threatened or vulnerable species* (Order-in-council 75, 2005).

Data from the winter 2020 inventory show that a group of seven woodland caribou was spotted south of La Grande-3 reservoir, about 30 km from the site selected for the quarry (Szor and Gingras, 2020). More generally, the quarry site is located in the western sector of the inventory area, where the observed densities are very low (0.17 caribou per 100 km^2), compared to the eastern sector (1.42 caribou per 100 km^2). Lastly, the proposed quarry site is located in an area where habitats are considered to be of high quality.

Hydro-Québec produced a finer scale analysis of woodland caribou habitat quality (see Figure 5-1), following the method outlined by Leblond et al. (2014), but adapting the *Ecological mapping of the vegetation of northern Québec* (MFFP, 2018*b*), including the AQRéseau+ road network (MERN, 2020*a*) and mining sites (MERN, 2020*b*). The methodology used in this analysis is set out in Appendix F. This analysis shows the existence of quality habitat within a 50-km radius of the proposed quarry, but also indicates that habitat quality varies greatly and that, as expected, habitat quality is strongly affected by the presence of anthropogenic infrastructure (in the Leblond et al. [2014] model, roads and mines).

Figure 5-1: Analysis of woodland caribou habitat quality



Source: Hydro-Québec, based on Leblond et al. (2014).

Barren-ground caribou

Migratory caribou frequenting the vicinity of the study area likely belong to the Leaf River Herd (Taillon et al., 2016). This herd currently has no legal protection status in Québec. Federally, the eastern migratory population to which this caribou belongs was designated as endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 2017 and is being reviewed for addition to Schedule 1 of the *Species at Risk Act*. Inventory data obtained in November 2018 indicate that the Leaf River Herd's population is still in decline (Cision, 2018).

The study area is located in the southern portion of this herd's distribution range, which is primarily its wintering ground, frequented between the months of December and April (Taillon et al., 2016). However, the distribution range fluctuates with population size (Couturier et al., 2010), so the likelihood of frequenting the study area would decrease as the herd declines.

In winter, migratory caribou frequent forests rich in terricolous and tree lichen (Messier and Huot, 1985, in Taillon et al., 2016). Within a 1-10 km radius of the proposed quarry, based on a compilation of data from the *Ecological mapping of the vegetation of northern Québec* (MFFP, 2018*b*), the proportion of forests with more than 40% understory lichen cover ranges from 26 to 35%. Telemetry data obtained from the MFFP show historical use of the proposed quarry area by migratory caribou, which has persisted in the recent period (since 2016).

Least weasel

The least weasel, a little-known predator, is a species likely to be designated threatened or vulnerable in Québec. There are few references to this weasel in Québec, and it is considered rare in Canada. This carnivore feeds primarily on micromammals (Feldhamer et al., 2003). The species determines its habitat based on the local distribution of its prey, changing location over time depending on the relative abundance of different micromammal species and their respective preferred habitats. Its presence is still possible in the study area, based on micromammal-friendly habitats, but should be considered undetermined due to the lack of data on its regional distribution.

Rock vole

According to Duhamel and Tremblay (2013), the currently recognized range of the rock vole is not representative of the actual range, as it is probably more a result of a lack of data than an actual absence of the rock vole at higher latitudes. The authors thus suggest, based on a reliable record from the CDPNQ, that the actual range reaches at least to Caniapiscau River. If that were the case, this vole would likely be found in suitable habitats in the study area. However, the rock vole prefers rocky environments adjacent to water sources (Desrosiers et al., 2002). The species is generally found at the

feet of cliffs, on rock outcrops, and on rocky, damp slopes (Duhamel and Tremblay, 2013). The 2021 herpetofauna inventory field visit confirmed the presence of a potential habitat, namely a rock outcrop located southeast of the biophysical environment inventory area (see Map 5-2).

Southern bog lemming

The most northerly record of the southern bog lemming currently known is Lake Boyd (Fortin et al., 2004). It is therefore likely that the actual distribution of this vole overlaps the study area. The southern bog lemming likes grassy wetlands such as marshes, swamps and bogs (Getz, 1961; Linzey, 1984; Krupa and Haskins, 1996). However, it is often forced to use suboptimal habitats, particularly shrubby environments (e.g., riparian scrubland; Fortin et al., 2004), which are excluded from its preferred habitats by the field vole, which is dominant there (Linzey, 1984). The 2021 herpetofauna inventory field visit confirmed the presence of several potential habitats (see Map 5-2).

Wolverine

Wolverine are very rare or possibly extinct in Québec (COSEWIC, 2014*a*). This species is designated threatened in Québec and of special concern in Canada. Considering the scope of their home ranges and movements, as well as their presumed very low numbers, the presence of wolverines in the study area would be coincidental and of very short duration, if at all.

5.4.2.2 Bats

The study area overlaps the distribution range of six of the eight species of bats found in Québec (Jutras et al., 2012; EnviroCree, 2018; Équipe de rétablissement des chauves-souris du Québec [Bat Recovery Team of Québec], 2019; see Table 5-15). The northern boundary of the small-footed bat *(Myotis leibii)* and eastern pipistrelle *(Perimyotis subflavus*) distribution range is located farther south, in the Laurentides and Outaouais regions. According to Jutras et al. (2012), the northern boundary of the big brown bat distribution range would also be farther south in the Abitibi-Témiscamingue and Mauricie regions. However, a recent acoustic inventory conducted by EnviroCree (2018) and analyzed by WavX Solutions identified the presence of this species in the southern part of the Nord-du-Québec region.

Table 5-15: Bat species likely to frequent the study area

Species		Species status in Québec [a]	Species status in Canada [b]
Common name	Scientific name		
Big brown bat	*Eptesicus fuscus*	–	–
Silver-haired bat	*Lasionycteris noctivagans*	Species likely to be designated threatened or vulnerable	–
Red bat	*Lasiurus borealis*	Species likely to be designated threatened or vulnerable	–
Hoary bat	*Lasiurus cinereus*	Species likely to be designated threatened or vulnerable	–
Little brown bat	*Myotis lucifugus*	–	Endangered
Northern long-eared bat	*Myotis septentrionalis*	–	Endangered

a. Designation under the *Act respecting threatened or vulnerable species.*
b. Designation under the *Species at Risk Act.*

Sources: According to Jutras et al., 2012, and Équipe de rétablissement des chauves-souris du Québec, 2019.

This acoustic inventory conducted in 2018 as part of a forest access road expansion project (EnviroCree, 2018) confirmed the presence of five species in the Nord-du-Québec region, namely the big brown bat, silver-haired bat, red bat, hoary bat and little brown bat. Although the northern long-eared bat was not detected during this inventory, its presence cannot be excluded in this region of Québec since it is located in its known (Jutras et al., 2012) and potential (Équipe de rétablissement des chauves-souris du Québec, 2019) distribution range. Furthermore, this species has been recorded with little brown bats as far north as the 54th parallel in 2013, in the Labrador region (Broders et al., 2013).

Bats are species that can be considered generalists in terms of their diverse resting habitat and foraging needs (Jones et al., 2009). During the breeding season, bats feed mostly on nocturnal insects within 10 km of their daytime roosting habitats (Fabianek, 2015). Potential habitats used during this period must allow them to satisfy their roosting, maternal, watering, feeding and movement needs along functional dispersal corridors.

Habitats of particular interest to the six species of bats potentially present in the study area are characterized by riparian, mature, and old-growth forest (Grindal et al., 1999; Hogberg et al., 2002; Ford et al., 2005), as well as wetlands and water bodies (Kurta 2001; Seibold et al., 2013). These potential habitats were validated in the field in June 2021 when acoustic recording stations were installed in the study area. Wooded or shrubby edges and waterways can also serve as dispersal corridors between different potential habitats. Preferred foraging habitats are generally located along forest trails,

in wooded or riparian edges (Grindal and Brigham 1999; Ford et al., 2005), along the edges of watering holes and wetlands (Grindal et al., 1999; Hogberg et al., 2002; Fabianek et al., 2011), and along streams (McCain 2007; Seibold et al., 2013). Bats also use quiet waterholes and streams to drink in the dark (Kurta, 2001).

With the exception of the big brown bat, all the bat species likely to frequent the study area have a special provincial or federal status (see Table 5-15). CDPNQ (2021) has not reported any bat species with a special status in Québec within the study area.

The hoary bat and red bat primarily use tree and shrub foliage for their daytime roosting or as a maternity roost for breeding females (Tremblay and Jutras, 2010). Those species are said to be arboreal. Little brown bats, northern long-eared bats and silver-haired bats shelter under tree bark, in cavities in mature and standing dead trees, and in shelters beneath rocks (Lacki et al., 2007). These species are said to be cavity-using species. Potential roosting and maternity habitats for these species are more likely to be located within 2 km of a watering hole, within mature and old-growth forest with a significant proportion of standing dead trees and trees with cavities with diameter at breast height (DBH) greater than 30 cm in southern Québec (Fabianek, 2015). Given the prepond-erance of low DBH black spruce at this latitude, it is possible that the trees bats use as roosting habitats in the study area have a DBH of less than 30 cm. Buildings and shelters in rock cracks appear to be used more at such northerly latitudes (Park and Broders, 2012; Broders et al., 2013) by species with more arboreal behvaior in southern Québec and Canada (Fabianek 2015; Équipe de rétablissement des chauves-souris du Québec, 2019).

5.4.2.2.1 2021 field inventories

Acoustic inventory is an approach that provides a quick and representative picture of the species present in a given habitat over a defined period of time (Brigham et al., 2004). However, this approach does not allow the number, gender, or reproductive status of individuals recorded to be determined (Brigham et al., 2004).

Description of the acoustic inventory

The presence and nocturnal activity of bats were documented through an acoustic inventory using fixed stations during the bat breeding season (MRNF, 2008), i.e. between June 19 and July 18, 2021. Two SM4BAT (Wildlife Acoustics) ultrasonic sensors, installed at individual fixed stations (see Map 5-1), recorded the full spectrum of bat signals (WAV audio format). Each sensor was equipped with a hemi-directional microphone connected to a 3-m cable and positioned about 2 m from the ground. The two fixed stations were placed in the most attractive bat habitats within the study area, i.e., along a stream and an open wetland, to maximize the chances of detecting the species present (Grindal and Brigham 1999; Grindal et al., 1999; Ford et al., 2005; Fabianek et al., 2011).

The detectors were programmed to record bat signals throughout the night, from sunset to sunrise, in an effort to cover variations in nighttime activity and thus maximize the chances of detecting all bats (Kunz et al., 2007). The sample consisted of approximately five hours of recording each night, for a total of 150 hours of recordings at each fixed station, over 30 nights of inventorying. The recordings selected for analysis were all made under optimal nighttime temperature conditions and without precipitation. Optimal inventory conditions are characterized by no precipitation, no or low wind (<20 kph), and an ambient temperature above 10°C (Erickson and West, 2002; MRNF, 2008; Frick et al., 2012). The acoustic identification procedure is presented in Appendix G.

Inventory of roosting habitats

Large trees in mature forests with cavities in their trunks or shelters under their bark could be used as roosting sites for at-risk cavity-roosting species (i.e., northern long-eared, little brown and silver-haired bats) and as breeding sites for breeding females. The presence of these microhabitats cannot be estimated from ecoforestry maps of the forests; it requires a visual field inventory. The potential of the forests in the study area as roosting habitats for bats was therefore assessed during the daytime while the fixed stations were being installed. Trees with a DBH of less than 20 cm, exposed trunk cavities, lifted bark, or a crack in the trunk, as well as standing dead trees (Fabianek, 2015) were considered potential roosting habitats for at-risk cavity-roosting bats (including the northern long-eared, little brown and silver-haired bats). Where appropriate, these trees were geolocated within the study area and the potential of the remaining forests was visually assessed.

5.4.2.2.2 Results

The results obtained during this acoustic inventory are summarized by species or group of species and by inventory station in Table 5-16. This inventory confirms the presence of two of the six bat species potentially present in the Nord-du-Québec region, namely the hoary bat and the little brown bat (see Table 5-16). The presence of the northern long-eared bat, big brown bat, silver-haired bat and red bat could not be acoustically confirmed during this inventory. In the entire proposed quarry study area, and for the entire duration of the acoustic inventory, the little brown bat was the most active species with a total of 35 passes identified, followed by the hoary bat (with 12 passes). There were also 11 passes of bats from the *Myotis* genus and 11 passes of bats whose genus and species could not be acoustically identified.

Table 5-16: Summary of the results of the acoustic inventory of bats using fixed stations in the study area

Species		Type of identification	Number of passes Station 1	Number of passes Station 2	Total number of passes
Common name	Scientific name				
Hoary bat	*Lasiurus cinereus*	By species	5	7	12
Big brown bat	*Eptesicus fuscus*		0	0	0
Silver-haired bat	*Lasionycteris noctivagans*		0	0	0
Red bat	*Lasiurus borealis*		0	0	0
Little brown bat	*Myotis lucifugus*		1	34	35
Northern long-eared bat	*Myotis septentrionalis*		0	0	0
Big brown bat or silver-haired bat	*Complexe Eptesicus-Lasionycteris*	By undifferentiated group	0	0	0
Bats of the *Myotis* genus	*Myotis* spp.		0	11	11
Indeterminate bats	–		4	7	11
Total			**10**	**59**	**69**

The acoustic inventory of 30 nights during the breeding season recorded an average of 2.3 bat passes per night (standard deviation ±2.6 passes), for a total of 69 passes for all species. The diversity of species recorded was equivalent at both fixed stations, although Station 2 had higher nighttime activity compared to Station 1. This difference was primarily caused by higher activity by little brown bats (see Table 5-16).

The various sectors in the study area that were inspected did not have any trees that met the selection criteria stated above. The forests observed were primarily composed of black spruce with DBH less than 20 cm, with no visible cavities or raised bark on their trunks. The characteristics of trees that cavity-roosters use at such northerly latitudes are not known and are expected to differ from those selected farther south in Québec (Fabianek, 2015). Nevertheless, the mature coniferous forests of greatest interest to bats were identified in the study area and are presented on Map 5-2.

The presence of two of the five special-status species likely to be found in the Nord-du-Québec region was confirmed in the proposed quarry study area (see Table 5-16). The little brown bat was particularly active along the stream, which appeared to be used as a feeding and dispersal corridor.

Of the two species from the *Myotis* genus considered endangered in Canada and likely to occur in the study area (Government of Canada, 2018; Équipe de rétablissement des chauves-souris du Québec, 2019), the little brown bat is the only one that was acoustically identified. Recordings of bats from the *Myotis* genus could have included the northern long-eared bat and little brown bat, since the quarry project study area falls within their potential ranges in Québec (Équipe de rétablissement des chauves-souris du Québec, 2019) and these species have also been recorded as far north as the 54th parallel in the Labrador region (Broders et al., 2013). However, the few signals collected during this inventory and the overlap between the echolocation signals of these two species did not allow us to validate the presence of the northern long-eared bat beyond any reasonable doubt.

The hoary bat is the only one of the three migratory species present in Québec that was recorded during this acoustic inventory (see Table 5-16). This species is also listed on the MFFP list of wildlife species likely to be designated as threatened or vulnerable (2021). Unlike resident species, migratory bats are present only during the summer season and make significant seasonal movements in spring and as early as late summer (Cryan et al., 2004; Kunz and Fenton, 2006). The hoary bat is widely distributed across Québec, particularly within open coniferous forest, and is less sensitive to forest habitat fragmentation compared to forest species (Loeb and O'Keefe, 2011). This species uses multiple foliage roosting sites and foraging habitats distributed within a home range of several square kilometres in the summer season (Gorresen et al., 2015).

5.4.2.3 Birds

Although the work of the *Québec Breeding Bird Atlas* (QBBA), published in 2019[1], pertains to southern Québec, the QBBA website (2021) compiles data for the northern section of the province. The La Grande-3 region includes a 10 km by 10 km parcel of the *Atlas* (18VE35). While it does not overlap with the study area, it is located within 8 km of the study area, so the portrait of local birds is considered representative. An inventory effort of 20.8 hours is associated with this parcel, which meets the *Atlas* protocol. The list of possible, probable or confirmed breeding species based on this source is presented in Table 5-17; it contains 52 species (QBBA, 2021). Although the inventory effort was comprehensive, additional bird species could be added to this list, as rarer habitats (e.g., string bogs) within the study area are not found in the 10 km by 10 km 18VE35 parcel.

1. ROBERT, M. M.-H. HACHEY, D. LEPAGE and A. R. COUTURIER (dir.) 2019. *Second Atlas of Breeding Birds of Southern Québec*. Montréal, Regroupement QuébecOiseaux, Canadian Wildlife Service and Bird Studies Canada, 694 pages.1.BP: before present, which is a dating indication based on the number of years elapsed from a constant reference point set by convention at 1950 A.D.

Table 5-17: Breeding bird species recorded in parcel 18VE35 located near the study area

Species [a]		Breeding status
Common name	**Scientific name**	
Osprey	*Pandion haliaetus*	Possible
Wilson's snipe	*Gallinago delicata*	Possible
White-winged crossbill	*Loxia leucoptera*	Likely
Canada goose	*Branta canadensis*	Possible
White-throated sparrow	*Zonotrichia albicollis*	Likely
Lincoln's sparrow	*Melospiza lincolnii*	Likely
Swamp sparrow	*Melospiza georgiana*	Possible
Fox sparrow	*Passerella iliaca*	Likely
Savannah sparrow	*Passerculus sandwichensis*	Possible
Red-tailed hawk	*Buteo jamaicensis*	Possible
American black duck	*Anas rubripes*	Likely
Spotted sandpiper	*Actitis macularius*	Possible
American crow	*Corvus brachyrhynchos*	Possible
American kestrel	*Falco sparverius*	Likely
Sharp-shinned hawk	*Accipiter striatus*	Possible
Ring-necked duck	*Aythyia collaris*	Possible
Common goldeneye	*Bucephala clangula*	Possible
Ring-billed gull	*Larus delawarensis*	Possible
Herring gull	*Larus argentatus*	Possible
Common raven	*Corvus corax*	Confirmed
Common merganser	*Mergus merganser*	Likely
Swainson's thrush	*Catharus ustulatus*	Likely
Hermit thrush	*Catharus guttatus*	Likely
Tree swallow	*Tachycineta bicolor*	Confirmed
Bank swallow	*Riparia riparia*[a]	Possible
Dark-eyed junco	*Junco hyemalis*	Likely
American robin	*Turdus migratorius*	Likely
Boreal chickadee	*Poecile hudsonicus*	Possible
Gray jay	*Perisoreus canadensis*	Confirmed
Yellow-bellied flycatcher	*Empidonax flaviventris*	Likely
Alder flycatcher	*Empidonax alnorum*	Likely
Wilson's warbler	*Wilsonia pusilla*	Likely

Table 5-17: Breeding bird species recorded in parcel 18VE35 located near the study area (*cont.*)

Species [a]		Breeding status
Common name	**Scientific name**	
Yellow-rumped warbler	*Setophaga coronata*	Likely
Magnolia warbler	*Setophaga magnolia*	Possible
Northern waterthrush	*Parkesia noveboracensis*	Likely
Yellow warbler	*Setophaga petechia*	Likely
Common yellowthroat	*Geothlypis trichas*	Possible
Tennessee warbler	*Leiothlypis peregrina*	Possible
Blackpoll warbler	*Setophaga striata*	Likely
Orange-crowned warbler	*Leiothlypis celata*	Likely
Black-backed woodpecker	*Picoides arcticus*	Possible
Northern flicker	*Colaptes auratus*	Possible
Common loon	*Gavia immer*	Possible
Golden-crowned kinglet	*Regulus satrapa*	Possible
Ruby-crowned kinglet	*Corthylio calendula*	Likely
Green-winged teal	*Anas crecca*	Possible
Red-breasted nuthatch	*Sitta canadensis*	Likely
Arctic tern	*Sterna paradisaea*	Possible
Common tern	*Sterna hirundo*	Possible
Spruce grouse	*Falcipennis canadensis*	Possible
Winter wren	*Troglodytes hiemalis*	Likely
Philadelphia Vireo	*Vireo philadephicus*	Possible

a. The bank swallow is designated as threatened in Canada.

Source: QBBA, 2020.

Special-status species potentially present in the study area

Although no occurrences recorded with the CDPNQ have been reported in the study area, the Direction de la gestion de la faune du Nord-du-Québec points out that the study area could be occupied by one avian species designated as vulnerable, namely the bald eagle, as well as four avian species likely to be designated as threatened or vulnerable, namely the common nighthawk, short-eared owl, olive-sided flycatcher and rusty blackbird (MFFP, 2020). There are also two species designated in Canada under the *Species at Risk Act*: the red-necked phalarope, a species of special concern, and the bank swallow, a threatened species. Table 5-18: Special-status bird species potentially present in the study area.

Table 5-18: Special-status bird species likely present in the study area

Species		Species status in Québec [a]	Species status in Canada [b]
Common name	Scientific name		
Common nighthawk	*Chordeiles minor*	Species likely to be designated threatened or vulnerable	Threatened
Short-eared owl	*Asio flammeus*	Species likely to be designated threatened or vulnerable	At risk
Bank swallow	*Riparia riparia*	–	Threatened
Olive-sided flycatcher	*Contopus cooperi*	Species likely to be designated threatened or vulnerable	Threatened
Red-necked phalarope	*Phalaropus lobatus*	–	At risk
Bald eagle	*Haliaeetus leucocephalus*	Vulnerable	–
Rusty blackbird	*Euphagus carolinus*	Species likely to be designated threatened or vulnerable	At risk

a. Designation under the *Act respecting threatened or vulnerable species.*
b. Designation under the *Species at Risk Act* and listed species in Schedule 1.

Common nighthawk

The common nighthawk nests in open environments with unvegetated soils such as rock outcrops, logged areas, burns, bogs, sand or gravel banks, and gravel roofs (COSEWIC 2007*a*; Environment Canada 2016*a*). The Direction de la gestion de la faune du Nord-du-Québec mentions this species as possibly present in the study area (MFFP, 2020).

Although this habitat appears to be present in the study area, the northern boundary of the common nighthawk's distribution range is located within the study area, so the likelihood of its presence is considered low.

Short-eared owl

The short-eared owl's known breeding range covers almost the entire province of Québec, with the possible exception of the northern part of the Ungava Peninsula (Environment Canada, 2016*b*). The study area therefore intersects with the breeding range of this species. Its preferred nesting habitats are open areas such as prairies, Arctic tundra, taiga, bogs, coastal wetlands, coastal heaths, natural prairies dominated by sand sage (*Artemisia filifolia*), estuaries and marshes (Environment Canada, 2016*b*).

In addition to being mentioned as a species potentially present in the study area by the Direction de la gestion de la faune du Nord-du-Québec (MFFP, 2020), the SOS-POP database (2020) reports one historical record located within 10 km of the proposed quarry. However, in the absence of suitable habitat parcels of at least 15 ha (Environment Canada, 2016*b*) in the study area, the potential for this species to be present should be considered low.

Bank swallow

The bank swallow is widespread in Québec and nests in large colonies in sand pits and along steep banks (COSEWIC, 2013). Its habitats primarily include lake and coastal cliffs, banks of watercourses, gravel and sand pits, road cuts and sand piles.

The *Québec Breeding Bird Atlas* (2021) mentions the bank swallow in a parcel adjacent to the study area. However, considering the low probability of finding vertical sandy walls in the study area, the potential for the presence of this species is considered low.

Olive-sided flycatcher

The olive-sided flycatcher inhabits coniferous or mixed forests with openings with trees or snags, such as the edges of logging cuts, clearings or bogs, wooded shorelines of streams, rivers or lakes with dead trees, as well as beaver ponds (COSEWIC 2007*b*). The Direction de la gestion de la faune du Nord-du-Québec mentions this species as possibly present in the study area (MFFP, 2020).

A wetland in the western portion of the study area may be suitable for olive-sided flycatcher nesting. The species remains rare in the project area so the likelihood of encountering it in the study area is considered low to moderate.

Red-necked phalarope

The red-necked phalarope breeds in the subarctic and Low Arctic wetlands near ponds, lakes or freshwater streams (COSEWIC*b*, 2014).

The study area is located on the southern edge of the red-necked phalarope's range (QBBA, 2021). At that latitude, the species has been confirmed as breeders in string bogs, but more to the east. The probability of finding this species in the study area is therefore considered low, according to current knowledge.

Bald eagle

Bald eagles typically nest in the tallest trees in a mature forest within 300 m of a body of water populated with fish (Bird and Henderson, 1995; Fradette, 1998; MFFP, 2010). The body of water may be a large lake, a high-flowing river, or a large man-made reservoir, which it frequents to feed on fish (MFFP, 2010; Shaffer et al., 2011). Its minimum surface area should be 0.3 km^2 (USFWS, 2018) and ideally, greater than 10 km^2 (Naylor and Watt, 2004). The Direction de la gestion de la faune du Nord-du-Québec mentions this species as possibly present in the study area (MFFP, 2020).

In the absence of large water bodies, however, the likelihood of finding this species in the study area is considered low.

Rusty blackbird

During the nesting period, the rusty blackbird is found in wetlands such as bogs, low-flow streams, sedge meadows, marshes, beaver ponds, swamps, riparian scrubs, as well as alder and willow thickets (Environment Canada, 2015). Its presence in wetlands is generally associated with persistent and shallow ponds (Environment Canada, 2015). Breeding sites generally include small conifers, especially spruce, which it uses to nest. The Direction de la gestion de la faune du Nord-du-Québec mentions this species as possibly present in the study area (MFFP, 2020).

A wetland in the western section of the study area may be suitable for rusty blackbird nesting. However, the species remains rare in the project area so the likelihood of finding it in the study area is considered low to moderate.

5.4.2.3.1 2021 field inventories

Bird inventories were conducted on June 18 and 19, 2021, in the biophysical environment inventory area and in the study area.

Methodology

Breeding songbirds in the study area were counted using point counts. Five listening points spaced at least 250 m apart were established due to the small size of the biophysical environment inventory area. A summary description of the habitat was made for each listening point, all of which were located in open taiga. Listening station locations are shown on Map 5-2.

Point counts were conducted using the fixed-radius point count (FPRC) method (Bibby et al., 1992) and the unlimited-distance point count (known as IPA) method (Blondel et al., 1981). The FRPC technique consists in counting all birds seen or heard within an imaginary circle with a 50-metre radius every 5 minutes, over a 10-minute period. The IPA method was used in conjunction with the FRPC method. It differs from the FRPC in that it does not impose any distance limit between the birds counted. The FRPC method began after a quiet period of about five minutes to allow the birds to recover from the disturbance caused by the observers' movements. This inventory was conducted during the nesting period, taking into account the northern latitude. To determine the level of certainty of species nesting, breeding evidence from the *Québec Breeding Bird Atlas* (QBBA, 2020) was used.

To expand the list of bird species observed, the presence of any other bird species, particularly special-status species, was also noted during movement within the biophysical environment inventory area and study area.

The method of counting the common nighthawk was inspired by the 2018 version of the *Protocole canadien d'inventaire des engoulevents* (Knight, 2018) and the Programme québécois de suivi des engoulevents published by QuébecOiseaux (2013). Thus, the count was conducted in the evening at two twilight listening stations located along the main road. The inventory began 30 min before sunset and ended before the 2-hour limit expired. Each listening station session lasted six minutes.

This inventory was conducted during an evening with mild weather (no precipitation, little wind [maximum of 3 on the Beaufort scale], little or no cloud cover, and a temperature above 10°C). At each station, nighthawk observations and viewing conditions were noted.

5.4.2.3.2 Results

The various inventories conducted in the biophysical environment inventory area and study identified 36 bird species, i.e., 2 confirmed breeders, 10 probable breeders, 24 possible breeders. Table 5-19 presents these species and their breeding status following field observations in June 2021. Four species not included in the literature review were detected in the study area during the 2021 inventory: solitary sandpiper, cedar waxwing, least flycatcher and red-eyed vireo. The total number of species is therefore 56, according to the literature review and inventories.

Table 5-19: Bird species observed in the biophysical environment inventory area and study area on June 18 and 19, 2021, and breeding status

Species		Field observation – June 2021	
Common name	**Scientific name**	**Breeding code[a]**	**Breeding status in the study area**
Osprey	*Pandion haliaetus*	H	Possible
White-winged crossbill	*Loxia leucoptera*	H	Possible
Lincoln's sparrow	*Melospiza lincolnii*	S	Possible
Swamp sparrow	*Melospiza georgiana*	S	Possible
Fox sparrow	*Passerella iliaca*	M	Likely
White-throated sparrow	*Zonotrichia albicollis*	M	Likely
Wilson's snipe	*Gallinago delicata*	S	Possible
Solitary sandpiper	*Tringa solitaria*	H	Possible
American crow	*Corvus brachyrhynchos*	C	Likely
American kestrel	*Falco sparverius*	H	Possible
Herring gull	*Larus argentatus*	H	Possible
Ring-billed gull	*Larus delawarensis*	X	Possible
Common merganser	*Mergus merganser*	H	Possible
Hermit thrush	*Catharus guttatus*	S	Possible
Swainson's thrush	*Catharus ustulatus*	M	Likely

Table 5-19: Bird species observed in the biophysical environment inventory area and study area on June 18 and 19, 2021, and breeding status (*cont.*)

Species		Field observation – June 2021	
Common name	**Scientific name**	**Breeding code[a]**	**Breeding status in the study area**
Tree swallow	*Tachycineta bicolor*	H	Possible
Cedar waxwing	*Bombycilla cedrorum*	H	Possible
Dark-eyed junco	*Junco hyemalis*	S	Possible
American robin	*Turdus migratorius*	AT	Confirmed
Alder flycatcher	*Empidonax alnorum*	S	Possible
Least flycatcher	*Empidonax minimus*	S	Possible
Yellow-bellied flycatcher	*Empidonax flaviventris*	S	Possible
Boreal chickadee	*Poecile hudsonicus*	H	Possible
Gray jay	*Perisoreus canadensis*	JE	Confirmed
Northern waterthrush	*Parkesia noveboracensis*	M	Likely
Yellow warbler	*Setophaga petechia*	M	Likely
Tennessee warbler	*Leiothlypis peregrina*	S	Possible
Orange-crowned warbler	*Leiothlypis celata*	M	Likely
Wilson's warbler	*Cardellina pusilla*	M	Likely
Yellow-rumped warbler	*Setophaga coronata*	M	Likely
Magnolia warbler	*Setophaga magnolia*	S	Possible
Common loon	*Gavia immer*	S	Possible
Bald eagle	*Haliaeetus leucocephalus*[b]	H	Possible
Ruby-crowned kinglet	*Corthylio calendula*	M	Likely
Common tern	*Sterna hirundo*	H	Possible
Winter wren	*Troglodytes hiemalis*	S	Possible

a. The bald eagle has been designated as a vulnerable species in Québec.

b. Breeding code (according to the *Québec Breeding Bird Atlas*):
Species observed
X: Observation of the species during its breeding period, but in a habitat not suitable for nesting.
Possible nesting
H: Species observed during its breeding season, in suitable nesting habitat. S: Singing male observed in its habitat during the nesting period.
Probable nesting
M: At least seven individuals singing or producing sounds associated with breeding (e.g., calls, drumming), heard during a single visit during the species' breeding season in suitable nesting habitat. P: Pair observed in suitable habitat during the species' breeding season. T: Presumed territory based on observation of an adult bird on two different days at least one week apart during the breeding season. C: Breeding behavior involving a male and female (e.g., display, courtship feeding and copulation) or antagonistic behavior between two individuals in suitable nesting habitat during the species' breeding season. V: Bird visiting a probable nest site during the species' breeding season. A: Agitated behavior or alarm call of an adult in suitable nesting habitat during the species' breeding season.
Confirmed nesting
CN: Nest building, including the carrying of nesting material, by all species except wrens and woodpeckers. DD: Individual attempting to draw attention away from a nest or young by feigning injury or by using any other distraction display. NU: Empty nest used or shells of eggs laid during the same period. JE: Recently fledged (nidicolous species) or downy (nidifugous species) young incapable of sustained flight. NO: Adult occupying, leaving or entering a probable nest site (visible or not). FE: Adult carrying a fecal sac. AT: Adult carrying food for young. NF: Nest containing one or more eggs. NJ: Nest with one or more young (seen or heard).

Source: Robert et al., 2019.

The number of breeding pairs observed at different stations within a 50-metre radius (FRPC) is presented in Table 5-20. Orange-crowned warbler, ruby-crowned kinglet and white-throated sparrow are among the dominant species.

Table 5-20: Number of breeding pairs of landbirds recorded on June 19 within 50 m of the five listening stations

Species		Listening station				
Common name	**Scientific name**	**AV1**	**AV2**	**AV3**	**AV4**	**AV5**
Fox sparrow	*Passerella iliaca*	–	–	–	–	1
White-throated sparrow	*Zonotrichia albicollis*	–	–	1	1	–
Boreal chickadee	*Poecile hudsonicus*	–	–	0.5	–	–
Yellow-bellied flycatcher	*Empidonax flaviventris*	–	–	1	–	–
Alder flycatcher	*Empidonax alnorum*	–	–	–	1	–
Wilson's warbler	*Wilsonia pusilla*	1	1	–	–	–
Yellow-rumped warbler	*Setophaga coronata*	–	–	–	1	–
Tennessee warbler	*Leiothlypis peregrina*	–	1	–	–	–
Northern waterthrush	*Parkesia noveboracensis*	–	1	–	–	–
Orange-crowned warbler	*Leiothlypis celata*	1	–	1	–	1
Ruby-crowned kinglet	*Corthylio calendula*	1	1	–	–	1

Source: Bibby et al., 1992.

At the listening stations, the species richness was assessed at 21 species, based on the data collected, regardless of distance (IPA). In addition to the 11 species listed in Table 5-20, osprey, white-winged crossbill, Lincoln's sparrow, swamp sparrow, hermit thrush, Swainson's thrush, dark-eyed junco, American robin, yellow warbler, and winter wren were recorded. The solitary sandpiper, Wilson's snipe, and gray jay were also incidentally observed while traveling outside the listening stations, for a total of 24 species in the biophysical environment inventory area.

No nighthawks were heard or seen during the twilight inventory dedicated for this species, despite ideal conditions (temperature around 18°C, low wind and no precipitation).

No birds of species at risk were observed in the biophysical environment inventory area during the 2021 field visits. The presence of an adult bald eagle was noted at the foot of the La Grande-3 dam on June 20, 2021, some 12 km from the proposed quarry site. However, no suitable nesting habitat for this species is present in the biophysical environment inventory area.

5.4.2.4 Reptiles and amphibians

A search of the Atlas of Amphibians and Reptiles of Québec (AARQ) database through the Saint-Lawrence Valley Natural History Society did not return any records of amphibians or reptiles in the study areas (AARQ, 2020*a*). At northern latitudes, temperature is the most significant limiting factor for amphibians and reptiles (Bleakney, 1958).

Based on current knowledge, six species of anurans, two species of salamanders, and one species of garter snake could potentially frequent the study area (AARQ, 2020*a*, 2020*b*; see Table 5-21). The northern boundary of the known distribution range of the common garter snake, northern leopard frog, northern spring peeper, two-lined salamander, and blue-spotted salamander is located in the project area (AARQ, 2020*b*; Fortin, 2006, 2007). Field inventories conducted in 2011 confirmed the presence of wood frog, northern spring peeper, and American toad in the biophysical environment inventory area.

Table 5-21: Amphibian and reptile species likely to frequent the study area

Species		Species status in Québec [a]	Species status in Canada [b]
Common name	**Scientific name**		
Anuran			
American toad	*Anaxyrus americanus*	–	–
Wood frog	*Lithobates sylvaticus*	–	–
Mink frog	*Lithobates septentrionalis*	–	–
Northern leopard frog	*Lithobates pipiens*	–	–
Northern spring peeper	*Pseudacris crucifer*	–	–
Boreal chorus frog	*Pseudacris maculata*	Species likely to be designated threatened or vulnerable	–
Salamander			
Two-lined salamander	*Eurycea bislineata*	–	–
Blue-spotted salamander	*Ambystoma laterale*	–	–
Snakes			
Common garter snake	*Thamnophis sirtalis*	–	–

a. Designation under the *Act respecting threatened or vulnerable species.*
b. Designation under the *Species at Risk Act* and listed species in Schedule 1.

Sources: AARQ, 2020*a*, 2020*b*.

Although the known distribution range of the boreal chorus frog, a species likely to be designated threatened or vulnerable in Québec, does not overlap the study area, very few studies have specifically inventoried this species in the mainland portion of Baie James (James Bay) at the appropriate time. To date, the species has only been recorded in four coastal bays south of Baie James: Chiyask, Cabbage Willows, Rupert's and Boatswain's bays (Fortin et al., 2003; Ouellet et al., 2009). Field inventories conducted in 2021 confirm the absence of this anuran in the biophysical environment inventory area.

The study area is also located well outside the known distribution range of turtles; no records of this species group have been reported in the Baie-James area (AARQ, 2020*b*).

Streams and rivers represent habitats of interest for two-lined salamander, while lakes, marshes, swamps, and permanent ponds are favorable for aquatic frogs (northern leopard frog, mink frog) and other anuran species (northern spring peeper, American toad; Rodrigue and Desroches, 2018). Wood frogs, boreal chorus frogs and blue-spotted salamander use temporary spring ponds for breeding. The garter snake uses a variety of terrestrial and wetland habitats. It should be noted that the terrestrial environments adjacent to the wetlands and aquatic environments are also habitats of interest to amphibian species likely to be present in the study area, for feeding or hibernation, depending on the species.

5.4.2.4.1 *2021 field inventories*

A specific amphibian and reptile inventory was conducted on May 31 and June 1, 2021, within the biophysical environment inventory area. Three groups were targeted: anurans, salamanders and garter snakes.

Anurans

The only special-status anuran species likely to be found in the study area is the striped chorus frog (Rodrigue and Desroches, 2018). The optimal time to inventory the breeding chorus for this species appears to be the last week of May (Fortin et al., 2003; Ouellet et al., 2009). Since this species sings both during the day and in the evening, the breeding chorus was heard on May 31 in the afternoon (air temperature: 20°C) and in the early evening (air temperature: 12°C) in the potential habitats for this species, i.e., three ponds (A01 to A03) located along the La Grande-3 road (see Map 5-1).

These two listening sessions on May 31 were also conducive to listening for other anuran species that were potentially present. Another listening session was also conducted on June 19 in the evening (air temperature: 18°C) at station A02 during the bird inventory. Relative abundance was estimated using scores ranging from 1 to 3 (see Table 5-22). Work done at station CE02 as part of other field work (surface water and sediment sampling) was another opportunity to listen for the anuran breeding chorus.

Table 5-22: Abundance rating of the anuran breeding chorus

Rating	Description
0	No calls heard.
1	Songs can be identified separately, and the number of singing males can be counted.
2	Songs overlap and not all singing males can be counted (partial song overlap).
3	Continuous choir, the songs are impossible to count.

During the inventory conducted on May 31 and June 1, the edges of the three ponds (A01 to A03) were scoured for egg clusters, juveniles and adults. Several small pools within the biophysical environment inventory area were also scanned for the same sign of activity. Adult anurans were also likely to be observed during field team travel.

Salamanders

All three ponds (A01 to A03) were suitable for blue-spotted salamander egg laying. Thus, the edges of the three ponds were scoured for egg clusters. Several small pools within the biophysical environment inventory area were also scanned for the same sign of activity.

Snakes

Only the garter snake, a common species in Québec, is known in the region. Active terrestrial searches involved lifting rocks in search of juveniles and adults. Garter snakes were also likely to be observed during field team travel.

5.4.2.4.2 Results

The presence of three species of anurans was noted, namely the wood frog, the northern spring peeper and the American toad. Table 5-23 shows the sites and dates of occurrence and nature of the observations. The American toad was recorded along one stream (CE02), in one pond (A02) and in one pool (A04), the wood frog was recorded in two ponds (A01 and A03), while the northern spring peeper was heard in all three ponds and along stream CE02.

No evidence of salamanders or garter snakes was noted, although this does not preclude species from being present.

Table 5-23: Anuran species found in the biophysical environment inventory area

Species		Site	Sign of activity (chorus abundance rating)	Date of occurrence
Common name	Scientific name			
American toad	*Anaxyrus americanus*	CE02 A02 A04	Breeding choruses (2) Breeding choruses (2) Three egg clusters	June 1 May 31 June 1
Wood frog	*Lithobates sylvaticus*	A01 A03	One egg cluster Three egg clusters	May 31 May 31
Northern spring peeper	*Pseudacris crucifer*	A01 A02 A03 CE02	Breeding choruses (3) Breeding choruses (3, 2) Breeding choruses (3) Breeding choruses (1)	May 31 May 31 and June 19 May 31 June 19

5.4.2.5 Fish

Fish species likely to be encountered in the study area were assessed based on known distribution ranges (Desroches and Picard 2013; Bernatchez and Giroux 2012) and habitats present in the study area (streams, rivers, ponds, and lakes). The main habitats present are an unnamed stream, tributary to the effluent of several lakes, which flows into Robert-Bourassa reservoir, and one unnamed lake of approximately 4.4 ha. Eighteen (18) species are likely to be present in the study area (see Table 5-24).

Except for lake sturgeon, which is considered a species likely to be designated threatened or vulnerable in Québec, no fish species potentially present in the study area has a legal protection status.

There is limited habitat potential for fish fauna in the biophysical environment inventory area. No streams were observed. The two ponds that are part of the MH01-3 and MH03 wetlands located along the La Grande-3 road dry up either partially or completely during low-flow periods and are connected to the road's drainage ditch network.

Table 5-24: Fish species likely to frequent the study area

Species		Habitat
Common name	**Scientific name**	
Acipenseridae		
Lake sturgeon	*Acipenser fulvescens*	Creeks, rivers and lakes
Salmonids		
Lake cisco	*Coregonus artedi*	Rivers and lakes
Lake whitefish	*Coregonus clupeaformis*	Rivers and lakes
Round whitefish	*Prosopium cylindraceum*	Rivers and lakes
Brook trout	*Salvelinus fontinalis*	Creeks, rivers and lakes
Lake trout	*Salvelinus namaycush*	Rivers and lakes
Esocidae		
Northern pike	*Esox lucius*	Rivers, lakes and reservoirs
Cyprinidae		
Lake chub	*Couesius plumbeus*	Creeks, rivers and lakes
Creek chub	*Semotilus atromaculatus*	Creeks, rivers and lakes
Longnose dace	*Rhinichthys cataractae*	Creeks, rivers and lakes
Suckers		
Longnose sucker	*Catostomus catostomus*	Rivers and lakes
White sucker	*Catostomus commersonii*	Creeks, rivers and lakes
Lotidae		
Burbot	*Lota lota*	Rivers and lakes
Gastrosteidae		
Threespine stickleback	*Gasterosteus aculeatus*	Creeks, rivers and lakes
Ninespine stickleback	*Pungitius pungitius*	Creeks, rivers and lakes
Sculpins		
Mottled sculpin	*Cottus bairdii*	Creeks, rivers and lakes
Slimy sculpin	*Cottus cognatus*	Creeks, rivers and lakes
Perches		
Walleye	*Sander vitreus*	Rivers, lakes and reservoirs

5.4.2.6 Summary of special-status wildlife species

The CDPNQ did not report any occurrence of wildlife species that are threatened, vulnerable or likely to be so designated in Québec within the study area (MFFP, 2020).

Based on known distribution ranges (Desroches and Picard, 2013; Desrosiers et al., 2002; Feldhamer et al., 2003; MFFP, 2021*b*; Jutras et al, 2012; Naughton, 2012; AARQ, 2020*b*), habitats considered suitable for the species and available habitats, five species of terrestrial mammals, five species of bats, one species of fish, and one species of special-status amphibians are likely to use habitats within the study area (see Table 5-25). Table 5-25 also presents the probability of occurrence for each species in the biophysical environment inventory area. The details for each species are presented in the previous sections.

The list of special-status bird species potentially present in the study area was determined using data from the *Québec Breeding Bird Atlas* (QBBA, 2021). Although the CDPNQ (2020) does not mention this in the study area, the Direction de la gestion de la faune du Nord-du-Québec states that five special-status bird species are likely to be found there. According to these various sources, there are seven special-status bird species likely to frequent the study area.

Table 5-25: Summary of special-status wildlife species likely to frequent habitats located in the study area and probability of occurrence in the biophysical environment inventory area.

Species	Species status in Québec [a]	Species status in Canada [b]	Probability of occurrence in the biophysical environment inventory area [c]
Terrestrial mammals			
Least weasel	Species likely to be designated threatened or vulnerable	–	High
Rock vole	Species likely to be designated threatened or vulnerable	–	Low
Southern bog lemming	Species likely to be designated threatened or vulnerable	–	High
Wolverine	Threatened	At risk	Low
Woodland caribou	Vulnerable	Threatened	Low
Bat			
Silver-haired bat	Species likely to be designated threatened or vulnerable	–	Average
Hoary bat	Species likely to be designated threatened or vulnerable	–	High

Table 5-25: Summary of special-status wildlife species likely to frequent habitats located in the study area and probability of occurrence in the biophysical environment inventory area (*cont.*)

Species	Species status in Québec [a]	Species status in Canada [b]	Probability of occurrence in the biophysical environment inventory area [c]
Bats (*cont.*)			
Northern long-eared bat	–	Endangered	Average
Red bat	Species likely to be designated threatened or vulnerable	–	Average
Little brown bat	–	Endangered	Average
Birds			
Common nighthawk	Species likely to be designated threatened or vulnerable	Threatened	Low
Short-eared owl	Species likely to be designated threatened or vulnerable	At risk	Low
Bank swallow	–	Threatened	Low
Olive-sided flycatcher	Species likely to be designated threatened or vulnerable	Threatened	Low to moderate
Red-necked phalarope	–	At risk	Low
Bald eagle	Vulnerable	–	Low
Rusty blackbird	Species likely to be designated threatened or vulnerable	At risk	Low to moderate
Amphibians			
Boreal chorus frog	Species likely to be designated threatened or vulnerable	–	None
Fish			
Lake sturgeon	Species likely to be designated threatened or vulnerable	–	None

a. Designation under the *Act respecting threatened or vulnerable species*.
b. Designation under the *Species at Risk Act.*
c. Assessment based on the species' known distribution range, reports around the study area, ecology of the species and the presence and abundance of potential habitats available in the biophysical environment inventory area.
High probability: the species' distribution range clearly overlaps the study area, potential habitats are present in the biophysical environment inventory area and the species is not particularly rare.
Moderate probability: the study area is located within the species' distribution range, potential habitats are present in the biophysical environment inventory area, and the species is not particularly rare.
Low probability: very few potential habitats are present in the study area or the availability of potential habitats is unknown, but appear to be insufficient, or the surface area of the biophysical environment inventory area is particularly small in relation to the range of the species' movements, or the species is present in very low numbers in the project region.
Zero probability: no potential habitat is present in the biophysical environment inventory area.

5.4.2.7 Habitats and wildlife sites of interest or regulated

No mapped wildlife habitat, as defined in the *Regulation respecting wildlife* (CQRL, c. C-61.1, r.18), overlaps the study area (MFFP, 2020*b*). However, while not mapped in this area, aquatic environments frequented by fish constitute fish habitat under this regulation.

The MFFP did not report any wildlife sites of interest (MFFP, 2020) within or near the study area.

5.5 Human environment

5.5.1 Land development and use

5.5.1.1 Land organization

The study area is located in the Nord-du-Québec administrative region (10) and is part of the Eeyou Istchee Baie-James territory, located south of the 55th parallel. The Eeyou Istchee Baie-James territory includes four non-Indigenous municipalities and three non-Indigenous communities, nine Cree communities, and seven unorganized territories (MAMH, 2020; GREIBJ, 2020). The study area is only accessible via Route Billy-Diamond and the Transtaïga highway.

The *James Bay and Northern Québec Agreement* (JBNQA) divided the Eeyou Istchee Baie-James territory into three categories of land:

- Category I: lands allocated to Cree communities and divided into two categories:
  - Category IA: the administration, management and control are transferred to the Government of Canada, for the exclusive use and benefit of Cree First Nations.
  - Category IB: lands whose (collective) ownership is transferred by the Government of Québec to Cree land corporations that administer them and may grant rights to them.
- Category II: public provincial lands where Cree have certain exclusive hunting, fishing and trapping rights.
- Category III: provincial public lands where the Cree have exclusive trapping rights (with some exceptions in the south) as well as some non-exclusive hunting and fishing rights (EIJBRG, 2020). These lands are managed by the EIJBRG.

The study area is located entirely on Category III lands, is nearly 200 km from the nearest Cree villages of Chisasibi and Wemindji, and more than 100 km from the community of Radisson (see project location map).

The project study area is predominantly located on public lands.

5.5.1.2 Administrative framework

The present administrative structure of the Eeyou Istchee Baie-James territory results from the *Agreement on Governance in the Eeyou Istchee James Bay Territory* and *An Act establishing the Eeyou Istchee James Bay Regional Government*, and certain legislative amendments respecting Cree Nation Government, adopted in June 2013. This act led to the creation of the Eeyou Istchee James Bay Regional Government (EIJBRG), which replaced the Municipality of Baie-James (MBJ) as of January 1, 2014. The EIJBRG has the same jurisdiction, functions and powers over Category III lands in the territory that were assigned to the MBJ. It has the option of declaring its jurisdiction as a regional county municipality (MRC) and acts as a Conférence régionale des élus [regional conference of elected representatives] (CRE) with respect to territory and resources (EIJBRG, 2020). This regional government is composed of 22 Cree and Jamesian members, including the chiefs of the Cree communities, as well as the mayors of the municipalities and the presidents of the villages in the territory.

EIJBRG is mandated with providing public services to the residents of the Eeyou Istchee Baie-James territory in several sectors, including economic development, potable water and wastewater management, resource and land management, waste management and environmental protection (EIJBRG, 2020).

The Grand Council of the Crees (Eeyou Istchee) and the Cree Nation Government are two separate legal entities; however, they have identical membership, board and governance structures and are *de facto* directed and managed as a single organization by the Cree Nation (Grand Council of the Crees [Eeyou Istchee] and Cree Nation Government, 2022). The Grand Council of the Crees (Eeyou Istchee) and the Cree Nation Government are governed by a 20-member council elected by the Cree beneficiaries.

The mandate of the Environment and Remedial Works department of the Cree Nation Government is to monitor, implement, coordinate and advise on all matters related to the environment in the Cree territory in accordance with the agreements and legislation; most notably, this department is responsible for monitoring the environmental and social impacts of proposed development projects in Eeyou Istchee Baie-James, according to the Environmental and Social Impact Assessment (ESIA), a process created under Section 22 of the *James Bay and Northern Québec Agreement* (JBNQA).

At the local level, the Cree nations of Chisasibi and Wemindji are each governed by a council composed of elected members. These local Indigenous councils manage the services and nearby infrastructure located in Category I lands and are active in the social and economic development of their communities. These councils also represent the interests of community members who carry out activities on traplines located on Category II and III lands, as they can offer services to facilitate these activities on the land. Land users can also count on the support of the CTA.

The village of Radisson is led by a village president and their team of counselors (village of Radisson, 2020).

5.5.1.3 Land planning and zoning

According to the Eeyou Istchee Baie-James territory zoning by-law, the study area is part of zone 53-06R, and its dominant use is "resource." The quarry site is currently a vacant forest area. Among the possible categories of uses are: various leisure and recreation, public and institutional, public utility networks, dispersed resort, agriculture without livestock and resource harvesting (Municipality of Baie-James, undated in SNC-Lavalin, 2020).

Based on photointerpretation using orthophotographs taken in 2018 and 2019, only 9.3 % of the surface of the study area is occupied by infrastructure related to human use of the territory: the La Grande-3 road and the power line rights-of-way. A Cree camp is also present in the study area, but its exact size was not known and not calculated in this analysis of land cover.

5.5.1.4 Cree land use

The Eeyou Istchee Baie-James territory is divided into traplines used by Cree families. The study area overlaps the CH40 trapline, which belongs to the community of Chisasibi, and touches a very small section of the VC20 trapline, which belongs to the community of Wemindji. The camp located along the road at the southwestern end of the study area belongs to the CH40 trapline tallyman in the community of Chisasibi. An interview was conducted with him to document his land use. (see Chapter 4).

5.5.1.5 Other

There are no organized tourist activities in or around the study area. No regional or Trans-Québec snowmobile or ATV trails intersect the study area. There are, however, a few recreational leases located north of the study area, near the La Grande-3 road. Recreational activities are also practised by non-Indigenous Baie-James residents, including fishing, moose hunting and small-game hunting. Subsequent to the ban instituted in Zone 22, caribou hunting is no longer practised in the study area. Lastly, open and flat spaces along Robert-Bourassa reservoir have been developed for wilderness camping. There are also boat ramps. However, no such infrastructure is present within the project study area.

There are no major development projects currently planned in the study area. Hydro-Québec plans to rehabilitate the access roads to La Grande-3 road and the Sakami residences; this will be the main construction activity in the study area over the next few years.

5.5.2 Public services and infrastructure

The public infrastructure and utilities present in or near the study area are very limited since it is far from the Cree villages and municipalities.

5.5.2.1 Transportation

The closest airport to the study area is approximately 5 km to the southwest. La Grande-3 airport is operated by Hydro-Québec and used mainly for charter flights to transport its employees who work at La Grande-3 generating station (see project location map).

The project study area is accessible from the Transtaïga highway (unpaved road), which provides access to the hydroelectric infrastructure located east of the Robert-Bourassa development. From the Transtaïga highway, the La Grande-3 road intersects the study area from north to south, leading to the La Grande-3 facilities. A power line access trail intersects the proposed quarry site, connecting the La Grande-3 road to the 735-kV power line right-of-way (circuits 7057 and 7059).

5.5.2.2 Electrical energy

Three 735-kV transmission lines intersect the study (circuits 7057, 7059 and 7060). These power lines originate at Chissibi substation and run east, south and west on the other side of the study area (see Map A, in pocket).

The La Grande-3 substation, generating station and dam are located more than 12 km northeast of the study area (see project location map).

5.5.2.3 Extraction site and mining claims

There are currently no extraction sites in the study area, but it is almost entirely covered by active mining claims. It overlaps 18 mining claims held by Azimut Exploration Inc. and six claims held by Osisko Baie James SENC.

Communication with Osisko representatives confirmed that there are no conflicts between their mining activities and Hydro-Québec's plans in the area of the proposed quarry. Thus, there is no need to transfer or assign mining claims. To date, no discussions have been possible with Azimut Exploration Inc. representatives.

5.5.3 Socioeconomic profile

5.5.3.1 Indigenous communities

As previously stated, the study area is far from Cree communities and villages in the Eeyou Istchee Baie-James territory. However, most of the study area is occupied and used by one family and members of the community of Chisasibi. The primary characteristics of this community are listed hereunder.

Population

According to the 2016 census, Chisasibi (Cree reserve lands) has a population of 4,872 (Statistics Canada, 2017a). The vast majority of this population is Indigenous. Only 5.7% of the population reported in the census was of non-Indigenous origin. Chisasibi is the most populated of the Cree villages in the Eeyou Istchee Baie-James territory, which has a total population of 18,220 (MAMH, 2020). From 2011 to 2016, the population of Chisasibi increased by 8.7%, a greater percentage of increase than the population of Nord-du-Québec and Québec as a whole, which were 4.7% and 3.3%, respectively, for the same period.

The average age of the Chisasibi population (29.1 years of age) is much lower than the average age for the province (41.9 years of age), but similar to the average age for all of Nord-du-Québec (32.0 years of age; see Table 5-26). Chisasibi has a higher proportion of people under the age of 15 (31.7%) and a lower proportion of people 65 or older (about 5.9%) as compared to the entire province of Québec (16.3% and 18.3%, respectively). The distribution of the population of Nord-du-Québec by age is comparable to that of the community of Chisasibi (Statistics Canada, 2017a; 2017*b*).

Table 5-26: Sociodemographic data of Chisasibi compared to Nord-du-Québec and the province of Québec

Parameter	Chisasibi	Nord-du-Québec	Province of Québec
Population in 2016	4,872	44,561	8,164,361
Population in 2011	44,84	42,579	7,903,001
Change in population from 2011 to 2016 (%)	8.7	4.7	3.3
Percentage of population aged 0 to 14	31.7	27.5	16.3
Percentage of population aged 15 to 64	62.5	64.7	65.4
Percentage of population aged 65 or older	5.9	7.7	18.3
Average age	29.1	32.0	41.9
Percentage of Indigenous population	94.3	66.7	2.3

Sources: Statistics Canada, 2017*a*, 2017*b*.

Households

The average household size in Chisasibi in 2016 was 4.8 people. This average is higher than that observed in Nord-du-Québec and Québec as a whole, which were 3.2 and 2.3 persons per private household, respectively (i.e., a person or group of persons occupying a private dwelling) in 2016. The percentage of single parent families was higher in Chisasibi (36.6%) than in Nord-du-Québec (26.2%) and in Québec as a whole (16.8%). Table 5-27 presents the data available for households in Chisasibi, Nord-du-Québec, and Québec as a whole.

Table 5-27: Characteristics of private households and housing in Chisasibi compared to the Nord-du-Québec region and the province of Québec (2016 census)

Parameter	Chisasibi	Nord-du-Québec	Province of Québec
Total number of people in private households	4,855	43,890	7,965,455
Total number of private households	1,005	13,675	3,531,665
Average number of people in private households	4.8	3.2	2.3
Single-parent families (%)	36.6	26.2	16.8

Sources: Statistics Canada, 2017*a*, 2017*b*.

Demographic projections

According to the Institut de la statistique du Québec (ISQ), the population of the Eeyou Istchee Baie-James territory (considered by the ISQ to be a regional county municipality [MRC]) will increase from 17,300 inhabitants in 2016 to 22,600 in 2041, which represents a 25.5% increase. This MRC is one of those that will see the greatest demographic increase by 2041. While Québec will record an overall aging of its population in the next 25 years, Eeyou Istchee Baie-James territory will have one of the lowest proportions of people aged 65 or over, at 12.8% compared to 26.3% for Québec as a whole. In 2041, the proportion of the population aged 0 to 19 is projected to be 31.9% in this territory, and 19.5% for Québec. According to ISQ demographic projections, the Eeyou Istchee Baie-James territory will have one of the lowest average ages of the MRCs in Québec in 2041, at 35.1 years of age, compared to 45.7 years of age for Québec as a whole (ISQ, 2019).

Education and training

The Cree School Board manages educational services in the Cree communities of the Eeyou Istchee Baie-James territory. In the Cree village of Chisasibi, Waapinichikush Elementary School offers instruction in Cree, English and French to over 700 students. James Bay Eeyou School is also located in the village, with almost 500 students. Sabtuan Adult Education Services offers adult education programs in the Eeyou Istchee Baie-James territory. In Chisasibi, adult education programs are offered at the high school (Cree School Board, 2020). Lastly, there is an early childhood center (CPE) in Chisasibi called the Anjaboway Childcare Centre.

In terms of levels of education, 58.4% of the population aged 15 and over in Chisasibi have no certificate, diploma or degree; that statistic is 44.6% for Nord-du-Québec and 19.9% for the province of Québec as a whole (see Table 5-28). The percentage of the population whose highest level of education achieved is a high school diploma or equivalent certificate is twice as high in the province of Québec (21.5%) as in Chisasibi (10.7%), while it is 14.9% in Nord-du-Québec. While 58.5% of the population of Québec holds a postsecondary certificate, diploma or degree, that percentage is 30.9% for Chisasibi and 40.6% for Nord-du-Québec (Statistics Canada, 2017*a*).

Table 5-28: Level of education in Chisasibi compared to Nord-du-Québec and the province of Québec (2016 census)

Highest level of education achieved [a]	Chisasibi (%)	Nord-du-Québec (%)	Province of Québec (%)
No certificate, diploma or degree	58.4	44.6	19.9
High school diploma or equivalent certificate	10.7	14.9	21.5
Postsecondary certificate, diploma or degree	30.9	40.6	58.5
Apprenticeship or trades certificate or diploma [b]	*9.2*	*18.7*	*16.9*
College, CEGEP or other non-university certificate or diploma [b]	*11.2*	*12.1*	*17.6*
University certificate, diploma or degree at bachelor level or above [b]	*3.0*	*2.4*	*3.6*
University certificate, diploma or degree at bachelor level or above [b]	*7.4*	*7.3*	*20.5*

a. Population aged 15 or older.
b. Data from "Postsecondary certificate, diploma or degree" category.

Source: Statistics Canada, 2017*a*.

Economy and employment

Data from Statistics Canada (2017*a*) presented in Table 5-29 show, in Chisasibi and in the province of Québec as a whole, similar participation rates with 63.4% and 64.1% respectively, while this rate is higher in the Nord-du-Québec region (68.1%). Chisasibi has a lower employment rate (53.3%) than Nord-du-Québec (59.3%) and Québec as a whole (59.5%). The unemployment rate is clearly higher in Chisasibi (16.0%) and Nord-du-Québec (13.0%) than in Québec as a whole (7.2%). For the community of Chisasibi, it is possible to infer that this employment rate, combined with a high activity rate, is typical of an economic context where seasonal or short-term jobs and periods of unemployment alternate among the members of the community. According to 2016 census data, the average total household income in 2015 was $120,210 in Chisasibi, while it was $92,866 in Nord-du-Québec and $77,306 in the province of Québec as a whole (Statistics Canada, 2017*a*; 2017*b*).

Table 5-29: Labor market participation rate, employment rate, unemployment rate and average annual income in Chisasibi, compared to Nord-du-Québec and the province of Québec (2016 census)

Parameter	Chisasibi	Nord-du-Québec	Province of Québec
Participation rate (%)	63.4	68.1	64.1
Employment rate (%)	53.3	59.3	59.5
Unemployment rate (%)	16.0	13.0	7.2
Total average household income in 2015 ($)	120,210	92,866	77,306

Sources: Statistics Canada, 2017*a*, 2017*b*.

The main economic vocation of the Nord-du-Québec region relates to the harvesting and processing of natural resources. Mining is an economic sector that is characteristic of this region. In 2020, the primary sector accounted for four times the proportion of jobs observed for Québec as a whole (9.4% compared to 2.3%). The portion of employment in manufacturing and construction was 13.9% and 3.8% respectively, compared to 11.8% and 6.3% for the province as a whole. In this region of Québec, natural resource processing accounts for most manufacturing jobs. As for the tertiary sector, it represented 72.4% of jobs in the region in 2019, a lower proportion than that recorded in Québec as a whole (79.9%) (MEI, 2020).

More locally, employment in Chisasibi is primarily associated with education, law, social, community, and government services (19.1%), management (6.8%), sales and service (23.1%), business, finance, and administration (13%), along with trades, transport, machinery, and related occupations (16.2%) (Statistics Canada, 2017*a*).

In addition to wage-paying jobs, hunting, fishing, trapping and other traditional activities are part of the economy of the community of Chisasibi. They provide food and resources for many families, but they are also a source of income, particularly through the Economic Security Program for Cree Hunters. In 2017–2018, 552 Chisasibi units or families benefited from this program, including 717 adults and 250 children (OSRCPC, 2018). In addition to these adults, whose main occupation is hunting and trapping, the community has several hunters, trappers and fishermen who are active in season. In 2020-2021, the Chisasibi Cree Trappers' Association (CTA) had over 2,000 members, including 1,941 adults and 79 juniors (CTA, 2021).

Health and social services

The Cree Board of Health and Social Services of James Bay (CBHSSJB) is responsible for the administration of health and social services in the Eeyou Istchee Baie-James territory. The CBHSSJB manages a Community Miyupimaatisiiun Centre (CMC) in each of the nine Cree villages. A CMC is similar to integrated health and social services centers elsewhere in Québec and offers general medicine, home care, dental care, as well as social and paramedical services. In addition to the CMCs, CBHSSJB operates the Chisasibi Regional Hospital Centre, group homes for at-risk youth, a public health department and a program planning unit (CBHSSJB, 2020).

The Chisasibi Regional Hospital Centre provides health care and community health services to the population of Chisasibi as well as other Cree communities. This facility also offers emergency medical services, dental care, pharmaceutical care and medical imaging services. A new regional health center will be built by 2025. It will combine a hospital to serve the population of the Eeyou Istchee Baie-James territory and a community health center to provide front-line and community health services to the population of Chisasibi. This new 52-bed facility should include telehealth facilities and offer a full range of services (ambulatory services, hospitalization, technical platform, traditional care, social services, support, administration and teaching; MSSS, 2022). Eventually, users will be able to access a wide range of care and services without having to travel outside their region. Currently, the closest regional hospital is in Val-d'Or, located more than 1,000 km away.

In addition to the hospital and CMC, Chisasibi has a Multi-Service Day Centre (MSDC), which is a place of gathering, healing, and learning (CBHSSJB, 2020). Programs are tailored to people in social isolation, seniors, adults with special needs and people with mental health issues. Chisasibi also has an adolescent rehabilitation center, the Weesapou Group Home, which provides support to at-risk youth. This center contributes to the protection, rehabilitation and well-being (physical, mental, emotional and spiritual) of the youth under its care. In Chisasibi, the home has eight beds, including one emergency bed (CBHSSJB, 2020). Lastly, the Chisasibi Elders' Home is designed for seniors and all those who have lost their independence, providing an assisted living environment where they receive the support they need to live life to the fullest. There, they enjoy a high quality of life and care, engage in Cree lifestyle activities, and are able to interact meaningfully with family and staff (CBHSSJB, 2021).

5.5.3.2 Non-Indigenous communities

Population

In 2020, the Baie-James region population was 13,470. The Jamesian population is spread out in the municipalities of Matagami, Chapais, Chibougamau and Lebel-sur-Quévillon, as well as the villages of Radisson, Valcanton and Villebois. The proportions of people under 15 years of age and from 15 to 64 years of age are slightly higher in the Baie-James region (21.8% and 61.8%) than in the province of Québec (16.3% and 65.4%). On the other hand, the proportion of people over 65 years of age is lower in the Baie-James region (16.4%) than in the province as a whole (18.3%) (see Table 5-30; ISQ, 2021).

According to Statistics Canada data, the village of Radisson, located over 100 km northwest of the study area, had a population of 468 in 2016. From 2011 to 2016, the population of this village increased by 73.3%, an exponentially larger change than the population of the province of Québec (3.3%) for the same period (Statistics Canada, 2017*c*).

Table 5-30: Sociodemographic data for Radisson and the Baie-James region compared to the province of Québec

Parameter	Radisson (2016)	Baie-James region (2020)	Province of Québec (2016)
Population in 2016	468	13,470	8,164,361
Population in 2011	270	N/A	7,903,001
Change in population from 2011 to 2016 (%)	73.3	N/A	3.3
Percentage of population aged 0 to 14	N/A	21.8 (0–19 years of age)	16.3
Percentage of population aged 15 to 64	N/A	61.8 (20–64 years of age)	65.4
Percentage of population aged 65 or older	N/A	16.4	18.3
Average age	N/A	N/A	41.9

N/A: Not available.
Sources: ISQ (2021); Statistics Canada, 2017*c*.

Household information for the village of Radisson and the Baie-James region is not available. Data for Radisson are considered too unreliable to be published on the Statistics Canada website (2017*c*).

Demographic projections

According to the Institut de la statistique du Québec (ISQ), the population of the Baie-James region will decrease from 14,400 inhabitants in 2016 to 12,800 in 2041, which represents a 9.0% decrease. Like the population of the province of Québec, the population of the Baie-James region as a whole will age over the next 25 years. According to ISQ demographic projections, by 2041, the Baie-James region will have an average age of 44.2, compared to 45.7 for the entire province (ISQ, 2019).

Education and training

The Centre de services scolaires de la Baie-James (CSSBJ) manages educational services for Jamesians. In the village of Radisson, the Jacques-Rousseau School offers primary and secondary education (CSSBJ, 2020). There is also an early childhood center (CPE) called Le Jardin du Nord.

In terms of level of education, Radisson and the province of Québec have relatively similar percentages of population with no certificate, diploma or degree (12.2% and 19.9% respectively); this statistic is 44.6% for Nord-du-Québec (see Table 5-31). The percentage of the population whose highest level of education achieved is a high school diploma or equivalent certificate is 24.4% in Radisson, 19.9% in the province of Québec as a whole, and 14.9% in Nord-du-Québec. While 40.6% of the population in the Nord-du-Québec region holds a postsecondary certificate, diploma or degree, this percentage is even higher in Radisson, at 63.4%, and 58.5% in Québec as a whole (Statistics Canada, 2017*c*). While college and university graduation rates are similar in

Radisson, Nord-du-Québec and Québec as a whole, Radisson stands out in the certificate, apprenticeship or trade school diploma category with a rate of 34.1%, compared to 18.7% in Nord-du-Québec and 16.9% in Québec as a whole.

Table 5-31: Level of education in Radisson compared to Nord-du-Québec and the province of Québec (2016 census)

Highest level of education achieved	Radisson (%)	Nord-du-Québec (%)	Province of Québec (%)
No certificate, diploma or degree	12.2	44.6	19.9
High school diploma or equivalent certificate	24.4	14.9	21.5
Postsecondary certificate, diploma or degree	63.4	40.6	58.5
Apprenticeship or trades certificate or diploma[b]	*34.1*	*18.7*	*16.9*
College, CEGEP or other non-university certificate or diploma[b]	*14.6*	*12.1*	*17.6*
University certificate, diploma or degree at bachelor level or above[b]	*4.9*	*2.4*	*3.6*
University certificate, diploma or degree at bachelor level or above[b]	*12.2*	*7.3*	*20.5*

a. Population aged 15 or older.
b. Data from "Postsecondary certificate, diploma or degree" category.
Source: Statistics Canada, 2017*c*.

Economy and employment

Data from Statistics Canada (2017*c*) presented in Table 5-32 shows that the participation rate in Radisson is much higher (90.2%) than the rates for Nord-du-Québec (68.1%) and the province of Québec (64.1%). The same is true for the employment rate, which is 90.2% in Radisson, while it is 59.3% in Nord-du-Québec and 59.5% in the province of Québec as a whole. The unemployment rate is clearly higher in Nord-du-Québec (13.0%) as compared to the province of Québec (7.2%). We also note that Radisson has a significantly lower unemployment rate than the region and the province as a whole (5.4%).

Table 5-32: Labor market participation rate, employment rate, unemployment rate and average annual income in Radisson 2015, compared to Nord-du-Québec and the province of Québec

Parameter	Radisson[a]	Nord-du-Québec	Province of Québec
Participation rate (%)	90.2	68.1	64.1
Employment rate (%)	90.2	59.3	59.5
Unemployment rate (%)	5.4	13.0	7.2
Total average household income ($)	N/A	92,866	77,306

N/A: Not available.
a. Information for the village of Radisson is from sample data (25%).

Source: Statistics Canada, 2017*c*.

The main characteristics of the Nord-du-Québec economy were presented in Section 5.5.3.1. In terms of the local economy, Radisson is inhabited by workers who, for the most part, are associated with Hydro-Québec projects (village of Radisson, 2020).

Health and social services

The Centre régional de santé et de services sociaux (CRSSS) de la Baie-James (James Bay regional health and social services center) provides health and social services to the population of Nord-du-Québec. The CRSSS de la Baie James has facilities in five municipalities and villages in the region, including Radisson. The administrative center is located in Chibougamau. In Radisson, there is a health center where a family physician is assisted by a locum tenens. The emergency department at Centre de santé de Radisson has low patient numbers, and also acts as a walk-in clinic (CRSSS de la Baie-James, 2020; village of Radisson, 2020).

5.5.4 Heritage and archaeology

The study site is located on the boundary between the Grande Rivière watershed to the north and the Rivière Sakami watershed to the south. Based on available geo-morphological data, the study area was covered by the Tyrrell Sea approximately 8,350 years BP (Archaeotec, 2021:3). Approximately 7,400 years BP[1], marine regression had begun, and approximately 6,500 years BP, the study area was free of marine and glaciofluvial influences. The environment gradually became habitable for human groups after vegetation and various animal populations began to appear. Climatic fluctuations, particularly temperature and precipitation, have played a significant role in the presence and density of animal populations and survival of human groups.

According to the synthesis of archaeological and ethnohistorical data of the La Grande complex by the Cree Regional Authority (1985), the cultural chronological sequence of the territory is divided into four major periods:

- Early phase (3,500–1,500 years BP)
- Recent prehistory (1,500–300 years BP)
- Historical period (300–100 years BP)
- Modern and contemporary period (100 years BP to present)

According to archaeological digs carried out in the areas affected by the La Grande complex, human presence in the Caniapiscau reservoir dates back approximately 3500 years BP. In the La Grande-3 development and study areas, the first settlements date back to recent prehistory, around 660 years BP (Archéotec, 2009).

1. BP: before present, which is a dating indication based on the number of years elapsed from a constant reference point set by convention at 1950 A.D.

With the arrival of the Europeans 300 years ago, traditional tools were slowly replaced by goods from Canadian and European manufacturers. At the turn of the 20th century, about 100 years ago, several groups of hunters shared the Grande Rivière watershed. In the 1930s, following a decline in the number of beavers in Québec's forests, the Government of Québec, with federal government assistance, created beaver reserves. These are specific trapping territories, some of which are exclusive to Indigenous people because furbearer trapping is the basis of their food and income (Lebeuf-Paul, 2018). Each beaver reserve was subdivided into traplines and a tallyman was appointed to be responsible for beaver harvesting on each trapline (Nove Environnement, 2004). Today, Québec is divided into 96 furbearer management units (UGAF, unités de gestion des animaux à fourrure). In FMUs 6, 7 (except for the wildlife reserve), 29, 31, 32, 50, 56 and 87 to 96, trapping is reserved exclusively for (Indigenous) persons covered by the *Regulation respecting beaver reserves* and the *Act respecting hunting and fishing rights in the James Bay and New Québec territories* (MFFP, 2022).

Construction of La Grande complex hydroelectric facilities began in 1973 and the Phase I facilities, such as La Grande-3 generating station, were completed in 1985. Since Route Billy-Diamond opened, linking Matagami and Radisson, the region is also frequented by tourists, hunters and fishermen.

5.5.4.1 Known archaeological data

According to the *Inventaire des sites archéologiques du Québec* (ISAQ) maintained by the Ministère de la Culture et des Communications (MCC), no archaeological sites are known to exist in or near the study area (Archéotec, 2021:25).

The Société de développement de la Baie-James (SDBJ) and Hydro-Québec conducted several archaeological investigations in the 1970s and 1980s in the area where Robert-Bourassa and La Grande-3 developments are located. Most of the known sites were found along large rivers or on the shores of large lakes (see Figure 3.1 in Appendix H and Table 5-33).

Of the known archaeological sites in the La Grande-3 development area, 11 have a recent prehistoric component. These sites contain lithic materials such as quartz, Mistassini quartzite and chert. Only one archaeological site (FjFw-01) was excavated in 1980. This site illustrates the prehistoric archaeological wealth of the region, but also the continuous presence of the Crees from recent prehistory to the contemporary period. The remainder of the known archaeological sites in the area are associated with the historic (recent settlement) and contemporary periods.

Table 5-33: Known archaeological sites around the study area, in the Robert-Bourassa and La Grande-3 development areas

Site	Altitude in relation to the body of water (m)	Distance from body of water (m)	Period	Reference	Intervention
FiFw-01	5.00	4.50	Prehistoric	Séguin, 1979	Surface harvesting
FiFw-02	–	–	Contemporary	Séguin, 1979	Surface harvesting
FiFw-03	–	–	Contemporary	Séguin, 1979	Surface harvesting
FiFw-04	–	–	Contemporary	Séguin, 1979	Surface harvesting
FiFw-05	–	–	Contemporary	Séguin, 1979	Surface harvesting
FiFw-06	–	–	Contemporary	Séguin, 1979	Surface harvesting
FiFw-07	–	–	Contemporary	Séguin, 1979	Surface harvesting
FiFw-08	–	–	Contemporary	Séguin, 1979	Surface harvesting
FiFw-09	–	–	Contemporary	Séguin, 1979	Surface harvesting
FiFw-10	–	–	Contemporary	Séguin, 1979	Surface harvesting
FiFw-11	–	–	Contemporary	Séguin, 1979	Surface harvesting
FiGc-01	1.70	7.80	Contemporary	Desjardins, 1974	Surface harvesting
FiGd-01	0.50	5.00	Contemporary	Desjardins, 1974	Surface harvesting and soundings
FiGd-02	1.50	15.20	Contemporary	Desjardins, 1974	Surface harvesting and soundings
FiGd-03	0.30	3.80	Contemporary	Desjardins, 1974	Surface harvesting and soundings
FiGd-04	3.15	15.00	Contemporary	Desjardins, 1974	Surface harvesting and soundings
FiGd-05	2.00	11.00	Contemporary	Desjardins, 1974	Surface harvesting and soundings
FiGd-06	1.06	11.00	Contemporary	Desjardins, 1974	Surface harvesting and soundings
FiGd-07	2.45	24.85	Contemporary	Desjardins, 1974	Surface harvesting and soundings
FiGd-08	2.00	23.00	Contemporary	Desjardins, 1974	Surface harvesting and soundings
FiGd-09	1.38	8.70	Contemporary	Desjardins, 1974	Surface harvesting and soundings
FjFw-01	2.00	5.00	Prehistoric	Mandeville and Séguin, 1980; Cérane, 1982	Digs
FjFw-01	2.00	5.00	Recent settlement	Mandeville and Séguin, 1980; Cérane, 1983	Soundings
FjFw-02	1.50	7.00	Recent settlement; wooden winter camp	Séguin, 1979	Soundings
FjFw-02	1.50	7.00	Prehistoric	Séguin, 1979	Soundings
FjFw-03	1.00	Bank	Contemporary	Séguin, 1979	
FjFw-04	0.50	Range	Contemporary	Séguin, 1979	Information
FjFw-05	–	Bank	Contemporary	Séguin, 1979	
FjFw-06	–	–	Contemporary	Séguin, 1979	
FjFw-07	–	–	Contemporary	Séguin, 1979	
FjFw-08	–	–	Contemporary	Séguin, 1979	Information

Table 5-33: Known archaeological sites around the study area, in the Robert-Bourassa and La Grande-3 development areas (*cont.*)

Site	Altitude in relation to the body of water (m)	Distance from body of water (m)	Period	Reference	Intervention
FjFw-09	–	–	Contemporary	Séguin, 1979	Information
FjFw-10	–	–	Contemporary	Séguin, 1979	Information
FjFw-11	–	–	Contemporary	Séguin, 1979	Information
FjFw-12	–	–	Contemporary	Séguin, 1979	Information
FjFw-13	–	–	Contemporary	Séguin, 1979	Information
FjFw-14	–	–	Contemporary	Séguin, 1979	Information
FjFw-15	–	–	Contemporary	Séguin, 1979	
FjFw-16	–	–	Contemporary	Séguin, 1979	
FjFw-17	–	–	Contemporary	Séguin, 1979	Information
FjGc-01	–	–	Prehistoric	Watson, 1974	Surface harvesting
FjGc-02	–	–	Prehistoric	Watson, 1974	
FjGc-06	–	–	Prehistoric	Watson, 1974	Surface harvesting
FjGc-07	–	–	Contemporary	Watson, 1974	
FjGd-01	–	–	Prehistoric	Watson, 1974	Surface harvesting
FjGd-02	–	–	Prehistoric	Watson, 1974	Surface harvesting
FjGd-03	–	–	Prehistoric	Watson, 1974	Surface harvesting and soundings
FjGd-08	–	–	Prehistoric	Watson, 1974	Surface harvesting and soundings
FjGf-01	–	–	Prehistoric	Watson, 1974	Surface harvesting and soundings

An archaeological survey was conducted 8 km south of the study area by Cérane in 1990 during the construction of the northern section of the 12th 735-kV transmission line, between Chissibi, Albanel and Chibougamau substations. This inventory led to the discovery of a contemporary Indigenous site (FjGa-1, 33F09) on the south bank of a small stream belonging to the Lac Bonfait drainage system, on trapline VC24. The site consists of an imposing dwelling structure with a porch and a latrine (Cérane, 1990). The dwelling would date from 1987–1988 and would have been occupied mainly in winter. This site was not selected as an archaeological site by the ISAQ.

There are no heritage sites listed or classified in the Registre du patrimoine culturel du Québec [Québec cultural heritage register] in the study area.

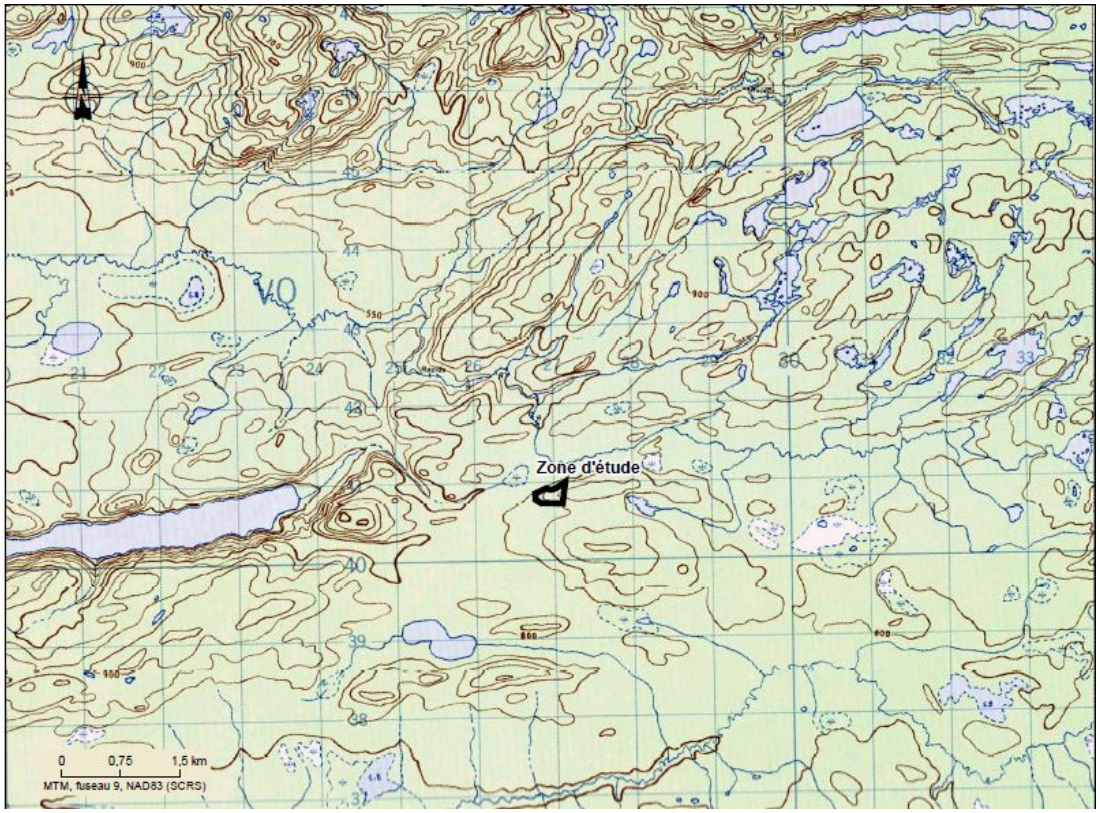
5.5.4.2 Overview of archaeological potential in the area by affected by work

The archaeological potential of the study area, including the quarry and access roads, was validated by a potential study prepared by Archéotec (2021) and presented in Appendix H. This study did not identify any areas of archaeological potential within the study area. Similarly, in the archaeological potential study and inventory of the rights-of-way for the two 735-kV lines (circuits 7057 and 7059) conducted by Cérane in 1990, no areas with archaeological potential were identified in the proposed quarry study area.

Indeed, before the hydroelectric developments of the 1970s, the study area was a linear mound, composed of rock outcrops and surrounded by peat bogs. The study area was not located near a body of water (see Figure 5-2, dated 1965). Possible travel routes based on local lithic resources, workcamps or portage areas were established a few kilometres north and south of the study area (Archéotec, 2021; Cérane, 1990). An analysis of the meaning of the place names and travel routes recorded from Cree informants reflect what activities were practised in the historical and contemporary periods and lead us to conclude that the study area does not have any particular significance.

The study area has no characteristics of known archaeological sites in the area; therefore it cannot be considered an area of archaeological interest.

Figure 5-2: Study area environment prior to hydroelectric development



Source: Department of Energy, Mines and Resources, Ottawa, topographic map 33F/09 – Edition 1, 1965 (from Archéotec, 2021).

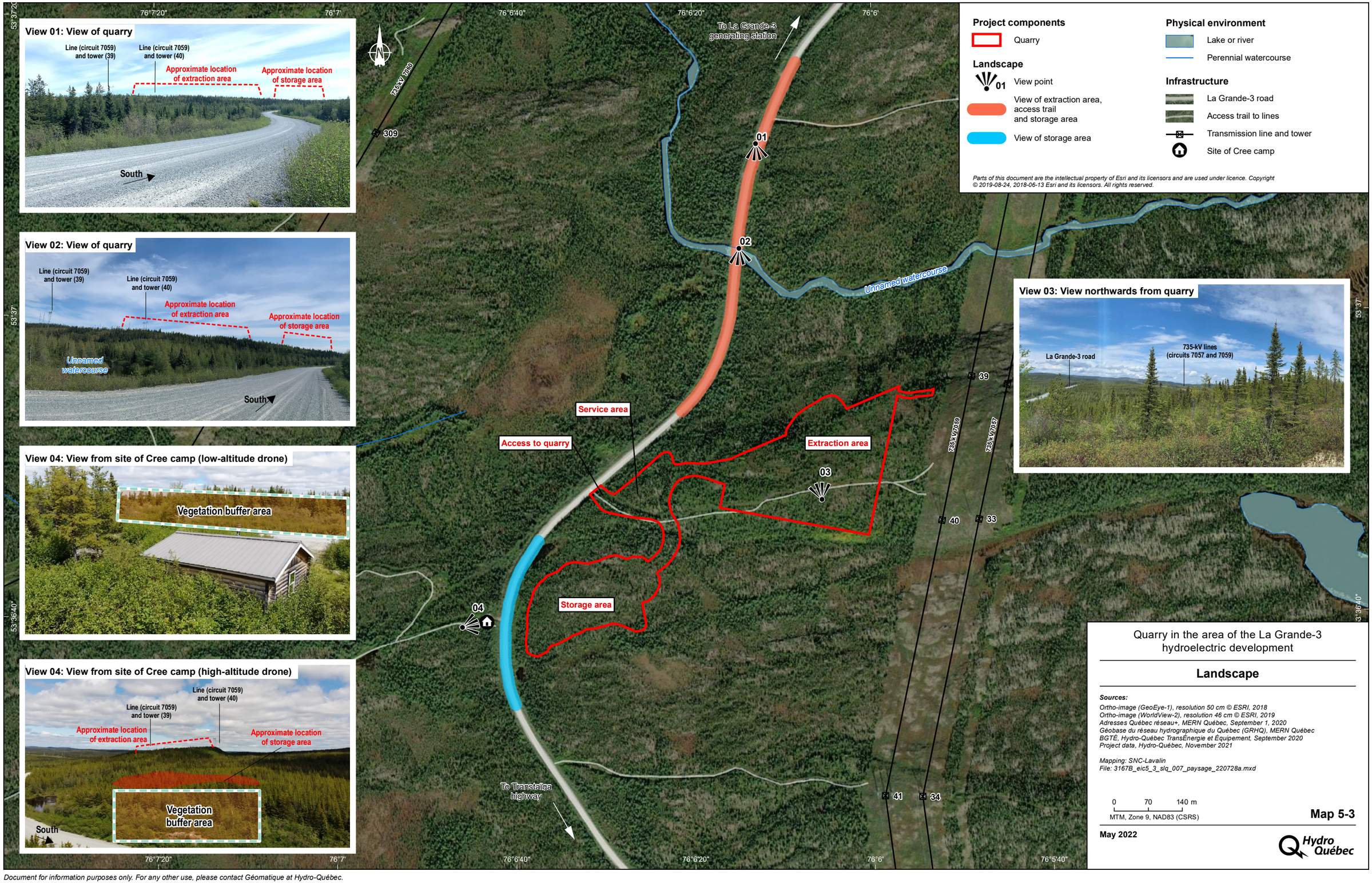
5.5.5 Landscape

The landscape study is based on the intrinsic characteristics of the study area's landscape, along with the values and concerns of the populations and users involved, namely the Cree users, since they are the main users of the area, apart from Hydro-Québec employees. It is inspired by the *Méthode d'étude du paysage pour les projets de lignes et de postes* [Landscape study method for transmission line and substations] (Hydro-Québec, 1993), but was adapted since this project is a one-time development and not a linear one. The landscape study focuses on describing the visual fields from the main points of interest in the study area (see Map 5-3). The points of interest include Cree and non-Indigenous access routes, as well as Cree and non-Indigenous sites of interest.

5.5.5.1 Cree landscape design and appreciation

The concept of landscape among the Crees is based on the notions of territory and its integrity, whether in terms of wildlife resources or any natural resource essential to traditional Cree activities. It is also based on the notions of a sense of belonging and collective identity. The Crees' value in the landscape is often linked to the presence of wildlife resources of interest to them. Appreciation of the landscape also includes a sacred or spiritual dimension linked to the original natural landscape, and any modification generated by the harvesting the territory may alter this dimension (Hydro-Québec, 2017).

In an interview with the CH40 trapline tallyman, he identified the locations he values in the proposed quarry area. The places he values are directly linked to the hunting and fishing activities practised on the territory. These sites are concentrated to the north of the proposed quarry site. Within a 5-km radius of the quarry, the sites are spread out on either side of the La Grande-3 road, north of the quarry site. During the interview, the tallyman did not mention any points of interest or valued landscapes in the study area, nor from his camp located at kilometre 7 of the La Grande-3 road. The landscape in the study area is described by the tallyman as being populated by black spruce; he did not identify any particular landscape characteristics. The landscape of the study area is homogeneous, with a relatively dense forest cover that offers few visual openings on the territory.



Quarry in the area of the La Grande-3 hydroelectric development

Landscape

Sources:

Ortho-image (GeoEye-1), resolution 50 cm © ESRI, 2018
Ortho-image (WorldView-2), resolution 46 cm © ESRI, 2019
Adresses Québec réseau+, MERN Québec, September 1, 2020
Géobase du réseau hydrographique du Québec (GRHQ), MERN Québec
BGTÉ, Hydro-Québec TransÉnergie et Équipement, September 2020
Project data, Hydro-Québec, November 2021

Mapping: SNC-Lavalin
File: 3167B_eic5_3_slq_007_paysage_220728a.mxd

0 70 140 m
MTM, Zone 9, NAD83 (CSRS)

Map 5-3

May 2022

Hydro Québec

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5.5.5.2 Regional landscape

Based on ecological classification reference developed by the MELCC, the study area is part of the hills of the Grande Rivière natural province. This province consists of rolling plains with numerous scattered barren rocky surfaces. The eastern portion is characterized by mounds and low, very close hills. Elevations range from sea level on the shores of the bays to 600 m at the base of the Monts Otish in the southeastern tip of the province.

Generally east-west in orientation, the hydrographic system is dense and almost parallel. The vegetation is dominated by open black spruce-lichen forests in the south and center, while forest tundra occurs in the north. Finally, numerous burns and extensive barrens from former fires occupy significant areas of this natural province (Li et al., 2019).

The study area is part of the structural depression of Grande Rivière, characterized by this major watercourse and its developed reservoirs. The proposed quarry site is located between the vast Robert-Bourassa and La Grande 3 hydroelectric reservoirs.

5.5.5.3 Study area landscape

The landscape of the study area is characteristic of the Québec taiga. The vegetation is dominated by black spruce, lichen and moss. Open coniferous forests occupy a large proportion of the study area, which contributes to the limited openings on the landscape. The study area includes several wetlands, a few streams and two small bodies of water (see Map A, in pocket). The largest stream is located north of the proposed quarry site. The La Grande-3 road crosses this unnamed watercourse, which is one of the main natural visual landmarks of the study area. Elevations in the study area range from 190 m to 290 m. There are also a few low hills, including the one most directly affected by the proposed quarry, which reaches nearly 280 m. The northern slope of this hill, where the quarry will be partially located, is particularly exposed due to a 50-m difference in elevation between the top of the hill and the stream below.

The La Grande-3 road along with the two power line rights-of-way intersect the study area from north to south, and testify to the vast presence of Hydro-Québec's energy production infrastructures in the region. These elements are the main visual landmarks of the study area, especially the rights-of-way for the two 735-kV lines (circuits 7057 and 7059), which the La Grande-3 road intersects twice, thus offering vista clearings on portions of the territory. Some of the towers on the 735-kV lines in the study area are visible from the La Grande-3 road. Towers 32 and 33 (circuit 7057), as well as towers 39 and 40 (circuits 7059), located directly east of the proposed quarry site are especially visible from the road, since it runs at a high elevation through the study area (280 m).

5.5.5.4 Observers' visual fields

The La Grande-3 road is the main route into the area. In addition to providing access to Hydro-Québec facilities (La Grande-3 generating station), it also provides access to recreational activities further north and to the tallyman's CH40 trapline. This roadway is the primary source of potential observers in the study area. The visual field of the observers who use the La Grande-3 road and study area is generally closed due to the dense coniferous forests that cover most of the area. There may be occasional vista clearings in the study area, particularly from certain high points or at the intersection of the La Grande-3 road and Hydro-Québec's 735-kV power line rights-of-way (circuits 7057 and 7059). Observers are mostly mobile and random. Users of the camp located on trapline CH40 and along the La Grande-3 road (kilometre 7) are the only fixed observers in the study area.

6 Impact analysis

6.1 Impact assessment method

The impact assessment was conducted according to the methodology presented in Appendix I.

The purpose of the impact assessment is to determine the significance of the impacts this project would have on environmental components during its construction (development) and operation. The assessment takes general and special mitigation measures into account, and covers both the positive and negative impacts of the project. The significance of an impact is determined based on three criteria: intensity, extent and duration of the impact. The impact assessment begins by identifying the sources of the project's impact on the environment and components of the biophysical and human environment that may be affected. Only the valued components of the environment for which an impact is anticipated are assessed. The selection rationale used to select components for the assessment, which is also based on project issues, is stated before the impact assessment method is applied.

The method for assessing impact significance distinguishes between modifications to components of the physical environment and the impacts these modifications have on the biological and human environments. The physical modifications are described in terms of their intensity, extent and duration, but their significance is not qualified. The impacts of these modifications can be mitigated by applying general or special mitigation measures. The significance of the impacts is assessed based on the components of the biological and human environments, since they are affected, both negatively and positively, by the physical modifications of the environment caused by the project.

The impact assessment is based on technical project data, scientific documentation, Hydro-Québec's relevant experience, and an analysis of the components of the bio-physical and human environments.

General mitigation measures and project-specific measures are identified prior the residual project impact assessment. Mitigation measures are designed to reduce negative project impacts.

Hydro-Québec has a number of tools to determine the general or specific mitigation measures for a project, including *Standard Environmental Clauses* (SECs), which is a document that groups together a series of measures that contractors responsible for carrying out construction work for Hydro-Québec must implement. Hydro-Québec also incorporates mitigation measures into request for proposals documents relating to the project, to ensure that they are implemented on the work site.

For this project, the phases considered for impact assessment include the development, operation, maintenance and closure of the quarry. Impacts are classified according to their significance as major, moderate or minor.

The environmental overview, presented in Chapter 8, summarizes the environmental assessment and renders a global decision regarding the residual impacts of the project, both positive and negative.

The environmental assessment includes the development of an environmental compliance monitoring program with the following objectives:

- Identify the main activities, steps or sources of impact to be subject to environmental compliance monitoring in the field.
- Enforce application of the recommendations and measures stipulated in the environmental impact statement and request for proposal documents on the work site.

Hydro-Québec may also establish an environmental monitoring program, depending on the type and scope of issues raised. Monitoring consists in checking the project's actual impact on the environment, measuring the effectiveness of specific mitigation measures and implementing any corrective actions necessary.

6.2 Issues

In the directive sent to Hydro-Québec, the Ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC) and the Comité d'évaluation des répercussions sur l'environnement et le milieu social (COMEV) have raised certain environmental, social and economic issues to be considered during the implementation of the quarry project:

- Preservation and protection of water resources
- Protection of wetlands and aquatic environments
- Protection of flora, fauna and their habitats, in particular species at risk or species of interest to the Cree
- Preservation of the quality of the atmosphere
- Reduction of dust and noise nuisances
- Reduction of greenhouse gas emissions (GHGs) and adapting to climate change
- Land user safety
- Access, use and occupation of the territory by the Cree
- Hiring and training in the Cree community
- Maintenance of the aesthetic quality of the landscape

Taking into account the proposed project, the knowledge acquired about the host environment and the knowledge gained from meetings Hydro-Québec held with the communities and other stakeholders, the main issues at stake in the quarry project are as follows:

- Preservation of the quality of the surface water and drainage
- Protection of wetlands
- Survival and movement of land animals and birds, including special-status species
- Reduction of dust and noise nuisances
- Reduction of GHG emissions and adapting to climate change
- Maintenance of public safety
- Reconciliation between land uses and the Cree's traditional activities
- Economic spinoffs in Cree communities
- Maintenance of landscape quality

The valued environmental components targeted for impact analysis are related to project issues. These issues are presented in the paragraphs hereunder.

Preservation of the quality of the surface water and drainage

The MELCC directive specifies that surface water flow and the conservation and protection of water resources are issues. Thus, the current status of these components must be assessed and the impacts of the project on them must be measured.

In addition, consultations with local communities indicate a concern on the part of the Council of the Cree Nation regarding the availability and quality of natural water sources for trappers operating on territories located far from the community. The Council wants to ensure that the project will not alter the water sources used by families in the area.

Protection of wetlands

The MELCC directive specifies that impacts such as the loss or modification of wetlands and, where applicable, fish habitats, as well as the effects on plant species, particularly species at risk or of interest to the Crees, must be assessed during the proposed quarry development and operation phases.

Survival and movement of land animals and birds, including special-status species

According to the MELCC directive, some of the elements for which the project impacts must be assessed include the survival and movement of land animals and birds, as well as the destruction or modification of their habitats or the habitats of species at risk, most specifically species of interest to the Cree. Special-status species are also legally protected by the provincial *Act respecting threatened or vulnerable species* and federal *Species at Risk Act*.

Special-status species including caribou (woodland ecotype and migratory ecotype), birds, small mammals and bats are valued components that the environmental and social impact assessment for the quarry project must take into account. Caribou was retained for the impact analysis because this species is valued by the Cree. The woodland ecotype has a double legal protection status (provincial and federal) and anthropogenic activities are known for their negative influence on caribou behavior.

Migratory and special-status birds were also selected as valued components. Habitat loss and land clearing are threats to these groups, especially during the nesting season.

Special-status bats were selected as a valued component because habitat loss is one of the major threats to this group. Furthermore, the little brown bat and hoary bat, two special-status species that have been confirmed in the area, are likely to breed in the biophysical environment inventory area.

Reduction of dust and noise nuisances

Industrial projects must demonstrate that they preserve air quality, and proposed quarries are required to limit the dust and noise nuisances they cause. This concern was also raised during the public consultations. In this regard, the MELCC directive indicates that mitigation measures must be implemented to limit project impacts on the quality of the atmosphere, including dust and noise.

According to the *Regulation respecting sand pits and quarries* (Chapter VI, Division I, s. 25), a predictive noise climate study is required when a quarry site is proposed within 600 m of a dwelling or public facility. In the meaning of this regulation, the tallyman's camp does not meet the definition of a dwelling, i.e., a structure intended to house people and that is connected to individual or collective drinking water supply and wastewater treatment systems. Thus, no dwelling or public establishment is located within a 600-m radius of the proposed quarry. That said, a new camp will be built for the tallyman away from the proposed quarry for compensation purposes, and so that he will not be subjected to the nuisances associated with the operation of the proposed quarry (noise, dust, increased road traffic). Consequently, it is not necessary to assess the noise emitted by the quarry, since the noise climate is not included as a valued component. However, the quarry operator will have to comply with legislation relating to worker health and safety and implement Hydro-Québec's Standard Environmental Clause 2.

With regard to dust, given the absence of sensitive receptors in the vicinity of the quarry, an atmospheric emissions dispersion study is not required. Therefore, only air quality was selected as a valued component for this issue.

Reduction of GHG emissions and adapting to climate change

Reducing GHGs and adapting to climate change are objectives that contribute to the protection of the environment and species, human health and quality of life. In 2020, Québec adopted the *2030 Plan for a Green Economy*, in which it committed to an ambitious project to electrify the economy and fight climate change (Government of Québec, 2020). The reduction of GHG emissions is one of the primary measures recommended in the fight against climate change. Québec has committed to GHG reduction targets that challenge the entire industrial sector.

These objectives are in line with one of the issues of the quarry project in the La Grande-3 development area. Indeed, the development and operation of the proposed quarry involving GHG emitting activities, maintaining reduced GHG emissions and the fight against climate change are valued components of the project under study.

Maintenance of public safety

The MELCC directive stipulates that part of the fundamental purpose of an environmental assessment is to protect human life, health, safety, well-being and comfort. The quarry project in the La Grande-3 development area is located far from municipalities and Cree villages. It is therefore not expected to have any impacts on the health, well-being or comfort of community residents. However, blasting activities on the quarry site represent the risk of mineral substances being projected off-site. Hauling of aggregates and quarry employee transportation will result in an increase in traffic on the La Grande-3 road. These activities may raise an issue of public safety for Cree and non-Indigenous land users.

Reconciliation between land uses and the Cree's traditional activities

Trapline CH40 users who frequent the line for hunting, fishing, and trapping, are considered mobile observers likely to be in the vicinity of the proposed quarry or to use the road to the quarry. The same is true for owners of resort leases north of the study area, who are likely to use this area from time to time.

The MELCC directive states the importance of taking into account project impacts on access to, use of and occupation of the territory, particularly by the Crees for their traditional activities. The analysis of land use in the context of the project reveals that the study area and proposed quarry site are hunting, gathering and wood cutting areas for the CH40 trapline tallyman and his extended family.

Economic spinoffs in Cree communities

The MELCC directive emphasizes the opportunities that the quarry project potentially represents for the Cree community, i.e., training, hiring or obtaining contracts for Cree individuals or businesses. The subject of contract and employment opportunities was also raised during consultations with the community of Chisasibi. The challenge is to maximize the positive economic spinoffs in the surrounding Cree communities, and more specifically those closest to the project, namely Chisasibi and Wemindji.

Maintenance of landscape quality

The MELCC guideline emphasizes the importance of assessing project impacts on the landscape when elements are added or modified.

Although the CH40 trapline tallyman did not mention any valued landmarks or landscapes in the study area, he did point out several valued locations in the vicinity of the proposed quarry site. Considering that the concept of landscape for the Crees is based on the notions of territory and its integrity, of a sense of belonging and collective identity, and that the appreciation of the landscape has a sacred or spiritual dimension, the landscape has been retained as a valued component in relation to this issue.

6.3 Identification of valued environmental components

The valued environmental components were identified by taking into account elements of the environment deemed important by the various project stakeholders, as well as the considerations of government agencies and those expressed by the MELCC in the project directive.

The following valued environmental components were selected to analyze the anticipated project impacts:

- Soil
- Surface water
- Wetlands
- Caribou (woodland and migratory ecotypes)
- Birds
- Special-status bats
- Air quality
- Reduction of GHG emissions and the fight against climate change
- Public safety
- Cree land use
- Economic spinoffs in Cree communities
- Landscape

For the reasons presented in the paragraphs hereunder, the following environmental components were excluded from the impact assessment.

Special-status vegetation and plant species

The proposed quarry site is characterized by a black spruce-lichen forest and the presence of rock outcrops, which are both extremely common elements in the entire region. The area and the vegetation it supports are little disturbed by human activity, since the site is located outside the territorial limit of attributable forests and is not affected by forestry activity. It should be noted, however, that some tree cutting and rutting resulting from drilling activities on the site were observed. The area cleared for the development of the proposed quarry infrastructure and areas will be 12.4 ha. The primary forest type affected will be an open coniferous forest with moss (11.6 ha) and an open coniferous forest with shrubs (0.8 ha), both dominated by black spruce and jack pine. This area is negligible considering the wooded portion of the study area (nearly 85%) and the absence of anthropogenic disturbance, if we exclude the La Grande-3 road and the three power transmission lines. The Cree community occupying the territory will be offered the harvested timber first, for valorization and reuse. No special-status plant species were identified in the inventory area. For these reasons, this component was not included in the impact assessment.

Aquatic environments and wildlife

No streams were observed in the biophysical environment inventory area during the 2021 field visits. The runoff sometimes observed in the vicinity of the ponds present in marsh WL01-3 and shrub swamp WL03 (see Map 5-2) corresponds to groundwater flow associated with the topography of the area, along with runoff from the embankment and ditch along the La Grande-3 road. This component was not included in the impact assessment.

Land wildlife

No special-status amphibian, reptile or bat species were confirmed to be present in the biophysical environment inventory area or even in the project area, either through inventories conducted as part of this project or from consulting other data sources. Amphibians and reptiles are not included in the impact analysis.

Common land mammal species were also excluded from the impact analysis because they were not associated with any particular issue during the public consultations, and none of the anticipated impacts (e.g., habitat disturbance, loss and alteration, mortality due to machinery and vehicles) are likely to substantially alter the abundance of these species across the project area. Fur-bearing animals have a good ability to move and disperse. As for micromammals, they have reproduction rates that make them relatively insensitive to minor environment changes; in the vast majority of cases, the affected individuals will move to neighboring habitats.

Like common land mammal species, special-status land mammal species are not included in the impact analysis. In the case of the least weasel, even if the species were present on the proposed quarry site, the impacts would be negligible. In fact, given the low density in North America, the few individuals that could be affected would move into the many suitable habitats located in the immediate surroundings of the proposed quarry site. Furthermore, this small member of the weasel family is versatile in terms of habitat use; since it has high reproduction rates when its prey is abundant, its population is relatively insensitive to the environment changes associated with the project.

In addition, the proposed quarry will not impact the rock vole, southern bog lemming or wolverine, three other special-status species of land mammals. In the case of the rock vole, the project footprint does not overlap any potential rock vole habitat. For the southern bog lemming, the project footprint overlaps only one small potential habitat area (0.16 ha), which will not affect the survival of the species on a local scale, considering the presence of many other potential habitats observed in and around the biophysical environment inventory area. As for wolverines, given the size of their home ranges, their movements and their presumed very low population, their presence in the study area and in the biophysical environment inventory area would only be incidental and of very short duration, if at all, which reduces the potential impacts on this predator. Furthermore, the biophysical environment inventory area does not present any particular interest for these species, and even less so since the surface area of the site under study is very small.

Special-status birds

The bird inventory conducted in June 2021 did not reveal the presence of any special-status bird species, so this component is not included in the impact assessment.

Archaeology

The study area does not have archaeological potential, as shown in the archaeological potential study of the study area conducted by Archéotec (2021) and presented in Appendix H.

6.4 Sources of impact

The sources of impact are related to the project implementation stages that could alter the environment in whole or in part, either temporarily or permanently. These sources are defined based on the knowledge of the technical characteristics of the project, the work methods selected to develop the quarry, as well as the operation and closure of the proposed quarry. The main activities that could constitute sources of impact are as follows:

During the development phase:
- Land clearing
- Drilling and blasting
- Crushing and screening
- Development of roads and activity areas
- Transport and traffic
- Accommodation and presence of workers in the Sakami residences
- Employment and purchases of goods and services

During the operation and maintenance phase:
- Drilling and blasting
- Crushing and screening
- Aggregate washing
- Stockpiling of aggregate
- Transport and traffic
- Machinery management and maintenance
- Presence of the quarry and its facilities
- Accommodation and presence of workers in the Sakami residences
- Employment and purchases of goods and services

During the closure phase:
- Restoration
- Reshaping and revegetation of the site

The project implementation stages are presented in Section 3-3. The matrix of impacts (see Table 6-1) presents the interaction between the sources of impact and the valued environmental components.

Table 6-1: Matrix of potential impacts of the project

Valued environmental components	Land clearing	Drilling and blasting	Crushing and screening	Development of roads and activity areas	Transport and traffic	Aggregate washing	Stockpiling of aggregate	Machinery management and maintenance	Presence of the quarry and its facilities	Accommodations and presence of workers	Employment and purchases of goods and services	Site restoration, reshaping and revegetation
Biophysical environment												
Soil	X	X		X	X			X	X			X
Surface water	X	X	X	X	X	X	X	X	X			X
Wetlands	X	X	X	X		X		X	X			X
Caribou (woodland and migratory ecotypes)	X	X	X	X	X							X
Birds	X	X	X	X	X		X					X
Special-status bats	X	X	X									X
Air quality		X	X	X	X		X					
Human environment												
Reduced GHG emissions and the fight against climate change	X	X	X	X	X		X		X	X		X
Public safety		X			X				X	X		X
Cree land use	X	X		X	X				X			X
Economic spinoffs in Cree communities	X								X	X	X	X
Landscape	X			X			X		X			X

6.5 General mitigation measures

Hydro-Québec automatically applies general mitigation measures to reduce the impact of its operations on the environment, at the source. These measures are described in Hydro-Québec's *Standard Environmental Clauses* (SEC) (Hydro-Québec Innovation, équipement et services partagés, 2018). General mitigation measures are particularly effective in limiting or preventing potential impacts on the physical environment (contamination, disturbance of soils and surface drainage). Protection measures are applied to sensitive areas, and all work carried out near watercourses is managed in such a way as to minimize the impact on aquatic wildlife and environmental components. The SECs are outlined in Appendix J.

Although Hydro-Québec is committed to systematically implementing all of the SECs in its projects (insofar as they are applicable), the following sections of the SECs apply more specifically to the quarry project in the La Grande-3 development area:

- Section 1 – General
- Section 2 – Noise
- Section 3 – Quarries and sandpits
- Section 4 – Land clearing
- Section 5 – Snow removal
- Section 6 – Accidental contaminant spills
- Section 7 – Drainage
- Section 8 – Raw and drinking water
- Section 9 – Wastewater
- Section 10 – Excavation and earthwork
- Section 11 – Drilling and sounding
- Section 15 – Equipment and traffic
- Section 16 – Hazardous materials
- Section 17 – Waste materials
- Section 19 – Heritage and archaeology
- Section 20 – Air quality
- Section 21 – Site restoration
- Section 22 – Petroleum product tanks and storage facilities
- Section 23 – Blasting
- Section 24 – Contaminated soil
- Section 26 – Work in wetlands

Besides the measures listed in the SECs, Hydro-Québec will implement specific mitigation measures to further reduce the impacts of the project on the environment. These measures are outlined in sections 6.6 to 6.8 and in Chapter 7, which pertain to the various impacts on the biophysical and human environments.

Table 8-1 (see Chapter 8) stipulates the applicable SECs and specific mitigation measures applicable to the environmental components potentially affected by the project.

6.6 Impacts on the physical environment and mitigation measures

6.6.1 Soils

Development phase

Land clearing, levelling, backfilling and earthwork could alter the composition, profile and quality of the surface soil or lead to erosion of bare soil.

The recommended clearing method is adapted to the sensitive areas of the environment: C-mode outlined in SEC 4. It consists of mechanized felling of trees and manual felling in areas that are difficult for machinery to access.

Hauling materials and machinery traffic is not expected to create ruts, considering the predominance of rock.

Before proceeding with the earthwork, the organic soils on the surface will be stripped. It will be stockpiled in designated areas and, where possible, used to cover exposed surfaces during site restoration at quarry closure.

The contractor responsible for quarry development and granular material production will prepare and produce an erosion prevention and sediment management plan to protect nearby wetlands and water bodies. The plan will stipulate which measures are to be implemented where to prevent soil erosion.

Accidental spillage of petroleum products from the use of machinery and inadequate management of construction waste pose risks of soil contamination during construction.

To summarize, the quarry operator will apply the following Hydro-Québec SEC measures during construction: 3, 4, 6, 7, 10, 11, 15, 16, 17, 22 and 24.

The following specific mitigation measure will also be applied:

- Produce an erosion prevention and sediment management plan for the work area.

Operation phase

Fuel storage and refueling activities at the generating station, as well as management of used oil during the proposed quarry operation phase pose risks of soil contamination in the event of an accidental spill.

The hauling, storage and management of petroleum products during quarry operation will be carried out in accordance with applicable provincial and federal regulations.

Fuel will be stored in outdoor tanks in accordance with regulations in force. Used oil will be recovered and stored in sealed containers inside the hazardous material recovery center (HMRC) before it is sent to MELCC-authorized treatment facilities.

General mitigation measures during the development of the proposed quarry will also significantly reduce impacts to soils during operation.

As a specific mitigation measure, the quarry operator will implement safety measures to prevent accidental spills and prepare an emergency response plan outlining the actions required in the event of a spill.

Closure phase

At the time of site restoration, soils will be characterized in the areas used for machinery maintenance and petroleum product storage. In the event of contamination, remediation work will be carried out and the contaminated soils will be disposed of at an MELCC-authorized site. Site reshaping and revegetation involve activities similar to those required in the development phase. Thus, the same general mitigation measures will be applied, in addition to SEC 21 relating to site restoration.

Residual impact assessment

The risks of soil contamination are low given the general and specific mitigation measures to be implemented during the proposed quarry's development, operation and closure. The intensity of the impact is considered low, and its scope limited, as the impact will be limited to the quarry site. The duration of the impact is long, as the proposed quarry will operate for 20 years. The significance of the residual impact on the soil is therefore considered minor.

6.6.2 Surface water

Development phase

Increase in suspended solids (SS) due to runoff

During the proposed quarry's development, planned activities—mainly clearing, road and activity area development, material hauling and traffic—may cause fine particles to be carried into nearby wetlands and aquatic environments by runoff. This particulate matter could also settle in aquatic environments into which this runoff flows.

Where necessary, sediment traps may be installed in drainage ditches where problems may arise during development. The development phase's erosion prevention and sediment management plan will provide details on these measures.

Increase in SS due to dust deposit in water and its sedimentation

During the proposed quarry's development, dust will likely be generated by clearing operations, access road and activity area development, transportation and traffic.

This dust could settle directly in nearby wetlands and aquatic environments or on soil and be swept into these environments by runoff. During the quarry's development, various measures will be implemented to reduce dust emissions (see the air quality section). These will reduce the amount of fallen dust that could indirectly affect the aquatic environment.

Contamination in the event of a fuel leak

A spill during equipment refueling and maintenance, or after equipment failure, could contaminate surface water if the spilled fuel flows into the nearby water system or is swept away by runoff.

Various measures will be implemented to prevent such contamination: dedicated refueling and maintenance areas, a spill response plan and oil spill response kits available on site.

Operation phase

During crushing and screening activities, wastewater will be generated from washing certain grades of aggregate and using water to remove dust. However, the anticipated volume is low and this water will be drained via soil infiltration. No impacts are therefore anticipated for these activities. If the volumes generated exceed expectations, a management methodology will be defined in the operation phase's erosion prevention and sediment management plan.

Furthermore, on-site chemical toilets will help manage wastewater. No impacts are therefore anticipated in this regard.

Increase in SS due to runoff

During the proposed quarry's operation, planned activities—mainly drilling, blasting, crushing, screening, material hauling, aggregate piling and machinery and vehicle movement—could increase suspended solids (SS) in the receiving environment's surface water, into which site runoff flows, due to water erosion on surfaces disturbed by the work or depositing of materials. The particles could also settle in wetlands and aquatic environments into which runoff flows.

Where necessary, sediment traps or other SS management methods may be installed in drainage ditches where problems may arise and be detected during follow-up. These measures will be specified in the erosion prevention and sediment management plans developed for each of the quarry's operation phases.

Increase in SS due to dust deposit in water and its sedimentation

During the operational period, airborne dust will likely be generated by planned activities, such as:

- work (drilling, blasting, crushing, screening, aggregate piling) and material hauling
- wind erosion of disturbed surfaces or material depots

This dust could settle directly in nearby wetlands and aquatic environments or on soil and be swept into these environments by runoff.

Various measures will be implemented to reduce dust emissions during operation (see the air quality section). These will reduce the amount of fallen dust that could indirectly affect aquatic environments.

Ammonia release due to the use of explosives

Ammonium nitrate is the main component used in explosives. If it is not consumed by the explosion, toxic ammonia can be carried into the aquatic environment by runoff.

The amount of ammonia runoff will be minimized through the implementation of best practices in explosives management (optimizing charges, minimizing losses, monitoring ammonia runoff). The use of emulsion explosives is another mitigation measure under consideration.

Increased salinity due to the use of a dust suppressant

The spreading of a dust suppressant could be used to manage dust emissions in open quarry areas. If a dust suppressant (other than water) is used, some of the salts within may be swept away by runoff, which would slightly increase the salinity of surface water in the receiving environment.

As a mitigation measure, the use of a dust suppressant will be kept to a minimum at first. A dust suppressant will be used that complies with the most recent edition of the BNQ 2410-300 standard of the Bureau de normalisation du Québec.

Contamination in the event of a fuel leak

A spill during equipment refueling and maintenance, or after equipment failure (tanks, hydraulic hose, etc.), could contaminate surface water if the spilled fuel flows into the biophysical environment and nearby water system or is swept away by runoff.

Various measures will be implemented to prevent such contamination: a machinery refueling area (except for the crusher, drills and power shovel), a light maintenance area for machinery, above-ground petroleum tanks with recovery basins or double-walled protection, a storage area for residual hazardous waste, a spill response plan, response kits available on site, etc.

Closure phase

During the proposed quarry's closure, restoration and reshaping work, including on-site transportation, will impact surface water quality. The site will be restored and revegetated. The quarry extraction area will remain open on the north side to prevent water from accumulating after closure.

The new vegetation will prevent water erosion and fine particles from being swept away by runoff. The drainage ditches put in place during the proposed quarry's operation will be maintained, redesigned or backfilled as necessary to drain runoff as was initially done on the site.

Residual impact assessment

The intensity of the impact will be low, given the planned mitigation measures for managing suspended solids in runoff, dust emissions, and explosives. These mitigation measures may change over time, based on monitoring and follow-up results.

The proposed quarry's development, operation and closure could impact (dust and fine particles) an unnamed watercourse flowing approximately 200 m north of the site. This watercourse runs for about 1 km before flowing into the Robert-Bourassa reservoir. Since any dust and particulate matter will dilute in the reservoir, the effect there would be negligible. The scope of the impact would therefore be limited, as it would be mainly limited to this watercourse.

The duration is long, as the impact will be felt throughout the proposed quarry's development and operation. There will be no further impact after the site is restored and revegetated.

For all of these reasons, the residual impact on surface water quality is considered minor.

6.6.3 Air quality

Development phase

Dust and air contaminants (e.g., nitrogen oxide, fine particles, gaseous hydrocarbons) will likely be generated by blasting, crushing, screening, access road and activity area development, and transport due to diesel engines being mainly used by the drill, excavator, dozer, wheeled loader, truck and generator.

As previously mentioned, the dust generated by these activities could increase the SS in nearby wetlands and aquatic environments (dust deposit and/or fine particles leaching).

The general mitigation measures concerning air quality, i.e., Section 20 of Hydro-Québec's SECs, will be implemented during the work and make mitigation of this impact possible. The general dust management measures for development work will be applied, including Section 15.4 of the SECs on roadway maintenance and protection.

As for fine particle emissions generated by crushing and screening operations, additional mitigation measures, such as moistening aggregate or using a dust collector, may be implemented to meet emission standards under the *Regulation respecting sand pits and quarries*.

Operation phase

During operation, the activities are the same as those from the development phase, with the exception of aggregate piling. The anticipated impacts are therefore the same as those for the quarry's development phase and the same general mitigation measures will apply.

Closure phase

No significant additional impacts to air quality are anticipated during the proposed quarry's closure phase.

Residual impact assessment

With general mitigation measure implemented at each phase of the project, the intensity of the impact on air quality is considered low and its scope is limited, as activities will be limited to the proposed quarry site. The impact duration is long, as the quarry will be operated seasonally for 20 years. The residual impact of the project on air quality is considered minor.

6.7 Impacts on the biological environment and mitigation measures

6.7.1 Wetlands

Seven wetlands have been identified in the biophysical environment inventory area (see Map 5-2). Of these, two correspond to complexes consisting of several types of wetlands. The vast majority of the wetland area is peat bog (2.2 ha), followed by swamp (1.7 ha) and marsh (0.2 ha).

Development phase

The open bog, located in the aggregate storage area (WL02), will be directly affected by jobsite clearing, preparation and installation as well as leveling, backfilling and earthwork. This vegetation community consists primarily of black spruce and understory ericaceous species. Thus, an area of 1,630 m^2 of this wetland will be destroyed (see Table 6-2).

Table 6-2: Wetland area destroyed by the proposed quarry's development

Source of impact	Wetland No.	File No.	Type of impact	Area affected (m^2)	Impact on wetlands	Main ecological function affected
Storage area	WL02	ST10	Direct	1,630	Permanent loss	Biodiversity conservation: slight loss of wildlife habitat

The wetlands observed provide diverse quality habitats for local wildlife. They serve important ecological functions, including maintaining biodiversity, carbon sequestration, water regulation and retention. The wetland area, particularly the peat bogs, is considerable in Nord-du-Québec. Wetlands make up 11.3% of the biophysical environment inventory area. This permanent loss represents 0.4% of this area. Furthermore, the quarry footprint, i.e., access roads and activity areas, has been optimized to avoid mapped wetlands to the extent possible. A 30-m wide strip will also border the wetlands, except for the storage area road. This strip will act as a natural buffer zone and reduce the quarry's impact on the surrounding environment.

Wetlands near access roads and activity areas will be marked off to ensure that they are not affected by the work. The contractor shall apply the general measures in sections 4, 10, 15, 21 and 26 of the SECs. In addition, culverts will be installed at strategic locations to maintain the site's natural drainage (see Map 5-2) and the hydrological connection between wetlands on both sides of the storage area access road.

Operation phase

During the proposed quarry's operation phase, no encroachment on wetlands is anticipated besides those assessed in the development phase.

Closure phase

During the proposed quarry's closure phase, anthropized areas will be restored and revegetated with species adapted to the site's regional climate and pedologic conditions upon the work's completion, i.e., substrate low in organic matter. Faces will be smoothed and leveled before revegetation. The wetland (WL02) destroyed during development will not be restored in the closure phase.

Residual impact assessment

The intensity of the impact is considered low given the type of wetland affected—peat bog—and its major presence in the project area, the small area directly affected and the general mitigation measures applied during the proposed quarry's development. The scope of the impact will be limited, as it will be limited to a small area, and its duration will be long, as it will be permanent. The significance of the residual (negative) impact is therefore considered minor.

6.7.2 Woodland caribou

Development phase

Clearing operations will affect 12.6 ha, mainly consisting of open coniferous forest with shrubs and open coniferous forest with moss (12.4 ha). The proposed quarry's development will destroy these forests. Similarly, habitats could suffer a small functional loss due to possible avoidance of the jobsite periphery. This loss could be in the range of a few kilometres. However, no open coniferous forest with lichen will be affected by the clearing.

During the work, habitat loss and disturbances caused by development operations, transportation, traffic and worker presence will cause caribou to shift their home ranges depending on the neighboring habitats. A number of studies have demonstrated that caribou make little use of environments near areas disturbed by human activity (Fortin et al., 2013; Leblond et al., 2011; Lesmerises et al., 2013).

However, the quarry will be located immediately next to existing sources of anthropogenic disturbances, including a permanent road and two power lines, which already reduces the likelihood that habitats visited by caribou will be disturbed directly or indirectly. An analysis of habitat quality based on distance from the quarry clearly demonstrates that the average habitat value at and within 1 km from the proposed quarry site (V_{mean} = 0.49 and 0.55, respectively) is lower than the average habitat quality at a distance of 5 km (V_{mean} = 0.64) and further (V_{mean} > 0.70 for distances greater than 20 km).

Moreover, no source of impact poses a risk to the survival of caribou. The risks of collision associated with transportation and traffic are very low given the slow speed of vehicles on the jobsite during the development phase and the good visibility had by drivers (absence of trees or other visual screens).

Operation phase

The presence of the quarry, operation activities, including blasting, and employee movements, may disturb the caribou, which would then move away from the area. However, the area has already been affected by the presence of infrastructure (road, power lines, other borrow pits within 5 km, airport within 7 km), which reduces the likelihood that caribou will visit the habitats within the area.

Closure phase

The restoration, reshaping and revegetation work may disturb the caribou, which would then move away from the area. However, as previously mentioned, the area is already affected by the presence of infrastructure, which reduces the likelihood that caribou will visit habitats in the area. Moreover, the caribou habitat will benefit from coniferous reforestation (jack pine and black spruce) following restoration of the proposed quarry site.

Residual impact assessment

The intensity of the impact will be low, as the proposed quarry will be near areas that are already disturbed, in a low-quality area for woodland caribou that is hardly or never visited by them. The scope is limited, as the impact will be limited to the proposed quarry and its vicinity. The duration is long, as the impact will be felt throughout the quarry's service life. For all of these reasons, the significance of the residual impact on woodland caribou is considered minor.

6.7.3 Migratory caribou

Development phase

Clearing operations will be carried out on 12.6 ha, mainly consisting of open coniferous forest with shrubs and moss (12.4 ha). However, no open coniferous forest with lichen will be affected by the clearing.

A small functional loss of habitat is also anticipated due to possible avoidance of the jobsite periphery by caribou. This loss could affect an area of a few hundred metres or even a few kilometres away. In fact, the avoidance of human disturbance by migratory caribou is well documented in the scientific literature (see Plante et al., 2018). For example, roads, villages, power lines, mineral exploration sites, mines and other types of industrial disturbances generate avoidance responses that, depending on the nature

of the disturbance, can be particularly pronounced (Plante et al., 2018). Migrating caribou therefore avoid habitats along the jobsite periphery, which results in a functional loss of habitat. If such were the case during the current project, caribou would no longer use certain habitats of interest during the construction period, which overlaps with the occupation period for caribou in the study area (between December and April). However, the proposed quarry will be located immediately next to existing sources of anthropogenic disturbances, including a permanent road and two power lines, which already reduces the likelihood that habitats visited by migrating caribou will be disturbed directly or indirectly.

Moreover, no source of impact poses a risk to the survival of caribou. The risks of collision associated with material hauling and traffic are very low given the slow speed of vehicles on the jobsite during the development phase and the good visibility had by drivers (absence of trees or other visual screens).

Operation phase

The presence of the proposed quarry, operation activities, including blasting and employee movements, may disturb the caribou, which would then move away from the area. However, the area has already been affected by the presence of infrastructure (road, power lines, borrow pits within 5 km, airport within 7 km), which reduces the likelihood that caribou will visit the habitats in the area during winter.

Closure phase

The restoration, reshaping and revegetation work may disturb the caribou, which would then move away from the area. However, as previously mentioned, the area is already affected by the presence of infrastructure, which reduces the likelihood that caribou will visit the habitats in the area. Moreover, coniferous reforestation (jack pine and black spruce), following restoration of the proposed quarry site, will enhance the caribou habitat.

Residual impact assessment

The survival of the caribou affected by the project is not at stake. Few impacts on their behavior (avoidance) are anticipated during the proposed quarry's development and operation phases, as this area has already been affected by the presence of infrastructure, which has diminished the quality of winter habitats there. It should also be noted that direct and functional habitat losses will be negligible given the abundant replacement habitats available in the wintering grounds. The intensity of the residual impact is therefore considered low. Its scope will be limited, as the project is only located in the wintering grounds. Its duration is long, as the impact will be felt throughout the quarry's service life. The significance of the residual impact on caribou is therefore considered minor.

6.7.4 Birds

Development phase

The main anticipated impacts during the development phase are related to the loss of habitat in the biophysical environment inventory area (12.4 ha of open coniferous forest). However, clearing will be performed before or after the bird nesting season. According to the Birds Canada nesting calendar request tool (Birds Canada, 2021), the critical period for potential nesting species in the inventory area is approximately May 15 to August 15.

The habitat loss will force some species to seek a new habitat, but the small area affected means that the impact will be negligible considering the abundance of similar habitats in the surrounding areas. The various development activities, material hauling and traffic may also disturb the birds and encourage them to move temporarily. Nevertheless, birds using the habitats affected by the work may find other similar habitats nearby.

No special-status bird species has been observed in the study area and no impacts are anticipated in this regard.

The intensity of the impact on birds is considered low, as clearing operations will be, to the extent possible, outside the nesting period. Furthermore, no special-status bird species is likely to be disturbed during the proposed quarry's development. The scope of the impact will be limited, as the use of the environment by the different bird species will be altered only within the project footprint. The duration of the impact is considered short for bird species that currently nest in the inventory biophysical environment inventory area, as they will be able to use nearby spruce forests. The disturbance of birds during the work will also be short term. The overall significance of the residual impact on birds is therefore considered minor.

With clearing currently scheduled for winter, there are very few occasions to destroy nests or chicks of protected migratory birds.

Operation phase

The anticipated impacts during the operation phase are considered minor and limited to temporary disturbance from the noise generated by operational activities. However, this disturbance will not prevent the migratory birds present from successfully reproducing, much less cause mortality.

Closure phase

No significant additional impacts to birds are anticipated during the proposed quarry's closure phase. If biophysical environments are restored, uncommon gains in habitats may be recorded in the region.

Residual impact assessment

The clearing and presence of the quarry will result in a loss of small area habitats for birds. In addition, no special-status bird species is likely to be disturbed during the proposed quarry's development and operation. The scope of the impact will be limited, as the use of the environment by different bird species will be altered only within the proposed quarry area. The duration of the impact is considered short for bird species that currently nest in the biophysical environment inventory area, as they can use nearby woodlands. The overall significance of the residual impact on birds is therefore considered minor.

6.7.5 Special-status bats

Development phase

During the proposed quarry's development phase, clearing to develop access roads and activity areas will cause the loss of 12.4 ha (34%) of the biophysical environment inventory area (36.5 ha). This latter area includes 1.9 ha of mature and over-mature (≥70 years) forests, which are widely used by special-status bats as hunting and roosting habitats (Brigham, 2007). The visual inventory of forests conducted in the field also confirmed that all forests 70 years and older in the biophysical environment inventory area have good potential as hunting and roosting habitats for special-status bats. Only 0.1 ha (5.5%) of forests 70 years and older located in the inventory area will be affected by the proposed quarry site (see Map 5-2).

The roosting and breeding habitats of the hoary bat, red bat, little brown bat, long-eared bat and silver-haired bat are mainly used during gestation, lactation and juvenile rearing, i.e., June 1 to July 31 in Québec (MRNF, 2008). Clearing could destroy roosting and maternity habitats in trees (for breeding females) if carried out during bat breeding season. This destruction would have a temporary, negative impact directly on the five special-status bat species mentioned above, including a mortality risk for juveniles unable to fly before August.

The clearing could also result in the potential loss of roosting habitats for the five special-status bat species. The edge effect associated with the opening of forest cover could also cause a negligible, indirect impact on roosting areas in adjacent areas, where the microclimate or thermal conditions may be altered (Johnson and Lacki, 2014). However, in the longer term, the creation of a steep forest fringe could increase the proportion of available standing dead trees, which cave-dwelling bats prefer (Fabianek, 2015). It is therefore difficult to anticipate whether there will be a positive or negative indirect impact on potential roosting habitats for bats.

However, clearing will have a direct positive impact on feeding habitats and migration corridors that may be used by bats during their nocturnal movements (Hogberg et al., 2002; Patriquin and Barclay, 2003; Henderson and Broders, 2008). In fact, following clearing, the bats will use forest fringes along activity areas and access roads to move and forage (Loeb and O'Keefe, 2011; Jantzen and Fenton, 2013). The majority of bats present in Québec move about and forage within 40 m of forest fringes (Jantzen and Fenton, 2013). Only a minimal area of potential feeding habitats (i.e., less than 12.4 ha cleared) will be lost during the proposed quarry's development phase (since bats will likely use the created gap).

General mitigation measures in sections 2, 4, 10, 23 and 26 of the SECs will be implemented to limit disturbance and loss of potential bat feeding and roosting habitats. These will be supplemented by the following specific mitigation measures:

- To the extent possible, perform clearing outside bat breeding season, which occurs between June 1 and July 31, to avoid destroying potential roosting habitats where breeding individuals are present.
- Do not systematically remove standing dead trees near cleared areas and along tracks; remove them only if they pose a problem for worker safety or infrastructure integrity.

Operation phase

During the operation phase, the noise generated from drilling and blasting operations could result in the loss of potential roosting habitats nearby (<100 m). However, this negative impact would be temporary and relatively limited in scope. The study by Shannon et al. (2016) states that a noise tolerance threshold over 80 dBA causes a significant drop in nocturnal activity by the greater mouse-eared bat (*Myotis myotis*), which suggests that it avoids areas where it senses noise pollution. This noise tolerance threshold might be higher for other species or during the diurnal resting phase of bats. As this information is unavailable, the tolerance threshold of 80 dBA is generally used as the noise limit for bats. General mitigation measures in sections 2 and 23 of the SECs will be implemented to limit disturbance and loss of potential bat roosting habitats.

Closure phase

The restoration, reshaping and revegetation work will have a slight positive impact for bats since they will be able to use the gap in vegetation for foraging at first. Then, once tree species mature (≥70 years), they can serve as potential roosting habitats for special-status bats. No significant additional impact is anticipated for special-status bats during the proposed quarry's closure phase.

Residual impact assessment

During the proposed quarry's development and operation phases, the intensity of the impact on special-status bats will be low due to the application of general and specific mitigation measures and the temporary scope of the negative impacts—mainly the functional loss of potential roosting and feeding habitats—which will be offset by the creation of functional bat migration corridors along forest fringes next to access roads. The duration of the impact will be long, as some disturbances (both positive and negative) to potential roosting and feeding habitats will remain for the proposed quarry's operational duration. The significance of the residual impact is therefore considered minor.

6.8 Impacts on the human environment and mitigation measures

6.8.1 Public safety

The land is used by the Cree for hunting, fishing and trapping, by owners of vacation leases north of the study area and by road users using the La Grande-3 road to access their jobsite or the airport. Therefore, safety issues for these users must be assessed. The tallyman for trapline CH40 indicated that traffic on the La Grande-3 road could be hazardous in winter during ptarmigan hunting along the road.

Development phase

The main source of impact during the proposed quarry's development will be related to material hauling and traffic. These activities could disturb local traffic and contribute to the deterioration of roads used by the three types of users.

The occasional blasting activities could also cause rock and debris projection, which could compromise public safety, i.e., users of the La Grande-3 road and land users.

The anticipated workers during the development phase are another source of impact. They will be staying at the Sakami residences, located 16.5 km north of the proposed quarry site. This residential complex has all of the necessary amenities to receive, house and feed them. Every day, they will shuttle between the residences and quarry in their vehicles. These movements will kick up dust, generate noise and increase the risk of collisions on the La Grande-3 road.

Since the proposed quarry site is in a remote area, a communication plan will be required to disseminate the procedure for traffic accidents related to the proposed quarry's development. An ambulance and nurse will always be present at the Sakami residences.

In addition to general measures in SECs 3, 15 and 23, the following specific mitigation measures will be implemented during the proposed quarry's development phase:

- Inform the Chisabisi community of the work schedule, including blasting times.
- Clearly delineate and mark off the authorized work area and, when blasting, visually monitor the activity to ensure rock and debris projections remain within the authorized area.
- Implement measures in sections 23.1 and 23.4 of the SECs applicable to blasting and, in particular, the *Regulation respecting sand pits and quarries*, which includes the implementation and maintenance of best practice procedures for blasting (s. 30, para. 1).
- Ensure that there is adequate signage on both sides of the La Grande-3 road and that vehicles are clearly visible to truckers leaving the quarry in order to increase road user safety.
- Temporarily close the La Grande-3 road to traffic during rock blasting.
- Where appropriate, install signs indicating the presence of Cree camps on the La Grande-3 road.
- Encourage workers to carpool in order to limit the number of vehicles traveling between the quarry site and residences.
- If necessary, use signalers or a safety escort during maneuvers by trucks or oversize loads.
- Provide a plan and means to maintain effective, constant communication with Hydro-Québec emergency services.

Operation phase

Since the same impacts are anticipated for both the development and operation phase, the same mitigation measures will be applied. The operation phase will involve a small number of employees. The aggregate from the proposed quarry will be used first to rehabilitate the La Grande-3 road and then to perform Hydro-Québec work near La Grande-3 generating station facilities. Furthermore, the operator for the proposed quarry will be required to implement safety measures and an emergency response plan specific to this phase of the project.The proposed quarry site's distance from Cree villages will help reduce public safety risks. Only occasional land users, such as Crees who are hunting, fishing and trapping, leaseholders located north of the study area and La Grande-3 development workers, will likely visit the areas adjacent to the proposed quarry and be exposed to sources of impact during the quarry's operation.

Closure phase

During the proposed quarry's closure, the project's impacts on public safety will be less than during the development and operation phases, as the main sources of impact (material hauling and traffic, blasting and drilling) mentioned above will no longer be present. The possibility of the public accessing the site when the site is no longer supervised will create risks of falling or accidents. However, the site's security and restoration, subject to the *Regulation respecting sand pits and quarries* and Section 3.4 of the SECs on quarries and sand pits, have measures to ensure that public health and safety risks will be negligible at this phase of the project.

Residual impact assessment

With mitigation measures in place for every phase of the project, public safety impacts will mainly be related to increased vehicle traffic and blasting activities during the proposed quarry's development and operation. Upon its closure, given the measures taken to secure the site, the risks of falling or accidents are negligible. The duration of the impact is therefore considered long, as it extends over several years, spanning both the development and operation phases. The intensity of the impact is low and its scope is limited. The significance of the residual impact is therefore considered minor.

6.8.2 Cree land use

The site selected for the quarry development is located approximately 250 km from the Cree village of Chisasibi. The proposed quarry site is located entirely on trapline CH40. Roderick Ratt is the tallyman for this trapline, which is regularly used by five or six families. The tallyman has a camp at kilometre 7 of the La Grande-3 road, adjacent to the proposed quarry site, but on the opposite side of the road. It was built in this spot to mark the trapline's southern boundary. This camp is accessible year round, but it is usually visited in winter when other tallyman camps are more difficult to reach. It is mainly used by Roderick Ratt, but his brothers and sisters occasionally use it as well. The activities carried out by the tallyman in the vicinity of the proposed quarry site are woodcutting, beaver trapping, ptarmigan and moose hunting and hare snaring. However, since he does the majority of these activities elsewhere, either further north or west of the proposed quarry site, they will not be affected by the project.

Development phase

Equipment transport and development activities at the proposed quarry will increase truck traffic on the La Grande-3 road. Drilling, blasting, crushing and screening operations will generate noise, dust and vibration. Road traffic will also increase due to workers traveling approximately 16 km daily between the proposed quarry site and the Sakami residences. Due to the traffic and noise generated by it, small-game hunting and trapping along the La Grande-3 road, near the proposed quarry site, may shift toward similar locations further north along the same road. Furthermore, the tallyman and his family also have the option of using other camps located on his trapline more frequently during work or high traffic periods at the proposed quarry.

At a meeting held in October 2021 with the Council of the Cree Nation of Chisasibi, the possibility of offering users of trapline CH40 the wood from clearing activities during the proposed quarry's development phase was discussed. Hydro-Québec will check whether the tallyman is interested in this wood and may, if necessary, offer it to him.

The following specific mitigation measures will be implemented during the proposed quarry's development phase:

- Inform the Chisasibi community, more specifically the tallyman of trapline CH40, of the work schedule, including blasting times and the number of anticipated workers.
- Implement measures in sections 23.1 and 23.4 of the SECs applicable to blasting and, in particular, the *Regulation respecting sand pits and quarries*, which includes the implementation and maintenance of best practice procedures for blasting (s. 30, para. 1).
- Build a new camp, in a timeframe agreed upon with the tallyman, in order to provide the tallyman and his family with an alternative to their current camp during work phases that may generate impacts (e.g., noise, dust, blasting, traffic). In accordance with the tallyman's wishes, leave the camp located at kilometre 7 on the La Grande-3 road intact as an entry marker for trapline CH40.
- Give Cree users of trapline CH40 first choice of the timber from clearing activities. Storage quantity, format and location will be determined.
- Encourage workers to carpool in order to limit the number of vehicles traveling between the quarry site and residences.

Operation phase

During the proposed quarry's operation phase, the impacts will be similar to those experienced during the development phase. The same mitigation measures will therefore be implemented during this phase. That said, the quarry will operate on an irregular and seasonal basis, which could be a source of uncertainty and contingencies for other land users.

Closure phase

Once the proposed quarry has closed, the impacts on Cree land use will be very low. After the site has been restored, some areas can be used again for hunting and trapping, including the mining pit, where slopes will be made gentler and stabilized. Furthermore, the site's security and restoration, subject to the *Regulation respecting sand pits and quarries* and Section 3.4 of the SECs on quarries and sand pits, have measures to ensure that risks for Cree users will be negligible at this phase of the project.

Residual impact assessment

The proposed quarry project of over 3 ha, which will operate seasonally for 20 years, will have impacts on users of trapline CH40. Measures will be implemented to protect users of the camp at kilometre 7 of the La Grande-3 road from these impacts. Small-game trapping and hunting in the vicinity of the proposed quarry may continue being carried out further north during the development and operation phases.

The intensity of the impact is considered low, as the proposed quarry site only affects two roadside hunting and trapping areas, and these activities can be carried out elsewhere on the trapline. The camp in the vicinity of the proposed quarry can still be used by users of trapline CH40 during seasons when the quarry is not in operation, thus alternating with other tallyman-owned camps or the new camp planned to be built as part of the quarry project. The scope of the impact will be limited, as it will be felt by a limited portion of the population and in a small area. The duration of the impact is long, as the impact will occur during the development and operation phases. The significance of the residual impact on Cree land use is therefore considered minor.

6.8.3 Economic spinoffs for the Cree communities

With the objective of maximizing the project's local economic spinoffs, regional Cree businesses will be approached by Hydro-Québec first to verify that they are interested in and able to carry out all or part of the planned quarry development and aggregate production work as part of the La Grande-3 generation station road rehabilitation. As long as Hydro-Québec's procurement rules are respected, one or more requests for proposals limited to Cree regional businesses may be issued. Then, if necessary, open requests for proposals will be issued at the same time for work not covered by the limited requests for proposals.

The number of contracts awarded for the proposed quarry's subsequent operation and closure phases is not known at this time.

Development phase

The proposed quarry's development and aggregate production to rehabilitate the La Grande-3 road will employ approximately 15 to 20 workers between spring 2024 and fall 2025.

A Cree contractor being awarded a contract for goods and services, in whole or in part, would maximize economic spinoffs for the Cree communities, particularly for those communities closest to the selected quarry site, i.e., Chisasibi and Wemindji.

In the event that certain project components are not covered by the request for proposals limited to local businesses, Hydro-Québec will nevertheless endeavor, as part of an additional open request for proposals, to promote regional economic spinoffs by implementing the following measures:

- Have local contractors perform the clearing work.
- Insert, in public requests for proposals, a clause encouraging regional Indigenous subcontracting. (This clause will help Cree suppliers benefit from economic spinoffs arising from contracts awarded to companies outside the region.)

Operation phase

The methods of awarding contracts for the aggregate production phases following the rehabilitation of the La Grande-3 generation station road is not known at this time. Hydro-Québec's internal policy to promote local economic spinoffs will nevertheless continue to guide future processes for awarding contracts.

Between phases of operation, Hydro-Québec does not plan to maintain any permanent jobs. The proposed quarry's maintenance will be carried out by Hydro-Québec.

Closure phase

The proposed quarry's closure will mark the end of economic spinoffs experienced during the operation phase. There will therefore be a loss of potential jobs or contracts and a return to conditions prior to the quarry project.

Residual impact assessment

The proposed quarry's development and operation will have a positive impact on Cree communities due to economic spinoffs. The Chisasibi and Wemindji communities may gain a greater portion of economic spinoffs in Cree communities due to their proximity to the proposed quarry. The project could lead to one or more direct contracts or subcontracts for local businesses, in addition to some indirect and induced spinoffs for other businesses and services in the Cree communities. During the development and operation phase, the intensity of the impact is considered low, its scope is regional and its duration is long. The significance of the positive residual impact is considered moderate. In the closure phase, the positive effect will cease to be felt.

6.8.4 Landscape

Development and operation phases

The impact on the landscape will start appearing during the proposed quarry's development, but it will be most noticeable during the operation phase. The clearing and development of roads and activity areas will be the main sources of impact during the

development phase. During the operation phase, the sources of impact on the landscape will be aggregate piling as well as the quarry's presence and facilities. A 12.4-ha area will be cleared to develop the quarry.

The proposed quarry site (see Map 5-3), including the access road and service area, will be particularly visible to users traveling south on the La Grande-3 road. The cleared area will be noticeable at first and the rock mining area will gradually increase as it is mined over a 20-year period.

Mobile observers traveling south on the La Grande-3 road will have an open and direct view of the proposed quarry's mining area and its northern access for a distance of approximately 700 m. Most of them are Hydro-Québec employees or contractors working on the La Grande-3 hydroelectric development. Land users visiting trapline CH40, mainly for hunting, fishing and trapping, are also mobile observers who will likely see the proposed quarry. The same is true for vacation leaseholders, located north of the study area, who will likely use this area from time to time.

The stockpiles in the storage area will have a maximum height of 12 m and will extend above the area's forest cover, which is between 8 m and 10 m high. The layout and height of the stockpiles will vary during operation. A vegetation strip of at least 35 m will be preserved between the La Grande-3 road and the storage area. Since the vegetation in this area is relatively sparse, the storage area will be partially visible and filtered from the La Grande-3 road, at the height of the storage area. The crusher, which is generally 7–8 m, will not extend beyond the forest cover.

The quarry site may be visible from higher, more distant points. However, these views will be intermittent. Occasionally, dust from the quarry site may be noticeable. A dust suppressant (water) will be used to mitigate this impact during the operation phase.

Users of the camp on trapline CH40 at kilometre 7 of the La Grande-3 road are potentially the only stationary observers in the study area. However, they are seasonal and occasional observers. Furthermore, a new camp will be built to keep them away from operational nuisances and to ensure that they are not present during the proposed quarry's development and operation. In addition, the presence of coniferous forests around the camp will help block the view of the proposed quarry all year round. The proposed quarry and access roads will not be very noticeable from this camp, as the quarry will be mainly located on the opposite side of the hill (north side). Storage area stockpiles will nevertheless be noticeable from this camp due to its proximity. At the intersection of the La Grande-3 road and the camp access road, the storage area and possibly other proposed quarry components will be directly visible, albeit filtered.

Closure phase

The reshaping and revegetation of the proposed quarry site at the end of its operation will give the environment a more natural appearance, which will help mitigate the impact on the landscape.

Residual impact assessment

The proposed quarry and its facilities will be partially visible due to forest cover (moderate absorption level) with visual breaks present. The degree of integration of the project is moderate, given the presence of power lines (conductors and towers) and the La Grande-3 road in the same area. The intensity of the impact is moderate.

The degree of visibility is considered low, as observers are few, mobile and present temporarily, and since quarry visibility is limited to people traveling south on the La Grande-3 road. However, observer sensitivity is high because Cree users value natural, wildlife-rich landscapes, which is likely the case as well for vacation leaseholders who will likely visit this area. However, it should be noted that the tallyman interviewed does not find that the proposed quarry site's landscape is unique, aesthetically distinct or displays as much wildlife harvesting potential as other areas in the vicinity.

The duration of the impact will be long, as its effect will be experienced continuously over a period of more than 20 years.

With the mitigation measures implemented during the proposed quarry's operation and closure phases, the significance of the residual impact on the landscape is considered minor. The construction of a new Cree camp away from the proposed quarry will limit its users from being exposed to nuisances caused by the work. The maintenance of a wooded buffer zone of more than 35 m in width between the La Grande-3 road and the project site will act as a partial visual screen for occasional users of this road.

6.9 Greenhouse gas emissions

Greenhouse gas emissions (GHG) were quantified for the quarry project in the La Grande-3 development area based on how much was produced from an aggregate volume of 590,000 m^3, which corresponds to the quantity available at the mining floor set at 262 m.

Three main sources of GHG emissions were identified as part of the project:

- emissions associated with clearing during the quarry's development phase
- emissions associated with machinery fuel consumption during the quarry's development and operation for an anticipated 20-year service life—production of 590,000 m^3 of aggregate
- emissions associated with the use of explosives

6.9.1 Quarry development

The proposed quarry's development will result in the clearing of approximately 12.6 ha of forest. It should be noted that several extraction and storage areas have sparse forest cover due to the presence of rocky outcrops. These local variations were not taken into account when estimating GHG emissions associated with deforested areas; for simplicity, forest cover was assumed to be uniform and dense.

The equation provided in the MELCC's *Guide de quantification des émissions de gaz à effet de serre* (2019) was used to estimate GHG emissions related to deforested areas. This equation is based on the methodological approach in the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (IPCC, 2006*a*):

$$GHG\ emissions\ (t.\ CO_2\ eq.) = N_H * T_{Msh} * (1 + T_x) * CC * 44/12$$

where:

N_H: number of hectares cleared
T_{Msh}: tonnes of dry matter per hectare
T_x: ratio of below-ground to above-ground biomass
CC: carbon fraction in tonnes of carbon/tonnes of dry matter
44/12 = ratio of CO_2 molar mass/C molar mass

The values in Table 6-3 were used for the equation parameters. According to this calculation, the emissions resulting from the clearing of 12.6 ha for the project amount to 1,883 t CO_2 eq.

Table 6-3: Values used to calculate clearing-related GHG emissions

Parameter	Value	Rationale
N_H	12.5	Impact study
T_{Msh}	62	*2006 IPCC Guidelines for National Greenhouse Gas Inventories – Volume 4: Agriculture, Forestry and Other Land Use*; Chapter 6, Table 6.4, value for Boreal – Dry & Wet.
T_x	0.39	*Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories – Volume 4: Agriculture, Forestry and Other Land Use*. Table 4.4 (IPCC, 2019)
CC	0.47	Default value provided by MELCC based on *2006 IPCC Guidelines for National Greenhouse Gas Inventories – Volume 4: Agriculture, Forestry and Other Land Use* (IPCC, 2006*b*).

6.9.2 Emissions associated with fuel consumption by machinery

First, the consumption of fossil fuels (gasoline and diesel) was estimated based on the number of work hours during which fuel-consuming equipment would be used. It should be noted that the number of hours represents the total hours required to perform the work, not the number of hours during which the vehicles and other equipment will be in operation; in reality, equipment will not operate continuously. For this reason, the GHG emissions for the project have been overestimated. The calculation for the number of hours associated with machinery fuel consumption covers the quarry's service life, during which an estimated volume of 590,000 m^3 of aggregate will be produced at the mining floor set at 262 m.

Second, the consumption data for each type of equipment was extracted from the manufacturers' technical specifications. The actual equipment used by contractors may differ slightly from those in Hydro-Québec's estimate, but this should not significantly affect the calculated GHG emissions.

Third, the emission factors in Annex 6 of the *1990–2019 Canada National Inventory Report* (ECCC, 2021) were used to calculate GHG emissions related to equipment use. Based on the type of equipment, the following factors were used:

- Heavy-duty diesel vehicles, advanced control
- Light-duty gasoline trucks, tier 2
- Off-road gasoline-powered vehicles, 4-stroke
- Off-road diesel-powered vehicles, 19 kW or more, tier 4

The global warming potentials from the Intergovernmental Panel on Climate Change's Fourth Assessment Report (IPPC, 2012) were used for the calculation.

For the quarry project, the total consumption of fossil fuels is estimated at 1,043,230.64 L of gasoline and diesel. In total, the combustion of these fuel volumes will emit approximately 2,798.70 t CO_2 eq. into the atmosphere throughout the project (see Table 6-4).

Table 6-4: Estimated fuel consumption and GHG emissions for the production of 590,000 m³ of aggregate

Equipment	Estimated sum of hours	Estimated total fuel consumption (L)	Estimated GHG emissions (t CO_2 eq.)
Crawler dozers, 175 kW	625.60	14,688.31	39.50
Compressors, 700 A 900 CFM	4,469.70	118,737.58	319.29
Hydraulic shovel, 1 m^3	4,313.00	107,184.72	288.22
Crusher	4,538.50	102,163.72	274.72
Wheeled loader, 5.7 m^3	4,578.50	145,663.98	391.69
Brush cutter, 100 hp or higher	463.10	4,633.15	12.46
Mechanical saw, 16 in.	1,852.60	1,743.20	4.49
Dynamite truck, 1.5 tonnes	2,938.40	27,914.80	76.18
Articulated truck, 36 mt	6,280.30	243,788.91	665.30
Pickup truck, 4x4, 1 tonne	5,652.80	50,875.20	117.88
Mobile workshop, 4 tonnes	1,680.00	42,638.40	116.36
Tractor unit, 6x4, <45,000 kg	2,640.00	86,896.37	233.66
Track-mounted geotechnical drill rig, ROC-601	4,469.70	28,406.29	76.38
Generator, 125 kW	2,880.00	67,896.00	182.57
Grand total	**47,382.20**	**1,043,230.64**	**2,798.70**

6.9.3 GHG emissions attributable to the use of explosives

GHG emissions attributable to the use of explosives were calculated using the following equation from the *Guide de quantification des émissions de gaz à effet de serre* (MELCC, 2019).

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

where:

E_{CO2_Exp}: annual CO_2 emissions from fossil fuel consumption used in explosives, in tonnes per year
n: months
$FFexp_n$: mass of fossil fuel contained in explosives used in months n, in kilograms of fuel
CC_n: average carbon content of fossil fuel used in explosives in month n, in kilograms of carbon per kilogram of fossil fuel
3.664: molecular weight ratio of CO_2/carbon
0.001: conversion factor from kilograms to tonnes

The type of explosives that will be used in the proposed quarry is ammonium nitrate/fuel oil (ANFO). For the sake of simplicity, the following data from the *Pits and Quarries Reporting Guide* by Environment Canada (Environment Canada, 2017) was used (see Table 6-5).

Table 6-5: Emission factor of ANFO-type explosives and their use

Type	Composition	Use	CO_2 (kg/tonne)
ANFO	Ammonium nitrate/fuel oil, 5.8–8%	Construction, blasting in mines	125

The total volume of ANFO explosives is estimated at 767 tonnes. According to this calculation, the CO_2 emissions resulting from using 767 tonnes of explosives in the project amount to 95.6 t CO_2 eq.

6.9.4 GHG emissions summary

Table 6-6 summarizes the estimated GHG emissions for the entire quarry project.

Table 6-6: Summary of GHG emissions associated with the proposed quarry

Activity	Source of emissions	Quantity (t CO_2 eq.)
Clearing	Clearing-related losses	1,883.0
Use of explosives	Amount of carbon present in ANFO explosives	295.6
Quarry development	Emissions from the use of machinery	2,798.7
Total		4,977.3

6.9.5 GHG emissions reduction

Several measures have been planned for the proposed quarry's planning, design, development and operation phases. Table 6-7 summarizes the proposed measures to reduce project-related GHG emissions.

Table 6-7: Project-related GHG emissions reduction measures

Type of activity	Emission reduction measures
Choice of quarry site	The quarry project will be located on a partially wooded rock hill with rock outcrops present. Clearing operations will therefore be reduced. Due to its geographic location—along the La Grande-3 road, between the airport, the La Grande-3 generating station and the Sakami residences—aggregate hauling times will be reduced during the restoration, refilling, refurbishment and maintenance work planned for the next 20 years, which will have a direct, positive impact on GHG emissions generated by these activities.
Use of mobile equipment	There are clauses in the contractors' contracts that stipulate that they must keep their vehicles in good working order by inspecting and cleaning them daily.
Clearing	Organic soil that has been excavated will be replaced upon the work's completion. The proposed quarry site will be revegetated when its operation ends.

7 Assessment of cumulative effects

The cumulative effects study, an essential component of any impact study, is presented in a separate section to clearly distinguish cumulative effects from the quarry project's direct or indirect effects.

7.1 Approach

The approach for the cumulative effects assessment was derived from various documents, including the *Directive pour le projet de carrière de plus de 3 ha à proximité de l'aménagement hydroélectrique La Grande-3 par Hydro-Québec* (MELCC, 2020*c*) and the *Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012* (IAAC, 2018).

This approach examines the main project's impacts, i.e., the subject of the environmental and social impact study, but in combination with the impacts of past, ongoing and upcoming projects, activities and events. The assessment is based on the notion that any impact related to a given activity under the main project may interfere, in time or space, with past, ongoing or upcoming projects and cause additional consequences, direct or indirect, on valued environmental components selected for the cumulative effects analysis.

The valued components selected are related to the project's main issues—mostly Cree land use in this case. These valued components also include components where the main project's residual impacts have combined with major residual impacts from other past, ongoing and upcoming projects, activities and events (i.e., its occurrence is reasonably foreseeable).

The cumulative effects analysis shall consider:

- A sufficiently broad spatial and temporal scope that allows for the assessment of the main project's impacts on valued environmental components when combined with other impacts from past, ongoing or upcoming projects, activities or events.
- Major impending or foreseeable development projects (residential, commercial, industrial and infrastructure), in order to assess potential cumulative impacts.

The list of projects with the potential to interact with the main project was determined during public consultations or from project notices published on the websites of competent authorities. Therefore, based on the available information on certain upcoming or reasonably foreseeable projects, environmental effects that could combine with the main project's consequences and create cumulative effects have been identified. (The environmental effects of projects other than the main one are estimated based on the usual effects seen in similar projects.)

The cumulative effects assessment approach includes three main steps:

- Establish the scope of the study, i.e., rationale behind selecting the valued components, and establish the spatial and temporal boundaries for consideration.
- Identify past, ongoing and upcoming projects, activities and events that impact at least one of the valued components under study.
- Analyze the actual cumulative effects.

7.2 Study scope

The valued components selected to assess the cumulative effects are:

- surface water quality
- economic spinoffs for the Cree communities
- Cree land use

The following sections present:

- rationale for the valued components selected
- established spatial boundaries
- past and future temporal boundaries

7.2.1 Valued components selected

7.2.1.1 Surface water quality

The surface water quality is a valued component, since the Cree community has expressed concerns regarding the potential impacts of the proposed quarry's operation on the quality of surface water drawn for domestic use or consumption. During consultations, the Council of the Cree Nation of Chisasibi emphasized that the availability of natural water sources is important to trappers operating on lands far from the community. The Council therefore wants to ensure that the project will not alter the water sources used by families in the area. It should be noted that the tallyman does currently obtain drinking water from the unnamed watercourse, located north of the proposed quarry, but for the purposes of this study, it was included since this water source could eventually be used.

As illustrated on Map 7-1, this component's spatial boundaries include the sub-watershed of the unnamed watercourse where the proposed quarry site is located and the bay southeast of the Robert-Bourassa reservoir, which receives water from the unnamed watercourse. These boundaries make it possible to account for all past and upcoming projects and activities within this sub-watershed that are likely to impact surface water quality.

7.2.1.2 Economic spinoffs for the Cree communities

For the impact analysis of cumulative effects, the valued component of economic spinoffs for the Cree communities is relevant, as it aligns with Hydro-Québec's intention to prioritize local economic spinoffs for the Cree communities. The tallyman also wants his family to benefit from the project.

To this end, the spatial limits of the cumulative effects related to economic spinoffs take into account the Chisasibi and Wemindji communities, located five hours away by car from the La Grande-3 road. Within these boundaries, other ongoing or planned development and infrastructure projects that will impact the economic spinoffs and workforce of these two Cree villages, in the Eeyou Istchee Baie-James territory, will be identified.

7.2.1.3 Cree land use

Cree land use is a valued component that was selected for the cumulative effects analysis due to concerns raised during meetings with the Chisasibi community. As indicated in Section 4.5, the community is concerned that the potential impacts from developing and operating the proposed quarry over several years could adversely impact the tallyman and his family's activities, since they visit the camp at kilometre 7 on the La Grande-3 road, and the land's continued use by this family and others who use trapline CH40.

The spatial boundaries of this component correspond to those of trapline CH40, which is operated by the tallyman and his extended family and includes the Robert-Bourassa and La Grande 3 reservoirs. The analysis therefore identifies past and upcoming projects, activities and events that impact access to the trapline and harvestable resources.

7.2.2 Temporal boundaries of valued components

The past temporal boundary of all of the valued components is based on the territory's development since the construction of the La Grande complex—a major event for the Eeyou Istchee Baie-James territory. This temporal boundary, which goes back 50 years to the early 1970s, enables changes to be observed since the construction of the hydro-electric developments and power transmission infrastructure: economic development of the Cree communities, opening up of the territory with the development of the road network in Eeyou Istchee Baie-James and changes in land use.

The future boundary has been set based on the proposed quarry's estimated 20-year operation, plus an additional 5-year period for site restoration. If the quarry operation begins in 2024, the future temporal boundary will therefore be 2048.

7.3 Past, ongoing and upcoming projects, activities and events that may affect the valued components

An exhaustive list of past, ongoing and upcoming projects, activities and events most likely to affect the valued components selected was developed based on stakeholder consultations and currently available data, which, as a result, carries a certain degree of uncertainty, particularly with regard to upcoming projects, activities and events. In addition, it should be assumed that certain projects in the planning stage may not proceed for various reasons.

The list of projects, activities and events is presented in Table 7-1 and on Map 7-1. These are described in more detail in the following sections. To be selected, the projects, activities and events needed to have significant impacts on at least one of the valued components selected for the cumulative effects analysis.

Table 7-1: Major past, ongoing and upcoming projects, activities and events likely to affect the valued components

Main projects, activities and events	Description				Potential impact		
		Past	Ongoing	Upcoming	Surface water quality	Economic spinoffs for the Cree communities	Cree land use
Mining and resource extraction							
Borrow pits	Quarries and sand pits that have been operated since the 1970s for the La Grande-3 generating station development and related infrastructure (roads, access roads, airports, dikes, dams, etc.). A total of five borrow pits are located in the La Grande-3 generating station area. The potential of these sites has nearly been fully exhausted (GHD, 2019).	X	X				
Road and trail infrastructure							
Transtaïga highway	A 666 km unpaved road that runs west to east across the Eeyou Istchee Baie-James territory. The road is maintained by the Société de développement de la Baie-James.	X	X	X			X
La Grande-3 road	A 30-km unpaved road, built in 1977, that leads to La Grande-3 generating station and is maintained by Hydro-Québec, including access roads to the facilities.	X	X	X	X		X
Trails	Access trails that are used by Hydro-Québec to maintain 735-kV transmission lines. Unofficial all-terrain vehicle (ATV) and snowmobile trails that are used by the Cree community and crisscross traplines.	X	X	X			X
Road repair program by the Société de développement de la Baie-James	Road repair program that ensures the sustainability of Route Billy-Diamond, Chemin de Chisasibi and Chemin de Wemindji. This program also aims to maintain a safe road infrastructure for various users. The first phase of this program began in 2015 and is expected to be completed in 2022 (SDBJ, 2021). This program includes several activities: • reconstruction of curbs • opening, reopening and expansion of quarries • opening and operation of an asphalt concrete plant • repair of bridges • development of drainage ditches • replacement of numerous culverts The second phase of work is planned between 2023 and 2027 (SDBJ, 2021).	X	X	X		X	

Table 7-1: Major past, ongoing and upcoming projects, activities and events likely to affect the valued components (*cont.*)

Main projects, activities and events	Description	Past	Ongoing	Upcoming	Potential impact		
					Surface water quality	Economic spinoffs for the Cree communities	Cree land use
Mining and resource extraction (*cont.*)							
Maintenance and refurbishment project involving several structures in the La Grande-3 generating station area	Work planned by Hydro-Québec from 2024 to 2043 that will require 500,000 m^3 of aggregate material, all produced at the proposed quarry in the La Grande-3 development area. The work will be divided into six phases: • rehabilitation of the La Grande-3 generation station road • resurfacing of the Transtaïga highway • resurfacing of Hydro-Québec's secondary roads, including culvert maintenance • maintenance of the La Grande-3 Airport runway • performance of various civil engineering projects at the Sakami residences and the La Grande-3 generating station • maintenance of civil engineering works, such as dikes, weirs, dams.			X	X	X	
Airport infrastructure							
La Grande-3 Airport	Airport that is operated by Hydro-Québec and located at kilometre 94 of the Transtaïga highway.	X	X	X		X	
La Grande-Rivière Airport	Airport that is owned and operated by the Société de développement de la Baie-James. It is located south of Radisson.	X	X	X		X	
Chisasibi and Wemindji airports	Robert-Kanatewat Airport in Chisasibi that is operated by the Cree Nation of Chisasibi and the Wemindji airport, operated by Transport Canada.	X	X	X		X	
Habitat enhancement and wildlife management							
Subsistence hunting, fishing and trapping by the Cree	See Section 5.5.1.4	X	X	X		X	X

Table 7-1: Major past, ongoing and upcoming projects, activities and events likely to affect the valued components (*cont.*)

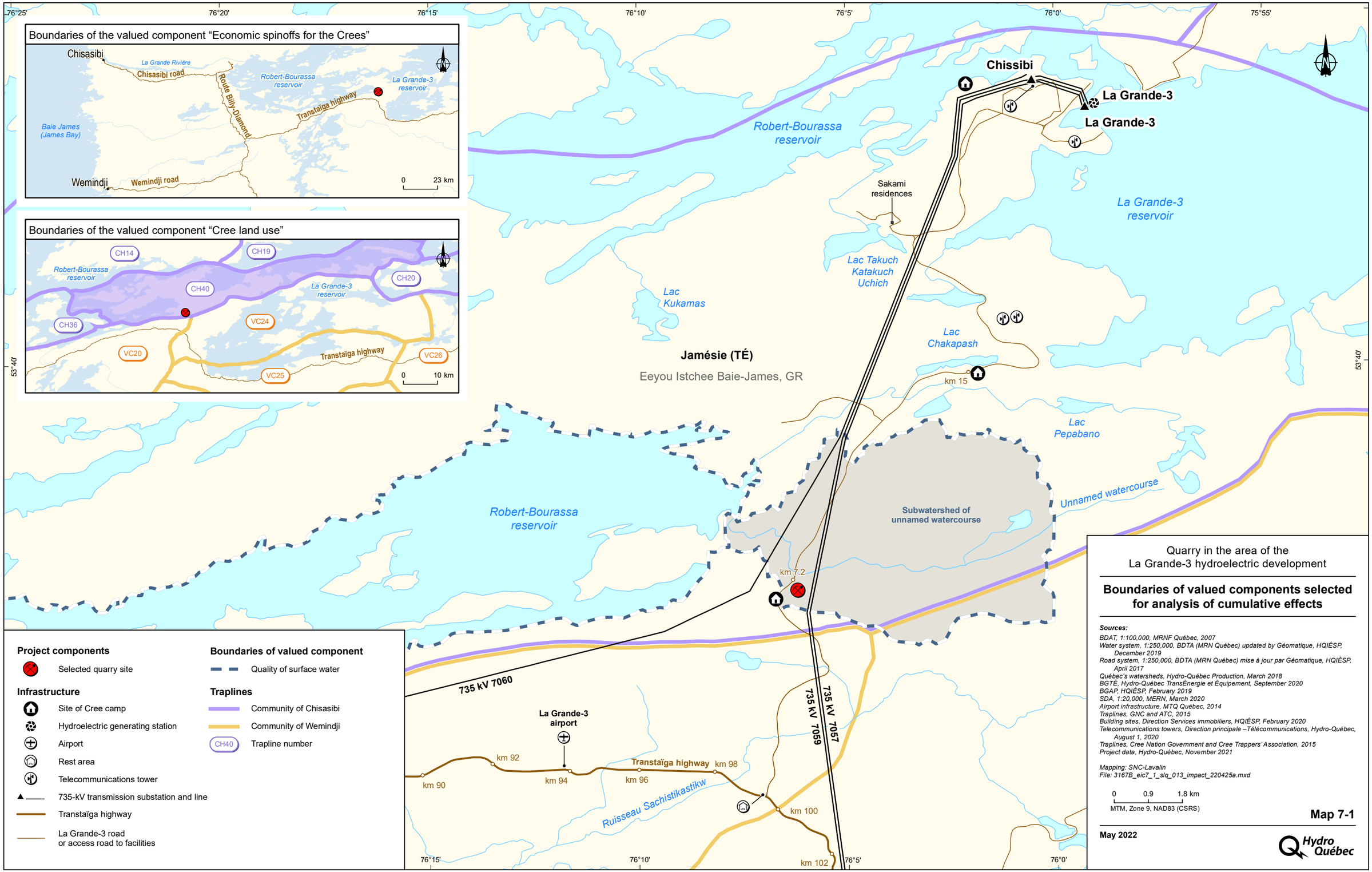
Main projects, activities and events	Description	Past	Ongoing	Upcoming	Potential impact		
					Surface water quality	Economic spinoffs for the Cree communities	Cree land use
Land use							
Cree camps	Temporary and permanent camps on trapline CH40 that are used by the tallyman, Mr. Ratt, and his family.	X	X	X			X
Vacation leases	See Section 5.5.1.5	X	X	X			X
La Grande complex	The La Grande complex has eight generating stations in total located in the Grand Rivière watershed and other rivers in Nord-du-Québec. The work was divided into two phases: the first phase, from 1973 to 1985, enabled the construction of the three largest generating stations in the project, i.e., La Grande-2 (now Robert-Bourassa), La Grande-3 and La Grande-4, as well as the diversion channel of the Caniapiscau, Eastmain and Opinaca rivers into the Grande Rivière. The project's second phase took place between 1987 and 1996 with the development of La Grande-1, La Grande-2-A, Laforge-1, Laforge-2 and Brisay generating stations. The complex required the construction of seven airports, seven work camps, 1,300 km of road and enabled the construction of 10,000 km of high-voltage power lines (Hayeur, 2001). The La Grande-3 hydroelectric generating station, built between 1976 and 1983, was commissioned in 1984. This project led to the creation of the La Grande 3 reservoir (Hayeur, 2001). The La Grande-3 and Robert-Bourassa reservoirs, downstream, flooded 54% of the area of trapline CH40 (including terrestrial and aquatic environments). The Hydro-Québec infrastructure on trapline CH40 is as follows: • 51 km of 735 kV transmission lines • 36 km of roads • 1 residential complex • 1 hydroelectric generating station • 1 switchyard • 1 dam • 4 dikes	X	X	X	X	X	X
Camping	Unserviced campgrounds and boat ramps located on the periphery of the Robert-Bourassa and La Grande 3 reservoirs (EUBRG, 2021).	X	X	X		X	

Table 7-1: Major past, ongoing and upcoming projects, activities and events likely to affect the valued components (*cont.*)

Main projects, activities and events	Description	Past	Ongoing	Upcoming	Potential impact		
					Surface water quality	Economic spinoffs for the Cree communities	Cree land use
Governance and land use							
Signing of the *James Bay and Northern Québec Agreement*	In 1975, the *James Bay and Northern Québec Agreement* was signed. It grants certain privileges to the Crees, including the exclusive right to hunt, trap and fish in certain predetermined areas, the establishment of independent management committees and the possibility of actively participating in environmental decisions as part of projects in the territory (Petit et al., 2011).	X	X	X	X	X	X
Grande Alliance	The Grande Alliance is a memorandum of understanding for consolidating and building socioeconomic ties between the Cree Nation and the Québec government to connect, develop and protect the territory. This memorandum has three phases, the last two of which involve projects near Chisasibi (Grande Alliance, 2021). **Phase 2** • Construction of a railway along Route Billy-Diamond on the eastern section between Chemin de Waskaganish and Chemin de Wemindji • Construction of a road between the Radisson and Whapmagoostui villages **Phase 3** • Extension of the railway to Whapmagoostui Project-specific impact studies for phases 2 and 3 are scheduled to begin in 2025. The construction on some projects could begin in 2028–2029.			X		X	
Paix des Braves	A political and economic agreement, between the Québec government and the Crees, that was signed on February 7, 2002. With this agreement, the Québec government undertook to involve the Crees in the development of the North and to pay them more than $3.6 billion over 50 years (Bourdeau, 2018).	X	X	X		X	
Agreement on Cree Nation Governance	Agreement that was signed between the Crees of Eeyou Istchee and the Government of Canada in 2017. The *Agreement* eliminated federal oversight of Cree governance on Category IA lands and made the Cree First Nations and the Cree Nation Government solely responsible for their self-government (Indigenous and Northern Affairs Canada, 2017).	X	X	X	X	X	X

Table 7-1: Major past, ongoing and upcoming projects, activities and events likely to affect the valued components (*cont.*)

Main projects, activities and events	Description	Past	Ongoing	Upcoming	Potential impact		
					Surface water quality	Economic spinoffs for the Cree communities	Cree land use
Governance and land use (*cont.*)							
Société du Plan Nord	This corporation is responsible for the deployment of the Québec government's *2020–2023 Northern Action Plan*. It contributes to the sustainable development of Québec territory that extends north of the 49th parallel (Québec government, 2021). Its mandates: • to accompany and support local and Indigenous communities in their community, social and economic development projects • to carry out or contribute to research and development activities as well as activities aimed at acquiring knowledge of the territory • to contribute to the implementation of mechanisms that will allow 50% of the area covered by the Northern Action Plan to be devoted to non-industrial uses and that will ensure environmental protection and the preservation of biodiversity by 2035		X	X		X	



Quarry in the area of the
La Grande-3 hydroelectric development

Boundaries of valued components selected for analysis of cumulative effects

Sources:

BDAT, 1:100,000, MRNF Québec, 2007
Water system, 1:250,000, BDTA (MRN Québec) updated by Géomatique, HQIÉSP, December 2019
Road system, 1:250,000, BDTA (MRN Québec) mise à jour par Géomatique, HQIÉSP, April 2017
Québec's watersheds, Hydro-Québec Production, March 2018
BGTÉ, Hydro-Québec TransÉnergie et Équipement, September 2020
BGAP, HQIÉSP, February 2019
SDA, 1:20,000, MERN, March 2020
Airport infrastructure, MTQ Québec, 2014
Traplines, GNC and ATC, 2015
Building sites, Direction Services immobiliers, HQIÉSP, February 2020
Telecommunications towers, Direction principale –Télécommunications, Hydro-Québec, August 1, 2020
Traplines, Cree Nation Government and Cree Trappers' Association, 2015
Project data, Hydro-Québec, November 2021

Mapping: SNC-Lavalin
File: 3167B_eic7_1_slq_013_impact_220425a.mxd

0 0.9 1.8 km
MTM, Zone 9, NAD83 (CSRS)

Map 7-1

May 2022

Hydro Québec

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7.4 Analysis of valued components

The analysis of each of the valued components includes the following steps:

- Identify projects, activities and events whose impacts are deemed significant.
- Identify certain projects, activities and events whose impacts are deemed to have little or no significance.
- Establish the baseline, which corresponds to the situation at the time of the past temporal boundary; for some valued components, the information is fairly limited.
- Describe the historical trends of the component, one of its aspects or certain factors known to affect the component; historical trends are established from the baseline up to completion of the environmental and social impact assessment.
- Qualitatively assess the significance of the cumulative effects.
- Implement additional mitigation measures or a follow-up program, where necessary.

The two ultimate objectives of this analysis are: 1) to qualitatively assess the nature and scope of the total cumulative effects, i.e., those associated with the quarry project's three phases in combination with those of all projects, activities and events likely to alter valued components; 2) to specify the quarry project's relative contribution to the total cumulative effects. It is important that the cumulative effects assessment clarifies, as much as possible, the extent to which this project under study solely contributes to the total impacts (Hegmann et al., 1999).

However, the cumulative effects assessment does have limitations for all of the components under study, for the following reasons:

- The details of certain projects, activities and events were not always accessible or available during the assessment.
- The scientific knowledge on cumulative effects applied to the valued components under study is limited.
- The future temporal boundary should, at a minimum, correspond to the quarry project's planned end. However, this analysis does not take into account several unconfirmed or unknown projects that may take place between now and then.

7.4.1 Surface water quality

7.4.1.1 Major projects, activities and events

The proposed quarry area is relatively undeveloped and mostly contains infrastructure, such as the La Grande-3 road and transmission lines. The use and maintenance of this infrastructure can affect the local surface water quality, through erosion and dust emissions, which can settle directly in surface water or on soil, to be carried away by runoff.

In the proposed quarry area, the La Grande complex development is the major regional project and has had a decisive impact on surface water quality due to the creation of reservoirs (which involved flooding vast areas of vegetation and forest soils) and the diversion of rivers. More locally, the construction and commissioning of La Grande-3 hydroelectric generating station, between 1976 and 1984, led to the construction of the aforementioned roads and transmission lines, as well as much greater land use.

In the short term, the repair project for the La Grande-3 road could have a local impact on surface water quality. In the longer term, other as-yet-undefined activities under the *James Bay and Northern Québec Agreement* (JBNQA) and the Grande Alliance Memorandum of Understanding, could also have a local impact on surface water quality. All of these projects, whether defined or not, must comply with environmental protection legislation. Accidental events, such as forest fires or oil spills, could also impact surface water quality in the future.

Climate change is expected to cause the following regional consequences (SNC-Lavalin, 2022):

- Total annual precipitation is expected to increase slightly—by 5–8% over a 30-year horizon (+40–60 mm).
- Maximum daily precipitation is not expected to increase significantly, but extreme precipitation events are expected to increase by approximately 10%.

An increase in instream flow in the unnamed watercourse, located north of the proposed quarry site, could occur during the project. For instance, Ouranos anticipates, with early spring floods, a 2%–15% increase in the river flow in 2015 in the Eeyou Istchee Baie-James territory (Ouranos, 2017). As a result, there may be a slight increase in erosion of the unnamed watercourse's watershed and an increase in suspended solids in runoff.

7.4.1.2 Baseline

In 2020 and 2021, three sampling campaigns, as part of the proposed quarry's impact assessment, characterized the quality of local surface water (unnamed watercourse located to the north and small marshes nearby). Detailed results of the characterization can be found in Section 5.3.6. In summary, the results indicate that surface water:

- generally meets the criteria of the Ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC) and the Canadian Council of Ministers of the Environment (CCME)
- has low alkalinity and is sensitive to changes in pH, especially acidification
- has few suspended particulates and can be described as clear
- is very soft and has low mineralization
- has low productivity (low nutrient content)

7.4.1.3 Description of past trends

It is impossible to establish any finding on the change in surface water quality beyond the first sampling campaign in September 2020, due to a lack of previous data on the study area, particularly for the unnamed watercourse running north of the proposed quarry site.

As for Robert-Bourassa reservoir, into which the unnamed watercourse flows, the water quality has changed significantly since the reservoir was created due to the subsequent decomposition of the flooded biomass. However, environmental follow-up of the La Grande complex demonstrates that after a few years, the water quality has returned to comparable levels in the surrounding areas. A new balance was therefore achieved after 10–15 years (SEBJ and Entraco, 1995). As for fish mercury levels, data collected at the La Grande complex indicates that levels have nearly returned to those recorded in the area 15 to 25 years after impoundments for non-piscivorous species and 20 to 30 years after impoundment for piscivorous species (Schetagne et al., 1996).

7.4.1.4 Significance of cumulative impacts

As indicated in Chapter 6, the significance of the proposed quarry's residual impact on surface water quality will be minor, given all of the general and specific mitigation measures that will be implemented. This minor residual impact may occur in the unnamed watercourse north of the proposed quarry site, but it should no longer be noticeable in the Robert-Bourassa reservoir. When considering the contribution of all past, ongoing and upcoming projects, activities and events, including climate change and individual infrastructure projects, the total cumulative effects on surface water quality within the spatial boundaries are considered moderate. However, the project's relative contribution to these effects is considered low.

7.4.1.5 Mitigation measures and follow-up program

Since the project's relative contribution to the total cumulative effects is not significant with respect to surface water quality, no additional mitigation measures or follow-up are required.

7.4.2 Cree land use

7.4.2.1 Major projects, activities and events

The quarry project's impact on traditional hunting and trapping in the area, more specifically on trapline CH40, was a concern raised during meetings with the Chisasibi community. This project joins the list of projects, activities and events, mainly from the 1970s, contributing to non-Indigenous activities that encroach upon hunting and trapping grounds and alter Cree wildlife harvest methods. The Chisasibi community is concerned that this project will limit Cree activities on the trapline and the tallyman's future use of this area.

The La Grande complex development, from 1973 to 1996, including La Grande-3 hydroelectric generating station, commissioned in 1984, and the creation of La Grande-3 and Robert-Bourassa reservoirs, flooded 54% of trapline CH40 (both aquatic and terrestrial portions). This flooding had repercussions on certain activity areas, including goose-hunting sites. The trapping grounds were also changed over the years by related developments, such as the transmission line rights-of-way, Chissibi substation, borrow pits and the Sakami residences.

The La Grande complex development and flooded land caused traditional activities to become concentrated within a limited area in the territory. The construction of road infrastructure, including the Transtaïga highway and the La Grande-3 road, made it easier to travel by snowmobile and ATV. It also increased the frequency of return trips between the hunting grounds and the community, maintained subsistence hunting and fishing activities and provided greater access to traplines and camps used by the tallyman and his family, mainly during the fall and winter periods. The roads also made it easier for a greater number of non-Indigenous people to visit the territory. Before the 1970s, long stays in the territory were mainly recorded in winter, but the roads have made short stays possible all year round.

7.4.2.2 Baseline

The baseline with respect to Cree land use dates back to the state of the land prior to the construction of the La Grande complex, which began in the early 1970s, and the signing of the JBNQA. During this period, trapping and the sale of furs were important sources of income in the Cree communities. Most families alternated short summer stays at the trading posts on the James Bay coast with long winter stays on their hunting grounds. By the early 1970s, the process of sedentation of the communities around the trading posts was almost complete. This process accelerated in the 1930s with the establishment of local education and health services, compulsory education for children, and various government services and allowances. Sedentation affected the livelihoods of communities, and hunting, fishing and trapping activities became more concentrated near villages, in part to avoid the costs associated with transportation, while income from fur sales declined (Hayeur, 2001).

7.4.2.3 Description of past trends

The description of the hunting and trapping territory operated by the tallyman of trapline CH40 in the community of Chisasibi is presented in Section 5.5.1.4. It describes the current and past land uses and wildlife harvesting known by the current tallyman.

Since the construction of the La Grande complex and its related infrastructure, the usable area for hunting and trapping on trapline CH40 has decreased. This trend was observed on part of the territory of the community of Chisasibi, the most affected among the Eeyou Istchee Baie-James communities, where 26 of its 40 traplines (65%) were affected by the creation of reservoirs (Hayeur, 2001). As mentioned earlier, the creation of La Grande 3 and Robert-Bourassa reservoirs, commissioned in 1984, resulted in the flooding of 54% of the area of trapline CH40; in addition, the cons-

truction of transmission lines, dikes and workers' residences occupied some of the hunting and trapping grounds and generated more traffic on the territory. Trapline CH40 is one of the traplines most affected by the development of the La Grande complex.

However, the construction of the road network for the La Grande complex also had the effect of facilitating access to trapping grounds (Hayeur, 2001). The mitigation measures applied by Hydro-Québec in cooperation with the Indigenous community have mitigated the impact of the La Grande complex and its related infrastructure on Cree harvesting of the territory's resources. Several funds have been created over the years to support the practice of traditional activities and the development of the territory by the Cree.

Thus, since the creation of the reservoirs, hunting and trapping activities and use of camps on trapline CH40 have continued. One of the three Cree camp sites on trapline CH40 includes a camp built with mitigation funds from the La Grande complex. In addition, the tallyman for this trapline did not raise any concerns about the impact of the proposed quarry on his trapping grounds. The community of Chisasibi is asking that Hydro-Québec be favorable to requests from the tallyman that would allow him to harvest his territory more easily. In this regard, Hydro-Québec plans to offer the tallyman an alternative lodging solution at the camp at kilometre 7; it will also be able to make wood cut on the site of the proposed quarry available to him, if required.

7.4.2.4 Significance of cumulative effects

The significance of the residual impact of the development and operation of the quarry project on Cree land use is moderate, as stated in Section 6.8.3. The anticipated impact will be limited to a small area and will not restrict the access of the CH40 tallyman to the rest of the territory. The main wildlife harvesting areas currently in use will not be affected by the proposed quarry, nor will the water supplies and used trails. Considering all the projects, activities and events that took place on trapline CH40 compared to the baseline condition that prevailed before the construction of the La Grande complex, the total cumulative effects are considered high. However, the relative contribution of the proposed quarry to these total cumulative effects is considered negligible.

With respect to future infrastructure rehabilitation projects for the La Grande-3 development, it is difficult to anticipate their effects, but it is safe to assume that they will cause localized nuisances.

7.4.2.5 Mitigation measures and follow-up program

No additional mitigation measures or follow-up are required due to the negligible contribution of the quarry project to the total cumulative effects on Cree land use.

7.4.3 Economic spinoffs in Cree communities

7.4.3.1 Significant projects, activities and events

Consultations with stakeholders and Cree communities confirmed the importance of maximizing the economic spinoffs of the various projects in the region and in the Cree community of Chisasibi (see Section 4.4).

Various projects currently contribute to the economy of the Eeyou Istchee Baie-James territory, but the main activities that have most influenced the economy of Chisasibi and Wemindji as well as the occupation of the territory are the development of the region's energy potential as well as the various agreements reached between the Cree Nation and the governments of Québec and Canada over the past 50 years.

Hydro-Québec's operation of the La Grande complex remains the main economic activity in the area, and it also generates significant economic spinoffs at the national level. This complex, involving the construction—and now the maintenance—of several generating stations and their associated infrastructure (including 14 transmission lines, 7 airports, some 1,300 km of roads), has transformed the landscape and the regional economy since the 1970s. The operation of the La Grande complex provides some economic spinoffs to Chisasibi and Wemindji in terms of employment and contracts, but these are only a fraction of the jobs and contracts available.

The various agreements between the Crees and the governments of Québec and Canada, notably the JBNQA and the Paix des Braves, enhanced by the most recent La Grande Alliance Memorandum of Understanding and the *Agreement on Cree Nation Governance*, have helped promote the economic development of the Cree communities. These agreements have also made it possible to establish benchmarks aimed at minimizing the environmental, social and economic impacts of development projects on the region's Cree communities. These agreements have contributed to the economic changes that have occurred among the Cree over the past five decades (Hayeur, 2001).

These activities and projects have and will generate positive economic spinoffs for the Cree communities of Chisasibi and Wemindji. In terms of jobs and economic opportunities, La Grande Alliance aims to strengthen regional capacity by increasing local participation in regional development, creating a more stable job market in Northern Québec, and improving training planning and skills development through Apatisiiwin Skills Development (La Grande Alliance, 2021).

7.4.3.2 Baseline

The baseline for economic spinoffs for the Indigenous communities of Chisasibi and Wemindji corresponds to the period prior to the construction of the La Grande complex, i.e., the early 1970s. By this time, the sedentation of the Cree communities had been underway for a few decades: in 1971, more than a third of the 5,000 Cree in the region were living permanently in the villages. In Chisasibi, the most populous village, there were 1,500 people during this period (Hayeur, 2001).

The transition from the traditional subsistence mode to the market economy, which had already begun with the fur trade, accelerated with sedentation. According to some estimates in the early 1970s, about 20% of the Cree population was employed full time, 40% alternated between seasonal employment and hunting and trapping activities, and 40% lived on hunting, trapping and fishing activities exclusively (Roquet et al., 2004).

7.4.3.3 Description of past trends

It has already been documented that the construction of the large dams of the La Grande complex, and more particularly the agreements reached over the past 50 years with the Cree communities of the region, have had significant impacts on their economy and living environment. The following paragraphs provide a brief overview of the various findings of Hayeur (2001) in his summary document on the Northern environmental knowledge acquired.

From the 1970s to the present, the JBNQA has helped to open up the Cree communities (Wemindji and Eastmain roads built in 1993 and 1994, and Waskaganish road in 2001) which, since the early 2000s, have been mostly connected by roads. These new roads facilitate exchanges between Cree communities, but also with the urban centers of the southern part of the province. This has allowed communities to access less expensive goods, among other things, and to reduce the cost of manufactured or processed goods sold locally.

Another trend in recent decades has been the increase in wage-paying jobs in the Cree communities, especially through the creation of jobs within the organizations that emerged from the JBNQA (Hayeur, 2001). From 1971 to 1981, the portion of Cree household income tied to wages increased from 23% to 52%. Over the same period, the share of income derived from traditional activities underwent the opposite trend, falling from 61% to 43% (Hayeur, 2001). In 2016, with an employment rate of 53.3%, it was possible to say that just over half of the Cree of working age in Chisasibi were employed. The largest fields of employment were sales and services, education, law, and social, community, and government services (see Section 5.5.3.1).

In order to meet the infrastructure needs of the growing regional population and the needs of the Société de développement de la Baie-James (SDBJ) and Hydro-Québec, Cree businesses have multiplied and diversified and have also contributed to the regional economy. For example, Phase II of the La Grande complex generated $27 million in salaries for the Cree between 1987 and 1997, which corresponds to more than 670 jobs (Hayeur, 2001). The majority of these benefits have gone to the community of Chisasibi.

The types of contracts awarded to the Cree communities have diversified and multiplied from the construction of Phase I to Phase II of the project. In Phase I, Cree workers accounted for about 2% of all workers. The majority of contracts awarded to Cree businesses were related to clearing (Hayeur, 2001). Clearing occupied 65% of the Cree workers working on the project while 25% worked in construction (Genivar, 2012). Only one Cree company was present on the Phase I construction sites. During Phase II, seven Cree businesses had contracts that involved the construction, maintenance and repair of roads, dikes, dams and buildings, as well as the provision of services (Hayeur, 2001; Genivar, 2012). From 1989 to 1998, Hydro-Québec and its subsidiaries estimated the economic spinoffs for the entire Cree Nation at $350 million (Hayeur, 2001). With respect to operating activities associated with the La Grande complex, contracts awarded to Cree workers continued to increase, from $72.6 million in 2000 to $92.2 million in 2001, which includes SDBJ contracts for road maintenance financed in part by Hydro-Québec (Roquet et al., 2004).

In addition to energy development, the numerous agreements and amounts allocated under these agreements have contributed to the economic development of the communities in terms of services, with the creation of organizations, institutions, infrastructure and programs (Hayeur, 2001). The transfer of government programs to Cree entities has generated many permanent jobs in the public service sector, which represented nearly half of salaried positions in the Cree communities as a whole in 1996 (Roquet et al., 2004). Furthermore, as summarized by journalist Denis Lessard (2021), the Paix des Braves signed in 2001 has allowed for the continued economic development of the Cree communities. More recently, La Grande Alliance aims to enable the Cree government to develop transportation infrastructure in its territory (e.g., port, rail and road network). The economic spinoffs of these major construction projects should be felt throughout the Eeyou Istchee Baie-James territory.

7.4.3.4 Significance of cumulative effects

As indicated in Section 6.8.4, the residual impact of the operation of the proposed quarry on the economic spinoffs for the neighboring Cree communities is positive and its significance is moderate during the development and operation phases due to direct, indirect and induced spinoffs (e.g., jobs, business opportunities).

The significant projects and events presented above have contributed significantly to the improvement of the economic environment, which will be complemented by the spinoffs associated with the proposed quarry operation. In addition, road and other infrastructure projects (airport, generating station), to which the quarry project could contribute, point to other potential economic spinoffs.

The growth of Cree businesses over the years, especially in the construction field, suggests that the quarry project, even if it is small in scale, has a good potential for economic spinoffs in the Cree communities (direct or indirect spinoffs or through subcontracts).

Consequently, the total cumulative effects on the economic spinoff component for the Cree communities of Chisasibi and Wemindji are generally positive and of major importance. The contribution of the quarry project in the La Grande-3 development area to these positive cumulative effects is considered to be low, however, given that the other projects and agreements considered in the cumulative effects analysis have and will provide more jobs and much greater spinoffs than the quarry project, over a longer period of time.

7.4.3.5 Mitigation measures and follow-up program

Since the cumulative effects on the Cree economy are positive in nature, no mitigation measures are required. Furthermore, the relative contribution of the quarry project to the total cumulative effects is low, so no follow-up is required.

8 Environmental overview

Table 8-1 identifies the components of the biophysical and human environments potentially affected by the quarry project, potential sources of impact, the project's environmental impacts, mitigation measures that will be applied and residual impacts.

Table 8-1: Impact assessment overview

Environmental component	Main sources of impact	Description of impact	Mitigation measures	Significance of residual impact
Biophysical environment				
Soil	Clearing Drilling and blasting Development of roads and activity areas Machinery management and maintenance Presence of the quarry and its facilities	Alteration of surface soil composition and profile Contamination due to an accidental oil spill	SEC: 3, 4, 6, 7, 10, 11, 15, 16, 17, 21, 22 and 24 Erosion prevention and sediment management plan Safety measures to prevent accidental spills and spill contingency plan	Minor
Surface water	Drilling and blasting Crushing and screening Transport and traffic Stockpiling of aggregate	Increase in suspended solids (SS) transported by runoff Increase in SS due to dust emissions Ammonia release caused by the use of explosives Increased salinity if a dust suppressant is used Contamination due to an accidental oil spill	Installation of sediment traps, as required Measures to limit dust emissions Application of best practices in the use of explosives, use of emulsion explosives as required Managing the use of dust suppressants Hydrocarbon tanks with recovery basin or double-walled protection, refueling and maintenance areas, recovery kits, response plan	Minor
Air quality	Drilling and blasting Crushing and screening Development of roads and activity areas Transport and traffic Stockpiling of aggregate	Generation of dust and air contaminants	SEC: 15 and 20 Humidification of aggregates or use of a dust collector during crushing and screening, if necessary Erosion prevention and sediment management plan	Minor

Table 8-1: Impact assessment overview (*cont.*)

Environmental component	Main sources of impact	Description of impact	Mitigation measures	Significance of residual impact
Biophysical environment (*cont.*)				
Wetlands	Clearing Construction of roads and activity areas (excavation, grading, backfilling and earthworks) Drilling and blasting Crushing and screening Aggregate washing Machinery management and maintenance	Permanent loss of 1,630 m^2 of open bog wetlands Potential contamination of surface water, therefore possible contamination of wetlands	SEC: 4, 10, 15, 21 and 26 Installation of culverts to maintain water supply to wetlands	Minor
Woodland caribou	Clearing Drilling and blasting Crushing and screening Development of roads and activity areas Transport and traffic Restoration Reshaping and revegetation of the site	Permanent loss of habitat (approximately 12.6 ha) Functional loss of habitat due to disturbance	SEC: 2, 4, 15 and 23	Minor
Migratory caribou	Clearing Drilling and blasting Crushing and screening Development of roads and activity areas Transport and traffic Restoration Reshaping and revegetation of the site	Permanent loss of habitat (approximately 12.6 ha) Functional loss of habitat due to disturbance	SEC: 2, 4, 15 and 23	Minor
Birds	Clearing Drilling and blasting Construction of roads and activity areas (excavation, grading, backfilling and earthworks)	Loss of 1,630 m^2 of wetlands and forested areas (124,500 m^2) in which birds reproduce.	General mitigation measures Winter clearing	Minor

Table 8-1: Impact assessment overview (*cont.*)

Environmental component	Main sources of impact	Description of impact	Mitigation measures	Significance of residual impact
Biophysical environment (*cont.*)				
Special-status birds and bats	Clearing Drilling and blasting Crushing and screening	Loss of 1,286 m^2 of mature and old-growth forest (≥70 years old), potential roosting and foraging habitat Disturbance Creation of functional dispersal corridors along the wooded edges of access roads	SEC: 2, 4, 10, 23 and 26 Carry out clearing work outside of the bat breeding season, which generally runs from June 1 to July 31. Keep standing dead trees near cleared areas and along access roads, without compromising worker safety or infrastructure integrity.	Minor
Human environment				
Public safety	Drilling and blasting Transport and traffic Presence of the quarry and its facilities Accomodations and worker presence	Increased traffic Local traffic disruptions Degradation of roads Worker shuttle Occasional blasting activities that may result in rock and debris projections	SEC 23.1 to 23.4 during blasting Inform the public of the work schedule Delineate work areas during blasting Ensure adequate signage Close the road during dynamiting Encourage carpooling If necessary, use a signal person and a security escort for oversize loads Have an effective and ongoing communication plan and means of communication with emergency services	Minor
Cree land use	Clearing Drilling and blasting Development of roads and activity areas Transport and traffic Presence of the quarry and its facilities Restoration Reshaping and revegetation of the site	Increased traffic Activities generating noise, dust and vibrations Degradation of roads Worker shuttle Relocation of hunting activities	SEC 23.1 to 23.4 during blasting Inform the public of the work schedule Build a new camp for the CH40 tallyman Offer wood from clearing activities to Cree users of trapline CH40 on a priority basis Encourage carpooling	Minor

Table 8-1: Impact assessment overview (*cont.*)

Environmental component	Main sources of impact	Description of impact	Mitigation measures	Significance of residual impact
Human environment (*cont.*)				
Economic spinoffs in Cree communities	Clearing Presence of the quarry and its facilities Housing and worker presence Employment and purchases of goods and services Restoration Reshaping and revegetation of the site	Job creation during the development phase Award of contracts Regional economic spinoffs	Enhancements: 1- Awarding contracts to local suppliers and contractors for goods and services during the development of the quarry in order to promote local economic spinoffs in the communities closest to the proposed quarry site (Chisasibi and Wemindji) 2- If none of the invited bidders submits a satisfactory bid, Hydro-Québec will endeavor to promote regional economic spinoffs by applying the following measures: • inclusion of clauses in contracts requiring contractors to use the services of independent truckers, in accordance with the *Transport Act* • use of material and equipment depots located in the project area • have clearing done by local contractors • insertion, in public requests for proposals, of a clause favoring regional Indigenous subcontracting	Moderate
Landscape	Clearing Development of roads and activity areas Stockpiling of aggregate Presence of the quarry and the facilities	Visibility of the quarry and its facilities for mobile observers over a distance of approximately 700 m	Maintenance of a wooded buffer zone of more than 35 m in width between the road to La Grande-3 generating station and the project site Construction of a new Cree camp away from the quarry Restoration of the site and revegetation at the end of its operation	Minor

9 Climate change resilience analysis

9.1 Context and method

A climate change resiliency analysis of the quarry project was conducted (SNC-Lavalin, 2022) following the steps proposed in the guide *Les changements climatiques et l'évaluation environnementale – Guide à l'intention de l'initiateur de projet* (MELCC, 2021*b*). Thus, this chapter includes:

- a description of the project and the receiving environment
- a review of recent and future climate and hydroclimate conditions
- a description of project and receiving environment components that are potentially sensitive to climate change
- a climate vulnerability analysis of project components
- a risk analysis of components considered potentially vulnerable
- treatment measures for moderate and higher level risks
- a discussion of compensation for residual climate impacts and the implementation of an environmental follow-up program related to climate resilience

The study's conceptual framework is based on current practices, which define risk as the product of the probability of climate-related impacts and the severity of the consequences of the impacts associated with these uncertainties. A matrix was used to identify moderate and higher level risks in order to propose appropriate control measures to be applied during the development and operation phases of the proposed quarry.

The study is based on climate data from a set of global climate models downscaled to the local level and corrected for bias using the BCCAQv2 method. Two time horizons were considered: a short-term horizon (2015–2035) and a long-term horizon (2045–2065). The study is also based on two greenhouse gas emission scenarios, a moderate emission scenario (RCP4.5) and a high emission scenario (RCP8.5).

9.2 Description of the project and receiving environment

The development of the quarry will include the clearing and removal of vegetation, the construction of an access road and the establishment of a rock extraction area, a crushing and aggregate storage area and a heavy machinery maintenance area. The quarry will be operated on a discontinuous basis, from 4 to 6 months per year, for the next 20 years, depending on the need for granular material. Activities will include drilling production holes, blasting rock, excavating and trucking rock to the crushing area, crushing and screening, transferring and trucking aggregates to the stockpile area, and trucking gravel via the access road. The study also includes five receiving environment elements:

1. An unnamed stream located more than 200 m north of the proposed quarry
2. A network of wetlands located in the southern portion of the biophysical environment inventory area
3. Three 735-kV transmission lines (circuits 7057, 7059 and 7060) with towers, respectively at about 100 m and 900 m at their closest point to the proposed quarry
4. Tallyman camp in the southwest
5. A small lake (unnamed) about 800 m to the east

9.3 Description of recent and future climate and hydroclimate conditions

Data from weather stations in the vicinity of the proposed quarry site show an increase in temperature and precipitation over the past several decades. According to data from the La Grande Rivière (YGL) Airport station, located approximately 90 km as the crow flies from the proposed quarry, the average annual temperature has been increasing since 1977 at an average rate of 0.46°C per decade, with a greater increase in winter. Total annual precipitation has fluctuated widely since 1977, but there has been a slight increase of about 35 mm (+5% to 6%) between the 1971–2000 and 1991–2020 periods. Most (70% to 75%) of this precipitation, including the recorded increase, occurs between June and November (summer and fall) as rain.

The following findings also emerge from the analysis of recent climate data concerning extreme conditions in particular:

- There is an increase in extreme temperatures in the summer; however, extreme heat events (maximum daily temperature >30°C) are still relatively limited (<2 days per year).
- There is a decrease in the frequency of low temperature episodes in winter.

- The intensity-duration-frequency (IDF) curves at the YGL station indicate a daily maximum rainfall of 65 mm per day that can recur every 25 years and 70 mm per day that can recur every 50 years. For hourly maximums, precipitation of 35 mm per hour and 40 mm per hour must be anticipated every 25 and 50 years, respectively.
- Maximum daily rainfall is increasing very slightly, as is the number of days with daily rainfall accumulations above 25 mm.

With respect to future climate conditions, the following projections emerge from the analysis:

- The average annual temperature will increase by about 1.4°C to 2.2°C over the life of the project. The increase will be greater in winter (2.2°C to 3.7°C) than in other seasons.
- An increase in the extreme maximum temperature in summer is expected. The highest annual temperature could regularly reach 34°C or 35°C by 2050. The number of hot days will double by 2045–2065, but will remain relatively low (<5 days per year with a maximum temperature of 30°C and above).
- Total annual precipitation is expected to increase slightly by 5%–8% over the life of the project.
- An increase in extreme precipitation intensity of about 10% would be expected during the project period compared to historical observations.

Available climate data do not allow for projections of extreme weather events involving high winds. According to Ouranos (2017), these are expected to be more frequent and intense in the region by 2050, with an increase in wind gusts, especially in summer. Otherwise, it is difficult to make projections for other events such as lightning, fog, and freezing rain due to lack of sufficient knowledge on the subject.

9.4 Risk analysis

Of the 29 risks identified in this exercise, three are considered priority risks because they were scored as moderate-high risk. However, an exception is made for a moderate-level risk that is unlikely to occur, but where the severity of the impact is high. Table 9.1 summarizes the priority risks and proposed mitigation measures.

Table 9-1: Priority risks for the proposed quarry and mitigation measures

Initial risk score	Impact of climate hazards on the project	Mitigation measure	Level of residual risk	Comment
Moderate-high	Effect of a landslide on the explosives warehouse (explosive magazine outside the site of the proposed quarry)	Installation of the warehouse in a location that is not vulnerable to landslides	Low	This level of risk is based on the fact that the warehouse site is not yet fixed. Selecting a site based on landslide potential would reduce the probability to "unlikely."
Moderate-high	Effect of extreme precipitation on fuel tanks	Use of double-walled tanks	Low	A double-walled tank is designed to prevent accidental fuel spills as much as possible, unlike standard tanks whose recovery basins can fill up quickly in the event of heavy rain. The risk is considered low since rainfall has no effect on the double-walled tanks. In addition, the tanks will be installed on a temporary basis and will be removed from the site between each phase of aggregate crushing.
Moderate	Effect of dryness during land clearing and stripping activities	Require the use of spark arrestors on chain saws	Low	Fire is possible during clearing activities during dry periods. The impact of such an event could be very high. The use of systems to eliminate sparks or any source of ignition should therefore be considered in the event that clearing is done during a dry period.

10 Environmental compliance monitoring and follow-up

10.1 Environmental monitoring program

To ensure that mitigation measures are applied, Hydro-Québec conducts environmental monitoring at all stages of a project. At the engineering stage, all environmental protection measures identified in the environmental and social impact assessment statement are incorporated into the plans and specifications and other contractual documents for the project.

During preconstruction activities, the Hydro-Québec environmental officer on site ensures that the environmental measures, requirements, standards and other specifications set out in the contract documents for the project are implemented.

At the start of construction, the contract administrator, the site environmental officer and the construction contractor are provided with information on the company's commitments and specific environmental protection measures.

The site manager is responsible for environmental protection on the site. The site manager ensures that the contractor complies with the environmental protection provisions of the contract and that the contractor is fully aware of the Standard Environmental Clauses (SECs) in the contract and any special provisions for the project and specified in the environmental and social impact assessment statement. In addition, the site manager constantly monitors compliance with the company's environmental protection commitments.

At the end of the construction work, the environmental officer ensures that the site is restored, proceeds with the environmental acceptance of the work and certifies the application of the mitigation measures.

10.2 Environmental follow-up program

Hydro-Québec implements an environmental follow-up program to further the environmental assessment process and measure the actual impacts of its projects or activities. The program also makes it possible to evaluate the effectiveness of the mitigation measures applied and to adjust them as needed, with a view to ensuring continuous improvement.

Within the scope of the quarry project, no follow-up program has been foreseen.

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Printed on paper made in Québec
from 100% postconsumer recycled fibre

Original text written in French.
Ce document est également publié en français.

2022E0225-A