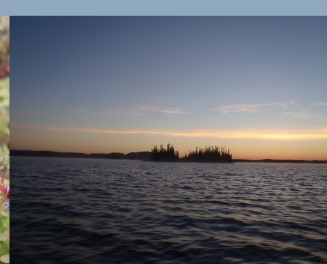
WHABOUCHI PROJECT

DEVELOPMENT AND OPERATION OF A SPODUMENE DEPOSIT IN THE JAMES BAY TERRITORY

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

March 2013



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NEMASKA LITHIUM

www.nemaskalithium.com

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Daniel Dufort	Vice President Operations
Ann Lamontagne	Environmental Manager

ESIA Team

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Catherine Lussier, anthropologist	Land and Resources Use
Corporation Archéo-08	Archaeology
Del Degan, Massé	Mapping
EEM	Human Environment
Golder Associates Ltd	Geochemistry, Cumulative Impact Assessment and Monitoring and Follow-Up Programs
J. P. Lacoursière Inc.	Technological Risks
Réjean Benoît, biologist	Birds
Richelieu Hydrogéologie Inc.	Hydrogeology
Senes Consultants Limited	Air Quality, Noise and Vibration
Sirieix Biologie Inc.	Biological Field Work

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NEMASKA LITHIUM

CHAPTER 1

INTRODUCTION AND BACKGROUND

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March 28, 2013

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1. INTRODUCTION AND BACKGROUND

This chapter outlines the Whabouchi Project, which consist in the operation of a spodumene deposit and concentrate the ore on-site. It introduces the project proponent and the consultants who contributed to the environmental and social impact assessment (ESIA), and describes the background and purpose of the project.

1.1 Project Outline and Location

Nemaska Lithium intends to develop and operate a spodumene deposit in the James Bay territory. The project, named Whabouchi, consists in extracting the spodumene from an open-pit mine and to concentrate this ore on-site. The Whabouchi project is located 30 km east of the Cree community of Nemaska and at 300 km north-north-west of the municipality of Chibougamau. The project site is accessible via the route du Nord (Figure 1-1). The mining project is in the Nord-du-Québec administrative region, on Municipalité de Baie-James territory. The geographic coordinates at the center of the mine site are as follows:

75°51'49.7'' W

51°40'42.0'' N

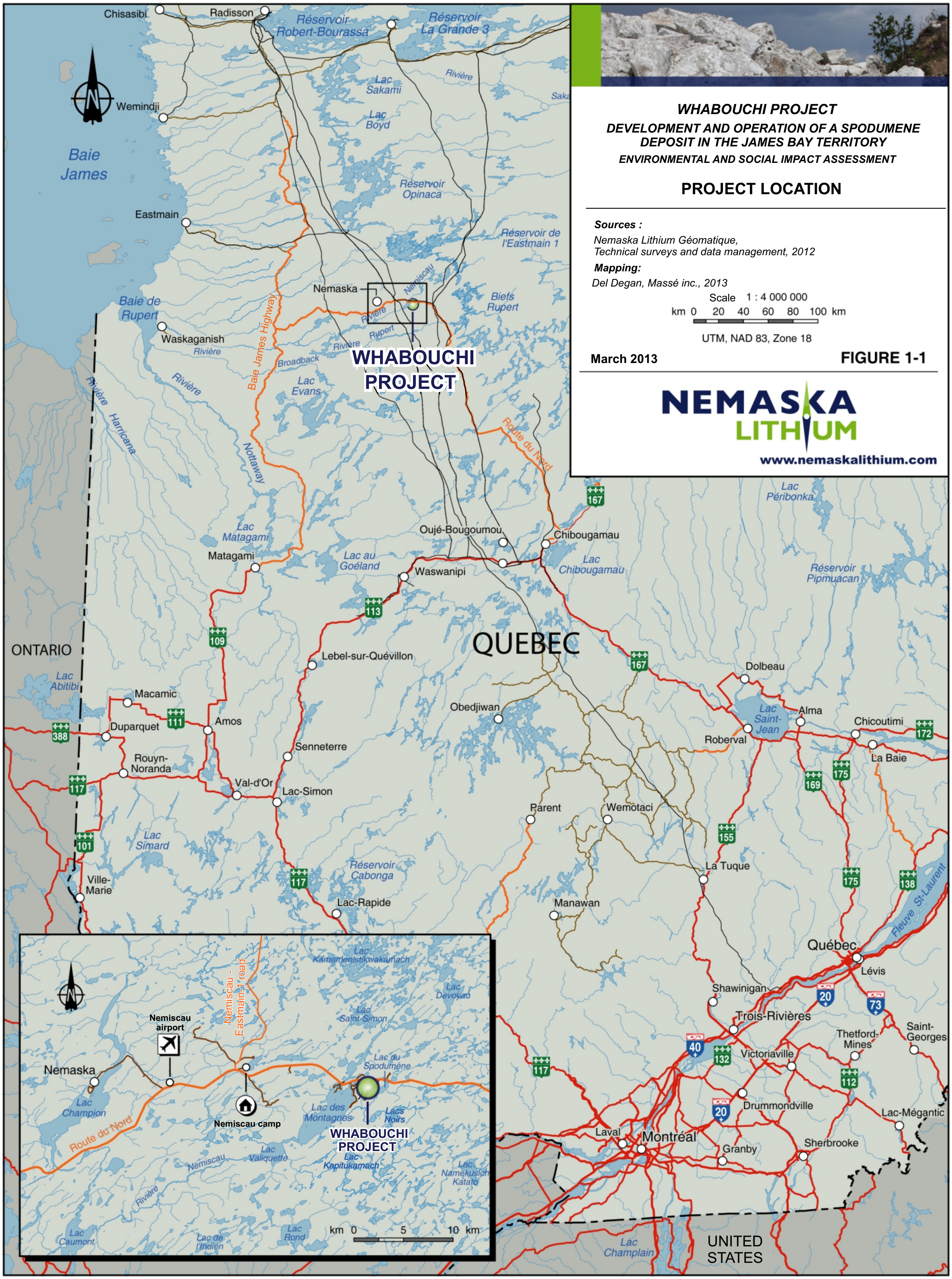
The deposit is considered one of the largest spodumene deposits in the world. The mining infrastructures will allow an annual output of approximately 1 million tonnes of ore, giving close to 213,000 tonnes of spodumene concentrate at 6% Li_2O. The anticipated life span of the mine is 23 years, including the construction and closure phases.

1.2 Project Proponent and Collaborators

1.2.1 Proponent

The proponent of the Whabouchi project, who is also responsible for the ESIA, is Nemaska Lithium, an exploration and development company active essentially in the James Bay territory, in Québec. Nemaska Lithium holds the exploration rights on the property where the project is located. An application for a mining lease to develop the mine pit was submitted to the ministère des Ressources naturelles in 2012 and it currently under consideration.

In addition to producing a spodumene concentrate at the Whabouchi mine site, Nemaska Lithium plans to produce lithium hydroxide and lithium carbonate in the region of Salaberry-de-Valleyfield, in Québec. The company's main assets are the Whabouchi property (lithium deposit), covering approximately 1,716 ha, and the Sirmac property (lithium showing) of approximately 645 ha, both wholly owned by Nemaska Lithium.



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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

PROJECT LOCATION

Sources :

Nemaska Lithium Géomatique,
Technical surveys and data management, 2012

Mapping:

Del Degan, Massé inc., 2013

Scale 1 : 4 000 000
km 0 20 40 60 80 100 km

UTM, NAD 83, Zone 18

March 2013 **FIGURE 1-1**

NEMASKA LITHIUM

www.nemaskalithium.com

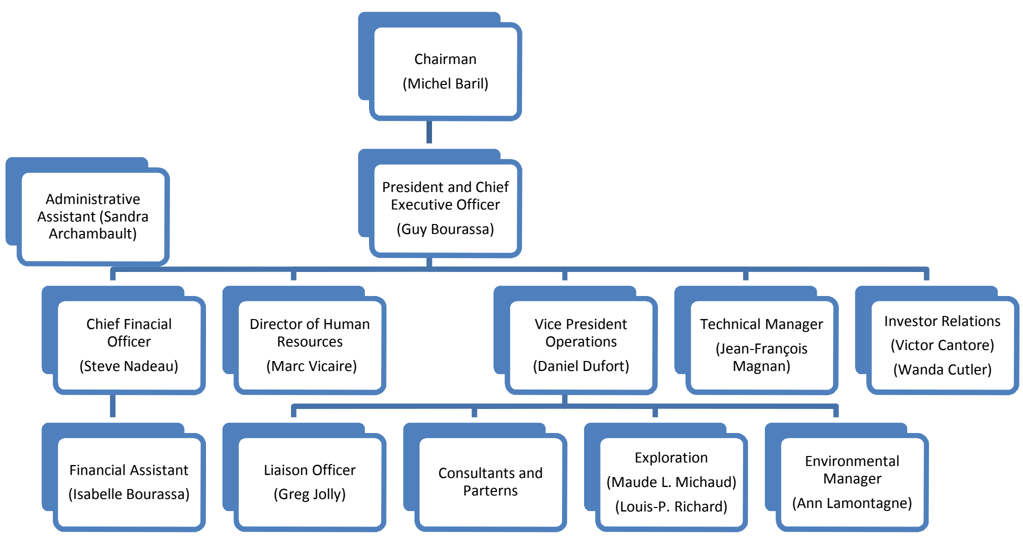
The head office of Nemaska Lithium is located in Québec, in the Province of Québec. The address of the head office is the following:

450 rue de la Gare-du-Palais, 1st Floor
Québec (Québec) G1K 3X2
Phone: 418-704-6038
Fax: 418-614-0627
Email: info@nemaskalithium.com

A second office will eventually be opened in Salaberry-de-Valleyfield for the purposes of the activities in that area.

The Nemaska Lithium team is made up of experienced people who have worked many years in the mining industry, both in exploration and operation activities. The company's corporate structure is shown in Figure 1-2. Currently, the company relies on a solid team of experienced employees and consultants. Concerning the impact assessment, the work was under the direction of Mrs. Ann Lamontagne. With more than 22 years of experience, she has developed a technical expertise in the mining sector, mainly in its environmental aspects.

Figure 1-2 Nemaska Lithium Corporate Structure



As this date, the Cree community of Nemaska owns 3.6% of the company's shares. Sichuan Tianqi Lithium Industries inc., a subsidiary of Chengdu Tianqi Industry Group Co. Ltd., is the largest manufacturer of battery-grade lithium products in the Asian market and holds approximately 19% of the shares in Nemaska Lithium. Major Québec mining exploration funds jointly own approximately 15% of the company.

Nemaska Lithium is a Canadian company incorporated under the Canada Business Corporations Act. Its head office is located in Québec. Its shares are traded on the TSX Venture Exchange under the NMX symbol and in the United States on the QX over-the-counter exchange under the symbol NMKEF.

1.2.2 Environmental and Social Impact Assessment Collaborators

To prepare the impact assessment, Nemaska Lithium retained the services of specialists in environmental and impact studies. The various collaborators who contributed to this assessment have specific and complementary expertises.

Golder Associates

Founded in Canada in 1960, Golder is a global organization that provides a wide range of specialized consulting, engineering and construction services in the fields of Earth sciences, environment and energy. It maintains 180 offices throughout North America, South America, Africa, Asia, Oceania and Europe. Present in Québec since 1988, it currently employs more than 200 persons in the province. Golder contributed to different aspects of the ESIA, notably to assess the impacts of the project on water quality, the cumulative impacts, and to develop the monitoring and follow-up programs.

ÉEM

ÉEM is a sustainable development consulting firm that specializes in the areas of environment, community engagement and strategy. In the assessment of the Whabouchi project impacts, ÉEM was responsible for the social aspect. More specifically, ÉEM coordinated the consultation and involvement activities in the Cree community of Nemaska.

Catherine Lussier

Mrs. Lussier is an anthropologist with more than 15 years of experience in conducting social studies, notably in Cree territories. In this ESIA, she acted as expert on social aspects, particularly with regard of the use of the land and its resources. She was also in charge of consultation activities in aboriginal community.

Senes Consultants Limited

Senes is an Ontario-based company that offers specialized environmental services since 1980. It operates offices in the following Canadian cities: Richmond Hill, Ottawa, Vancouver, Edmonton and Yellowknife. In the ESIA, Senes is responsible for the air quality and noise level components. It completed the modeling of air emissions and noise levels.

Corporation Archéo-08

Founded in 1985, Corporation Archéo-08 has completed a large number of archaeological investigations in Québec, notably in the Abitibi-Témiscamingue region. It also acts as a consulting expert for various public agencies in Abitibi-Témiscamingue. The Corporation is responsible for the archaeological heritage component.

JP Lacoursière inc.

Recognized expert in industrial risk management, Mr. Jean-Paul Lacoursière is responsible for the assessment of the project's technological risks and for developing the emergency measures plan. Mr. Lacoursière has completed many risks analyzes for industrial projects in the following sectors: petroleum refining, mining, petrochemistry, pulp and paper, agri-food, etc. He is quite familiar with Northern Québec region, having worked there several times.

Del Degan, Massé

Del Degan, Massé is a group of consultants active at the regional, national and international levels. The company main fields of activities are forest sciences, natural sciences, geomatic and information technologies, environmental sciences and land-use planning. More than 200 projects involving significant informatic or geomatic components have been carried out by Del Degan, Massé. In this ESIA, Del Degan, Massé is responsible for the mapping and certain components of the biological environment. They were also in charge of the soils and surface deposits component (PolyGéo).

Richelieu Hydrogéologie

A geological engineer specializing in hydrogeology, Mr. Yves Leblanc offers is services in private practice since 1993. He completed the modeling of the current and future hydrogeological conditions of the Whabouchi project.

BBA Inc. and Met-Chem Canada

The preliminary economic assessment of the project was completed by BBA Inc. and Met-Chem Canada Inc., two independent engineering consultants. It was posted in SEDAR on November 16, 2012 (Met-Chem, 2012).

1.2.3 Environmental Management System

Nemaska Lithium is in the process of implementing corporate policies relating mostly to hiring, health and safety, environment, training, etc. Nemaska Lithium will also develop environmental and health and safety management systems that will be operational at the onset of the mine construction activities.

Nemaska Lithium is committed to activities that combine environmental preservation, individual respect and a balance between economic prosperity and sustainable development responsibility. Nemaska Lithium will put into practice tools to protect life, health and environment for present and future generations. Protecting the environment will be a priority for Nemaska Lithium, as will the profitability of the project for its shareholders.

In order to ensure the protection of the biophysical and social environments, Nemaska Lithium will provide its employees and suppliers with the appropriate tools to achieve these goals. Nemaska Lithium is notably committed to:

- Complying with applicable laws and regulations and designing the infrastructures with the aim of always minimizing their footprint, selecting the most efficient technologies while respecting economic choices;
- Facilitating the use of the implemented management systems by providing coaching and support to the employees and suppliers;
- Empowering the employees and suppliers through awareness and training activities;
- Being proactive in the communities so as to stimulate the engagement and participation of the local communities in the diversification of their skills and activities;
- Giving the authorities, as well as to the engage community members, the employees and the supplier, access to its management plans, follow-up programs, etc.

1.2.4 Health and Safety Management System

For Nemaska Lithium, the health and safety of its workers is one of the most important priorities. The objective of this project is to create a healthy and safe working environment in order to avoid injuries and occupational diseases. The guiding principle is that all accident can be avoided if measures are in place to prevent them. Every employee is also responsible for the person working nearby. Every employee shall comply with the health and safety management system. In order to increase employee awareness and communicate the importance of health and safety for the company, Nemaska Lithium will implement the following elements:

- An orientation protocol for new employees and visitors;
- Posting of key messages on bulletin boards and constant reminding of the key elements of the health and safety management system;
- Communication of the key elements of the health and safety management system to the service providers, who shall pledge to comply with it.

1.3 Background and Purpose of the Project

The present section provides a summary description of the market in which the Whabouchi project fits, as well as the purpose of the project.

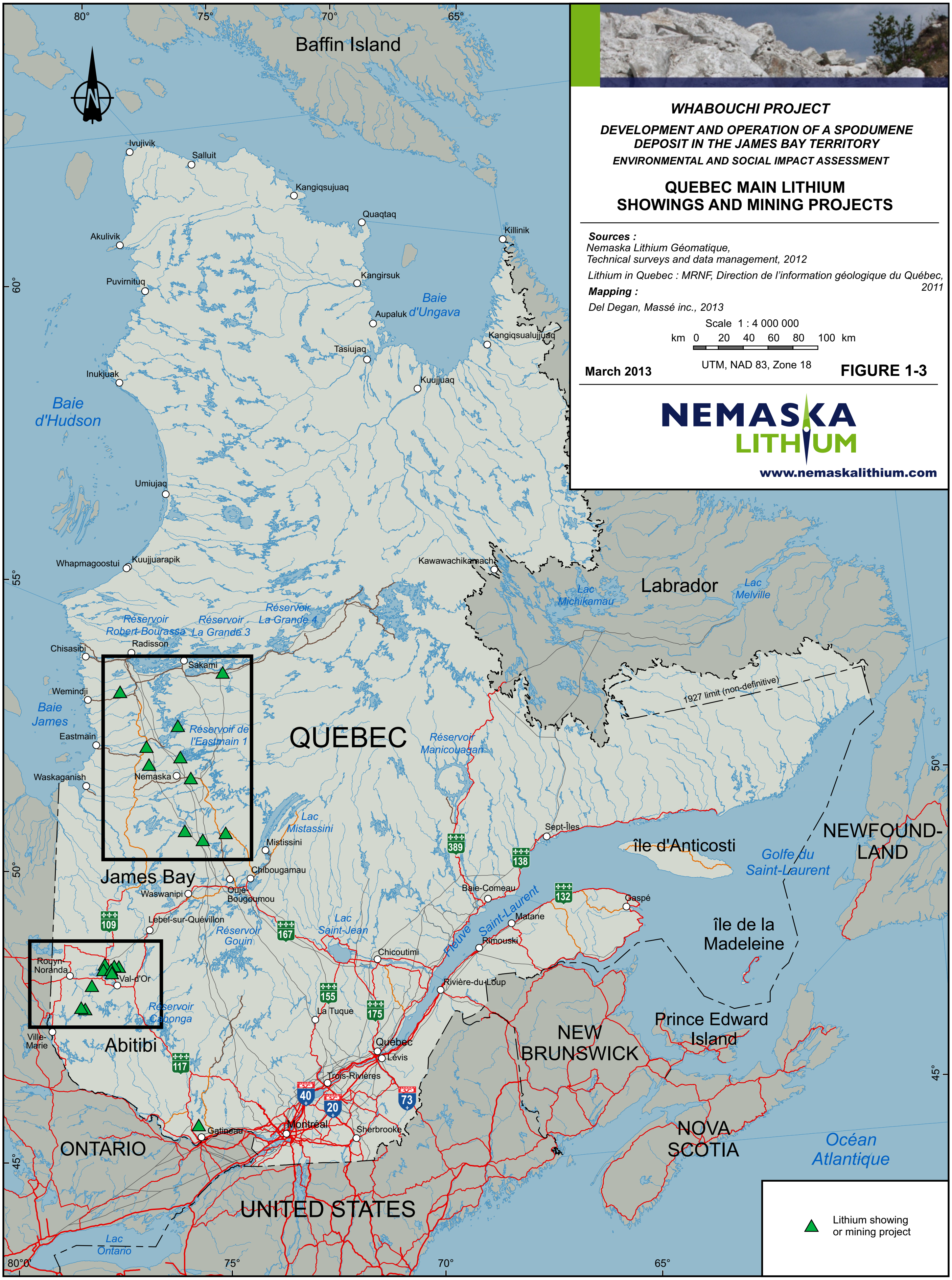
1.3.1 Market Context

Since the beginning of the 2000s, the demand for lithium has seen a sustained growth, mainly because of the increased use of lithium in the production of batteries. Thus, the total global demand for the various lithium compounds, expressed as carbonate equivalent (LCE), increased from 40,000 tonnes in 1990 (SignumBOX, 2010) to 140,000 tonnes in 2011 (SignumBOX, 2012). The demand for lithium in the batteries increased from 6% in 1990 to 35% in 2012 (SignumBOX, 2010, 2012).

In 2010, some 270 mining companies were active in the exploration and development of mineral deposits in Québec (MRNF, 2011). In 2010 only, these companies invested some 483 million dollars, mainly in the Abitibi-Témiscamingue and Nord-du-Québec territories. More specifically, 204 exploration projects were underway at the end of 2010 in the Nord-du-Québec region (MRNF, 2011). These exploration activities lead to the discovery of gold and lithium showings, among others.

Figure 1-3 shows the location of reported lithium mining projects in Québec.

Between 2000 and 2011, the worldwide production of lithium-ion batteries has seen an increase of 20% per year. The current production surpasses that of nickel-cadmium type batteries.


WHABOUCHI PROJECT
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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
QUEBEC MAIN LITHIUM SHOWINGS AND MINING PROJECTS
Sources :
Nemaska Lithium Géomatique, Technical surveys and data management, 2012
Lithium in Quebec : MRNF, Direction de l'information géologique du Québec, 2011
Mapping :
Del Degan, Massé inc., 2013
Scale 1 : 4 000 000
km 0 20 40 60 80 100 km
UTM, NAD 83, Zone 18
March 2013
FIGURE 1-3
NEMASKA LITHIUM
www.nemaskalithium.com
Lithium showing or mining project
Baffin Island
Baie d'Hudson
Baie d'Ungava
Baie James
James Bay
QUEBEC
Labrador
NEWFOUND-LAND
NEW BRUNSWICK
NOVA SCOTIA
Prince Edward Island
ONTARIO
UNITED STATES
Abitibi
Océan Atlantique
Golfe du Saint-Laurent
Fleuve Saint-Laurent
île d'Anticosti
île de la Madeleine
1927 limit (non-definitive)
Lac Michikamau
Lac Melville
Réservoir Robert-Bourassa
Réservoir La Grande 3
Réservoir La Grande 4
Réservoir de l'Eastmain 1
Réservoir Manicouagan
Lac Mistassini
Lac Saint-Jean
Réservoir Gouin
Réservoir Cabonga
Lac Ontario
Ivujivik
Salluit
Kangiqsujuaq
Quaqtaq
Killinik
Akulivik
Puvirnituq
Kangirsuk
Aupaluk
Tasiujaq
Kangiqsualujjuaq
Kuujjuaq
Inukjuak
Umiujaq
Whapmagoostui
Kuujjuarapik
Kawawachikamach
Chisasibi
Radisson
Sakami
Wemindji
Eastmain
Nemaska
Waskaganish
Mistissini
Chibougamau
Waswanipi
Oujé-Bougoumou
Lebel-sur-Quévillon
Rouyn-Noranda
Val-d'Or
Ville-Marie
Sept-Îles
Baie-Comeau
Gaspé
Matane
Rimouski
Chicoutimi
Rivière-du-Loup
La Tuque
Québec
Lévis
Trois-Rivières
Montréal
Sherbrooke
Gatineau
109
117
155
167
175
389
138
132
40
20
73
80°
75°
70°
65°
60°
55°
50°
45°
80°0'

According to the independent firm SignumBOX, the annual growth of the lithium demand should reach 10% to 12% (SignumBOX, 2012). This demand is closely related with the electric vehicles and electronics (electronic tablets, smartphones, portable computers, etc.) markets, as shown in Table 1-1.

Table 1-1 Lithium Consumption by Application (2011 – 2025 Forecast) Excerpted from SignumBOX, 2012

Application	2011	2015	2020	2025
	Metric Tonne as Lithium Carbonate Equivalent			
Batteries – Secondary cell	27,416	44,865	71,009	105,236
Batteries – Primary cell	3,000	3,647	4,654	5,940
Batteries – Electric Vehicles	3,359	18,223	62,412	181,628
Batteries – Scooter	3,607	7,401	14,455	23,274
Batteries – Power Grid	500	2,500	5,000	7,500
Ceramic	20,000	24,308	30,581	36,320
Glass	17,000	20,662	25,993	30,872
Lubricant Grease	18,000	24,249	34,641	44,211
Air Conditioning	5,400	6,439	8,100	9,621
Metallurgy	6,000	7,154	9,000	10,689
Medicine	4,000	4,502	5,194	5,876
Aluminum	5,000	5,933	7,464	8,865
Polymers	4,000	4,793	6,029	7,161
Others	12,000	14,308	18,000	21,379
TOTAL	**129,282**	**188,983**	**302,532**	**498,571**

Lithium comes from two main sources, brine and ore, which is mainly spodumene. In 2011, 57% of the lithium supply came from brines, essentially extracted by three large producers located in Argentina and Chile. The rest of the supply comes from spodumene, which is transformed in China by six processing plants that share a major supplier, the Greenbushes mine owned by Talison Lithium Inc. in Australia. Their production of various lithium compounds is sold to different types of users throughout the world. In the battery sector, the main lithium compounds that are used are lithium carbonate and lithium hydroxide. These compounds enter in the fabrication of cathodes, a component of the batteries. The main battery manufacturers are in Japan and South Korea.

Between 2012 and 2020, the demand for lithium hydroxide from lithium-ion battery cathode manufacturers should increase by 30% per year (Roskill, 2012), while the demand for lithium carbonate should grow by 12 to 13% per year over the same period (SignumBOX, 2012). This growth is due to the increased demand in the electric vehicle industry and for energy storage (SignumBOX, 2012). The most important producers of lithium hydroxide in the world are currently Rockwood and FMC.

A few exploration and development projects are underway in Québec and try to profit from the increasing demand for lithium. The prices of the various lithium compounds have increased significantly over the last few years. For example, the price of battery-grade lithium carbonate tonne has increased from $4,500 in 2006 to approximately $6,500 in 2011. The price of lithium hydroxide has also increased significantly during the last few years, passing from $5,500 in 2006 to approximately $8,000 in 2011 (Roskill, 2012). Lithium is not used only in the manufacturing of batteries, it is still today considered as in industrial mineral entering in the fabrication of glass, ceramic, metallurgy, and lubricant greases, among others.

1.3.2 Relations with Local Communities

Agreement Concerning a New Relationship between Québec Government and the Crees of Québec

As stated in the Agreement Concerning a New Relationship between Québec Government and the Crees of Québec (2002), agreement must be concluded by the proponent of a mining project and the Crees, notably with regard to employment and contract matters.

Grand Council of the Crees Mineral Policy

The Cree mineral policy of the Grand Council of the Crees for the Eeyou Istchee territory mentions notably the importance of developing the mineral resources present in the territory in consideration of the rights and interests of the Crees (Cree Nation Government, 2009).

Québec Mineral Strategy

The mineral strategy of the Québec Government confirms the importance of ensuring a mining development that respects the environment, involves the communities and is integrated in its environment (MRNF, 2009). In this regard, Nemaska Lithium and the Cree Nation of Nemaska are presently negotiating a Resource Development Partnership Agreement (RDPA) which aims to define the modalities for the sharing of the mines operating profits and provides mitigation measures and valorize the anticipated impacts of the project (see section 1.5.3 here under for more details).

Nemaska Lithium Development Policy

The collaboration agreement being currently discussed between Nemaska Lithium, the Resource Development Partnership of the Cree community of Nemaska, and the Cree Regional Administration (CRA) will ensure that the rights and interests of the Nemaska Crees will be considered in the Whabouchi project. More precisely, this agreement is based on the CRA mining policies. The participation of the Cree community of Nemaska in the project development is a key element and Nemaska Lithium has always advocated transparency and collaboration in the pursuit of its activities.

Thus, the collaboration agreement will cover the aspects of employment and contract award. Wherever possible, Nemaska Lithium will encourage the hiring of local labor and the local purchasing of goods and services.

The development of the Whabouchi project corresponds perfectly with the mineral strategy of the Québec Government, while respecting the rights and interests of the Cree community of Nemaska and the CRA mining policy.

1.3.3 Purpose of the Project

This project finds its justification in the increasing worldwide demand for spodumene. The spodumene showing that forms the Whabouchi deposit was found in 1962 and was the object of limited exploration works in 1963, before being abandoned due to the falling price of lithium at the time. It is only in 1973 that the showing was again the target of exploration works, once again very limited. Exploration works were carried out in 1987 and 1988 near the Whabouchi deposit, but its aim was to verify the mineral potential for chromium and base metals such as copper and nickel; this exploration was unsuccessful. Again in 2002 and 2003, the showing was the target of exploration works, this time to verify the potential for tantalum and niobium; without success again. At the time, the price of lithium did not justify exploration works to demonstrate the potential of this showing for lithium. Nemaska Lithium, founded in 2008, recognized in the fall of 2009 the interest of the showing discovered in 1962 and listed in the geoscientist compilation system of the Québec MRNF, on the basis of the strong growth in the lithium market and the availability of funds on the public markets to finance lithium exploration works. Since October 2009, Nemaska Lithium carried out significant exploration campaigns that included stripping, channel sampling, mapping, sampling, drilling and laboratory and pilot scale metallurgical testings, before clearly demonstrating a preliminary economic assessment completed in November 2012, barely three years after the first fieldwork, which is exceptional.

Nemaska Lithium's property for the Whabouchi project is composed of a bloc of 33 contiguous claims, for a total surface of 1,716 ha. The location of these 33 claims is shown on Map 1-1.

The Whabouchi project aims to develop this major spodumene deposit to supply a transformation plant that will be built in Salaberry-de-Valleyfield, in Québec.

The Whabouchi deposit is the richest in North America and represents the second largest lithium deposit in the world, after Greenbushes in Australia, property of Talison Lithium. The in-pit resource evaluated in the Met-Chem (2012) preliminary economic assessment is estimated at 19,639,000 tonnes of measured and indicated resources with a grade of 1.49% Li_2O (Met-Chem, 2012). On the basis of the estimated tonnages and the project design, the mine's operating life is estimated at 19 years, with a possibility of extending this period. The estimation of the resources in the proposed pit was completed by BBA inc. (Met-Chem, 2012), using the resources that were delineated by SGS Geostat in 2011. Table 1-2 presents an estimation of the in-pit mineral resources of the Whabouchi project.

Table 1-2 In-Pit Mineral Resource Estimate (Cutoff Grade: 0.4% Li_2O)

Category		Quantity (Thousands of Tonnes)	Li_2O Content (%)
ORE	Measured	10,197	1.53
	Indicated	9,442	1.45
	Measured + Indicated	19,639	1.49
	Inferred	377	--
Overburden		2,356	-
Waste Rock		56,646	-
Waste Rock/Ore Ratio		3.02	-

The development of the Whabouchi project will result in direct and indirect local and regional benefits, notably through the creation of jobs and the purchasing of goods and services. More specifically, some 250 jobs will be created during the construction phase and 140 jobs during the operation phase. Nemaska Lithium intends to give hiring priority to the local labor and encourage the award of contracts to local businesses in order to promote the local economy. Nemaska Lithium will need to invest approximately $154 millions to build the Whabouchi mine and its concentrator and to start a mining operation according to generally accepted practices.

1.4 Regulatory Context and Authorization Process

1.4.1 Introduction

Before developing a mineral deposit in the Québec territory, a mining company must go through a rigorous assessment process in order to secure the required environmental authorizations and demonstrate the social acceptability of its project. Different parameters that are intrinsic to the project dictate this process and the authorizations that will be required. For example:

- The nature of the deposit;
- The ore extraction and processing capacity;
- The geographical location of the project;
- The activities related to the project;
- The impacts of the project.

The Whabouchi project is located on James Bay treaty land. Therefore, the project is subject to a specific authorization process under the James Bay and Northern Québec Agreement (JBNQA). The Whabouchi project will also require authorizations from the municipal, provincial and federal authorities, according to the applicable laws and regulations. The following sections present an overview of the environmental legislation applicable to the Whabouchi project.

1.4.2 James Bay and Northern Québec Agreement (JBNQA)

The JBNQA was signed in 1975 by the Government of Québec, the Government of Canada, the Grand Council of the Crees (Eeyou Istchee) and the Northern Québec Inuit Association. The JBNQA applies to a territory of more than 1,082,000 km^2 in northern Québec.

The JBNQA introduces an environmental and social protection system for each of the two regions recognized by the JBNQA, the James Bay and the Nunavik. To this end, Chapters 22 and 23 of the JBNQA provide for mechanisms to assess the environmental and social impacts of the projects. The JBNQA was recognized in the Constitutional Act of 1982 (Article 35) ratified by the provincial government in the Act approving the Agreement Concerning James Bay and Northern Québec, and included in the Québec Environment Quality Act (EQA) under Chapter II (RSQ, ch. Q-2). This chapter present the provincial requirements for project impact assessments.

The JBNQA identifies three land categories, i.e. categories I, II and III (see Table 1-3). These categories distinguish the rights associated with the hunting, fishing and trapping activities, thus defining exclusive rights for the Crees (Category I lands) and the rights of the Government of Québec to develop hydraulic, mineral and forest resources on other categories (Category II and III lands). The Category II lands are public lands where the Natives have exclusive hunting, fishing and trapping rights. On Category III lands, the mining and surface rights belong to the Government of Québec and are subject to the applicable land use laws and regulations decreed by the provincial authority.

Table 1-3 Specific Rights on the Different Land Categories

Category	Specific Rights
Category I Lands	Lands reserved to the exclusive use of the Crees in the vicinity of Native villages.
Category II Lands	Public lands on which Native people have exclusive hunting, fishing and trapping rights.
Category III Lands	Public lands on which Native people can, subject to conservation principle, pursue their traditional activities all year long in addition to enjoying exclusive rights on the harvest of certain animal species.

The Whabouchi project is entirely located on Category III lands, near the Cree community of Nemaska.

1.4.2.1 Environmental and Social Impact Assessment Process under the JBNQA and the EQA

As mentioned earlier, the JBNQA was ratified by the Government of Québec with the adoption of the Act approving the Agreement Concerning James Bay and Northern Québec by the National Assembly of Québec in 1976, and its coming into effect in 1985. The Chapter II of the EQA includes environmental assessment provisions that apply to the James Bay territory and that incorporate the principles and requirements of the JBNQA. This environmental assessment procedure is specific to the Eeyou Istchee region and differs from the procedure that applies to projects south of the treaty lands.

The Whabouchi project is subject to the provincial environmental and social impact assessment procedure under Schedule A, Article 153 of the EQA, as well as Chapter 22, Schedule 1, Article 1 of the JBNQA. Therefore, the provincial environmental and social impact assessment procedure, as established in the provisions of Chapter II of the EQA applicable to the Eeyou Istchee region, applies to the Whabouchi project.

This procedure, in conformity with the provisions of the EQA applicable to the Eeyou Istchee region, is managed by three organizations: COMEV, COMEX and COFEX-Sud.

- The Evaluating Committee (COMEV) is a Québec-Canada-Cree tripartite agency responsible for the preliminary assessment and the development of directives for projects located south of the 55th parallel (articles 148 to 150 and 153 to 159 of the EQA and Article 22.5, JBNQA);
- The Review Committee (COMEX) is a Québec-Cree bipartite agency charged with evaluating projects located south of the 55th parallel (articles 151, 152 and 160 to 167 of the EQA and Article 22.6 JBNQA);
- The Federal Review Committee (COFEX-Sud) is a Canada-Cree bipartite agency responsible for the assessment of projects located south of the 55th parallel. This committee assembles only in cases where a federal regulator has jurisdiction.

The requirements regarding the preliminary information and the contents of the impact assessment are described in the Regulation respecting the environmental and social assessment and review procedure applicable to the territory of James Bay and Northern Québec.

Before undertaking its mining operation activities, the Whabouchi project must obtain an authorization under article 153 of the EQA.

1.4.2.2 Environmental and Social Impact Assessment Process under the CEA (2012)

At the federal level, the environmental assessment process under the Canadian Environmental Assessment Act (CEA) (2012) is not systematically applied. Since two of the activities planned during the operation of the deposit are defined as physical by the Regulations Designating Physical Activities (SOR/2012-147), Nemaska Lithium submitted at the end of 2012 a project description as required by the Prescribed Information for the Description of a Designated Project Regulations. In early 2013, Nemaska Lithium was notified by the Canadian

Environmental Assessment Agency (CEAA) that the project was to be subject to the federal environmental assessment process.

1.4.2.3 Rehabilitation and Restoration Work Plan under the Mining Act

Pursuant to articles 232.1 of the Mining Act and 109 of the Regulation respecting mineral substances, other than petroleum, natural gas and brine, Nemaska Lithium will submit a rehabilitation and restoration work plan for the Whabouchi project that will need to be approved by the Government of Québec. This document will be submitted to the ministère des Ressources naturelles (MRN) prior to the operation works.

1.4.2.4 Other Environmental Requirements

The design of the infrastructures, particularly those associated with the tailings and waste rock disposal areas, shall respect the Directive 019. Before undertaking the construction of any infrastructure, a certificate of authorization will be required and the works must be designed in conformity with the requirements of Directive 019 and the Metal Mining Liquid Effluent Regulations (MMLER) adopted pursuant to the Fisheries Act.

1.4.3 Permits, Licenses, Certificates, Approvals, Authorizations and Leases

Before beginning the construction works, Nemaska Lithium must obtain, in addition to the above-mentioned authorizations, other permits, licenses, certificates, approvals, authorizations and leases from the provincial and federal authorities that have jurisdiction. The following paragraphs list what need to be obtained by Nemaska Lithium from the two levels of government for the Whabouchi project.

1.4.3.1 Requirements under Provincial Acts

Mining Act and Applicable Regulations

- An approval relating to the siting of the concentrator plant and the tailings disposal, under articles 240 and 241 of the Mining Act and articles 124 and 125 of the Regulation respecting mineral substances, other than petroleum, natural gas and brine;
- Leases for the mining operation and for the operation of borrow pits, quarries and sand pits, under articles 100 and 140 of the Mining Act;
- Leases for the occupation of the State lands by the waste rock and tailings pile, under Article 239 of the Mining Act.

Act Respecting the Lands in the Domain of the State and Applicable Regulations

- Leases for the occupation of domain of the State by the waste rock and tailings pile and the explosive warehouses, under articles 47 of the Act Respecting the Lands in the Domain of the State and 35 of the Regulation respecting the sale, lease and granting of immovable rights on lands in the domain of the State, if these elements are located outside the mining leases.

Environment Quality Act and Applicable Regulations

- An authorization under Article 22 of the EQA for the following activities:
  - Operation of the deposit (pit, pile, bonds, etc.);
  - Construction and operation of the concentrator;
  - Management of the treated water;
  - Construction and operation of the explosives warehouse and of the service buildings;
  - Management and storage of hazardous materials;
  - Operation of a sandpit and gravel pit (borrow pits).
- An industrial depollution attestation under Article 31.10 of the EQA and Article 1, Division 1, Paragraph 1.1 of Order in Council 515-2002 concerning the application of Sub-section 1 of Division IV.2, Chapter I of the Environment Quality Act to the mineral and primary transformation of metals industries;
- An authorization under Article 32 of the EQA for the following identified activity:
  - Installation of devices for the treatment of drinking water and waste water.
- An authorization for the installation of apparatus or equipments to prevent, reduce or cause the cessation of the issuance of contaminants into the atmosphere, pursuant to Article 48 of the EQA.

Forest Act and Applicable Regulations

- A forest management permit for mining activities issued by the MRN for any deforestation activities, pursuant to articles 10, 20 and 21 of the Forest Act and the Regulation respecting standards of forest management for forests in the public domain.

Explosives Act and Applicable Regulations

- A permit for explosives pursuant to articles 2 and 3 of the Act respecting explosives and Article 2 of the Regulation under the Act respecting explosives.

Act Respecting the Conservation and Development of Wildlife

- An authorization must be obtained from the MDDEFP for activities that affect an aquatic or wildlife habitat, under Article 128.7 of the Act respecting the conservation and development of wildlife.

1.4.3.2 Requirements under Federal Acts

Fisheries Act and Applicable Regulations

- Should it be established that the project could have a potential impact on a fish habitat, it would be necessary to obtain an authorization to alter the fish habitat under Paragraph 35 of the Fisheries Act, including compensation measures for fish habitat losses.

Explosives Act

- An explosives permit will be required under articles 2 and 3 of the Explosives Act.

1.4.3.3 Under Municipalité de Baie-James Bylaws (outside RCM Municipality)

James Bay Region Development and Municipal Organization Act

- Certificates of conformity with municipal bylaws for the service infrastructures, roads and mine infrastructures;
- Certificate of authorization under Article 5.1 of the *Règlement relatif aux permis et certificats, aux conditions préalables à l'émission de permis de construction, ainsi qu'à l'administration des règlements de zonage, de lotissement et de construction*;
- Permits for a individual groundwater catchment and for a septic installation, as well as other works identified in Article 4.1 of the *Règlement relatif aux permis et certificats, aux conditions préalables à l'émission de permis de construction, ainsi qu'à l'administration des règlements de zonage, de lotissement et de construction.*

1.5 Collaborative Relationship with the Crees

The Whabouchi project is located near the Cree community of Nemaska, on traditional territory that is visited regularly by its members. The involvement of the First Nation of Nemaska throughout the project's life span is therefore a priority for Nemaska Lithium, which has invested time and resources to make sure the community can close the follow the evolution of the project and takes an active part in the development of measures to mitigate its impacts and optimize its benefits.

The actions taken by the proponent to build a trusting relationship with the Nemaska Crees are described below. Further details are provided in the relevant sections of this study.

1.5.1 Project Shareholders

As early as August 2009, the community of Nemaska, through its Band Council, expressed an interest in taking an active participation in the efforts of Nemaska Lithium in the community's traditional territory. After brief negotiations, the financial arm of the community, Nemaska Development Corporation, agreed to purchase shares in the company for a total sum of $600,000, thus obtaining 600,000 shares in the company, which represented at the time approximately 9% of the shares issued by the corporation. As of this date, this number of shares represents approximately 3.6% of the shares issued by the company. When the shares were subscribed, the Whabouchi project was still in the embryonic stage.

1.5.2 Consultation

1.5.2.1 Consultation Activities

As the onset of the exploration works conducted on the Whabouchi showing, Nemaska Lithium met with Mr. James Wapachee, tallyman of trapline R20, to explain the proposed works on his territory and to validate with him the boundaries of the said territory so as to avoid any tangles or misunderstanding with the tallymen of the adjacent traplines. Similarly, the tallymen of traplines R21, Mr. Freddie Jolly, and R18, Mr. Luke Tent, were met individually to validate the boundaries of their respective territories. Following the works carried out in October 2009, Mr. James Wapachee was met again to tell him about the necessity of pursuing diamond drilling works during the winter of 2010. In the spirit of the participative approach adopted from the beginning by Nemaska Lithium, hiring contracts were offered to Mr. Wapachee and his relatives to assist the geologists. These works were carried out between the months of January and April 2010. Subsequently, stripping, mapping and channel sampling works were required. Mr. Wapachee was met and the work program was presented to him. At the completion of the stripping and sampling works, Mr. Wapachee, his wife and his brother, Mr. Reggie Wapachee were invited to visit the worksite. During his visits in the community of Nemaska, Mr. Bourassa had regular meetings with Mr. James Wapachee and discussed with him the evolution of the project and the future works, often using plans, maps or photos. In addition to direct exchanges with Mr. James Wapachee and certain members of his family, Nemaska Lithium also maintained close relations with members of the Band Council, mainly with Chief Josie Jimiken, who was in place until the 2011 election, then with Chief Matthew Wapachee and other community staff, particularly Mr. Robert Kitchen and Mr. Matthew Tanoush, respectively Economic Development Officer and Environmental Manager.

Beginning in the fall of 2009, discussions were undertaken with Chief Josie Jimiken about the negotiation and conclusion by the community and the company of a *Memorandum of understanding* recognizing the rights and expectations of the parties, and particularly the necessity of respecting the Cree culture and traditions in the company's activities on the territory. This *Memorandum of understanding* was signed in August 2010 in the Council Hall of the community of Nemaska by Mr. Bourassa, president of Nemaska Lithium, Mr. Josie Jimiken, Chief of the community of Nemaska, and Grand Chief Matthew Coon-Come on behalf of the Grand Council of the Crees and the Cree Regional Authority. In August 2010, August 2011 and September 2012, Mr. Guy Bourassa was invited to present the status of the project to the annual general assembly of the community. In addition to these public presentations, during which the community members could take part and ask questions to the company's representatives, Mr. Bourassa gave a number of specific presentations to the Band Council during the mandates of Chief Jimiken and Chief Wapachee.

1.5.2.2 Consultations for the Social Impact Assessment

In 2011, Nemaska Lithium implemented a consultation plan of the Cree community of Nemaska. The purpose of this plan is, on one hand, to inform the community about the Whabouchi project and its potential environmental, social and economic impacts, and on the other hand, to record and considered their points of view, knowledge, concerns and expectations related to the development of the project.

Based on rigorous and accepted consultation practices, the plan helped to establish and build a durable relationship with the community and to identify relevant and adapted measures to benefit from the project spillovers and attenuate its effects.

The consultation team held interviews with key members of the community of Nemaska, as well as with representatives of local organizations. A Community Advisory Panel (CAP) was created to provide a platform for exchanges between the proponent and the various stakeholders in the community. Focus groups were organized to consider issues that are specific to certain sectors of the community. Also, visual tools such as a 3D scale model of the site and an information brochure were distributed and viewed on the occasion of cultural and community events. A Cree liaison officer residing in Nemaska was hired in October 2012 to maintain a permanent presence so that community members can obtain information at their convenience and can express their concerns in their own language to a member of their community.

Other consultation activities are planned for the beginning of 2013, including open house days in Nemaska and Chibougamau as well as a new meeting of the CAP. Among other purposes, these activities aim to give the community an opportunity to express its views about the anticipated impacts and the proposed mitigation measures. For the community of Mistissini, Nemaska Lithium will answer their request concerning the preferred mode of presentation of the project. Discussions on this subject are underway with this community.

1.5.3 Involvements of the Crees in the Fieldworks (Physical and Biological Environments)

During the 2011 and 2012 fieldworks, the involvement of the tallyman, Mr. James Wapachee, was regularly solicited. Mr. Wapachee has an extensive knowledge of the environment where the Whabouchi project is located. His participation in the study was therefore essential to ensure that the Cree point of view and knowledge of the territory are taken into account. Mr. Wapachee was involved at several levels in the field studies, notably during the works on the aquatic environment and the winter aerial survey for mammal locations. Also, Mr. Wapachee made some equipment available to Nemaska Lithium.

Other community members were also involved sporadically to provide support in the fieldworks, notably to ensure safety during forest travels.

1.5.4 Partnership Agreement with the Community

As mentioned above, in conformity with the mining policy adopted by the Cree Regional Authority (CRA) and to promote the social acceptability of the Whabouchi project, Nemaska Lithium undertook negotiations to conclude an agreement with the Cree community of Nemaska, the Grand Council of the Crees and the CRA. Among other goals, this agreement is intended to define modalities for the sharing of the mine's operating benefits and to provide for measures to mitigate or optimize the anticipated project impacts. These negotiations began in March 2011 and are actively pursued.

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CHAPTER 2

DESCRIPTION OF PROJECT VARIANTS

Environmental and Social Impact Assessment

March 28, 2013

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2. DESCRIPTION OF PROJECT VARIANTS

This chapter presents alternative means of carrying out the Whabouchi project that are technically and economically feasible. The alternative options were compared on the basis of technical, economic, environmental and social criteria. The criteria that were retained are specific to each means. The project elements that were included in the variant analysis are the following:

Technology variants:

- Ore extraction method;
- Ore processing method;
- Waste rock and mine tailings disposal;
- Water treatment;
- Ore transportation and storage;
- Power supply;
- Waste management method;
- Concentrate shipping method;
- Water supply.

Variants relating to locations and routes:

- Worker housing;
- Location of the access road;
- Location of the waste rock and tailings pile;
- Layout of the supporting infrastructures;
- Discharge of the final effluent.

2.1 Technology Variants

2.1.1 Variants Relating to the Ore Extraction Method

There are two possible ore extraction methods: an open-pit excavation and the development of an underground mine. The selection of the extraction method is always guided by economic factors associated with the configuration and position of the ore deposit. In the Whabouchi project, the deposit outcrops at the surface and is relatively continuous over a strike of more than 1 km and to a depth of at least 300 m. It would not be economical or even efficient to exploit this deposit by underground means, leaving a pillar to secure the operations, as a large fraction of the ore would be lost. Nemaska Lithium will therefore extract the ore from an open pit that will eventually reach a length of 1,200 m and a width of 500 m, at a depth of approximately 150 m.

On the other hand, both ore extraction methods result in environmental and social impacts. Although it is difficult to compare these extraction methods, some of their impacts are quite similar while others are rather different. With regard to the similar impacts, they notably include the incidences on land vegetation and wetlands, fish and its habitat, wildlife, the use of land and its resources, employment and economic spinoffs as well as archaeological resources. As for the rights under treaties, in this case those created by the James Bay and Northern Québec Agreement (JBNQA), they will not be affected by the Whabouchi project.

In general, the impacts of the two ore extraction methods differ where the following components are concerned: noise, dust, hydrology and hydrogeology, as well as landscape. Due to the fact that the mining activities mostly proceed underground, the dust and noise emissions generated by an underground operation will be more contained than those of an open-pit operation. In terms of landscape, an open-pit mine alters the landscape that is much more noticeable by the users of the land than is the case for an underground operation.

Nemaska Lithium the not complete an in-depth comparative study on these two ore extraction modes, particularly with regard to their impacts as, as already mentioned, the geomorphology of the deposit dictate the only possible option, an open-pit operation.

2.1.2 Variants Relating to the Ore Extraction Method

The concentration of spodumene, the mineral containing the lithium, can be achieved only by two methods, either in a dense media separation circuit or by flotation. The selection of one or the other technology depends on the quality of the supply source, i.e. the ore. In the case of the Whabouchi project, laboratory tests have shown that the optimal method to concentrate the ore involves a dense media separation, followed by flotation of the reject to extract a greater portion of the spodumene. The optimization of the process will be an ongoing task during the operation.

2.1.3 Variants Relating to the Waste Rock and Tailings Disposal Method

There is only one method to dispose of waste rock, and there are no possible variants, other than selecting a temporary storage at the surface until the waste rock can be returned to the pit at the end of operations. In this case, returning the waste rock extracted during the mining operations to the pit involves hauling it by truck over several years. The cost of returning the waste rock to the pit would be considerable, compared to the option of leaving it at the surface, and it would negate the economic viability of the project. The option of returning the waste rock in a pit that would be eventually flooded may be advantageous in the case of acidifying waste rock, where the re-creation of anoxic conditions could slow down the oxidation process and prevent the contamination of surface water. Since the Whabouchi project waste rock are not acidifying and are not leachable (see Chapter 4), it does not seem opportune, from an environmental perspective, to return it to the pit. The environmental bottom line associated with the haulage of several million tonnes of rock would effectively become negative due to the following factors:

- The combustion of fuel and the production of greenhouse gases by the loading and hauling equipment;
- The increased generation of dust on the mine site, notably due to the circulation of vehicles;
- Increased noise levels.

The positive impacts would be related to the creation of a few jobs for a limited number of years, and to the reduced impact on the landscape, compared to a pile of rocks. However, the waste rock pile would remain until the end of the operations, causing another negative impact during the operation phase because the progressive rehabilitation would not be a worthwhile option for Nemaska Lithium. The aspect of the waste rock pile would therefore the less natural over the operation of the mine. Additionally, due to bulking, it would be impossible to return the totality of the waste rock extracted during the life of the mine back into the pit. Effectively, this bulking or swelling would mean that there would not be enough space in the pit to accept the volume of waste rock and tailings that will have to be stored; only half this volume could be returned into the pit. Thus, the pit would appear as a small hill if all the waste rock was stored there, or Nemaska Lithium would need to keep a certain quantity of such waste rock in the waste rock and tailings pile. The waste rock remaining in the waste rock and tailings pile could be vegetalized and thus recover a more natural aspect. In the context of the Whabouchi project, it is recommended to leave the waste rock in place in the waste rock and tailings pile and to proceed with the progressive rehabilitation of this pile.

As for the mine tailings, two deposition methods were considered by Nemaska Lithium: the first as a slurry (30 to 60% solids by weight), and the second as filtered tailings (75 to 90% solids by weight). In the form of slurry, the tailings can easily be pumped over long distances. Their confinement requires the construction of impoundment dikes and, because the tailings settle in those ponds, there is always a body of water. In such facilities, the water must be returned to the concentrator for reuse, or treatment and release in the environment if its quality is acceptable. Photo 2-1 illustrates the deposition of tailings through pipes in a tailings pond. In the case of filtered tailings, their water content is reduced by filtering. They thus become dry enough to be hauled by truck, spread and compacted as shown in Photo 2-2.

Photo 2-1 Deposition of Tailings Slurry at Glebe Mines, Derbyshire, England (© Jon Engels)

Photo 2-2 Deposition of Dewatered Tailings at Raglan Mine, Xstrata Nickel

In the case of the Whabouchi Project, environmental, technical and economic criteria were considered to compare the two disposal methods and select the most advantageous. The criteria for this comparison are the following:

- Environmental:
    - Footprint;
    - Encroachment on wetlands;
    - Encroachment on aquatic environments;
    - Ease of recirculating the water;

  - Quality of the seepage;
  - Quality of the exfiltration;
  - Capacity of the proceeding with a progressive rehabilitation.
- Technical:
  - Available space;
  - Length of the slurry pipelines;
  - Risk of pipeline rupture;
  - Pumping;
  - Management of the confinement structures.
- Economic:
  - Capital cost of the filtration system;
  - Capital cost for the construction of the dikes;
  - Operating costs;
  - Costs associated with the rehabilitation.

Unlike the slurried tailings, dewatered tailings allow the progressive rehabilitation of the disposal site. Therefore, the environmental criteria were the most influential in the final selection. For example, water management, including the quality of the exfiltration and the seepage water, and footprint were the two decisive criteria in the choice of the disposal method. By retaining the tailings filtering option, it becomes possible to recirculate a maximum volume of water in the concentrator while avoiding the accumulation of water in a dike-confined tailings pond. Furthermore, the deposition of dewatered tailings allows a significant reduction of the footprint by co-depositing them with waste rock, thus circumventing the construction of a separate tailings facility. In addition to increasing the project footprint, such a tailings facility would have imposed an additional infrastructure in the landscape. From a economic point of view, the option of filtering the tailings is more expensive, both in capital and in operating costs, but the environmental benefits largely counterbalance the investment.

Opting for the co-disposal of mine tailings with the waste rock not only shrinks the footprint of the facility, but also reduces the environmental risks associated with several aspects of the operation. Table 2-1 summarizes the main features of the management of slurries and filtered tailings.

Table 2-1 Comparison of Options for the Management of Mine Tailings

Infrastructure / Environmental Aspect	Tailings Slurry	Co-Disposal of Filtered Tailings
Body of Water over the Tailings	Management of a water pond over the tailings facility	No accumulation of water in the tailings facility
Tailings Pipeline	Presence of a pipeline between the concentrator and the tailings facility	No pipeline
Dikes	Construction of dikes (borrow materials); risk of dike failure; footprint; monitoring	No dike
Water Management	Large volume of process water with the tailings	Very little process water in the tailings
Dust	Poor dust control	Better dust control
Environmental Footprint	Larger	Smaller
Gradual Rehabilitation	Planning is more difficult	Possible

With regard to the technical criteria, pumping the tailings is easier than filtering them. However, once they are out of the concentrator, filtered tailings are more advantageous than the slurry form when their storage is considered. Effectively, it is easier to stockpile dry tailings than confining them in the form of slurries, which requires containment structures.

After considering the advantages and the reduced environmental risk, Nemaska Lithium retained the option of depositing the filtered tailings with the waste rock in a common facility.

2.1.4 Variants Relating to the Treatment of Water

Nemaska Lithium has retained the option of filtering the tailings and recirculating all the process water at the concentrator. As water losses in the concentrator are unavoidable, and since the tailings still contain some water content, the water deficit at the concentrator will be compensated by the two runoff sedimentation ponds installed near the concentrator. Should the capacity of these basins be insufficient in low-flow seasons, fresh water would be pumped from the supply well. Due to the complete recirculation, there will be no release of contaminated water from the ore concentration activities. The selection of this option is based mainly on the obvious environmental and economic benefits of avoiding the treatment of process wastewater. Because the spodumene concentration process requires very little chemical products, Nemaska Lithium will be able to reuse the same water continually without causing efficiency issues.

On the site, the potentially contaminated water will come either from runoff on the waste rock and tailings pile, or from the dewatering of the pit. It is expected that this water will contain suspended matter. The retention time in the proposed sedimentation basins will ensure that the water meets the release criteria. However, if the discharge criteria are not respected, the water will be treated with products promoting the agglomeration of fine particles to accelerate their sedimentation. As of this data, Nemaska Nemaska Lithium does not expect to treat other parameters than suspended matter. A study to confirm this hypothesis is underway.

2.1.5 Variance Relating to Ore Haulage and Storage

In an open pit mine, the ore is transported mainly by trucks. Conveyors can be used in certain operations, but in the case of the Whabouchi project this option is not viable for economic and technical reasons. Effectively, a conveyor system can be used economically if the volume is important and if the inclination of the conveyor does not exceed 15%. The installation of conveyors to remove the ore from the pit also creates serious problems in winter conditions. The option of using conveyors was never considered by Nemaska Lithium, and no other possibility than trucking can be contemplated.

As for the storage of the ore on the mine site, a stockpile would be installed at the concentrator entrance. This storage would be temporary, as the ore would be used to feed the crusher. Effectively, the supply to the crusher must be constant in order to optimize the concentration process and the general operation of the mine. The ore stockpile was sized to accommodate a seven day reserve.

2.1.6 Variants Relating to the Supply of Energy

The total power consumption of the Whabouchi Project is estimated at 7.5 MW per year. Table 2-2 presents the breakdown of the estimated electrical demand for each of the mine operating sectors. The operating sector that has the greatest power consumption is the concentrator, at 3.42 MW.

Table 2-2 Estimated Power Consumption by Operating Sector (Met Chem, 2012)

Operating Sector	Estimated Annual Electrical Demand (MW)
Crusher (Grinders)	0.85
Concentrator	3.42
Utility and Technical Infrastructures	2.41
Distribution Network Losses	0.13
Estimated Consumption (Subtotal)	6.82
Safety Factor (10%)	0.68
Total Estimated Consumption	**7.50**

In order to ensure the supply of electrical power to the mine site, Nemaska Lithium considered three alternatives. The first consists in supplying the site exclusively with diesel generators. Five 2 KW generators would be necessary to meet the power demand.

The second alternative consists in building a 25 kV power line from Hydro-Québec's Albanel substation to the mine site, over a distance of approximately 20 km. This option requires the construction of a transformer substation at the mine site to lower the voltage for distribution. An aerial power distribution network would also be necessary on the site. Option 2 thus consists in supplying the mine site entirely from the grid.

The third and final option combines the first two. It calls for supplying the entire site except the pit from a connection to the Albanel substation. In this option, the mining equipment operating in the pit, including the dewatering pumps, would be powered by diesel engines.

For environmental and economic considerations, Nemaska Lithium cannot retain the first option. Compared to hydroelectricity, the use of diesel generators increases in the emission of greenhouse gases in the atmosphere. Due to economic and technical considerations, the second option was not retained. It is effectively cheaper and safer to operate diesel-powered pit machinery than with power lines.

Therefore, the third option was retained to supply power to the mine site.

2.1.7 Variants Relating to Waste Management

Three variants were considered for the management of waste materials generated at the mine site. For Nemaska Lithium, it is important to promote every possible effort to minimize the volume of waste that must be eliminated or disposed of, what is called ultimate waste. Thus, source reduction, reuse, recycling and reclamation will be the guiding principles of waste management in the context of the Whabouchi Project. However, even if those principles are implemented, some ultimate waste will remain and shall be managed as adequately as possible while minimizing the environmental footprint of the activity. The three variants considered for the disposal of ultimate waste are described below.

The first variant consists in managing the ultimate waste on-site by developing a landfill site. The second calls for the haulage of the ultimate waste to the waste disposal facility operated by the community of Nemaska. Finally, a third option consists in sending the ultimate waste to a licensed technical landfill site or a subcontractor in Chibougamau.

The development of a landfill on the mine site reduces the required transportation, since the ultimate waste is managed on-site. However, this option entails a new infrastructure in the landscape. This addition therefore increases the project footprint. A landfill could also attract animals such as bears, giving rise to nuisance issues that will have to be dealt with by Nemaska Lithium and other users of the territory. The possible contamination of the water table must also be considered a potential issue.

The transportation of the ultimate waste to a landfill site in the community of Nemaska offers the benefit of not adding an infrastructure on the territory. By using an existing facility, Nemaska Lithium limits the footprints of its project, maximises the use of operational equipment and somehow stimulates the local economy.

Talks are underway between Nemaska Lithium and the community of Nemaska to agree on modalities that would be appropriate and acceptable to both parties. This option was well received in discussions with community representatives.

Finally, the last option under consideration consists in hauling the ultimate waste to a licensed technical landfill site at Chibougamau. Compared to the second option, where the distance between the project site and the community of Nemaska is 30 km, the road to Chibougamau is much longer, totalling approximately 300 km. In addition to the distance, which entails greater greenhouse gas (GHG) emissions, this option deprives the Cree community of Nemaska of potential benefits generated by the management of the mine's ultimate waste.

2.1.8 Variants Relating to the Concentrate Transportation Mode

The spodumene concentrate produced on-site will be sent for processing into lithium carbonate and lithium hydroxide in a plant in southern Québec, or sold outside of Canada. The spodumene concentrate will be transported by truck from the mine site to Chibougamau (first destination) over the Route du Nord, the only road in northern Québec that links Chibougamau to the James Bay Highway. It meets Route 167 approximately 15 km north of Chibougamau. There, the concentrate will be loaded in rail cars that will carry it to the tertiary transformation site.

The construction of a rail link between the mine site and Chibougamau was rapidly rejected by Nemaska Lithium for two main reasons: the excessive construction costs and the major environmental and social impacts in regard of the quantity of concentrate to be hauled. Therefore, the use of existing road infrastructure was preferred as the concentrate transportation mode.

Thus, using the Route du Nord was deemed the only possible option to send the concentrate to Chibougamau. However, two possibilities were considered with regard to the type of truck that can be used. The first option is the use 40-tonne semi-trailers, while the second involves tandem tractor trailers (road trains). Due to the configuration of the Route du Nord, particularly at certain steep grades, the road train alternative was quickly discarded. Hauling the concentrate in 40-tonne semi-trailer rigs thus constitutes the option retained by Nemaska Lithium.

2.1.9 Variants Relating to Water Supply

Nemaska Lithium considered two options to supply fresh water to the project site: a surface supply drawing from an existing lake, or an underground supply from a developed well. The mine site water supply was above all thought out so as to maximize water use, notably by encouraging its recirculation in the concentrator. Nevertheless, a small volume of fresh water, estimated at approximately 6 m^3/day, will be necessary to ensure proper operations of the site.

The first option envisions drawing water from one of the many bodies of water near the mine site. For this purpose, Nemaska Lithium considered building a water intake in Lac du Spodumène to meet its fresh water needs.

The second option under consideration consists in developing a water well near the concentrator. This system involves a pumping station, two electrical pumps and a holding tank with a capacity of 760,000 litres.

Technical, economic and environmental criteria were used to select the best water supply scheme to fulfill the water requirements.

The first option, i.e. supplying the mine site with surface water, is the most costly. Effectively, this first option requires the construction of a water intake in Lac du Spodumène, the installation of an underground conduit and the construction of an access road between the water intake and the concentrator. The maintenance costs of such a water supply installation are also a factor. For these reasons, the environmental impacts of supplying the water from Lac du Spodumène are more significant than those associated with the development of a well. More specifically, the installation of an underground pipeline and the construction of the access road would cause ground disturbances and vegetation losses.

To supply water to its facilities, Nemaska Lithium has retained the second option, the installation of a well near the concentrator. This is the option that has lesser environmental impacts.

2.2 Variants Relating to Locations and Routes

The following paragraphs outline the different siting and routing variants that were studied by Nemaska Lithium for the worker housing, the access road, the waste rock and tailings pile, the supporting infrastructures and the final effluents.

2.2.1 Variants Relating to Worker Housing

The Nemaska Lithium employees working at the mine site will be housed at the Nemiscau truck stop (see Figure 5-1, Chapter 5), where a local business already offers room and board services. This local contractor, the Cree Construction and Development Company (CCDC), is currently modernizing and expanding the housing complex to accommodate the increasing demand. Photo 2-3 shows the existing camp in the foreground. Hydro Québec's Nemiscau camp is visible in the background. Another option would be for Nemaska Lithium to build its own worker housing complex, either on the mine site or nearby. Economic factors show that it is much more economical to rent existing facilities from a local business than building new installations. The truck stop site is very near Hydro-Québec's Nemiscau camp, where housing infrastructures for a large number of workers already exist. Environmental factors also showed that the negative impact would be more significant if Nemaska Lithium build a new camp accommodation and the ancillary installations, such as a building site, a water intake, a wastewater treatment system, etc. At the social level, using the CCDC camp involves a Cree business in the project and stimulates the local economy.

Photo 2-3 Existing Camp at the Nemiscau Truck Stop

2.2.2 Variants Relating to the Access Road

The Whabouchi project is located along the Route du Nord. Since it is adjacent to an existing road infrastructure, the project does not require the construction of an access road to the mine site. However, service roads will be obviously necessary to allow the vehicle and machinery movements on the mine site proper.

2.2.3 Variants Relating to the Location of the Waste Rock and Tailings Pile

The basic criteria considered by Nemaska Lithium to select a potential location for the waste rock and tailings pile are environmental, social, technical and economic.

First, the waste rock and tailings pile cannot be located near or directly over water bodies or streams, such as Lac des Montagnes, Lac du Spodumène and the Nemiscau River. Also, because it is valued and used by the Nemaska Cree community, the Nemiscau River should be avoided, meaning that it should not be crossed by trucks circulating between the pit and the tailings pile. The Nemiscau River, to the west, thus constitutes a natural physical boundary that Nemaska Lithium had to respect in the search for a waste pile site. In order to limit the haulage of materials and truck traffic, and to facilitate the reuse of materials, the waste rock and tailings pile should not be too far from the pit. Thus, for environmental, social and economic considerations, a distance of approximately 2 km from the pit was set as the maximum travel between the pit and the waste pile. Finally, the requirement of accepting 27.7 Mm^3 of tailings and waste rock influenced the surface area needed to develop the infrastructure. Additionally, it is important to limit as much as possible the height and footprint of the waste pile so as to preserve the current landscape.

Three options were considered for the location of the waste rock and tailings pile. Figure 2-1 presents the locations of the three alternatives. All three have approximately the same footprint. The three locations are shown in the following photographs (Photo 2-4 to Photo 2-8).

Figure 2-1 Location of the Three Siting Options for the Waste Rock and Tailings Pile

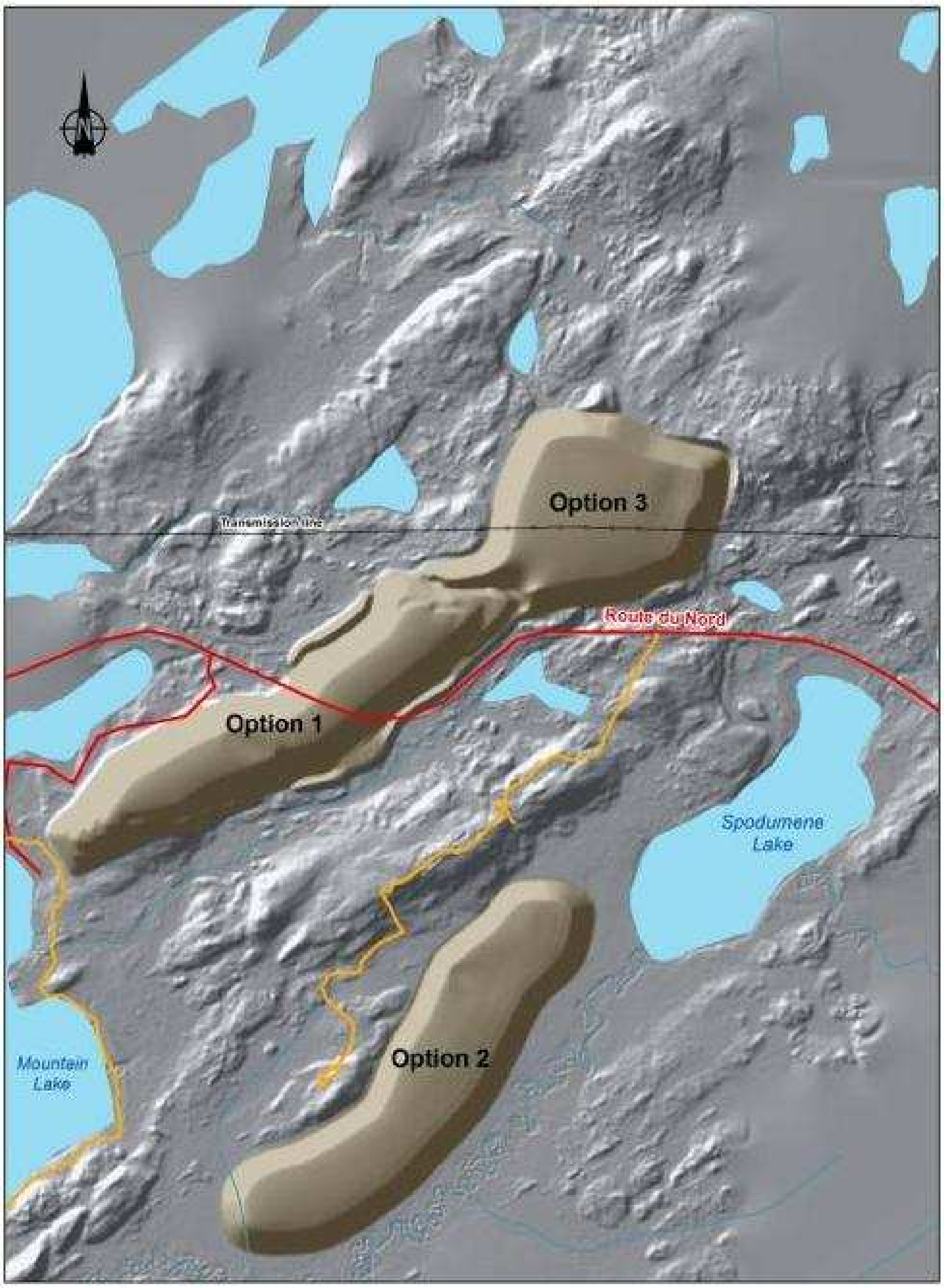

Photo 2-4 Waste Rock and Tailings Pile, Option 1

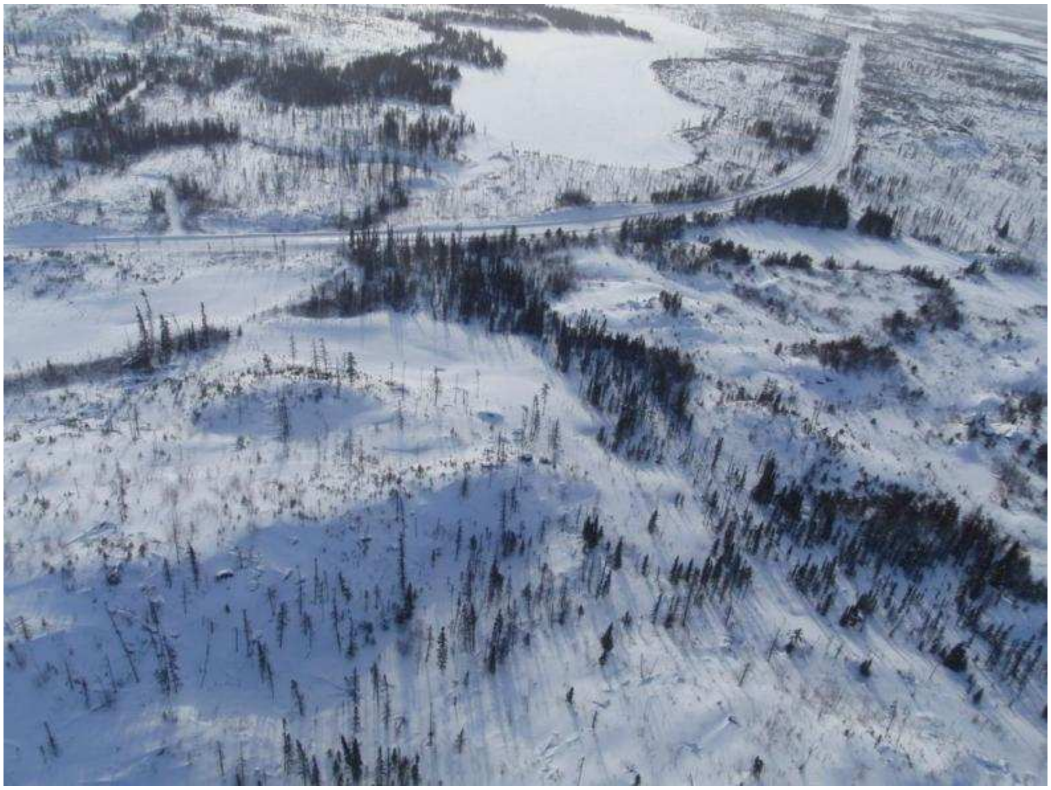

Photo 2-5 Waste Rock and Tailings Pile, Option 2

Photo 2-6 Waste Rock and Tailings Pile, Option 2

Photo 2-7 Waste Rock and Tailings Pile, Option 3

Photo 2-8 Waste Rock and Tailings Pile, Option 3

In the first option, the waste rock and tailings pile is located approximately 455 m north-north-west of the pit. This site involves the rerouting of a short section of the current Route du Nord. Specifically, a section of approximately 2 km must be deviated northward to allow the development of the waste rock and tailings pile. However, this deviation of the Route du Nord will become necessary only after the 10th year of mining operations. In the second option, the waste rock and tailings pile is located approximately 200 m south of the pit. However, this site would impact an important wetland. In the third and final option, the waste rock and tailings pile is located north of the road, approximately 550 m away from the pit. In this option, trucks would cross the Route du Nord many times every day, unless an overpass is built. Moreover, the Hydro-Québec power line would have to be moved to allow the development of the waste rock and tailings pile, mainly due to the height of the pile in relation to the electric cables.

The comparison of the three waste rock and tailings pile variants is presented in Table 2-3.

Table 2-3 Comparison of Siting Variants for the Waste Rock and Tailings Pile

Criterion	Option 1	Option 2	Option 3
Technical and scheduling	No effect on the Hydro-Québec power line A short section of the Route du Nord must be rerouted	No effect on the Hydro-Québec power line The Route du Nord is not affected	Involves rerouting the Hydro-Québec power line at significant additional cost Implies trucks crossing the Route du Nord
Environmental	Distance between the pit and the pile (approximately 455 m)	Distance between the pit and the pile (approximately 200 m) An important wetland is impacted	Distance between the pit and the pile (approximately 550 m)
Social	Lower incidence on the continuation of activities on the territory	Affects a snowmobile trail Proximity of a navigable waterway (Creek D)	Implies trucks crossing the Route du Nord (potential collisions) or the construction of an overpass Affects part of a ptarmigan hunting area Affects part of a trapline

The preferred alternative is Option 1. Among other factors, it preserves the important wetland south of the pit and concentrates the major mine infrastructures to the south of the Route du Nord, near the pit. This option was presented to the community of Nemaska during the consultations held in 2012.

2.2.4 Layout of the Supporting Infrastructures

The layout of the mine infrastructures and facilities is dictated mainly by the location of the ore deposit. Striking northeast-southwest, the spodumene pegmatite deposit lies between two lakes: Lac des Montagnes and Lac du Spodumène. These water bodies constitute a physical constraint to the siting of the mine infrastructures and facilities on the territory. Additionally, the Route du Nord and the Hydro-Québec power line are important existing infrastructures that Nemaska Lithium must compose with.

Other physical, biological and social constraints must be taken into account in the layout of the supporting infrastructures, particularly the topography, hydrographical network, wetlands, wildlife habitats, land uses, archaeological sites, health and safety considerations, etc. In addition to those constraints, considerations of a technical nature, such as the need for safe slopes in the pit design, also influence the positioning of the mine infrastructures and facilities.

For Nemaska Lithium, it is important to keep the number of mine infrastructures and facilities to a minimum, and to concentrate them near the ore deposit so as to minimize the project footprint. Also, this would reduce the distances covered by the mine workers and optimize the operations.

For logistical purposes, the administrative and technical buildings (engineering and mining operations management, supervisor's office, cafeteria, etc.) are grouped near the Route du Nord. This proximity will facilitate access. Additionally, grouping these facilities will limit the circulation of workers on the mine site and improve their safety.

The location of the sedimentation basins on the mine site is governed mainly by the topography. These basins will be built near the infrastructures and facilities that they drain, i.e. the waste rock and tailings pile and the pit.

The access roads on the mine site were laid out so as to minimize their length and optimize circulation on the site. There will be only one possible entry point to the site from the Route du Nord. This configuration provides a better control of entries and exits, ensures the safety of workers and limits access to the territory.

Map 2-1 illustrates the location of the major mine infrastructures and facilities of the Whabouchi Project. Note that their layout takes into account the requirements for minimum safe distances between the various buildings and the mining complex, as well as the evolving technical needs of the project.

2.2.5 Variants Relating to the Location of Final Effluent

Although Nemaska Lithium will maximize the recirculation of water on the mine site, thus limiting both consumption and rejects in the environment, some releases must be expected. The water that will be released in the environment will come from the two following sources:

- Surface runoff from then waste rock and tailings pile;
- Runoff from the footprint and the dewatering of the pit.

The treated water that will be returned in the environment will meet the quality requirements set out in Directive 019 of the ministère du Développement durable, de l’Environnement, de la Faune et des Parcs and in the Metal Mining Liquid Effluent Regulations.

Various locations were considered for the installation of the outfall(s) of the two sedimentation basins. They are the Nemiscau River, Lac du Spodumène, Lac des Montagnes and Creek C (see Map 2-1). The selection of the Nemiscau River would be justified mainly by the important dilution potential offered by this river. The presence of an important flow creates favorable mixing conditions. However, it was deemed preferable to avoid the Nemiscau River because it is used and valued by the Nemaska Cree community, who has several camps along its shores. The option of releasing effluent in the Nemiscau River was therefore abandoned.

The construction of one or several outfall(s) near the mining facilities limits the footprint of the project. Two sedimentation basins are located just east of Lac des Montagnes. The first receives water from the waste rock and tailings pile, while the second receives water drained from the pit. For technical reasons, these basins are located near the infrastructures that they drain. Thus, the outfall channel of the first basin discharges in Creek C, while the outfall of the second basin reaches Lac des Montagnes. Creek C flows toward Lac des Montagnes (Map 2-1).

Lac du Spodumène was also considered as a receptor for the effluent but, due to the current configuration of the mine site, it would be less practical than Lac des Montagnes. One factor is the greater distance between Lac du Spodumène and the two sedimentation basins that would produce the effluent. Additionally, the topography of the mine site is not favorable to gravity flow and the water would have to be pumped. Since Lac du Spodumène is valued by the Cree community of Nemaska, using it to discharge effluents would not be advantageous.

Creek C represents another potential receptor for the effluents. Due to its location, immediately south of the waste rock and tailings pile, and to the topography of the mine site, Creek C constitutes an interesting receptor for the runoff collected from the waste rock and tailings pile.

Nemaska Lithium opted to use Lac des Montagnes as the receptor of the effluent from the pit water sedimentation basin. As for Creek C, it was retained as the collection point for the runoff and seepage water from the waste rock and tailings pile.

2.3 Reference

Met-Chem Canada, 2012. Technical Report Preliminary Economic Assessment of the Whabouchi Lithium Deposit and Hydromet Plant. NI 43-101, November, 293 p.

CHAPTER 3

STAKEHOLDER CONSULTATION AND PARTICIPATION

Environmental and Social Impact Assessment

March 28, 2013

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3. STAKEHOLDER CONSULTATION AND PARTICIPATION

3.1 Objectives and Methodology

Early in the preliminary phases of development of its project, Nemaska Lithium[1] devoted significant time and resources to ensure a concrete and constructive involvement of the First Nation of Nemaska. Even before launching the environmental and social impact assessment (ESIA) process, the local authorities of the Nemaska Cree community took part in consultation activities intended to inform the community about the modalities and potential impacts of the project. Consultation with the stakeholders, particularly the Nemaska Cree community, and the communication of the various steps and activities related to the project are central to the preoccupations of Nemaska Lithium.

At the very beginning of the ESIA process, a communication and consultation plan was developed in conformity with the best practices established by the International Association for Public Participation (IAP2), the International Council on Mining & Metals (ICMM), and The Mining Association of Canada (MAC). The approach to consultation adopted by Nemaska Lithium is based on the following elements:

- Understand, appreciate and respect the history, rights and traditional lifestyle of the Cree;
- Ensure that the consultation meets the expectations and needs of the concerned communities;
- Involve the extended collectivity (e.g. elders, women, youth and social organisms);
- Work with the stakeholders to identify and evaluate the impacts of the project, and to review and plan mitigation measures;
- Understand the implications of the environmental impacts of the project on the protection of the Cree hunting, fishing and trapping rights;
- Communicate how the results of the consultation have influenced the project planning decisions.

The implementation of the plan began in November 2011, after a series of discussions between Nemaska Lithium and the Nemaska Band Council administrators, and at the general assembly of the community in the same year.

Several methods were used to collect and disseminate the opinions of the project stakeholders: distribution of an informative brochure, presentations on the project, individual interviews and focus groups. Each of these activities and their respective methodologies are presented in Section 3.2. The comments, preoccupations and general opinions expressed by the Cree participants in this approach are summarized in Section 3.3.

[1] For the purposes of Chapter 3, any mention of Nemaska Lithium refers to the employees of Nemaska Lithium and to the environmental and social impact assessment team.

Documentation

The opinions of the stakeholders in the Whabouchi project that were collected in the consultation process were documented and processed using the *Staketracker™ Relationship Management Software*. With this system, Nemaska Lithium can compile the interests, issues and preoccupations of the stakeholders and give them feedback on how these considerations were taken into account or resolved. This feedback is in fact one of the commitments of Nemaska Lithium toward the community.

Some of the information collected during the consultation activities was treated confidentially when asked by the stakeholder, for example during the consultations on land use with the tallymen and their families, since many aspects of the subject are sensitive. This information was not entered in the Staketracker™ database, but it was documented and incorporated in the analysis.

Translation

Cree Interpreters from the community of Nemaska were invited, when necessary, to provide translation services during the consultation activities. An interpreter was present at all meetings of the Community Advisory Committee (CAC) formed as part of the consultation plan (see Section 3.2.5), as well as the meetings where the community elders were expected. Cree elders are often unilingual and the presence of interpreters is essential to facilitate their participation in the discussions.

Consideration of the Local Aboriginal Point of View and Expertise

Nemaska Lithium considers the local knowledge and point of view of the members of the Nemaska Cree community as fundamental elements in the ESIA process. As the main occupants and users of the territory concerned by the project, the Cree have extensive knowledge of the territory and its resources. It is also essential to document the cultural, historical and affective value given to the territory and its components, both at the individual and collective levels. The value of the territory and its association with the cultural identity must be incorporated in the analysis of the project issues. The knowledge and perspectives of the Cree stakeholders allow us to define more clearly the environment of the project and, certainly, to better anticipate its impacts.

The following major themes were discussed during the consultation activities: land use, distribution and harvesting of wildlife (mainly the species of special interest), sites visited by families and the community, and the evolution of socioeconomic conditions in the community of Nemaska. The meetings helped circumscribed the values given by the Cree to the various components or social and environmental aspects considered in the ESIA.

A series of discussions was held with members of the community. The users of the territory affected by the project were met at several occasions for in-depth interviews in which they could express their points of view, preoccupations and comments. Their knowledge of the territory also helped target some of the field surveys, notably on aquatic fauna and archaeological resources. Validation meetings were held with the tallymen and the major families affected by the project. Additionally, meetings were held with representatives of organizations and services in the Nemaska community. These discussions helped identify and quantify the current socioeconomic issues in the community, which has seen many developments on its territory since the implementation of the Paix des Braves in 2002.

3.2 Consultation Activities

Since 2009, Nemaska Lithium has maintained its work base at the permanent camp of the Cree Construction and Development Company Ltd (CCDC), located at the Nemiscau truckstop, at kilometer 291 of the Route du Nord. Following a first official meeting between Nemaska Lithium and the Nemaska Band Council in 2009, a committee was created to define the terms of the Resource Development Partnership Agreement (RDPA) that should soon be signed between Nemaska Lithium and at the First Nation of Nemaska. In November 2011, Nemaska Lithium and its consultation team attended the band council meeting in order to review the details of the Whabouchi project and to present the consultation strategy. From that time on, Nemaska Lithium and its consultation team have maintained an ongoing presence in the community.

In 2009, Nemaska Lithium also took a contact with the municipality of Chibougamau to present the development of its project. Although the incidences of the project are expected mostly in the community of Nemaska, the municipality of Chibougamau could benefit of its economic spinoff and job creation, among others.

The list of the main consultation activities held in Nemaska since the onset of the consultation plan is presented in Table 3-1. The detailed information about the consultation activities is presented in Appendix 3-1.

Table 3-1 Consultation Activities with the Nemaska Community

Consultation activity	2011	2011		2012								2013
		Nov.	Dec.	Jan.	Feb.	Mar.	June	July	Sept.	Oct.	Dec.	
Meetings with the chief and the Nemaska Band Council	■	■	■									
Interviews with community members and local organizations				■	■	■						
Interviews with the tallymen and other Cree users of the territory				■	■					■	■	
Meetings of the Community Advisory Committee (CAC)					■	■						■
Distribution of the informative brochure								■				
Focus groups										■		
Presentation to the general assembly	■								■			
Hiring of the Community liaison agent (CLA) by Nemaska Lithium						■						
Open house day												■
Field visits							■					■
Participation in community events								■				

3.2.1 Meetings with the Nemaska Band Council

Since the beginning of the environmental assessment process, Nemaska Lithium has met with Chief Matthew Wapachee on several occasions, along with members of the band council. The main purpose of these meetings was to inform the chief and the band council of Nemaska Lithium's intent to mine the deposit and to inform them about project-related developments and the progress of the environmental assessment process. These meetings gave the council a better understanding of the extent of potential impacts of the project and of its potential economic spinoffs.

3.2.2 Participation in Community Events

Administrative Events

On the 19th, 20th and 21st of September 2012, Nemaska Lithium attended the general assembly of the community of Nemaska. The president of Nemaska Lithium, Mr. Guy Bourassa, gave an update on the project and presented a video that included a 3-D animation developed for the consultation. The content was interpreted from English to Cree for the benefit of the audience. The projection of the video was followed by a question period. During the same trip, Nemaska Lithium attended the inauguration of the new band council offices.

Photo 3-1 Presentation by Nemaska Lithium at the General Assembly of Nemaska, September 2012

Cultural Events and Site Visits

In July 2012, Nemaska Lithium participated in the annual congregation at Old Nemaska, the former site of the Cree community of Nemaska until its relocation at Lake Champion at the end of the 1960s. This meeting place is highly valued by the community, since it is steeped in important collective history and memories. This annual congregation is held every July to celebrate the heritage of the Nemaska Cree (GCC, 2012).

In September 2012 Nemaska Lithium also visited the *Bible Camp,* on the northeast shore of Lac des Montagnes, another important cultural site for the Cree community. Many members of the community expressed their worry that the use of this camp could be disturbed by the visual and auditory impacts of mine operations (see Section 3.3).

These field visits, as well as the many formal and informal meetings, encouraged the development of a familiarity in the relations between Nemaska Lithium and the members of the community. They also allowed Nemaska Lithium to better understand and appreciate the culture, values and preoccupations of the Nemaska Cree.

Photo 3-2 Visit of the *Bible Camp* at Lac des Montagnes by Nemaska Lithium, September 2012

3.2.3 Meetings with Local Organizations and Band Administrators

Although the Cree and regional institutions have basic socioeconomic data on the Eeyou Istchee territory as a whole, there are significant gaps with regard to information about specific communities. Where such data exist, they are often obsolete. To fill these gaps, semi-directed in-depth interviews were held with local representatives of the health and social services organizations, as well as with administrative personnel from the band council.

These interviews gave a better understanding of the social, economic and cultural issues that confront the community, and they helped identify the preoccupations and expectations of its members toward the project. A total of 13 individuals were interviewed. The interviewees and the date of the meeting are listed in Table 3-2.

Table 3-2 Calendar of Interviews Held for the ESIA

Title of the interviewee	Date of interview
Director of operations – Cree Nation of Nemaska	December 5, 2011
Coordinator – Niskamoon local, Niskamoon Corporation	December 5, 2011
Director – Land and Environment, Cree Nation of Nemaska	December 5, 2011
Director – Public works and maintenance, Cree Nation of Nemaska	December 6, 2011
Lieutenant – Nemaska police force	December 6, 2011
Director – Nemaska Community Welfare Center	December 7, 2011
Deputy Chief and Housing Administrator – Cree Nation of Nemaska	January 16, 2012
Economic Development Agent – Cree Nation of Nemaska	January 16, 2012
Coordinator – Chishaayiyuu Miyupimaatisiiun and Front line services, Nemaska Clinic	January 17, 2012
Coordinator – Awash and Uschiniichisuu Miyupimaatisiiun, Nemaska Social Services	January 17, 2012
Principle – Luke Mettawescum School	January 18, 2012
Coordinator – Multiservice Daycare Center	March 29, 2012
Director of child care – She She Guin Childcare Center	March 29, 2012

3.2.4 Interviews with the Tallymen

The Whabouchi project is located on trapline R20. Semi-directed interviews were held with the main users of this territory as well as with the tallymen of adjacent traplines, i.e. R16, R18, R19 and R21. The family of Mr. James Wapachee, tallyman of trapline R20, was met in several instances, given that the project is located on their land.

The consultation on land use covered a spectrum of issues and provided a description of the use of the territory by the Cree and of the evolution of its resources over two or three generations. Spatial data were geo-referenced, except when considered sensitive by the consulted users. The information collected during these interviews identified several project impacts on the use of the territory and helped explore appropriate mitigation measures for such impacts.

3.2.5 Meetings with the Community Advisory Committee

In January 2012, the Whabouchi Community Advisory Committee (CAC) was established as a platform for exchanges and collaboration between Nemaska Lithium and the community. The role of the CAC members is to voice their expectations and preoccupations with regard to the project and its potential impacts, to receive status updates and to collaborate in the identification of solutions to emerging issues.

Various community representatives were invited to take part in the committee so as to ensure that the community perspective is considered in the planning of certain aspects of the project. The CAC currently benefits from the participation of the following groups:

- The Public Works, Housing and Environment departments of the Nemaska Band Council;
- The Cree Trappers' Association;
- The Luke Mettawescum School
- The Nemaska social services;
- The Nemaska clinic (Cree Board of Health and Social Services of James Bay – CBHSSJB);
- The Youth Council of the Grand Council of the Crees of Quebec (GCCQ);
- The elders;
- The hunters;
- The families using traplines R20 and R21.

Nemaska Lithium attends every CAC meeting, accompanied by representatives of the company mandated with the study of social components and by experts in the biophysical environment. The members of the committee can thus interact directly with the team, and the technical experts can answer the questions and preoccupations that arise.

A summary of the meetings end of their highlights is drafted for each meeting and circulated to all members of the CAC. To this date, there have been two meetings. An outline of these meetings is presented in Table 3-3. The summary of the results is given in Section 3.3.

Table 3-3 Outline of the Community Advisory Committee (CAC) Meetings

Date	Subjects of discussion	Number of participants	
		Cree	Nemaska Lithium
February 4, 2012	• Purpose and objectives of the CAC • History of mining exploration in the project area • Description of the Whabouchi project • Open-pit mining methods • Types of mine tailings and waste rock • Potential location of infrastructures on the site • ESIA procedure	7	4

March 28, 2012	• Review of the Whabouchi project description and of the content presented at the previous CAC meeting
	• Landscape changes caused by the project (visual impacts)
	• Description of the environmental aspects that will be treated in the assessment
	• Description of the studies already completed and of their methodology
	  • Fish and bathymetry
	  • Water quality studies
	  • Study on small and large mammals
	• Presentation of the Community Liaison Agent (CLA) and of his role
		19	7

A third meeting of the CAC is scheduled early in 2013. The consultation process requires an on-going presence and communication effort that must last beyond the ESIA process. It should be noted that the description of the stakeholder consultation activities should be completed in 2013. Section 3.4 presents the upcoming consultation activities.

3.2.6 Focus Group Meetings

In October 2012, Nemaska Lithium organized three focus groups with the following community groups: the young people (Group 1), the elders, hunters and trappers (Group 2), as well as the women (Group 3).

The three focus groups had the common goal of further informing the community of Nemaska about the details of the Whabouchi project and to identify the issues specific to each group. The discussions helped identify approaches to maximize the spinoffs from the Whabouchi project and to minimize its potential negative impacts.

Youth Focus Group

The youth focus group was organized with the help of the chief of the young people of Nemaska and was held in the community sports complex on October 16, 2012. Nine younger members of the community participated. The objectives of this focus group were to define the perspectives of the young people on opportunities that the mine could bring to the community, and to learn their preoccupations, expectations and anticipations with regard to the project.

Elders, Hunters and Trappers Focus Group

The focus group with elders, hunters and trappers was organized with the coordinator of activities of the Nemaska multiservice daycare center and was held in this center on October 17, 2012. A total of 13 elders and hunters/trappers took part in the meeting, which helped the consultation team understand the point of view of the elders on their experiences with previous projects on the Nemaska territory, and to discuss ways to mitigate the potential negative impacts of such projects.

Women Focus Group

The women focus group reunited five participants and was held at the Nemaska welfare center on the evening of October 17, 2012. The objective was to receive the women's perspective on the types of spinoffs or social impacts that could be caused by the implementation of a mining operation near the community, and to begin discussions on appropriate mitigation measures for the potentially negative social impacts of the project.

The results of the focus groups are presented in Section 3.3.

Photo 3-3 Participants in the Elders, Hunters and Trappers Focus Group Discussing the Location of the Project, October 17, 2012

3.2.7 Field Visits

Several visits of the Whabouchi project site were organized to explain the project to the representatives of the Nemaska community and to the land users. The exploration process and the discovery of the Whabouchi deposit were described, as well as the proposed activities and their sequence.

Photo 3-4 Meeting between Nemaska Lithium and Representatives of the Nemaska Community

3.2.8 Community Liaison Agent and Local Office of Nemaska Lithium

In March 2012, Nemaska Lithium opened a local office in Nemaska and hired a community liaison agent (CLA) to facilitate the exchange of information between the company and the community. This office is located in the new Band Council building. There, the public can consult reports and a visual documentation about the project, among others. Ore samples are also kept on hand. Interested individuals can obtain information about employment opportunities offered by Nemaska Lithium.

3.2.9 Development of Consultation Material

In July 2012, an information brochure written in Cree and English was prepared and distributed in the community. This brochure provides information about the project proponent, lithium, open pit mining processes, the main infrastructures planned for the site and the types of jobs that would potentially be created.

Additionally, an animated video describing the main elements of the project through the construction, operation and closure phases was produced and presented to the general assembly of the community in October 2012. Visual material was also developed, such as posters and treaty projections illustrating the mine site, its infrastructure and the life cycle of the ore.

3.2.10 Negotiation of a Resource Development Partnership Agreement (RDPA)

Nemaska Lithium, the grand Council of the Cree and the Cree community of Nemaska are negotiating a Resource Development Partnership Agreement (RDPA) for the purpose of establishing modalities for the sharing of the mine operating profits, and planning mitigation and valorization measures for the anticipated incidences of the project. A negotiating committee was formed for this purpose and meets on a regular basis.

3.2.11 Involvement of the Chibougamau Community

In 2009, Nemaska Lithium engaged in a dialogue with the mayor and the municipal council of Chibougamau in order to inform them about the Whabouchi project and its potential spinoffs and impacts on the communities of Nemaska and Chibougamau. Since then, Nemaska Lithium and the municipal administrators have developed an involvement and communication program focused on Chibougamau, which will be the project's road terminal. The expected incidences on the municipality are mainly of an economic nature and are generally perceived as positive by the municipal authorities. An open house event is planned in early 2013.

3.2.12 Involvement of the Mistissini Community

In December of 2012, the directive issued by the Canadian Environmental Assessment Agency instructed Nemaska Lithium to consult with the Mistissini community and to inform its members about the Whabouchi Project, its impacts and its potential benefits. The Cree community of Mistissini and Nemaska Lithium are discussing the consultation method best suited to inform the population and, if necessary, receive its comments and concerns about the project.

3.3 Summary of Stakeholder Comments and Preoccupations

During the consultation activities, special attention was given to any comment, preoccupation, request and suggestion voiced by the stakeholders. Several recurring themes emerged from the meetings. The collected comments are grouped according to these themes in Section 3.3.1:

- Water quality
- Hunting, fishing, trapping and recreational activities
- Jobs, training and economic spinoffs
- Mine infrastructure and project design
- Community welfare

- Safety issues associated with mining activities
- ESIA procedure
- Miscellaneous

The summary of the consultations presented in this section covers only the comments gathered from the Cree community of Nemaska. The Chibougamau and Mistissini stakeholders will be consulted at the beginning of 2013, during an open house event and, possibly, through other consultation activities.

Table 3-4 synthetizes the frequency of recurrence of the various themes in the collected comments which are detailed in Appendix 3-2. A complete summary of the questions and preoccupations expressed by the members of the Nemaska community is presented in Appendix 3-3.

Table 3-4 Recurrence of Themes in the Collected Comments

Category of preoccupation	Subject of discussion	Number of mentions
Consultation process		**12**
	Involvement and representativeness of community members in the process	3
	Knowledge and expertise of the project proponent	2
	Consideration of the expressed points of view	2
	Accessibility of the project proponent to community members	1
	Tone of the consultations	1
	Dissemination of information about the project	1
	Transparency	1
	Preferential treatment of the tallymen over other affected users	1
Health and safety		**57**
	Water contamination (in general)	23
	Dust	8
	Traffic	5
	Highway safety	4
	Blasting	4
	Increased fear and anxiety	3
	Impacts on reproductive health	2
	Safety on the provincial highway	2
	Bulldozers	1
	Security perimeter around the project for hunting activities	1
	Impacts of lithium (product safety aspect)	1
	Substance abuse	1

Category of preoccupation	Subject of discussion	Number of mentions
	Air pollution (in general)	1
	Safety of community members	1
Social		**50**
	Training and knowledge development	7
	Lack of trust between the community and the project proponent	6
	Local competition for jobs	5
	Lack of housing	4
	Conflict among community members	4
	Impact of the project on a recreational activities	3
	Preservation of the Cree culture	3
	Cumulative impacts	2
	Traditional knowledge about ecological aspects	2
	Work schedule at the mine	1
	Land use rights	1
	Increased hunting, trapping and environmental pressure	1
	Corruption in contract award	1
	Educational criteria for hiring	1
	Influx of new individuals in the community	1
	Creation of conflict and tensions within families	1
	Nuisance effects on goose hunting activities	1
	Allegiance of Nemaska Lithium's community liaison agent toward the community	1
	Job opportunities for the young people	1
	Intercultural conflict	1
	Problems associated with alcohol abuse	1
	Interaction between the project proponent and the community	1
	Language and culture	1
Environmental		**65**
	Impacts of the mining activities on the environment	13
	Waste management	11
	Noise (on the mine site proper)	6
	Mine pit, tailings and waste rock pile, landfill	4
	Dust and particles (on the mine site proper)	4
	Closure and restoration	4
	Mammals	3
	Noise (impacts on wildlife)	3
	Contamination of surface water	2

Category of preoccupation	Subject of discussion	Number of mentions
	Visual impact	2
	Environmental protection measures	2
	Water uses	2
	Wildlife habitat	1
	Soil contamination	1
	Spills and incident management	1
	Fish	1
	Degradation of fish habitat	1
	Birds	1
	Drainage of water bodies	1
	Methods used in the project	1
	Workers camp	1
Cultural		**17**
	Hunting camps and shacks	10
	Trapline boundaries	5
	Guaranties on the respect of cultural traditions	1
	Non-aboriginal pressures on Cree hunting, fishing and trapping rights	1
Economic		**35**
	Job opportunities	10
	Royalties	10
	Local hiring	5
	Investment in the community	2
	Sustainability of the community	2
	Compensations awarded to the community	1
	Economic benefits for the community	1
	Unemployment and underemployment	1
	Direct opportunities for businesses	1
	Economic diversification	1
	Indirect opportunities for businesses	1
Others		**32**
	Location of the project proponent's administration building	10
	Impacts of trucks and vehicles on the road	10
	Remuneration of employees by the Band Council	10
	Environmental assessment procedures	1
	Name of the company	1

3.3.1 Summary of Stakeholder Comments and Preoccupations

Water Quality

Preoccupations concerning water quality were, by far, the most often voiced by participants in the Cree community. The Eeyou Istchee Crees have a privileged relationship with water, since it is considered as the element that maintains the health of the ecosystem on which they are dependent (GCC, 1999). The protection of water is intimately associated with the well-being of the community.

The members of the community notably expressed their preoccupations about the following issues:

- The measures to be adopted in order to prevent contamination of the water bodies;
- The runoff water from the waste rock and mining waste piles, especially due to their proximity to Lac des Montagnes;
- The risk of contaminated mud and surface water migrating toward water bodies after precipitations, which would modify the overall quality of water, and the difficulty of preventing such a migration;
- The dispersal of dust generated by mining activities, which could impact the quality of water.

Information about the management of water on the site, on the collection and treatment technologies that will be implemented, as well as on the control and mitigation measures will be provided during the 2013 consultations.

Hunting, Fishing, Trapping and Recreational Activities

All along the consultation activities, all the users of the territory and the community members affected by the project were able to express their preoccupations regarding the modifications to their environment resulting from the project, and particularly the impacts of these modifications on the Cree hunting, fishing and trapping activities.

Preoccupations regarding the inconveniences for hunting, fishing, trapping and recreational activities in the project area were expressed as follows:

- The dust generated by mining activities will settle on the neighboring camps, inconveniencing the activities of the residents;
- The dust generated by mining activities will impact the quality of water, damaging fish habitats;
- The noise generated by mining activities will scare the animals. The potential disturbance of geese and of their habitat is a particular concern;
- The noise generated by mining activities will disturb the tranquility of visitors to the Bible Camp.

Members of the community are concerned about the extent of the impacts of mining activities on the wildlife and on the well-being of animals in the project area and its vicinity. They also requested that the extraction activities be suspended during the important weeks of the Cree calendar, i.e. the spring goose hunt (Goose Break).

Jobs, Training and Economic Spinoffs

In general, the fact that training and job opportunities will be created around the Whabouchi project is well recognized within the community. The high unemployment rate among the youth of Nemaska was often mentioned during the consultations. The respondents manifested a particular interest for the opportunities offered to the young people, notably with regard to the development of skills and employment. More specifically, the members of the community required more information about:

- The types of jobs that will be offered to the Nemaska Cree;
- The training that will be given to promote the hiring of Nemaska Cree;
- The number of jobs eventually offered at the mine;
- The percentage of those jobs that will be reserved for Nemaska Cree.

Referring to their experience with past and current development projects near the community, some members expressed doubts about the perspective of economic benefits for the community over the entire life of the project. The interlocutors mentioned, among others:

- Preoccupations about the rather short life span of the project and the loss of its economic benefits at the end of operations;
- Preoccupations about the limited number of Nemaska Cree who will benefit from the economic spinoffs of the project; it is feared that the majority of mine employees will be non-aboriginal, notwithstanding priority hiring measures.

The community of Nemaska experiences an increasing demand for aggregates in its community infrastructure development projects, such as road improvements and the expansion of its urbanized area. It was mentioned in several instances during the consultation that waste rock by-products could be used as aggregate for such purposes.

Community Welfare

Social harmony and the welfare of the community are fundamental principles for the Cree society (GCC, 2011). Therefore, emphasis was placed on the understanding of the preoccupation of community members in relation with these principles. Some of the major preoccupations that were expressed include:

- The wish for an appropriate awareness of the project and its social acceptability among the entire community;
- Preoccupations about the fair distribution of social benefits among the community;
- Preoccupations about the increased use of community resources – e.g. the Nemaska clinic or the sports complex – due to the presence of greater numbers of workers from outside the community;

- Preoccupations concerning the easier access to alcohol or illegal substances in the camp, and the exacerbation of the social problems and criminal behaviors associated with their consumption;
- Preoccupations about discrimination toward Cree employees at the mine, and the wish that a clear code of conduct be implemented.

Mine Infrastructures and Project Design

The members of the community participating in the consultation discussed at length the location of the tailings and waste rock pile, as well as the mine effluents. The participants wondered why the waste rock could not be returned in the pit, and if it would be possible to store it elsewhere. The design and location of the tailings and waste rock pile and the management of mine effluent gave rise to the following observations:

- Preoccupations concerning the proximity of the tailings and waste rock pile to Lac des Montagnes;
- Preoccupations regarding the height of the tailings and waste rock pile and its eventual visibility, which could disturb the users of the territory and the families who visit the Bible Camp;
- Preoccupations about the visual integration of the tailings and waste rock pile into the surrounding landscape.

The participants in the consultation sessions also ask specific questions of the technical nature on the process used to extract the spodumene concentrate and on the infrastructures that are planned for the site. The most frequent questions concerned the mine pit, the tailings and waste rock pile, as well as the approximate life of the project. The following questions were also asked:

- Why was an open pit mine chosen as the method of extraction?
- How is spodumene separated from the rock?
- What will be the period of the day and the frequency of blasting operations, and how far will the blasting noise be heard?
- Will some lakes or water bodies be drained, and in which water bodies will the effluent be discharged?
- Where will the spodumene concentrate be shipped after processing?

Concerning the closure of the mine and the restoration of the site, the participants in the consultation sessions asked the following questions:

- Will the tailings and waste rock pile eventually be covered by vegetation, or will it forever remain a pile of rocks?
- What will become of the pit? Will it fill with water? Could it overflow?
- Will the mine continue to provide jobs after its closure?

Safety Issues Associated with Mining Activities

Preoccupations about the health and safety were generally related with the physical health and the safety of workers on the mine site, and to the increased traffic on the Route du Nord. Notable issues include:

- The physical safety of the employees, particularly where blasting is involved, and the need to provide adequate training on worksite safety;
- The delimitation and creation of a safety zone around the project, including physical barriers, to prevent people and animals from entering the pit;
- The noise, dust and air pollution that could result from the use of explosives and heavy machinery, not to mention the impact this could have on the health of people;
- The increased damage due to the use of vehicles and the accidents that could occur along the Route du Nord as a result of increased traffic, road defects and important dust emissions.

Procedures of an Environmental and Social Impact Assessment

Many comments from members of the Cree community of Nemaska concerned the ESIA process, the consultation sessions, and the contents of the ESIA. Members of the community mentioned in several occasions the importance of involving the users of the territory and the tallymen in the content of the ESIA. They also wanted warranties that the social and cultural impacts would be considered. Some voiced their skepticism about the assurance that the comments of the community members will be taken into account in the conclusions of the ESIA or in the definition and adoption of appropriate mitigation measures.

The participants had questions about the expected project start-up date, and members of the Nemaska youth council asked Nemaska Lithium to organize additional consultation activities in order to better inform the young members of the community.

Miscellaneous

The following questions were asked during the consultation sessions:

- How did the company choose the name Nemaska Lithium? Did members of the community give permission to use this name?
- For how long has exploration been underway in the project area?
- What is the content of the Resource Development Partnership Agreement? Will the consultation of this document be accessible for members of the community?
- Is there a strong demand for lithium on the world market? What will be the repercussions if this demand varies?
- To what purposes did the company use the funds invested by the Band Council?

3.4 Commitment on Upcoming Consultation Activities and the Ongoing Participation of the Nemaska Community

In order to meet its consultation objectives, Nemaska Lithium intends to continue reinforcing its relation with the community of Nemaska. A spirit of collaboration is essential to the success of the project and must be maintained during all the phases of development of the Whabouchi project.

With the aim of explaining the potential impacts of the project to the stakeholders and presenting the proposed mitigation measures, Nemaska Lithium is planning the following consultation activities in the first quarter of 2013:

- A third meeting with the Community Advisory Committee;
- Open house days at Nemaska and Chibougamau;
- A series of focused discussions in Nemaska with all the users of the territory affected by the project;
- Meetings with representatives of the community of Mistissini, the modalities of which will be decided shortly with the local authorities.

3.5 References

The Grand Council of the Crees (GCC), 2012. The Fire of Nemaska: Five Days in July. Internet site consulted on October 5, 2012. http://www.gcc.ca/archive/article.php?id=138

The Grand Council of the Crees (GCC), 2011. Cree Vision of the Plan Nord. February.

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CHAPTER 4

PROJECT DESCRIPTION

Environmental and Social Impact Assessment

March 28, 2013

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4. PROJECT DESCRIPTION

4.1 General Description of the Project

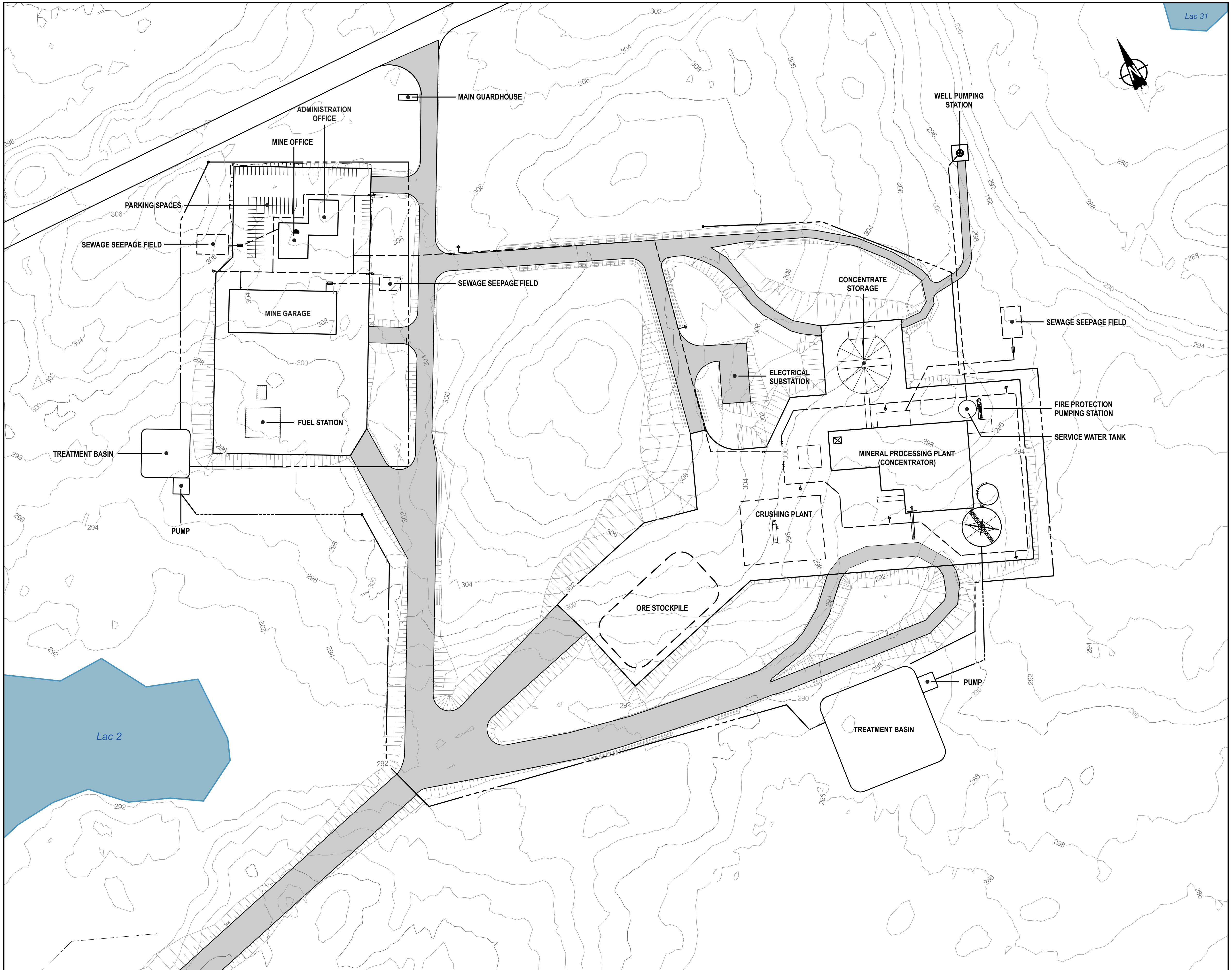
The Whabouchi project will consist in exploiting a spodumene pegmatite deposit. Spodumene is a mineral that contains lithium oxide (Li_2O). This spodumene will be concentrated at the mine site before being transported to a processing plant where it will be transformed into lithium hydroxide and carbonate. The Nemaska Lithium property is composed of a block of 33 contiguous mining claims, covering a total surface area of 1 716 ha (Map 1-1). Sixteen (16) of these claims were acquired from Victor Cantore's group ("Cantore") on September 17, 2009. Ten other claims were purchased from Goose Resources Inc. in January 2012. Nemaska Lithium acquired the final seven claims by map designation. The economic mineralization of the Whabouchi deposit consists mainly of spodumene, which contains 8% Li_2O (3.7% Li) in its natural state.

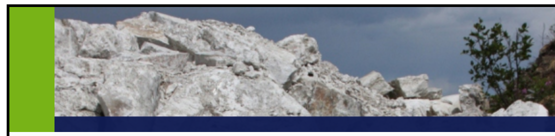
The exploration work in the region began in 1962; it resumed between 1973 and 1982, and again in 1987, 1988, 2002 and 2008. In 2010 and 2011, Nemaska Exploration (now Nemaska Lithium Inc.) undertook a major drilling program. According to a study dated October 2012, the Whabouchi deposit contains 19,639,000 tonnes of measured and indicated in-pit resources, at a grade of 1.49% Li_2O.

The spodumene pegmatite deposit is located at the center of the property, between Lac du Spodumène and Lac des Montagnes. The deposit takes the form of a series of secondary pegmatites, parallel and generally subvertical, globally striking northeast-southwest. The known extent of the deposit is approximately 1.3 km long, 130 m wide at its maximum, and at least 300 m deep.

The project calls for the construction and operation of infrastructures that include, among others, a mine pit reaching a depth of nearly 150 m, a waste rock and dewatered tailings pile, a maintenance garage and various administrative, engineering and utility buildings. The layout of the infrastructures is shown in Figure 4-1.

The period of initial mine operations will last approximately 19 years, excluding the periods necessary for construction and site rehabilitation. The first five years will be dedicated to mining the long hill that overlies the location of the mine pit and reaches a height of 25 to 30 metres. The open pit will then be excavated to continue mining the deposit over a period of approximately 15 years. The rehabilitation of the site (pit, waste rock and tailings pile, etc.) will occur during the three final years. However, gradual restoration works are planned for the tailings and waste rock pile as it reaches its final profile.





WHABOUCHI PROJECT

DEVELOPMENT AND OPERATION OF A SPODUMENE DEPOSIT IN THE JAMES BAY TERRITORY

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

INFRASTRUCTURES
GENERAL PLANT SITE PLAN

Infrastructure

Treatment basin tributary area limit

Pile / Pit line

Topography

Lake

Contour (equidistance : 2 m)

New road

Sources :
Nemaska Lithium Géomatique, Technical surveys and data management, 2012

Infrastructures : BBA, DRAWING No : 3073002-001000-41-D20-0002, 2011

Mapping :
Del Degan, Massé inc., 2013

m 0 25 50 75 100 m

UTM, NAD 83, Zone 18

March 2013

FIGURE 4-1

NEMASKA LITHIUM

www.nemaskalithium.com

No other development phase is planned at this stage. Photo 4-1 is an aerial view of the Whabouchi site superposed with the locations of the future open pit and of the waste rock and tailings pile. As for Photo 4-2, it reproduces a 3D simulation of the aspect of the site during the operations. In this picture, the waste rock and tailings pile has reached its full capacity and the Route du Nord has been relocated. In the foreground, the concentrator, garage and office buildings are visible.

Photo 4-1 Footprints of the Open Pit and Waste Rock and Tailings Pile

Photo 4-2 Visual Simulation of the Whabouchi Project Site near the End of Operations

4.2 Exploration Work and Description of the Deposit

4.2.1 Exploration Work

A total of 115 diamond drill holes were completed to define the mineral deposit, in addition to extensive mechanical stripping on surface to allow sampling of more than 140 channels. Table 4-1 summarizes the work carried out by Nemaska Lithium to define the mineralized pegmatite intrusion.

Table 4-1 Drilling Completed and Channel Sampling on the Whabouchi Deposit, 2009 – 2011

Year	Drill holes (number)	Metres drilled (m)	Channels (number)	Samples (number)
2009	7	915	35	295
2010	82	15,670	108	649
2011	26	5,500	---	---
Total	**115**	**22,085**	**143**	**944**

All the drilling used NQ or HQ coring size. The HQ size was used to take samples for metallurgical testing. These samples represent approximately 37% of the drill core material. The drill holes were generally spaced 25 m to 30 m apart with an azimuth between 312° and 340° (average 330°). The dips varied between 43° and 75° (average 49°). The deepest drill hole reached 500 m. The mineralized drill intersections ranges from the near true thickness (100%) to 70% true thickness, depending on the angle at which they were crossed.

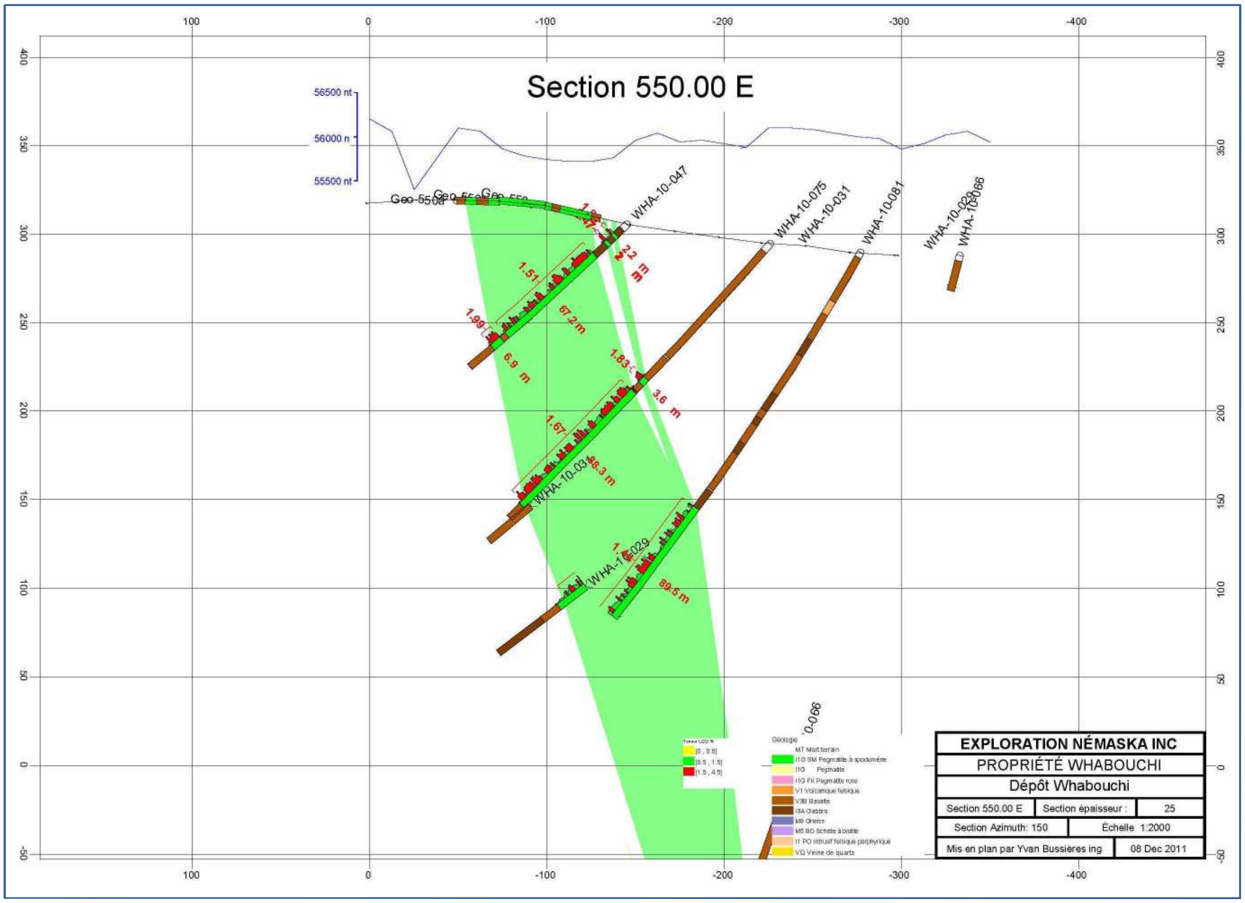
4.2.2 Description of the Deposit

The Whabouchi project deposit contains spodumene pegmatite; spodumene is a silicate mineral that contains lithium ($LiAl(Si_2O_6)$). The geometry of spodumene pegmatites is defined as a series of superposed dikes that includes a thicker main intrusion. Some pegmatites contain enclaves of the host rock that can reach a few meters in thickness and hundreds of meters in length. According to the data collected during the drilling campaign, the pegmatite intrusion is more than 1,300 m long and can reach a thickness of up to 130 m. The intrusions generally strike northeast-southwest (approximately 30°), dipping south at an angle varying between 80° and 85° and reaching depths of up to 300 m.

In the Whabouchi deposit, the lithium is found exclusively, or quasi-exclusively, in spodumene. The spodumene crystals are light green in color and their size can reach 30 cm. The spodumene contains between 7.6 and 8% Li_2O equivalent, according to its purity. Another lithium mineral, petalite, represents less than 2% of the volume of the Whabouchi deposit. Small occurrences of beryllium and rubidium are also present in the deposit. The beryllium is present in the form of beryl, generally as large, slightly blue crystals that can be of gem quality. The rubidium is contained in microcline (feldspar) and muscovite (mica). The metallurgical testing, however, has been conducted only on the lithium contained in the spodumene.

Figure 4-2 shows a cross-section of the deposit, approximately in the middle of the future open pit. The spodumene pegmatite mineralization appears in green.

Figure 4-2 Geological Cross-section of the Deposit



The following descriptions are excerpted from Section 8 of the NI 43-101 technical report by Laferrière and coll. (2011).

4.2.2.1 Origin and Features of the Rare Metal Pegmatites

The Whabouchi deposit is a lithium and beryllium bearing rare metal pegmatite. The emplacement of the rare metal pegmatites occurred during the last crystallization phase of a granite intrusion. Under high pressure, the residual fluids with abundant water, silica, alumina, alkalis and rich in rare metals and other volatile elements, resulting from the crystallization of an intrusion near the surface, concentrated at the contact boundaries of the granite intrusion. Under increasing pressure, these fluids expanded fractures that were already present in the surrounding rock, thus providing space for the emplacement of the pegmatites. The progressive crystallization of the minerals resulted in the enrichment of the residual fluid in the rare metals. This process leads to the formation of rare metal pegmatites for as long as the pressure remains high. A variety of types occurs, depending on the abundance and the type of rare metals associated with the parent granite intrusion and the physico-chemical conditions affecting the pegmatite emplacement sequence.

Petrologists classify the different varieties of pegmatites in several types and subtypes according to combinations of the following criteria:

- Mineralogical and geochemical signatures;
- Internal structure and zonation;
- Pressure and temperature conditions of crystallization.

These criteria are related through degree of fractionation, which is determined by the evolution of chemical conditions, temperature and pressure in the fluids over time, and by the distance that separated them from the parent granite intrusion. The rare metal pegmatites generally evolve according to the following sequence. At depth, under elevated pressure and temperature conditions, granitic pegmatites (quartz, feldspar and mica) crystallize in the fractures above and within the solidified granite intrusion. The residual fluids migrate along the fractures toward lower temperature and pressure zones, where beryl begins to appear in the mineralogic assemblage. The result is a presence of columbo-tantalite, the composition of which is initially rich in niobium then evolves toward an increasing tantalum/niobium ratio when the pegmatite begins to contain minerals comprising lithium, cesium, and rubidium. In some varieties, the lithium is present in the form of petalite, often associated with pollucite, lepidolite, etc. In other instances, the lithium is present in the form of spodumene, hence the albite-spodumene pegmatite type. Other minerals such as tantalite (tantalum) and cassiterite (tin) can also be present in some varieties. A final phase, which occurs in low pressure and low temperature conditions (greisen) can follow; it is identified by the presence of lepidolite, quartz, tantalum-rich minerals, tin, beryl, topaz, etc.

Three characteristics of the geological setting for rare metal pegmatites are common:

- Emplacement in concordant stacked sills;
- Presence of a compressed, near-vertical, syntectonic, mobile zone that is the locus of pegmatite intrusion;
- Host rock that is generally dominated by mafic volcanic rocks with intercalated metasediments and gabbroic rocks.

4.2.2.2 Sill Structure

The most interesting rare metal pegmatites, from an economic point of view, are generally found at shallow depth, with one or several strongly dipping feeder dykes. The stratification that exists between the layers of volcano-sedimentary rock creates planes of weakness along the contacts, thus facilitating the inflow of high pressure fluids carrying the rare metals. The stratification also constitutes a barrier that retains the volatile elements contained in the fluids from which the rare metal pegmatites crystallize during the final phase. The zonation within the pegmatite is a result of the fractional crystallization of minerals during cooling: an albite zone at the contacts, mainly composed of potassic feldspar with quartz and mica, followed by an intermediate zone of quartz, spodumene, feldspar and mica, and finally a quartz-rich central zone (in the case of the albite-spodumene type). This simple zonation is often more complex due to several pulses of intrusion, albitisation, and other replacement reactions.

4.2.2.3 Syntectonic Mobile Zone

The feeder dikes, which are generally subvertical, represent the conduit from depth connecting granite intrusion and the rare metal pegmatite bodies. In most cases, shearing at the contacts of the dike or plastic deformation, with or without mylonitisation in the feeder dikes, identifies the presence of a syntectonic mobile zone at depth. In extreme cases, the feeder dikes can be stretched and form a boudinage structure. The feeder dikes tend to have an intermediate composition in the fractionation process.

4.2.2.4 Mafic Host Rock

There is little documentation about the rock surrounding rare metal pegmatites. The studies that were carried out generally focused on the geochemistry and mineralogy of the contacts, and occasionally on the structural context. The presence of volcano-sedimentary rocks is a key element of the rare metal pegmatite genetic model, after the composition of the parent granite intrusion. Also, they are the most frequent host rocks for rare metal pegmatites. The stratification and ductility of the mafic volcanic rocks and gabbros allowed them to support deformation without breaking or fracturing, thus confining under high pressure the volatile elements that enter in the rare metal pegmatite crystallization process. This mechanical behavior promotes the emplacement of pegmatites along the contacts between the host rock units, explaining the abundance of deposits that take the form of sills. In the case of friable host rocks, these tend to fracture, eliminating or greatly reducing the pressure required for a coarse crystallization and allowing volatile elements to escape. The final product would then be a more uniform feldspar-mica-spodumene rock with subtle or quasi-inexistent zonation. When an active feeder dike (unsolidified) moves rapidly toward the surface through the fractures, the result is an extrusive rock called rhyolite.

4.2.2.5 Whabouchi Pegmatite

The Whabouchi pegmatite is actually a highly fractionated spodumene-rich pegmatites swarm. The different bodies present various degrees of the typical zonation: a relatively thin albite-rich wall zone at the contacts, followed by a potassic feldspar rich zone with lesser albite, quartz, mica, and little or no spodumene, and finally a spodumene-quartz rich core zone (with feldspars and micas) that makes up more than 90% of the cross-section. The Whabouchi deposit does not have the quartz-rich core zone typical of zoned pegmatites. The stratigraphic work completed on the host rock cannot confirm whether the bodies form sills as in classic cases. The alignment of the pegmatite bodies with the volcano-sedimentary belt and the extension of thin pegmatite bodies over a length and depth of more than 100 m support the hypothesis of this structural control.

Several locations at the southern contact show a high degree of shearing and stretching of the basalt pillow, indicating that the main pegmatite was emplaced in a mobile feeding zone, rather than in offshoot from the feeder dyke. This suggests that the feeder dike was controlled by steeply inclined layers of volcano-sedimentary rocks and that, above the present level, a now eroded away lithological unit or unknown structure sealed the system, thus confining the volatile elements in the fluids and resulting in the crystallization of rare metal pegmatite.

4.3 Development of the Deposit

4.3.1 Mining Reserve

The mineral resource estimate for the Whabouchi project was updated in October 2012. This estimate complies with the standards and directives of the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) and to standard NI 43-101 for the disclosure of resources and reserves. Table 4-2 presents the results obtained for the Whabouchi deposit, assuming a cutoff grade of 0.4% Li_2O.

Table 4-2 In-pit Mineral Resource Estimate (Cutoff Grade: 0.4% Li_2O)

Category		Quantity (thousand tonnes)	Li_2O Grade (%)
ORE	Measured	10,197	1.53
	Indicated	9,442	1.45
	Measured + indicated	19,639	1.49
	Inferred	377	--
Overburden		2,356	
Waste rock		56,646	
Waste/Ore ratio		3.02	

4.3.2 Mining Methods

Drilling and Blasting

The ore extraction activities will be carried out conventionally, using the open-pit mining method with drilling and blasting sequences followed by haulage of the ore to a ground-level concentrator. The drilling work will be performed with diesel drilling rigs, model DTH Cubex QXR 920 (or equivalent). The 6.5 inch diameter holes, spaced at 5 m intervals, will be drilled in the rock down to a depth of 11.5 m, including 1.5 m of sub-drilling. The drilling patterns will provide approximately 11,267 tonnes of ore and 12,770 tonnes of waste rock per shift.

Table 4-3 presents the parameters and assumptions relating to the drilling and blasting work.

Table 4-3 Drilling Parameters and Assumptions

Parameter	Unit	Ore	Waste rock
Hole Diameter	inches	6.5	6.5
Bench Height	metre	10	10
Subdrill Length	metre	1.5	1.5
In situ Bulk Density	tonne/m^3	2.70	3.06
Hole Spacing	metre	5	5
Burden	metre	5	5
Rock Mass per	tonne/hole	675	765
Penetration Rate	m/hour	25	25
Shift Drill Time	hour	8.06	8.06
Maximum Metres per Shift	metre	201.56	201.56
Redrill	%	5	5
Holes per Shift	number	16.69	16.69
Maximum Drilling Capacity per Shift	tonne	11,267	12,770

The explosives used in the blasting activities will be supplied by a Nemaska Lithium subcontractor. They will be of the emulsion type, with an average density of 1.25 g/cm^3. According to the drilling pattern, the quantities of explosives used will be 0.297 kg and 0.262 kg per tonne of ore and waste rock, respectively. These quantities differ because the rock densities are not the same. Since the holes will be loaded over a length of 5 m, each will receive 200.5 kg of emulsion. Storage tanks will be located at the mine site, but their content will be delivered from an outside plant. The emulsion delivered to the mine site will be stored in these tanks before being transferred into the trucks that will fill the holes.

Two explosives stores will be installed in the western part of the mine site, between the waste rock and tailings pile and the pit. One of these two magazines will be used to store detonators while the other will receive other blasting accessories. The footprint of each magazine is 52 m^2 (13 m x 4 m). The minimal distance between the explosives stores and the concentrator or any other surface infrastructure will be 1 km. The minimum distance between the magazines and the pit will be 800 m. The infrastructure layout shown in Map 2-1 shows the location of the explosives stores.

Emulsion-type explosives are preferred because of their low solubility in water. They also generate less ammonia than other types of explosives. Finally, electronic detonators will be used in order to achieve an optimal fragmentation of the rock.

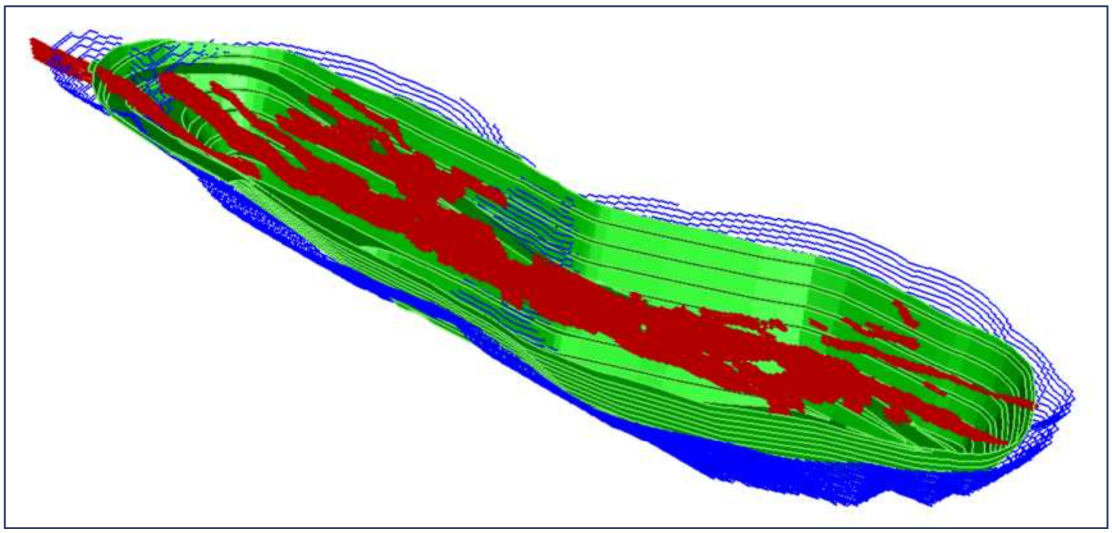
Two or three blasts will be executed every week, each producing approximately 50,000 tonnes. Blasting will be suspended during the two weeks of the goose hunting (Goose Break). During the Goose Break, there will be no extraction work, including the haulage of ore or waste rock. However, the concentrator will continue its operations and will be supplied by an ore stockpile. This interruption is designed to avoid disturbing goose hunting on the Lac des Montagnes.

Ore Extraction

The pit geometry was designed to optimize extraction from the deposit in terms of technical and economic parameters. The final configuration of the open pit is shown in Figure 4-3. Based on the geomechanical properties of the rock, the benches will be 10 m high and the berms will be 4 m wide with a bench face angle of 75° and inter-ramp angle of 56°. The slopes will be stable, due to the presence of competent rock. At the end of the operations, the mine pit will have reached a length of 1,250 m, a width of 320 m and a depth of 190 m.

The in-pit haulage road will be 22 m wide to allow the circulation of 46-tonne trucks in both directions. At the lower levels of the pit, however, the ramp will be 16 m wide and permit only one-way circulation. The maximum gradient of the ramp will be 10%. The ramp exit at surface will be on the north side of the pit so as to minimize the distance of travel to the waste rock and tailings pile or the concentrator. The detailed design of the open pit and the mining plan are presented in Appendix 4-1, which is a section of the preliminary economic assessment (Met-Chem, 2012).

Figure 4-3 3D View of the Open Pit with Mineralized Zones Shown in Red



The ore extraction activities will be carried out 24 hours a day, 350 days per year (15-day interruption for the Goose Break).

The overburden that will be excavated and moved to gain access to the deposit will be stockpiled near the pit (Map 2-1). the stripping of the overburden will occur during the first nine years of operation, as the pit is gradually enlarged. The overburden will be used in the progressive rehabilitation of the waste rock and tailings pile and for the restoration of the mine site. During the construction phase, excavating to reach the deposit will produce 1.14 Mt of waste rock that will be used to build the roads, pads, dams, etc. Finally, extraction of the ore will begin before the commissioning of the concentrator. The ore will be stockpiled near the concentrator. Table 4-4 presents the expected production over the mine life.

Ore and Waste Rock Haulage

The ore and the waste rock will be hauled by 46-tonne trucks (CAT 772 or equivalent) that will be loaded by hydraulic shovels equipped with a 6 m^3 bucket (CAT 390D or equivalent). The expected average extraction from the pit should be 3,000 tonnes per day of ore and 8,600 tonnes per day of waste rock. Assuming that the trucks will have a capacity of 46 tonnes, this will require an average of 250 trips between the pit and the waste rock pile or the concentrator (waste rock or ore). On the mine site, the 46-tonne trucks will travel at a speed of 15 km/h.

Table 4-4 Excavated Material during the Mine Operations (Planned)

Operation (year)	Ore (Mt)	Overburden (Mt)	Waste rock (Mt)	Moved material (Mt)
Pre-production	0.054	0.43	1.14	0.64
1	0.840	0.26	1.25	2.34
2	1.095	0.21	1.90	3.21
3	1.095	0.23	2.09	3.41
4	1.095	0.02	2.57	3.70
5	1.095	0.04	2.95	4.08
6	1.095	0.45	2.70	4.25
7	1.095	0.39	3.63	5.11
8	1.095	0.23	4.62	5.95
9	1.095	0.11	4.73	5.94
10	1.095	--	5.87	6.97
11	1.095	--	4.85	5.98
12	1.095	--	4.54	5.67
13	1.095	--	4.26	5.39
14	1.095	--	3.70	4.89
15	1.095	--	2.56	3.72
16	1.095	--	1.72	2.86
17	1.095	--	0.88	1.98
18	1.095	--	0.66	1.76
19	0.130	--	0.04	0.12
Total	**19.640**	**2.36**	**56.65**	**79.02**

4.3.3 Pit Lighting and Power Distribution

There will be no electrical distribution in the open pit. All the equipment, including the groundwater pumps, will be powered by diesel motors.

Lighting will be provided by diesel-powered systems and by the operating machinery (trucks, loaders, hydraulic shovels, etc.)

4.3.4 Open Pit Dewatering and Water Management

At the beginning of the operations, the elevation of the open pit bottom will allow the evacuation of groundwater and runoff by gravity via ditches draining in the sedimentation basin. As the pit gets deeper, basins will be excavated at the bottom of the pit to collect the groundwater and runoff. An adjustable variable-flow pumping system will be installed to dewater the open pit. A diesel pump will be installed at the lowest point of the pit and connected to a permanent steel pipe running along the pit walls to carry the water to the surface.

4.4 Ore Processing

4.4.1 Crushing and Milling

The mine will supply 3,000 tonnes per day of ore to the concentrator, i.e. about 1 million tonnes/year. The ore will be temporarily stored on a pad located near the concentrator. The primary crusher hopper will be fed by a loader. The 150 kW primary jaw crusher is followed by a 220 kW secondary crusher and by a tertiary cone crusher with a power of 295 kW. The crushing system will feed the fine ore (smaller than 10 mm) to a silo. The crushers will be installed in a separated building near the concentratorand will be linked together by a covered conveyor.

In the crusher building, dust will be collected and discharged onto the fine ore transfer belt conveyor.

4.4.2 Concentration of the Spodumene

DMS and Flotation Circuit

The crushed ore will be stored in a 510 m^3 bin. From there, it will be sent to a two-stage dense media separation (DMS) process, then to the flotation circuit. The purpose of the DMS is to remove part of its gangue from the ore, at a specific gravity of approximately 2.65, before the milling circuit required by the flotation, in order to produce a coarse spodumene concentrate with a specific gravity of about 3.00. Both circuits will optimize the total recovery of lithium. The crushed ore (less than 9.5 mm) will be washed and passed through a vibrating sieve with a 0.5 mm aperture. The sieve underflow (less than 0.5 mm) will be pumped into the milling circuit pump box, which will feed the flotation circuit. The overflow of the vibrating sieve will be sent by gravity to the input hopper of the dense media separation circuit. The dense liquid (ferrosilicon/magnetite) will be pumped to the circuit feed box to produce a slurry that will be sent to the first stage of dense media separation. The sink product from this first stage (dense media separation concentrate) will then pass over a vibrating sieve to recover the densified liquid that will be reused in the circuit.

The first stage sink product will be sent to the second dense media separation stage, at a cut-off grade of 3.0 g/cm^3. The second stage concentrate will be sent to the concentrate storage. The dense media separation reject, along with the granulometric fraction smaller than 5 mm, will feed a milling circuit consisting in a rod mill and a ball mill. The ore will then pass by a primary cyclone to remove ultra-fine particles. The underflow will be sent to a scrubber in which the mica particles will float. The mica flotation will be done in two stages: first a roughing stage, followed by a cleaning stage to recover fine spodumene particles that remain with the mica. The mica flotation reject, which is the input for the spodumene flotation, will be adjusted for pH and a spodumene collector will be added. That prepared slurry passes through a roughing stage and four cleaning stages to produce the 6% Li_2O concentrate. The final concentrate will be dewatered, filtered, dried and prepared for shipping. The concentrator rejects will be thickened before being sent to the waste rock and tailings pile.

The spodumene concentration process flow sheet is illustrated in Figure 4-4. As mentioned above, the final product, i.e. the spodumene concentrate, will have a minimum concentration of 6.0% Li_2O.

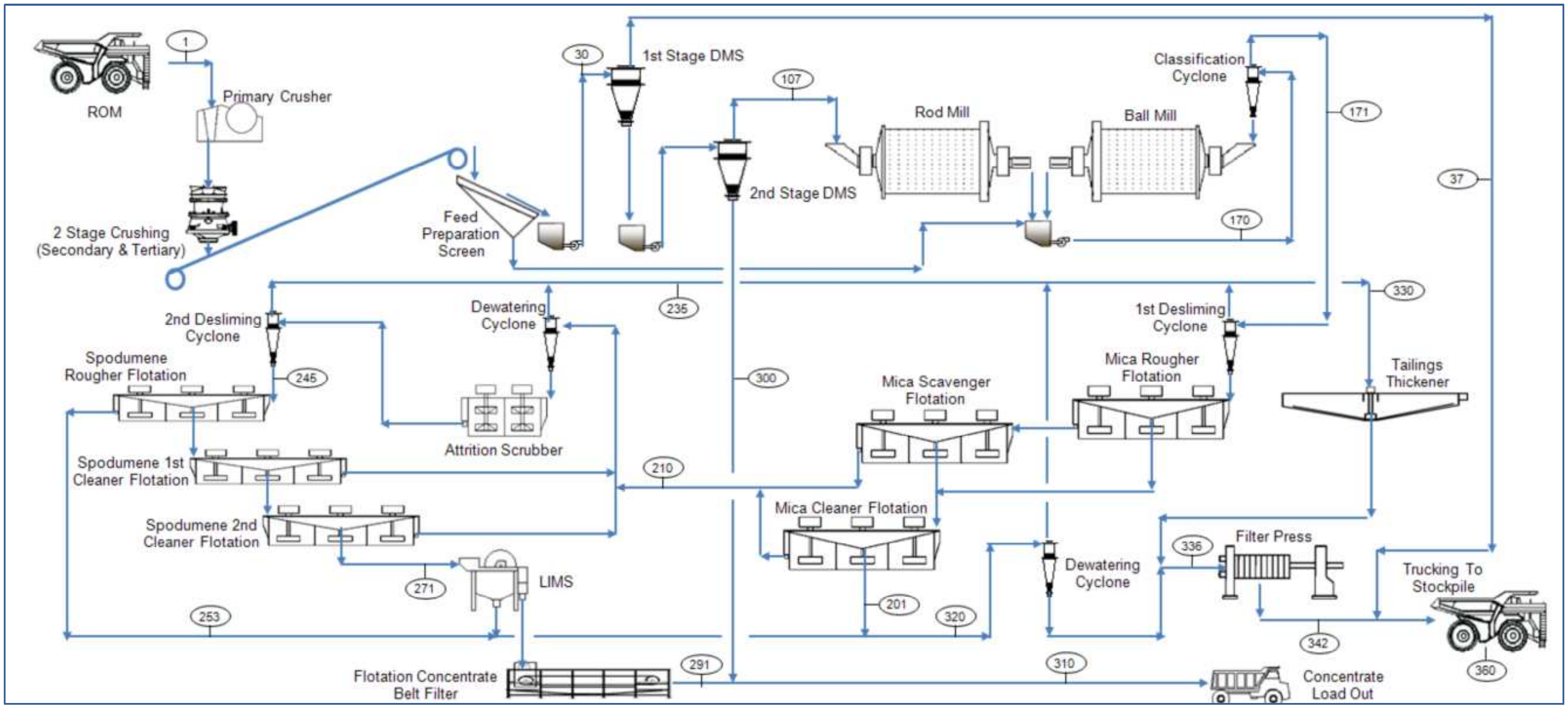
Chemicals

The concentration of spodumene pegmatite will require various chemical products. Table 4-5 lists the products that will be used and their estimated quantities. The chemicals will be stored in the concentrator buildings. Further details about their storage and the precautions for their handling are given in Chapter 10.

Table 4-5 Estimated Consumption of Chemicals at the Concentrator

Reagents	Consumption per tonne of solution (g/t)	Annual consumption (t/year)
Dispersant D618	249.6	156.7
Sodium carbonate	162.4	101.9
Caustic soda	278.4	174.7
Flocculant Magnafloc 10	276.0	50.8
Collector LR 19	1,132.9	711.1
Collector Armac C	63.4	39.7
Fuel oil	21.6	13.6

Figure 4-4 Spodumene Crushing and Concentration Process Flow Sheet



Tailings

The concentrator will generate two types of tailings. These tailings differ mainly in their particle size. They are classified as coarse grains and fine grains. The dense media separation generates coarse grains tailings. The residue from the flotation cells will be much finer and will be filtered before being mixed with the coarse grains tailings and hauled to the waste rock and tailings pile.

4.4.3 Tailings Haulage

At the concentrator, the tailings will be loaded into trucks by a conveyor. The trucks will carry the tailings to the waste rock and tailings pile, where they will be graded and promptly covered with waste rock. The water content of the tailings should be approximately 10%.

4.4.4 Transportation of the Spodumene Concentrate

The spodumene concentrate will be shipped from the mine site to Chibougamau on the Route du Nord. Nearly 213,000 tonnes of concentrate should be transported every year. The trucks will have a capacity of 40 tonnes, which corresponds to an average daily rate of 16 truckloads. The trucks will be equipped with tarpaulins to prevent the infiltration of water in the concentrate. At Chibougamau, the concentrate will be stored in a "Sprung" or "Megadome" type warehouse until it is loaded in enclosed railcars at the transshipment point and sent to the transformation plant in Salaberry-de-Valleyfield.

To prevent the freezing of the concentrate during transportation, its water content will be reduced to less than 5%. Additionally, the trucks will be equipped with tarpaulins to prevent contact with water or snow as well as the loss of concentrate through wind erosion. The maximum speed of the trucks on the Route du Nord will be 70 km/h.

4.5 Waste Rock and Tailings Management

4.5.1 Geochemical Characterization of the Waste Rock and Ore

The geochemical characterization of the waste rock and ore was completed by Lamont (2013) and the results are given in Appendix 4-2. The geological cross-sections of the deposit were investigated in order to establish a sampling pattern and select samples that would be representative of the composition and occurrence of the ore. The samples were required to characterize the spatial variation of the rock types that will be extracted from the open-pit mine. The number of samples selected for each lithological unit is proportional to the quantity of waste rock that will be deposited on the waste rock and tailings pile. The proportions of the various lithologies were estimated on the basis of geological cross-sections obtained during the exploration drilling.

According to the estimates, the expected 56.65 Mt of waste rock would be composed of:

- 35% gabbro;
- 50% basalt
- 10% pegmatite;
- 5% others.

For the geochemical characterization of the waste rock and ore, 83 samples were taken in the exploratory drill cores. The samples were distributed as follows:

- 5 samples of spodumene pegmatite (ore);
- 41 samples of basalt;
- 26 samples of gabbro;
- 9 samples of pegmatite;
- 2 samples of felsic volcanic rock.

For the purpose of the characterization, a test protocol was prepared in conformity with Directive 019 for the mining industry in Québec (MDDEP, 2012) and the Mine Environment Neutral Drainage Program (Price, 2009). The following tests were performed on all samples of solid material:

- Whole rock analysis (fusion and x-ray fluorescence);
- Metals analysis (MA.200- Met 1.2);
- Acid-generating potential (Sobek and coll. 1978, Modified);
- Static leaching tests (TCLP, MA.100-Lix. Com.1.1).

In addition to the static tests, five waste rock samples were submitted for humidity cell kinetic leaching tests (ASTM D457) (testing in progress). The kinetic tests provide a representation of the dynamics of the chemical reactions and help evaluating the impact of dissolution or oxidation of the various minerals on the quality of the water that comes in contact with the tailings. In these humidity cell tests, a 1 kg sample undergoes a 7-days test cycle consisting in three days under dry air, followed by three days under moist conditions, followed by leaching the sample with 1 L of water on the seventh day. Water samples are collected at the end of each cycle and analyzed in order to quantify several parameters. The leachate extracted from the samples in the humidity cells is analyzed to measure the metal concentrations and various other parameters.

The acid generating potential was evaluated for all samples. The results are presented in Table 4-6. The waste rock and the ore that will be extracted from the mine are not considered as potentially acid generating.

Table 4-6 Summary of the Waste Rock and Ore Acid Generating Potential Results

Rock type	Number of samples	Total sulphur (%) (median)	Net neutralization potential ($kgCaCO_3/t$) (median)	NP/AP[1] (median)	Potentially acid generating	
					Dir. 019	Price
Gabbro	26	0.15	9.7	2.1	No	No
Basalt	41	0.13	9.1	2.2	No	No
Pegmatite	9	0.05	3.1	1.7	No	Uncertain
Felsic volcanic rock	2	0.16	8.1	1.6	No	Uncertain
Spodumene pegmatite	5	0.04	2.8	1.5	No	Uncertain

[1] Neutralization potential/Acid generating potential

In addition to the acid generating potential test, all the samples were submitted to metals analyzes and leaching tests. The chemical analysis results show that, for each type of rock, the concentration of certain elements exceeded the A criterion of the *Politique de protection des sols et la réhabilitation des terrains contaminés* (PPSRTC) (MDDEP, 1998). The A criterion corresponds to the background concentration in the Superior geological province, where the Whabouchi project is located. Table 4-7 presents by types of rock the number of samples in which exceeding values were observed.

Table 4-7 Metals Exceeding the PPSRTC A Criterion in the Waste Rock and Ore

Rock type	Number of samples	Exceedance of PPSRTC A criterion
Gabbro	26	Cu (24)[1], Cd (3), Co (3), Ni (1)
Basalt	41	Cu (30), Co (1)
Pegmatite	9	Ag (1)
Felsic volcanic rock	2	Ba (1), Cd (1)
Spodumene pegmatite	5	Cu (2)

[1] () Number of samples exceeding the A criterion.

According to Directive 019, when a metal concentration in a sample exceeds the A criterion, the sample must undergo a leaching test following the TCLP protocol (Toxicity Characterisation Leaching Test, EPA 1311). Therefore all the samples were submitted for leaching tests. As specified in Directive 019, the leachate analysis results were compared to the following criteria:

- Water Quality criteria (Groundwater reporting to surface water (PPSRTC, Appendix 2);
- Hazardous Waste Guidelines (Directive 019, Appendix 2, Table 1).

To classify a mine tailing as leachable, two conditions must be met: at least one element must exceed the SPRCSP A criterion, and the concentration of this same element in the leachate is to exceed the SPRCSP criterion in the TCLP test.

Table 4-8 presents the results for the elements that exceeded the criteria in the solids test and the TCLP tests.

Table 4-8 Samples with Metal Concentrations Exceeding the A Criterion and the Leaching Criterion (TCLP)

Rock type	Number of samples	Leachable metals [1]	High risk
Gabbro	26	Cu (18)[2]	None
Basalt	41	Cu (20)	None
Pegmatite	9	None	None
Felsic volcanic rock	2	None	None
Spodumene pegmatite	5	Cu (2)	None

[1] As defined in Directive 019.
[2] () Number of samples exceeding both criteria.

Within the meaning of Directive 019, 48.7% of the tested waste rock samples are considered leachable, and only for copper. As for the spodumene pegmatite ore, two samples out of five are considered leachable within the meaning of Directive 019, again for copper.

The kinetic tests performed to this date show that there is no long-term leaching of metals from the five waste rock samples.

Furthermore, the waste rock samples were characterized to confirm their usability as construction materials, according to the *Guide de valorisation des matières résiduelles inorganiques non dangereuses de source industrielle comme matériau de construction* (MENV, 2002). Several parameters were compared to the criteria: non-hazardous materials, particle size, alteration, organic carbon content, neutralization potential, sulphide content, acid generating potential, metal concentrations, and the results of various leaching tests. According to this characterization, all the waste rock is classified as Class 1 material, suitable for road construction and backfilling. The details of the tests and their interpretation are presented in Appendix 4-3.

4.5.2 Geochemical characterization of the tailings

Five tailings samples were submitted for geochemical characterization testing. Four of them were various components of the tailings, while the fifth was a composite of the four other, proportional to the expected composition of the tailings. They were residues from a metallurgical test performed on a sample collected on the outcrop and from drill cores. The metallurgical testing was performed at the SGS laboratory in Lakefield.

The acid generating potential tests showed that the representative composite sample was non-potentially acid generating, with a sulphur content of less than 0.005% and a NP/AP ratio of 13.5. The sample was not leachable within the meaning of Directive 019. The kinetic tests completed to date confirm that the tailings present no leaching potential.

4.5.3 Waste rock and tailings disposal

The waste rock and tailings pile will be located to the north of the pit. It will be developed in two phases. The first phase will be built west of the mine site and the south of the Route du Nord. This first phase will receive close to 13.2 Mm^3 of waste rock and tailings during the first 12 years of operation. Subsequently, a short section of the Route du Nord will have to be relocated to accommodate the emplacement of an additional 14.5 Mm^3.

The tailings and waste rock will be pilled using a co-disposal methodology. The tailings will be filtrated at the concentrator, and will thus contain little water and be transportable by truck. The filtration of the tailings provides considerable environmental benefits. Effectively, although it is more expensive, this method allows to:

- Reduce the project footprint by allowing co-disposal with the waste rock, thus avoiding the construction of a tailings pile;
- Maximize the recycling of water at the concentrator, thus reducing the volumes released in the environment;
- Avoid the management of a water body and retaining dams, as in the case of slurred tailings;
- Limit water and wind erosion of the tailings by covering them daily with waste rock.

The design criteria used to define the geometry of the waste rock and tailings pile are the following:

- Bench face angle: 30°;
- Inter-ramp angle: 26.6°;
- Maximum height of pile: 70 m;
- Bench height: 10 m;
- Ramp width: 22 m;
- Ramp grade: 10 %;
- Disposal capacity: 27.7 Mm^3.

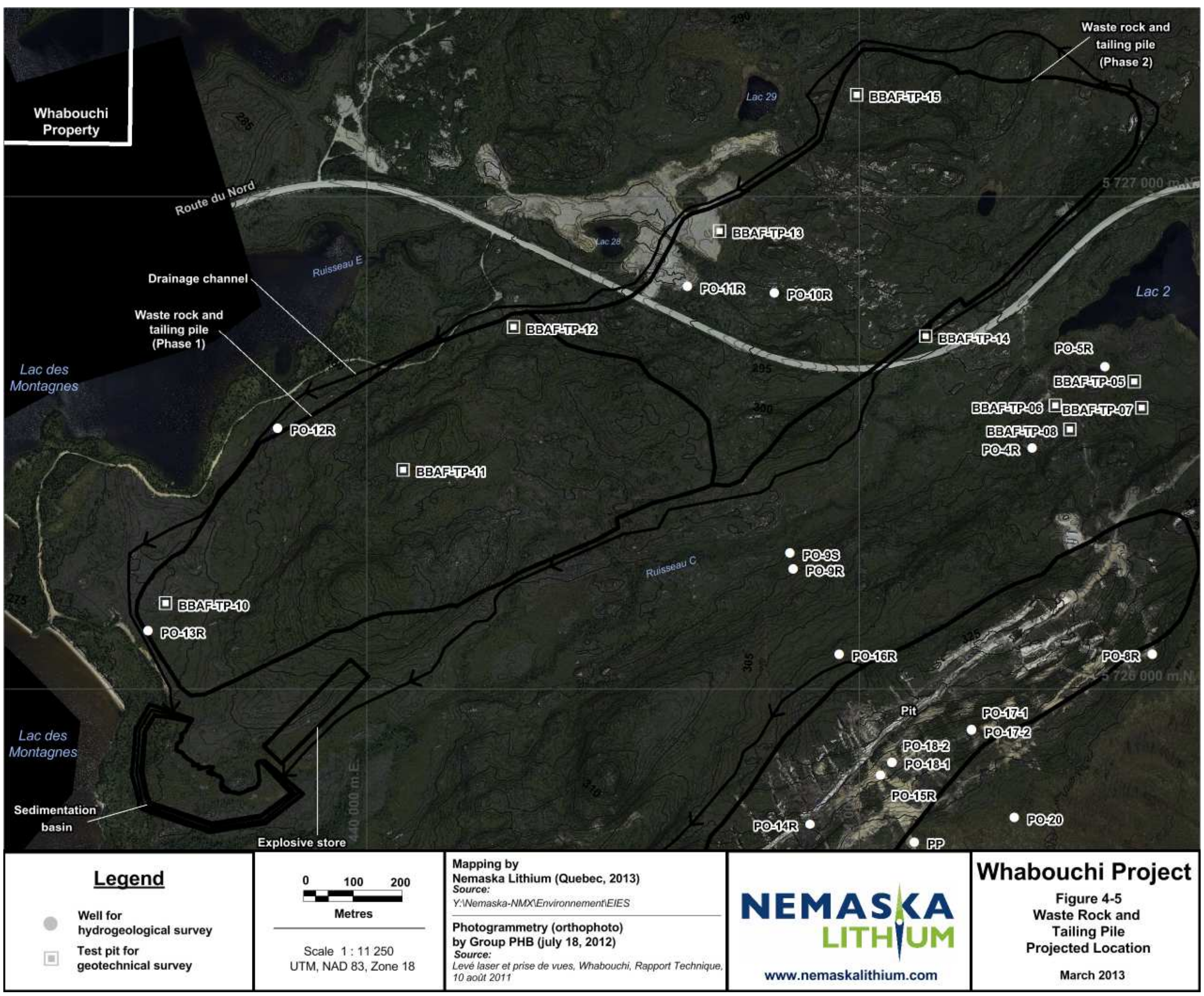
4.5.4 Geotechnical and Hydrogeological Conditions under the Pile

An aerial photograph of the proposed location of the waste rock and tailings pile is shown in Figure 4-5. Trenches were excavated and drillings were completed in the fall of 2011 in order to ascertain the soil conditions under the pile. The results showed that there is a thin layer of overburden composed mainly of discontinuous till.

At the pile location, the thickness of the till is generally less than 3 m. Therefore, this stratigraphic unit located on the bedrock is considered as the vadose zone and the underground water circulation is presumed to be vertical (Richelieu Hydrogéologie, 2012). Four wells within the footprint of the future pile were installed as piezometers, i.e. wells PO-10R, PO-11R, PO-12R and PO-13R. All four wells were installed down to the bedrock. The depth of the water table varied between 1 and 3 m from the natural ground level. The water quality analyzes showed that in these locations, the groundwater naturally contains copper, zinc and a small quantity of mercury.

As for the geotechnical investigation, the locations of the exploration trenches dug in the footprint of the future pile are shown in Figure 4-5. The soil collected from the trenches was analyzed in the laboratory; it is made up of pulverulent material varying from sandy silt to sand and gravel (Journeaux Associés, 2011). The detailed report on the investigation is presented in Appendix 4-3.

Figure 4-5 Location of the Future Waste Rock and Tailings Pile



4.5.5 Deviation of the Route du Nord

The Route du Nord will be relocated during the mining operations to allow the expansion of the waste rock and tailings pile. This deviation will involve the construction of a new 2.1 km section, as shown in Map 2-1.

The construction of the new section will require a new infrastructure built in conformity with ministère des Transports du Québec standards. The granular material will be provided by the waste rock pile. Sand, if required, will be extracted from existing borrow pits. The road section will be completed before any traffic is diverted. The construction of the road section should begin during the 9th year of operation of the mine, and be completed during the 11th year. Traffic should not be disturbed by the work, since it will be completed in the absence of circulation. All the slope, radius and signage standards of the ministère des Transports du Québec will be respected. The detailed engineering of this road section has not been completed, and the route will be optimized after the required geotechnical drilling and fieldwork.

4.6 Overburden Management

A total of approximately 2.4 million tonnes of overburden will be removed, essentially from the pit area or from the stripping of the soil under the infrastructures such as building or secondary roads. The overburden will be temporarily stored in a stockpile south of the waste rock pile (see Map 1-2). The overburden will be used in the progressive and final restoration of the waste rock and tailings pile.

4.7 Water Management

The water balance takes into account the five following conditions:

- Average annual precipitation;
- Runoff coefficients established according to the type of drained surface;
- Infiltration according to the type of surface (natural soil, road, pile, mine pit, etc.);
- Concentrator water balance;
- Evaporative water losses.

Two outlet points in the environment are planned. A sedimentation basin will be developed near the southwestern limit of the waste rock and tailings pile, and another basin will be installed to the southwest of the open pit. The water collected in these two main basins will come from:

- Runoff from the waste rock and tailings pile;
- Runoff in the open pit;
- Open pit dewatering.

The process water will be entirely recycled and there should be no reject of such water in the environment. A back-up source of water will be required for the operation of the concentrator.

The runoff from outside the mine site will not be collected by the drainage network serving the mine and its infrastructures. Rather, this water will be diverted so as to avoid any contact with the mine installations. In the case of water coming in contact with mine installations, e.g. the concentrator, the maintenance garage, etc., it will be collected and treated if necessary before being released in the environment.

The clean water will be diverted by berms erected along certain ditches, thus avoiding the capture of water that has not been in contact with site water. For example, the ditches surrounding the waste rock pile and the facilities will be protected by a berm made up of excavated materials. These berms will be inspected regularly during the operation of the mine to ensure their effectiveness. The runoff thus diverted will remain in the environment and ultimately reach the Lac des Montagnes.

4.7.1 Management of Runoff from the Buildings Area

Two treatment basins will be present on the site, near the concentrator, to collect drainage from the buildings area. Both basins will be located near the concentrator and the garage, and will collect the runoff from these facilities. Their respective capacities will be 7,800 m^3 and 2,500 m^3. These basins will constitute the main water supply for the concentrator. Pumps will be installed in the basins to send water to the concentrator. These basins will not have outlets, since it is expected that all the water will be used in the ore concentration process and that additional needs will be filled by a groundwater well located near the concentrator.

4.7.2 Management of Runoff from Waste Rock and Tailings Pile

A sedimentation basin will be built at the southwestern limit of the waste rock and tailings pile. This basin will collect runoff and seepage from the pile. It will be fed by the ditches surrounding the pile, which will drain the water by gravity. The perimeter ditches will be built in two phases, corresponding to the two pile construction phases. The drained surface area for phases 1 and 2 is 1,144,000 $m^{2.}$ The sedimentation basin was designed to receive the water from an extreme condition corresponding to a 24 hour rainfall with a 100 year recurrence, coupled to a 30 day snowmelt with a 1,000 year recurrence, which corresponds to an accumulation of 94 mm of water in 24 hours. This sizing criterion is specified by Directive 019. The basin dikes will have a waterproof core built with silty till or a waterproof membrane, depending on the availability of borrow materials near the mine site.

According to the current status of the waste rock and tailings geochemical characterization, it should be assumed that the water will have to be treated only for suspended matter before being released in the environment. The basin will have a capacity of 3,500 m^2, providing a retention time of 29 days in average operating conditions. The basin will be able to receive up to 140,000 m^3 of water. The water will flow out of the pond through a pipe installed in the dike. A system of valves will allow this pipe to be closed at any time.

The outlet of the sedimentation basin is Creek C, which empties in Lac des Montagnes. The ditch between the sedimentation basin and Creek C will be protected against erosion with rip-rap and geotextile, over its entire length if necessary. In average operating conditions, the volume of water that will be released in the environment is presented in Table 4-9. Runoff is assumed to be zero during the winter months, i.e. from December to March. Therefore, the outflow of Creek C will vary between 349 and 1,194 m^3/day in average conditions.

Table 4-9 Waste Rock and Tailings Pile Runoff in Average Conditions

Month	Daily water volume (m^3)	Monthly water volume (m^3)
January	0	0
February	0	0
March	0	0
April	1,194	35,826
May	681	21,102
June	399	11,976
July	548	16,994
August	372	11,537
September	569	17,059
October	711	22,037
November	349	10,466
December	0	0
Total		**146,997**

4.7.3 Management of Open Pit Runoff and Dewatering

The fourth sedimentation basin is located in the southwest portion of the mine site and will collect mine water, i.e. the groundwater seeping in the mine pit and the precipitations falling on the pit footprint. The volume of this basin is estimated at 82,000 m^3, providing a retention time of 26 to 40 days under normal precipitation conditions in year 18, which represents the worst case. The basin will empty through a spillway at the top of the dike.

The sedimentation basin will drain toward Lac des Montagnes. The spillway and the ditch between the pond and the lake will be protected against erosion with rip-rap and geotextile, over their entire length if necessary. The rate of groundwater seepage in the pit will increase gradually over the life of the mine, culminating when the pit reaches its maximum depth. The runoff flow will vary over the year, but since the footprint of the open pit will not vary significantly during its operation, it will be relatively constant year after year. The open pit dewatering flow was estimated by numerical modeling and is presented in Table 4-10.

Table 4-10 Average Mine Pit Pumping Rate

Year	Pit floor elevation (m)	Annual runoff volume (m^3)	Annual groundwater volume (m^3)	Total annual pumped volume (m^3)	Average daily volume at outlet (m^3/d)
5	237.5	81,700	313,900	395,600	1,084
10	167.5	81,700	697,150	778,850	2,134
18	117.5	81,700	757,375	839,075	2,299

Under average operating conditions, the volume of water that will be released in the environment in the 18th year of operation is presented in Table 4-11. Runoff is assumed to be zero during the winter months, i.e. from December to March. It is estimated that the seepage of groundwater will be constant in any month, for a given pit depth. Therefore the flow rate at the outlet to Lac des Montagnes will vary between 2,103 and 2,729 m^3/d at the 18th year of operation. The retention time will be between 26 and 40 days, allowing the suspended matter to settle at the bottom of the basin.

Other than suspended matter, the preliminary data predict no other treatment issues at this time. Explosives will be used during the entire life of the mine. The loading and detonation of the blasts will be controlled. Electronic detonators will be used to optimize the effectiveness of the explosives and completely eliminate residual ammonia and nitrates.

Table 4-11 Flow at the Sedimentation Basin Outlet at the 18th Year of Operation

Month	Daily water volume (m^3)	Monthly water volume (m^3)
January	2,103	63,114
February	2,103	63,114
March	2,103	63,114
April	2,729	82,734
May	2,448	74,971
June	2,294	69,673
July	2,375	72,721
August	2,279	69,733
September	2,386	74,483
October	2,464	75,483
November	2,266	68,846
December	2,103	63,114
Total	**2,299**	**839,075**

4.7.4 Effluent Quality

The runoff from the waste rock and tailings pile, as well as the open pit drainage will be analyzed and treated if necessary before being released in the environment. Applicable regulations will be respected at all times, notably those concerning the mining industry (Directive 019 of the ministère du Développement durable, de l'Environnement, de la Faune et des Parcs [MDDEFP]).

A study has been undertaken to ascertain the chemical composition of the effluent and validate whether treatment will be required. The results of this modeling, prepared by Golder Associates, will be presented in the upcoming weeks.

4.8 Support Infrastructure

The following sections present the various support infrastructures that will be developed for the Whabouchi project. These support infrastructures are required for the development of the mine project. The location of the support infrastructures is shown on Map 2-1. Figure 4-1 presents in further detail the infrastructures of the concentrator and utility buildings.

4.8.1 Workcamp

The workcamp, located 12 km from the mine site, is accessible by the Route du Nord and corresponds with the truck stop operated by the Cree Construction and Development Company (CCDC). This camp will house the workers over the entire life of the project, from construction to closure. The Nemiscau airport is located 7 km west of the workcamp, and 19 km from the mine site.

The development of the project will require an expansion of the existing CCDC workcamp to accommodate the Nemaska Lithium employees. CCDC will be responsible for the camp expansion as well as for the operation of the facility and its services. Nemaska Lithium will pay CDCC a per diem for each employee.

At the beginning of the development, the workcamp will house the workers hired for the construction of the Whabouchi project infrastructures. A total of 215 rooms will be required during this period. Subsequently, during the operation of the mine, 125 rooms will suffice to accommodate the employees.

4.8.2 Waste Management

In order to manage its wastes efficiently, Nemaska Lithium will apply 4R principles, as recommended in the MDDEFP's Policy on Residual Materials (Gouvernement du Québec, 2011). This policy encourages the management of residual materials by preventing or reducing their production, promoting their reuse and reclamation, and thus reducing the quantities of ultimate waste that must be disposed of in an authorized sanitary landfill. Nemaska Lithium expects that it will need to send nearly 1,000 tonnes per year to an appropriate landfill. The rest of the residual materials generated at the mine will be recycled or reused. Therefore, a recycling program will be implemented at the mine site. The ultimate wastes will be transported by truck to the landfill site operated by the community of Nemaska.

Residual materials will be generated by:

- Construction and demolition activities: The construction or demolition debris produced during the construction or closure phases will be managed so as to maximize their disposal facilities in the South. Most of these debris are anticipated to be large or voluminous. In the calls for tenders, the contractors will be invited to consider waste management so as to minimize landfilling at Nemaska and to promote source separation according to the materials.
- Garage: The residual materials that will be managed in the garage facility will be generated by machinery maintenance and repair work. They will include tires, obsolete parts and packaging of all kinds. Worn-out tires will be replaced by new ones and the supplier will have the responsibility of disposing of them appropriately, with a financial compensation. Metal parts that can be refurbished or recycled will be reclaimed. As for the packaging materials, they will be managed according to their reclamation potential.
- Workers rest area: There will be no kitchen producing food wastes on the site. Workers will bring their own meals, and microwave ovens will be provided. The residual materials will include recyclable materials (cans, cardboard, plastic, etc.) and ultimate wastes (food scraps, dirty cardboard, Styrofoam, etc.). Selective collection containers will be available to encourage a proper management of residual materials.
- Offices: The offices will be used by the mine's administrative staff. Residual materials should include paper, cardboard, printer cartridges, etc. Appropriately identified containers will be available to recycle paper and cardboard. Printer cartridges will be recycled so as to minimize disposal at the Nemaska landfill facility.

4.8.3 Service Buildings

The service buildings for the Whabouchi project include an administrative office, an engineering and operations management office, and a guardhouse. These buildings will be located along the mine access road, near the Route du Nord.

The administrative office will house the human resources, accounting, purchasing and environmental services, the first aid clinic, the general management of the project and a conference room for 18 persons.

The engineering and mining operations management office will be used by the mine personnel at shift rotations. It will house the mine supervision offices, including those of the superintendent and foremen, a cafeteria and two rooms that will be used for employee training or coordination meetings. This office will accommodate the following technical services: information technology, land surveying, geology, mine planning and environment.

The guardhouse will be staffed by security officers who will control the access to the site. The administrative and engineering offices will be connected by an indoor passage to facilitate the circulation of workers.

4.8.4 Maintenance Garage and Spares Warehouse

The maintenance garage and spare parts warehouse will be located near the administrative and technical services buildings and the employee parking area. The garage will be used for the maintenance of mine equipment, heavy machinery and light vehicles. It will be equipped with gantries, air compressors, lubricating equipment, etc. It will also comprise the following equipment: two bays for heavy machinery repair and maintenance, a large washing area and a bay for light vehicle maintenance. The spare parts store adjoining the garage will be designed to maximize storage space for parts and tools. The warehouse will be accessible from the garage by an internal door.

In addition to a cafeteria and employee room, the garage will also comprise three offices for administrative staff, i.e. the superintendent, foreman and clerk.

4.8.5 Freshwater Supply

The water required by the service buildings and the maintenance garage will be provided by the same well that will supply the concentrator. The demand for freshwater will be relatively small; it is estimated at 6 m^3/h, including the needs of the concentrator. When the concentrator begins operations, the demand for freshwater will temporarily reach 20 m^3/h for a period of approximately one week (assuming that 16 m^3/h will be provided by the well until the 2,500 m^3 basin is completely filled). Drinking water will be available after treatment. The freshwater network will include the pumping system, a treatment station and a storage tank. The quality of the drinking water will meet the requirements of the Regulation respecting the quality of drinking water. The treatment process will be a basic system that will eliminate suspended matter and incorporate a UV system. The drinking water will be concentrated in a strategic location in the plant, and warnings will be posted in locations where the water is not potable.

Water used to control dust at the primary crusher will be provided by the well. Firefighting water will be drawn from the main concentrator storage tank.

4.8.6 Sanitary Sewage Treatment

Domestic sewage will originate from the sanitary facilities in the administrative and technical service buildings, the garage and the concentrator. The sewage will be sent to septic tanks, followed by disposal field. The sanitary facilities will consist in bathrooms in the garage, concentrator and administrative offices. The design flows are 3,720 L/d for the offices, 1,805 L/d for the garage, and 2,925 L/d for the concentrator building. The sewage treatment system will use ground infiltration and no effluent will be released in the surface water network. The septic tanks will be emptied regularly by an authorized contractor. The engineering report is included in Appendix 4-4.

4.8.7 Fuel Depot

The fuel depot, with a capacity of 100,000 L, will be located near the garage. It will comprise two double-walled tanks installed on concrete slabs, each with a capacity of 50,000 L. The diesel fuel distribution network will comprise two fueling points for heavy machinery and one for light vehicles. The storage tanks and the fueling points will include a pumping system and lighting.

4.8.8 Concentrator Water Supply

The concentrator will be supplied from a water well. The water supply system, located near the concentrator, will include a pumping station with two electrical pumps and a 760,000 L storage tank. This storage tank will also be used for fire protection purposes. The firefighting water pumping station will include an electrical pump and a diesel-powered backup pump. A fire protection system will be installed in all buildings, including the electrical rooms and other high-risk areas. The final design of the fire protection system will comply with applicable regulations and with the specific requirements of the insurer.

4.8.9 Power Distribution

The total power consumption of the Whabouchi Project is estimated at 7.5 MW. Table 4-12 gives a breakdown of the estimated power demand of the different facilities.

Table 4-12 Estimated Power Consumption (MW) of the Whabouchi Project

Operating sector	Estimated power demand (MW)
Crusher (grinders)	0.85
Concentrator	3.42
Utility and technical infrastructures	2.41
Distribution network losses	0.13
Estimated consumption (subtotal)	6.82
Safety factor (10%)	0.68
Total estimated consumption	7.50

The energy for the project will be supplied from the Albanel substation, part of Hydro Québec's network, which is located in the area. A 25-kilovolt (25 kV) aerial electrical transmission line will be built from the station to a new step-down power transforming substation (4.16 kV), a distance of approximately 20 km. The power will be distributed on the site by a 10/13 MVA transformer that will supply the mine site electrical network. The electrical distribution room will be located within the concentrator building.

The 5 kV system will supply power to the mine site through an aerial line of the same capacity. The concentrator will be the facility using the most power. There will be no power distribution system in the open pit, since all the mining equipment, including the pumps, will be powered by diesel motors.

4.8.10 Emergency Generator

To ensure the safety of its personnel and the integrity of the facilities, an emergency power supply will be provided at the mine site. Emergency power will be supplied by a 1 MW diesel generator. In the event of a power failure, the generator will maintain the operation of the following equipment:

- Auxiliary power supply and main motors;
- Tank agitators;
- Thickener scraper;
- Submersible pumps;
- Emergency lighting and heating;
- Communications and equipment control.

4.8.11 Industrial Water Management

At this stage of the design, the only industrial wastewater that will need to be treated is the water used in the cleaning of heavy machinery at the maintenance garage. It will be collected regularly by a specialized contractor and treated.

4.8.12 Borrow Pits

It is estimated that approximately 200,000 m^3 of sand will be required in the construction of the various infrastructures, notably in the sedimentation pond dikes. This sand will be provided by borrow pits near the site, which are already in operation. Nemaska Lithium does not plan to operate new borrow pits.

4.9 Project Phasing and Scheduling

4.9.1 Construction

The construction of the project could begin as soon as the necessary authorizations are given. Nemaska Lithium's schedule assumes that the permits will be issued in the fall of 2013.

Hydro-Québec will then have completed its powerline to the mine site and the construction of the transformer facilities could begin. The construction will include the following activities:

- Brush and tree clearing and soil stripping for infrastructures construction;
- Construction of ditches and basins;
- Drilling of an artesian well;

- Haulage and management of unconsolidated deposits;
- Management of hazardous materials;
- Waste management;
- Petroleum product management;
- Water management;
- Construction of the various buildings;
- Preparation of access to the ore deposit.

More specifically, the deforestation work will consist in eliminating dead and burned wood as well as the regenerating shrubs. As mentioned earlier, the project site was affected by a major forest fire and a very few mature trees remain. Clearing will involve only the footprint of the infrastructures shown on the plans.

Very early in the construction of the mine, the development of the water management works such as ditches and basins will begin. The construction of the buildings, the stripping of the open pit, the secondary roads, etc. will be scheduled so as to optimize environmental management on the site while respecting technical constraints.

Worksite trailers will be used during the construction to provide workers with rest areas, and dry toilets will be installed. These toilets will be the responsibility of a specialized contractor, who shall ensure their adequacy.

4.9.2 Operations

The activities consist in exploiting an open-pit mine in which drilling and blasting operations will be carried out. The objective is to begin producing the spodumene concentrate in 2015. The excavation of the open pit will be progressive, extending from 2015 to 2035. The operating period of the mine is estimated to last 19 years. The working periods will be 24 hours a day, 350 days a year. When the operations of the mine begin, 125 persons will be present on the site.

4.9.3 Closure

The closure activities will consist in restoring the site to conditions that are acceptable for the safety of the users of the land, and to ensure a minimum of maintenance work during the transitional activities preceding the return of ownership of the land to the Crown. The closure activities will be carried out in conformity with the Mining Act and its applicable regulations. The activities of the closure phase will consist mainly in:

- Dismantling and demolishing the permanent infrastructures;
- Seeding the waste rock and tailings pile;
- Backfilling the ditches;
- Reclaiming the sedimentation basins;

- Reclaiming the roads;
- Flooding and securing the open pit;
- Building a spillway to control the open pit waters.

Before undertaking the construction work, the site restoration plan will be submitted to the ministère des Ressources naturelles (MRN). This plan will specify, among others, the restoration stages, the schedule, and the cost of the work. The restoration plan will also be presented to the Cree community of Nemaska, and it is expected that the community will take part in the mine closure activities.

Table 4-13 summarizes the main steps in the development of the Whabouchi project, from the construction to the closure phase.

Table 4-13 Timetable for the Project Main Phases

Project Phase (Year)																						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Construction																						
	Operations																					
						Restoration of the waste rock and tailings pile																
																					Closure	
2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036

4.10 Project Cost

The capital investment required for the construction of the infrastructures used to produce the spodumene concentrate is $159.2M (Met-Chem, 2012). A breakdown of this investment is presented in Table 4-14.

Table 4-14 Breakdown of Project Capital Costs (Million Dollars) (Source: Met-Chem, 2012)

Infrastructure	Estimated capital cost ($M)
Off-site infrastructures	0.9
On-site infrastructures	2.3
Administration and services	3.8
Mine	10.8
Crusher	10.1
Concentrator	79.0
Water and tailings management	3.8
Direct costs	**Estimated capital cost ($M)**
Project management and development	4.7
Pre-production development	1.7
Mining equipment	1.8
Power line – Hydro-Québec	0.9
Employee housing and off-site air transport	2.5
Indirect costs	**Estimated capital cost ($M)**
Engineering	9.4
Temporary construction infrastructures	9.1
Pre-operational costs	4.3
Contingencies	14.1
Total	**159.2**

4.11 References

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NEMASKA LITHIUM

CHAPTER 5

IMPACT ASSESSMENT METHODOLOGY

Environmental and Social Impact Assessment

March 28, 2013

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5. IMPACT ASSESSMENT METHODOLOGY

5.1 Introduction

The environmental and social impact assessment process is based on:

- The participation of the Cree community of Nemaska and the identification of its concerns;
- The directive issued by the MDDEFP on February 2nd, 2012;
- The environmental impact assessment guidelines issued by the Canadian Environmental Assessment Agency (CEAA) on March 18th, 2013;
- The actual applicable laws and regulations;
- The environmental and social concerns identified in similar previous projects;
- The technical and scientific knowledge of the members of the ESIA team.

5.2 Project Components and Activities

The project description in Chapter 4 draws an exhaustive picture of the various components and the planned activities of the Whabouchi project. On the basis of this information, the sources of impacts are identified according to the mine's construction, operation and closure phases. The sources of impact are those elements or activities that could harm one or several components of the physical, biological or human environments.

To summarize, the main mining installations and related infrastructures are the following:

- A mine pit;
- A waste rock and tailings pile;
- An overburden pile;
- A process plant;
- Four sedimentation basins;
- An explosives storage area;
- A fuel storage;
- A garage for the maintenance of machinery;
- Service roads over the mine site.

The activities of the Whabouchi project will occur in three phases: construction, operation and closure. The construction phase, including the preparation and development activities, will last approximately 18 months (from March 2014 to September 2015). The expected duration of the operation phase is 19 years (from 2015 to 2024). As for the closure phase, it will cover approximately 2 years (from 2034 to 2036).

The main activities of the Whabouchi project, which correspond to the sources of impacts, are the following:

Construction Phase

- Site clearing and preparation (excavation, stripping, backfilling, blasting and overburden management).
- Construction of the temporary and permanent infrastructures and facilities.
- Water management (runoff, drinking water, wastewater, etc.).
- Management of wastes, hazardous materials and fuel.
- Operation, maintenance and circulation of heavy machinery and vehicles.
- Presence of workers and purchasing of goods and services.

Operation Phase

- Site clearing and preparation (excavation, stripping, backfilling, blasting and overburden management).
- Presence and operation of the infrastructures and buildings.
- Extraction, storage and ore processing.
- Water management (runoff, drinking water, wastewater, etc.).
- Management of wastes, hazardous materials and fuel.
- Operation, maintenance and circulation of heavy machinery and vehicles.
- Presence of workers and purchasing of goods and services.
- Gradual rehabilitation of the tailings and waste rock pile.

Closure Phase

- Water management (runoff, pit flooding).
- Management of wastes, hazardous materials and fuel.
- Operation, maintenance and circulation of heavy machinery and vehicles.
- Site rehabilitation.
- Dismantling of the infrastructures and installations.
- Presence of workers and purchasing of goods and services.
- Presence of remnants on the site.

5.3 Study Area

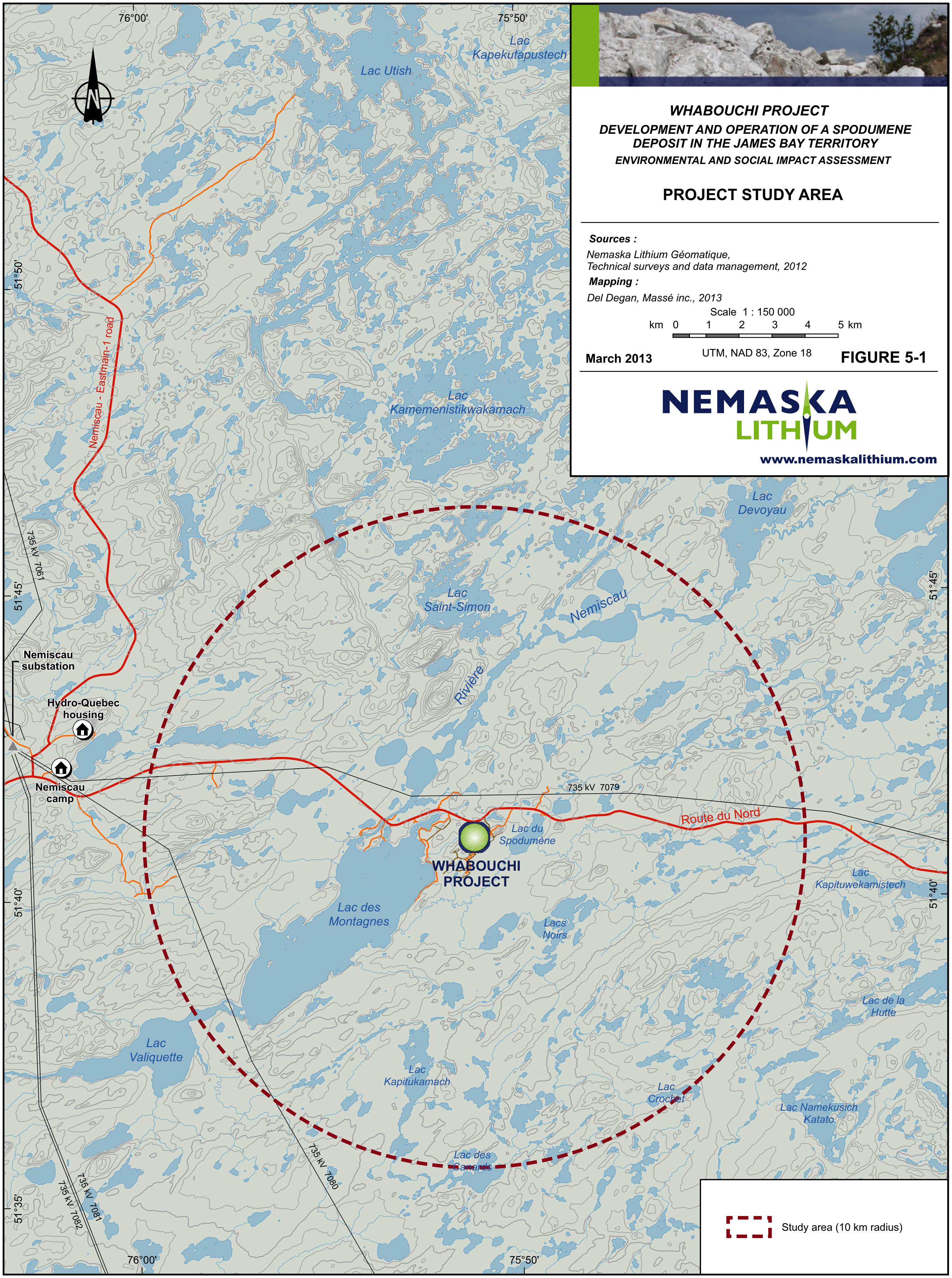
The study area selected to describe the environment that would receive the Whabouchi project and to evaluate the impacts of this project is shown on Figure 5-1. This study area is centered on the site of the future mine. It covers an area of approximately 314 km^2. This study area was circumscribed so as to include all of the physical, biological and human components susceptible of being affected by the project.

However, for certain components, the limits of the study area were modified in order to evaluate adequately the impacts of the project. Where applicable, these boundary modifications are specified in the appropriate component sections.

5.4 Methodological Approach

The main phases of the assessment of impacts on the environmental and social components are the following:

- Selection of the environmental and social components;
- Identification of the sources of impacts;
- Description of the impacts on the component;
- Identification of measures to mitigate the negative impacts and multiply the positive impacts;
- Assessment of the residual impacts (i.e. the significance of the impact);
- Selection of compensation measures (if necessary);
- Assessment of cumulative effects.



WHABOUCHI PROJECT
DEVELOPMENT AND OPERATION OF A SPODUMENE DEPOSIT IN THE JAMES BAY TERRITORY
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
PROJECT STUDY AREA
Sources :
Nemaska Lithium Géomatique, Technical surveys and data management, 2012
Mapping :
Del Degan, Massé inc., 2013
Scale 1 : 150 000
km 0 1 2 3 4 5 km
UTM, NAD 83, Zone 18
March 2013
FIGURE 5-1
NEMASKA LITHIUM
www.nemaskalithium.com
76°00'
75°50'
51°50'
51°45'
51°40'
51°35'
Lac Kapekutapustech
Lac Utish
Lac Kamemenistikwakamach
Nemiscau - Eastmain-1 road
Lac Devoyau
735 kV 7061
Lac Saint-Simon
Nemiscau
Rivière
Nemiscau substation
Hydro-Quebec housing
Nemiscau camp
735 kV 7079
Route du Nord
Lac du Spodumène
WHABOUCHI PROJECT
Lac Kapituwekamistech
Lac des Montagnes
Lacs Noirs
Lac de la Hutte
Lac Valiquette
Lac Kapitukamach
Lac Crochet
Lac Namekusich Katato
Lac des Canards
735 kV 7080
735 kV 7081
735 kV 7082
Study area (10 km radius)

5.4.1 Selection of the Environmental and Social Components

A description of the various components of the physical, biological and human environments susceptible of being affected by the project sheds light on the present environmental conditions, before the development of that project. A total of 23 environmental and social components were retained to comply with the requirements of the COMEV and CEAA concerning the environmental assessment. These environmental and social components, described in detail in chapters 6 (Physical Environment), 7 (Biological Environment,) and 8 (Human Environment), and listed in the impact matrix, are the following:

- Physical environment:
  - Air quality
  - Noise levels
  - Ambient light levels
  - Soil and surface deposits
  - Hydrogeology and groundwater quality
  - Hydrology
  - Quality of surface water and sediments
- Biological environment:
  - Land vegetation
  - Wetlands
  - Ichtyofauna and fish habitats
  - Herpetofauna
  - Large wildlife
  - Small wildlife
  - Chiroptera
  - Micromammals
  - Avifauna
- Human environment:
  - Land and resources use
  - Jobs and economy
  - Community welfare
  - Cultural and archaeological heritage
  - Landscape
  - Community infrastructure

5.4.2 Identification of the Impact Sources

The identification of impact sources is an important step in the assessment process. The sources of impact correspond to the various project activities susceptible of affecting directly or indirectly one or more components. More specifically, the identification of impact sources is based mainly on the technical characteristics of the planned infrastructures, the expected work methods, the planned activities and their scheduling.

Sources of potential impacts considered in the context of the construction, operation and closure phases of the Whabouchi project were described earlier in Section 5-2. They are also presented in the impact (see Table 5-1).

5.4.2.1 Relationship between the Impact Sources and the Environmental and Social Components

After selecting the environmental and social components and identifying the impact sources, an impact matrix is drawn up. This task consists in identifying, for all project phases, which components of the physical, biological and human environments will be affected, and by which impact source. Thus, when an "X" appears in a matrix cell, it means that an impact is apprehended.

The relationships between the impact sources and the components were established by the specialists in the multidisciplinary team in charge of the ESIA. As required by the COMEV and CEAA directives, the Table 5-1 presents the relationships between the components of the physical, biological and human environments, as well as the sources of impacts for the phases of the Whabouchi project.

Table 5-1 Impact Matrix

Project Phases			Physical Environment							Biological Environment									Human Environment					
			Air Quality	Noise Level	Ambient Light Level	Soil and Surface Deposits	Hydrogeology and Ground Water Quality	Hydrology	Quality of Surface Water and Sediments	Land Vegetation	Wetlands	Fish and Fish Habitat	Herpetofauna	Large Animals	Small Animals	Chiroptera	Micro mammals	Birds	Land and Resource Uses	Employment and Economy	Community Welfare	Cultural and Archaeological Heritage	Landscape	Infrastructures
Project Phases	Construction	Clearing and preparation of the sites (excavation, stripping, backfilling, blasting and overburden management)	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	
		Construction of the temporary and permanent infrastructures and facilities		X	X	X		X		X			X	X	X	X	X	X	X	X			X	
		Water management (runoff, drinking water, wastewater, etc.)					X	X	X	X	X	X	X						X					
		Management of wastes, hazardous materials and fuel				X	X		X	X	X	X	X						X					
		Use, maintenance and circulation of heavy machinery and vehicles	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X					
		Presence of workers and purchasing of goods and services		X								X		X	X			X	X	X	X			X
	Operation	Clearing and preparation of the sites (excavation, stripping, backfilling, blasting and overburden management)	X	X		X	X	X	X	X	X	X		X	X	X	X	X	X	X		X	X	
		Presence and operation of the infrastructures and buildings		X	X	X	X			X	X	X	X	X	X	X	X	X	X				X	
		Extraction, storage and processing of the ore	X	X		X	X	X	X						X	X			X			X	X	
		Water management (runoff, drinking water, wastewater, etc.)					X	X	X	X	X	X	X					X	X					
		Management of wastes, hazardous materials and fuel				X	X		X	X	X	X	X						X					
		Use, maintenance and circulation of heavy machinery and vehicles	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X					
		Presence of workers and purchasing of goods and services		X								X		X	X			X	X	X	X			X
		Gradual rehabilitation of the tailings and waste rock pile	X				X			X				X	X		X	X					X	
	Closure	Water management (runoff, pit flooding)					X	X	X			X	X						X					
		Management of wastes, hazardous materials and fuel				X	X		X	X	X	X	X											
		Use, maintenance and circulation of heavy machinery and vehicles		X	X	X	X		X		X	X	X	X	X	X	X	X						
		Site rehabilitation	X			X	X	X	X	X	X		X	X	X	X	X	X	X				X	
		Dismantling of the infrastructures and installations	X	X		X					X		X	X	X	X				X			X	
		Presence of workers and purchasing of goods and services	X	X								X		X	X	X		X	X	X	X			X
		Presence of remnants on the site					X														X		X	

5.4.3 Description of the Impacts

Once the impact matrix is completed, the impacts on the environmental and social components are described. In this description, the direct and indirect effects of the different project activities are considered for each of the project phases (construction, operation and closure). For example, a change in the noise level (direct impact) can result in a change in the use of the territory by large animals (indirect impact). This description of the impacts is quantitative; for example a loss of 0.7 ha of land vegetation.

A detailed description of each impact is given in the corresponding chapter (chapters 6, 7 and 8).

5.4.4 Selection of Mitigation or Valorization Measures

After describing the impacts on the various components, mitigation or valorization measures are proposed. The mitigation measures are intended to reduce the apprehended negative impacts, while the valorization measures increase the effect of possible positive impacts.

5.4.5 Assessment of the Residual Impact

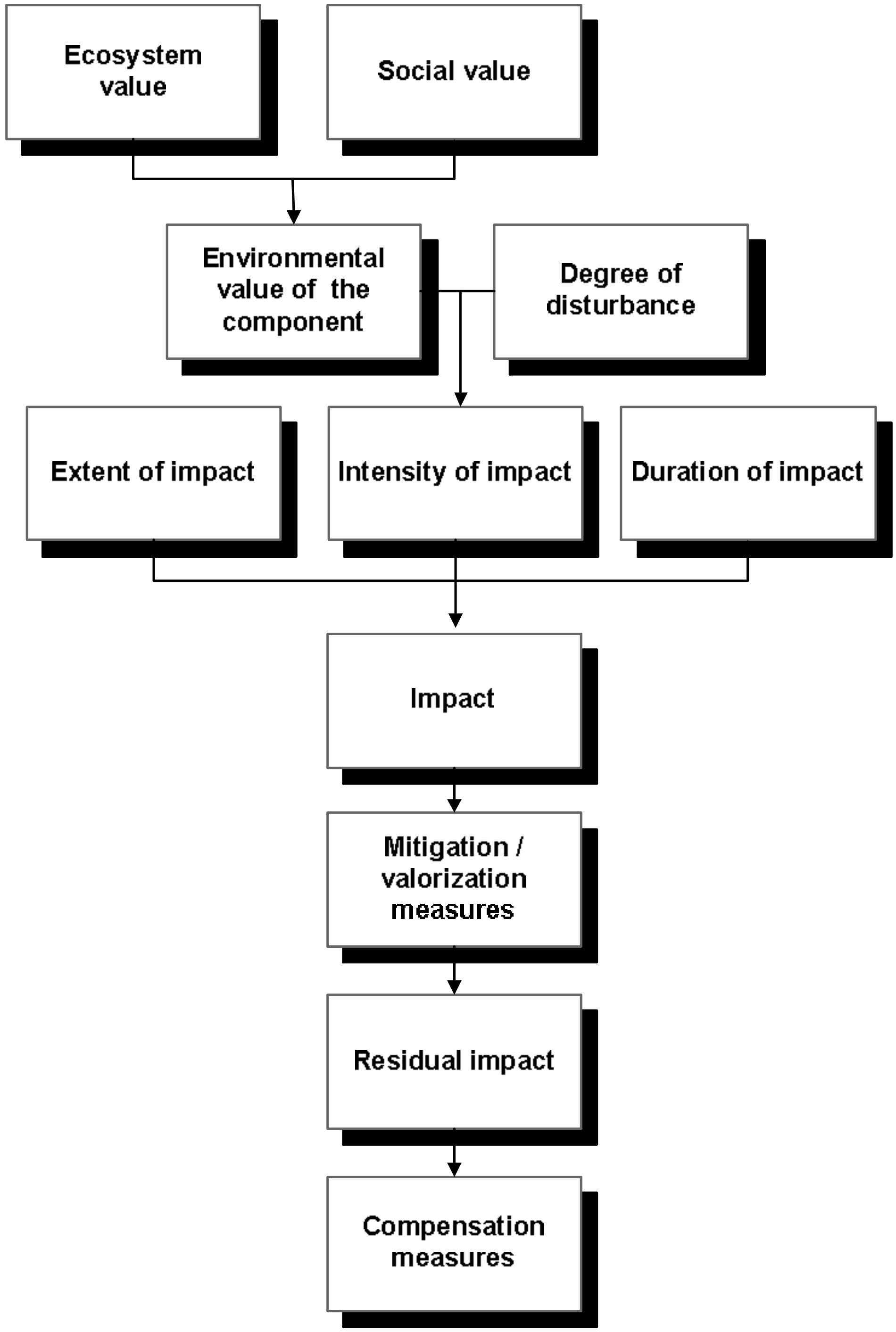
This section describes the process used to assess the residual impact. The evaluation of the residual impact is based on three indicators: extent, intensity and duration. The procedure is illustrated in Figure 5-2.

Three indicators are used to determine the importance of the residual impact. These three main indicators are the intensity, the extent and duration of the residual impact. In addition to these three indicators, the nature of the impact is also a factor. The nature of the impact can be positive, in the case of a desired effect (improvement and/or valorization of the component), or negative in the case of an undesired effect (deterioration of the component).

5.4.5.1 Intensity of the Impact

The intensity of an impact refers to the relative importance of the consequences (negative or positive) on the given component resulting from a modification/alteration of the environment. The evaluation of the intensity of the impact is based on the degree of disturbance of the component and the value of that component.

Figure 5-2 Evaluating the Importance of Impacts



More specifically, the degree of disturbance refers to the change that a project activity would cause, for example, on the structure or function of a component. The degree of disturbance is qualified as low, moderate or high.

Low: The impact modifies only slightly the quality, use or integrity of the component in the study area;

Moderate: The impact causes a detectable change in the component's quality or its use in the study area, without compromising its integrity;

High: The impact modifies the component's integrity or significantly modifies the quality of the component or its use in the study area.

The value of the component combines its ecosystem value and its social value. Thus, several factors can interact to define the value of a component. They can be its function within the ecosystem, its scarcity, its uniqueness, its protection status under a law, regulation or governmental decision, its valorization by the community concerned by the project, or a combination of any such factors.

The ecosystem value of the component can be:

Low: The component presents little interest in the ecosystem and its protection and conservation is not a subject of concern;

Moderate: The component has some significance in the ecosystem and its recognized attributes, including protection and conservation, are subjects of concern without finding consensus;

High: The component plays a major role in the ecosystem or is highly significant in terms of biodiversity and exceptional qualities. There is a consensus in the scientific community about the need for its protection.

The social value of the component can be:

Low: The component has little or no value or is not valued or used by the local population;

Moderate: The component is valued or used by a significant portion of the affected population, though it is not legally protected;

High: The component is subject to legal or regulatory protection measures or is essential to human activities.

Table 5-2 illustrates the process used to assign a value to a given component.

Table 5-2 Component Value Determination Matrix

Social Value	Ecosystem Value		
	High	Moderate	Low
High	High	High	Moderate
Moderate	High	Moderate	Low
Low	Moderate	Low	Low

Table 5-3 illustrates the process used to determine the intensity of the impact. The intensity of the impact can be low, moderate or high.

Low: The project slightly affects the component and has little impact on its quality, its general distribution or its use by the population;

Moderate: The impact alters the component by changing its quality, abundance, distribution or use by the population, without compromising its integrity;

High: The impact compromises or alters the integrity of the component, or strongly and irreversibly modifies the component or its use by the population.

Table 5-3 Impact Intensity Determination Matrix

Degree of disturbance	Value of the component		
	High	Moderate	Low
High	High	High	Moderate
Moderate	High	Moderate	Low
Low	Moderate	Low	Low

5.4.5.2 Extent of the Impact

The geographic extent of the impact refers to the surface area of the territory that is affected or to the proportion of the population that is concerned. The extent of the impact can be limited, local or regional.

Limited: The impact is limited to a confined area (e.g. the location of the pit) or affects a small proportion of the population in the study area;

Local: The impact is felt over an area that is larger than the project footprint or by a limited portion of the population in the study area;

Regional: The impact affects the entire study area or a majority of the population in the study area. The impact may also be felt beyond the study area.

5.4.5.3 Duration of the Impact

The duration of the impact refers to the period of time during which the activity is felt by the component. The duration of the impact can be short, medium or long.

Short: The impact is felt continuously or discontinuously over a limited period during the construction or closure phases of the mine project;

Medium: The impact is felt continuously or discontinuously over the entire duration of the project (from construction to closure), during the operation phase, or during the construction and closure phases;

Long: The impact is felt continuously or discontinuously beyond the closure of the mine.

5.4.6 Evaluating the Importance of the Impact

The importance of the impact refers to the changes caused by the project in a component of the environment. The importance of the impact is determined by the integration of the three indicators described above, i.e. intensity, extent and duration. The three indicators have the same weight in the evaluation of the importance of an impact.

The impact importance determination matrix of Table 5-4 presents the three degrees of importance that can be assigned, i.e. low, moderate and high.

5.4.7 Compensation Measures

Compensation measures are proposed, unless a residual impact cannot be avoided or attenuated by mitigation measures.

In addition to the three criteria described above (intensity, extent and duration), the assessment of impacts may consider other factors. These include the frequency and reversibility of the impact. The frequency of an impact refers to the number of instances where it is observed or perceived over the course of the project. Thus, the impact may procure only once, intermittently or continuously. For example, the noise caused by the circulation of vehicles and machinery can be of continuous frequency, since this impact on the noise levels will be felt repeatedly over the entire life of the project. On the other hand, the reversibility of an impact refers to the possibility of a return to the original conditions prevailing before the project. For example, at the end of mining operations, it is anticipated that the noise levels will return to what they were before the activities of the mine (reversible impact).

5.4.8 Cumulative Effects

As required by the COMEV and CEAA directives, an assessment of the cumulative effects of the Whabouchi project was completed. Cumulative effects refer to the changes resulting from the project when coupled to the existence of other past, current and reasonably foreseeable projects, activities and/or events. The methodology used to evaluate the curative effects is presented in Chapter 9.

Table 5-4 Impact Importance Determination Matrix

Intensity	Extent	Duration	Importance of the Impact
High	Regional	Long	High
		Medium	High
		Short	Moderate
	Local	Long	High
		Medium	High
		Short	Moderate
	Limited	Long	Moderate
		Medium	Moderate
		Short	Low
Moderate	Regional	Long	High
		Medium	High
		Short	Moderate
	Local	Long	High
		Medium	Moderate
		Short	Moderate
	Limited	Long	Moderate
		Medium	Moderate
		Short	Low
Low	Regional	Long	Moderate
		Medium	Moderate
		Short	Low
	Local	Long	Moderate
		Medium	Moderate
		Short	Low
	Limited	Long	Low
		Medium	Low
		Short	Low

CHAPTER 6
PHYSICAL ENVIRONMENT

Environmental and Social Impact Assessment

March 28, 2013

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6. DESCRIPTION OF THE PHYSICAL ENVIRONMENT AND IMPACTS ANALYSIS

6.1 General Context Description

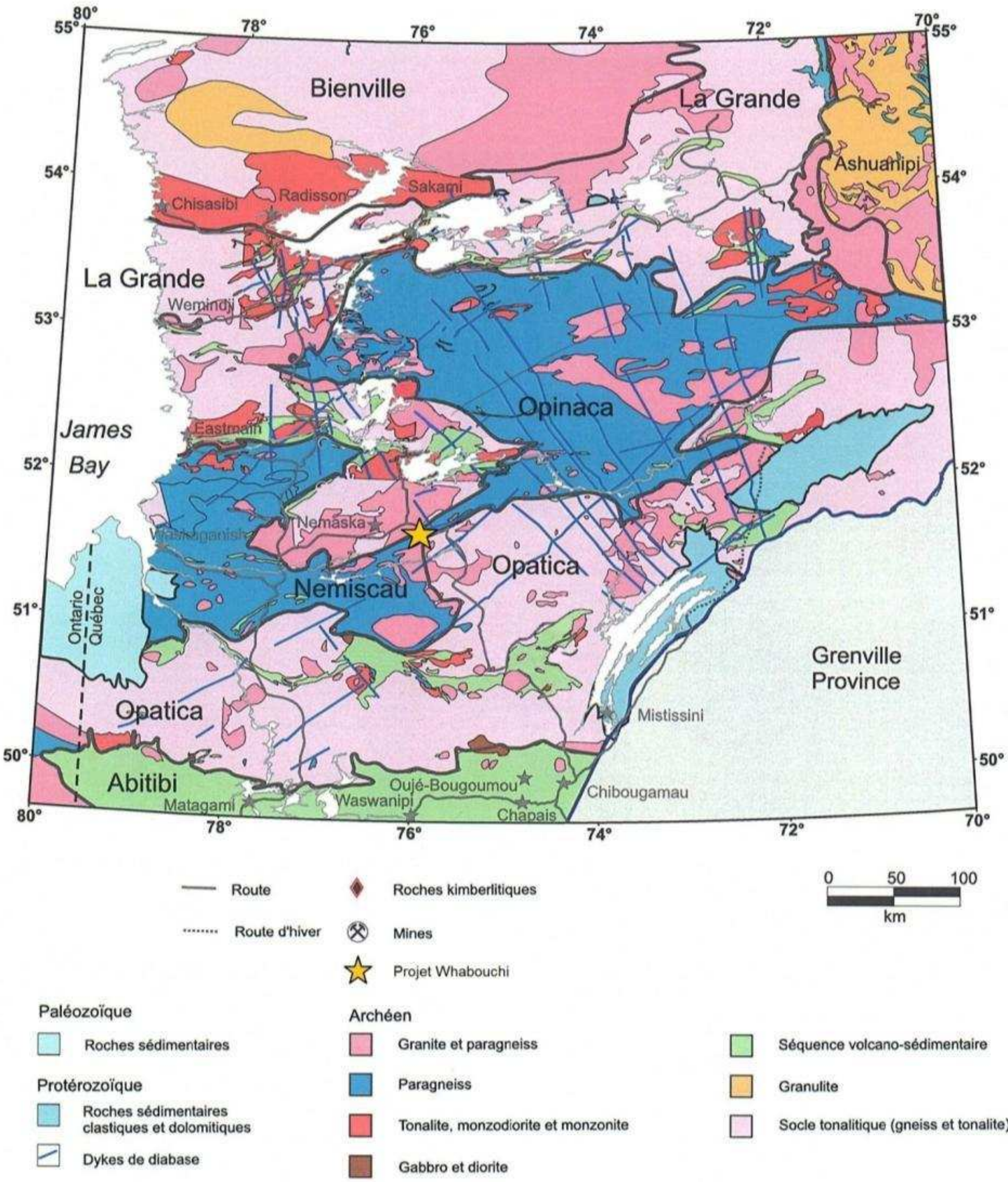
6.1.1 Geology

The project site is located in the Canadian Shield, in the northeastern part of the Superior province, one of the seven geologic provinces that form the Canadian Shield. Covering some 90% of the territory of Quebec, the shield is one of the most ancient geologic formations and is composed mainly of igneous and metamorphic rocks. The Superior geologic province is one of the most important mining regions in Quebec. It hosts, among others, copper, zinc, gold, iron and silver deposits.

The Superior province, which extends from Manitoba to Quebec, is mainly composed of Archean rocks (2.5 to 4 billion years). In Quebec, the eastern part of the Superior province is divided in several sub-provinces; from south to north they are: Pontiac, Abitibi, Opatica, Nemiscau, Opinaca, La Grande, Ashuanipi, Bienville and Minto (Hocq, 1994). The mine site is located in the Nemiscau sub-province. Figure 6-1 shows the location of the Whabouchi project in the Superior province and its subdivisions.

Locally, the Whabouchi project deposit is in the Lac des Montagnes formation, between the Lake Champion granitoids and orthogneiss and the undifferentiated granitoids of the NE Opatica. This area was the target of many geological mapping campaigns led by the MRN in the 1960s and 1970s (Valiquette, 1975). This volcano-sedimentary formation, approximately 7 km wide in the area of the mine site, is a sequence of meta-sediments (quartz-rich paragneiss, biotite-schist, sillimanite and staurotide, and garnet schist) and amphibolite (metavolcanic to ultramafic). These rocks are highly sheared and cut by late granitoids (leucogranite and biotite-bearing pegmatite). Table 6-1 presents the different geologic formations in the region of the mine site.

Figure 6-1 Regional Geology (from Perreault and coll., 2006)



WHABOUCHI PROJECT

DEVELOPMENT AND OPERATION OF A SPODUMENE DEPOSIT IN THE JAMES BAY TERRITORY

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

LOCAL GEOLOGY

Lithologies

- Spodumene bearing pegmatite
- Pegmatite
- Metabasalte
- Amphibolite
- Gneiss
- Ultramafic ROCK
- Granitoid
- Diabase
- Quartz rich metasediment
- Metasediment
- Breccia

Existing infrastructures

- Main road
- Access road
- Power line

Topography

- Lake
- Stream
- Contour (equidistance : 15 m)

Project

- Projected infrastructure

Sources :
Nemaska Lithium Géomatique, Technical surveys and data management, 2012

Mapping :
Del Degan, Massé inc., 2013

Scale 1 : 25 000

m 0 250 500 750 1 000 m

UTM, NAD 83, Zone 18

March 2013

FIGURE 6-2

NEMASKA LITHIUM

www.nemaskalithium.com

Table 6-1 Geologic Formations in the Region of the Whabouchi Project (from Valiquette, 1975)

Geological Period	Geological Formation
Pleistocene and Holocene	Moraines, eskers, alluvial deposits, string bogs, morainic ridges.
Proterozoic	Diabase.
Archean	Pegmatites: - white with muscovite, tourmaline, garnet and magnetite; - pink with microcline.
	Pink and white granite.
	Gray granite with oligoclase and hornblende, marked in several locations with phenocrysts of pink microcline.
	Ultramafic rocks (serpentinite, tremolite rocks).
	Hornblende-plagioclase gneiss.
	Metasomatic anthophyllite-cordierite rocks.
	Paragneiss or biotite schists; garnet-biotite schists; Porphyroblastic schists : - garnet, sillimanite, biotite; - garnet, cordierite, biotite; - garnet, andalousite, biotite; - staurotide, sillimanite, andalousite, biotite; - sillimanite, cordierite, andalousite, biotite; - amphibole paragneiss.
	Quartz-rich metasediments, quartz schist; sericite and sillimanite; impure quartzite
	Pillowed metavolcanic amphibolites
	Oligoclase gneiss

The local geology in the vicinity of the Whabouchi project is presented in Figure 6-2. This interpretation is drawn from previous geological work, combined with the geological mapping completed by Nemaska Lithium on the Whabouchi property. As mentioned earlier, the Whabouchi deposit is hosted by the Lac des Montagnes volcano-sedimentary formation. This formation is bordered by granitoids to the north and by meta-sediments to the south. The regional metamorphism is amphibolite facies, retrograded to greenschist facies. Several units also present different types of alteration, such as sericitization and silicification. The main orientation of the regional faults is northwest/southeast. The regional diabase dikes also follow this orientation, in association with the faults. The regional foliation is oriented southwest/northeast. These geological structures will have no incidence on the proposed infrastructures. Furthermore, this type of geological formation is not favorable to the presence of paleontologically or paleobotanically significant sites. Finally, no seismic activity or major landslide is reported in the area. The Nemaska region is in a low seismic activity area.

As described in section 4.2, the Whabouchi ore is a spodumene-bearing pegmatite, part of the rare-metal pegmatites group. Its mineralogical composition is mainly spodumene, quartz, feldspar and mica, with local presence of garnet, beryl, apatite and petalite. The pale green spodumene is easily recognizable in the pegmatite, which is white. The deposit is composed of a serie of sub-parallel and sub-vertical dykes. They are hosted in mafic rock units composed of metamorphosed basalt and gabbro which are mainly an assemblage of chlorite, amphibole and feldspar. Some minor layers of silicified meta-sediment, felsic volcanic and felsic intrusion were also described in the core logs. Several other pegmatite units were identified around the Whabouchi deposit, but no spodumene was observed in these from the exploration work. The pegmatites generally represent positive topographic highs due to their superior competence and higher resistance to erosion.

6.1.2 Geomorphology and Topography

The mine site is in the central portion of the James Bay Highlands, characterized by a strongly dissected topography composed of rocky hills separated by depressions of a few hundred meters to several kilometers in width (Hardy, 1976). The summits correspond to a general plane that rises toward the east, its altitude gradually increasing from 300 m to 400 m, then to more than 500 m east of the project site. The valleys, topographic lows and hill slopes are covered by deposits left by glaciers and ice meltwater. On steep slopes and hill summits the bedrock outcrops and is covered only by thin till veneers (<1 m). The bedrock also locally outcrops over smaller surfaces in the lower areas.

In the mine site area, the altitude varies between a minimum of approximately 270 m (Lac des Montagnes, and a maximum of 440 m (Mount Chinuchi). Rocky hills generally striking northeast/southwest rise between a few tens of metres to 100-120 m above the surface which is generally rolling gently at an altitude of approximately 300 m. On the mine property, the amplitude of the relief is slighter with maximum differences of 50 m to 75 m observed between the Lac des Montagnes shore and the rocky crest summits.

The unconsolidated deposits found in the area of the mine site were laid by the Laurentian Inlandsis and by meltwater during the ice retreat toward the end of the last Quaternary ice age (Wisconsinian) between 8000 and 7000 years ago (Occhietti and coll., 2004). The regional lobe of the Laurentian Inlandsis, the New Quebec glacier, retreated from the eastern James Bay from east to west (toward the center of Quebec). It left in the region a till layer of varying thickness that rests directly on the bedrock. Where sufficiently thick, the till was locally profiled into crests (drumlins and related forms) that extend in the direction of ice flow (northeast/southwest).

West of the mine site, up to the longitude of the Nemiscau substation (Long. 76° W), the glacier retreated at the contact with the Ojibway glacial lake, as the ice distribution further north obstructed the natural flow of meltwater in this direction (Hardy, 1982a). The glaciolacustrine episode ended approximately 8000 years ago, when Lake Ojibway suddenly drained to be replaced by saltwater from the Atlantic Ocean (Vincent, 1989). The saltwater flowed into lands that had subsided under the weight of the ice up to altitudes of 250 m to 290 m, forming the Tyrrell Sea that has reached eastward the front of the retreating glacier (Hardy, 1982a; Vincent, 1989).

The catastrophic events represented by the drainage of Lake Ojibway and the subsequent invasion of the Tyrrell Sea correspond to a relatively long pause in the glacial retreat (Vincent, 1989). In this context, the Sakami Moraine, a major glacial construction, was formed at the ice and sea contact, as an arc between the Mistassini Lake, to the southeast, and the estuary of the Great Whale River (Hardy, 1982b). The moraine is composed mainly of sand-gravel and sandy sediments. Small segments of the Sakami Moraine are present in the area of the mine site.

Following the formation of the Sakami Moraine, the glacier continued to retreat eastward, in an aerial or subaerial environment, with abundant glacial meltwater (Hardy, 1982b). The meltwaters left eskers and out washes, and locally cut channels in the till. Sandy deposits also accumulated at the bottom of some depressions. Since the lowest points in the mine site area are at the approximate altitude reached by the Tyrrell Sea, it is possible that some of these sediments deposited in shallow seawater.

In the last glacier melting, the rockrubbles contained in the ice accumulated in place as ablation till and, when very abundant, in the form of disintegration till (or moraine), characterized by an irregular relief of highs and lows of metric to decametric amplitude and by the abundance of boulders at the surface.

After melting of ice, the Nemiscau River cut through the fluvioglacial sediments that obstructed its valley until it reached its current course. The streambed slopes formed of till, rock, sand and gravel, and sand are now in equilibrium, with seasonal flow variations, and there is little or no erosion.

Over several millennia, peat accumulated in the flat and poorly drained areas of the land, mainly over sandy sediments, but also in depressions as the surface of the till and bedrock. The major bogs developed in the low-lying areas along the Nemiscau River and Lac des Montagnes. Organic matter has accumulated in thicknesses that could reach 3 m to 4 m.

6.1.3 Climate

The Nemaska region is characterized by a subarctic continental climate with strongly contrasting seasons, short cool summers and long harsh winters. The average daily temperature is -20°C in January and 17°C in July. Spring thaw usually occurs in early June, and the water bodies begin to freeze in early November.

In order to find out more about the climate in the vicinity of the project, three weather stations were selected among the eleven operated in the James Bay territory or its surroundings (Figure 6-3). A list of the 11 stations, their distance from the Whabouchi project, the logging frequency and the origin of the data are presented in Table 6-2. The data were sourced either from the ministère du Développement durable, de l'Environnement, de la Faune et des Parcs (MDDEFP) or from Environment Canada (EC). The number of data available and the distance of the station from the project site are the two criteria used to select stations for the estimation of the site's climatic conditions. Thus, the Chapais-2, La Grande Rivière A and Nemiscau A weather stations were selected because they provided sufficient data for the purpose of the study. Environment Canada compiles the average and extreme temperatures and the precipitation at the Chapais-2 and La Grande Rivière A stations since 1971 (Environnement Canada, 2012). These data were incomplete in the case of the Nemiscau A station, but hourly wind data are available since 1994. Therefore, the Nemiscau A data were used to characterize the origin and intensity of the wind.

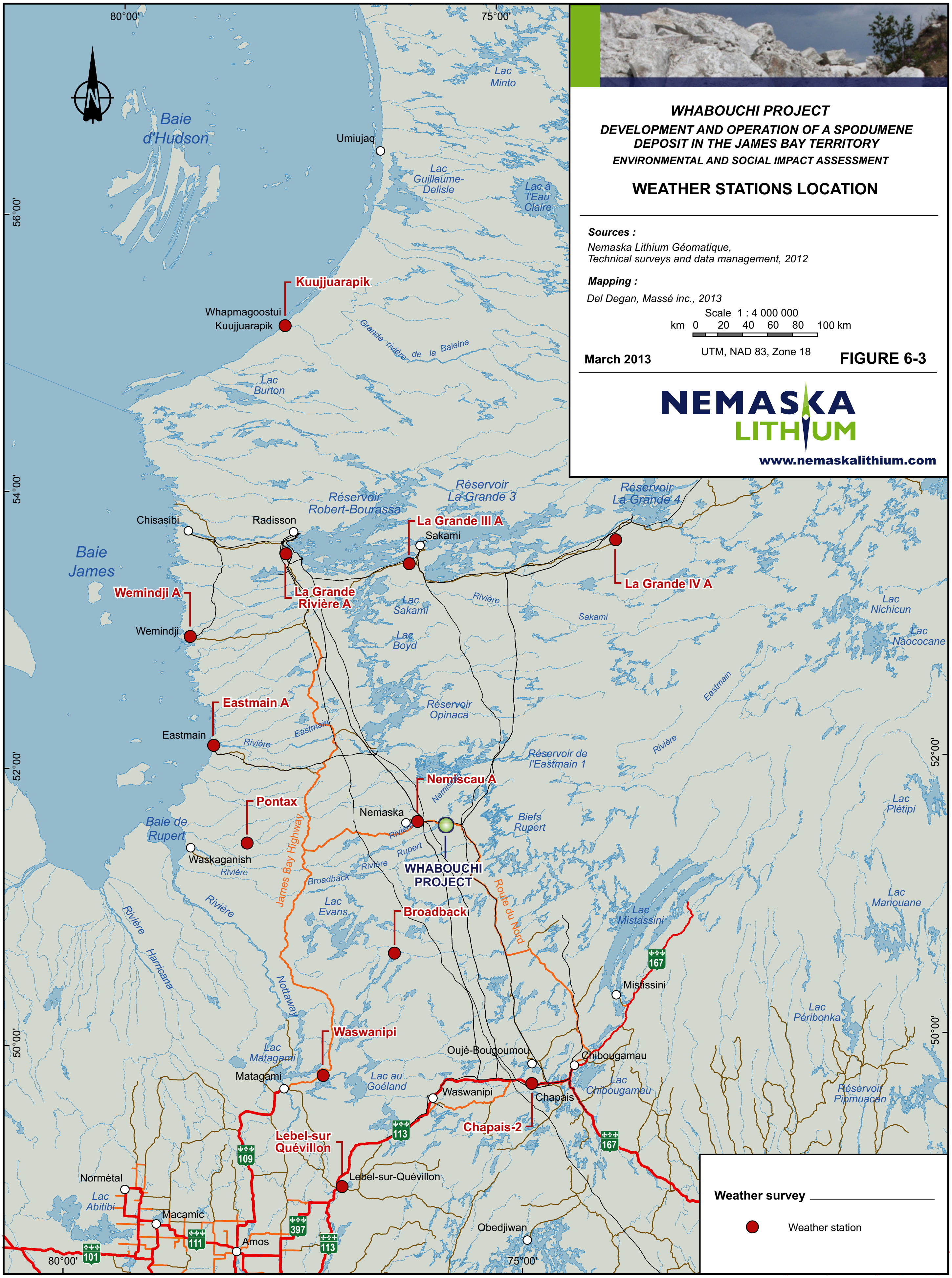

WHABOUCHI PROJECT
DEVELOPMENT AND OPERATION OF A SPODUMENE DEPOSIT IN THE JAMES BAY TERRITORY
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
WEATHER STATIONS LOCATION
Sources :
Nemaska Lithium Géomatique,
Technical surveys and data management, 2012
Mapping :
Del Degan, Massé inc., 2013
Scale 1 : 4 000 000
km 0 20 40 60 80 100 km
UTM, NAD 83, Zone 18
March 2013
FIGURE 6-3
NEMASKA LITHIUM
www.nemaskalithium.com
Weather survey
Weather station
80°00'
75°00'
56°00'
54°00'
52°00'
50°00'
Baie d'Hudson
Baie James
Baie de Rupert
Lac Minto
Umiujaq
Lac Guillaume-Delisle
Lac à l'Eau Claire
Kuujjuarapik
Whapmagoostui
Kuujjuarapik
Grande rivière de la Baleine
Lac Burton
Réservoir Robert-Bourassa
Réservoir La Grande 3
Réservoir La Grande 4
Chisasibi
Radisson
La Grande III A
Sakami
La Grande IV A
La Grande Rivière A
Wemindji A
Wemindji
Lac Sakami
Rivière Sakami
Lac Boyd
Lac Nichicun
Lac Naococane
Eastmain A
Eastmain
Rivière Eastmain
Réservoir Opinaca
Réservoir de l'Eastmain 1
Nemiscau A
Nemaska
Pontax
Waskaganish
Biefs Rupert
Rivière Rupert
WHABOUCHI PROJECT
James Bay Highway
Route du Nord
Rivière Broadback
Lac Evans
Broadback
Rivière Harricana
Rivière Nottaway
Lac Plétipi
Lac Mistassini
Lac Manouane
Mistissini
Lac Péribonka
Waswanipi
Lac Matagami
Matagami
Lac au Goéland
Oujé-Bougoumou
Chibougamau
Lac Chibougamau
Chapais
Chapais-2
Réservoir Pipmuacan
Lebel-sur-Quévillon
Normétal
Lac Abitibi
Macamic
Amos
Obedjiwan
101
109
111
113
167
397

Table 6-2 List of Weather Stations within 300 km of the Mine Site

Weather Station	Distance from the Mine Site (km)	Logging Frequency	Available Data	Source [1]
Broadback	106	Hourly from 1970 to 2012	Temperature	MDDEFP
Chapais-2	229	Daily from 1962 to 2004	Maximum, minimum and average temperature Warming and cooling degree-days Rain, snow and total precipitation Snow on the ground	EC
Eastmain A	174	Hourly from 1992 to 2012	Temperature Dew point Relative humidity Wind direction and speed Visibility Atmospheric pressure Wind chill	EC
La Grande Rivière A	241	Hourly from 1976 to 2012	Temperature Dew point Relative humidity Wind direction and speed Visibility Atmospheric pressure Wind chill	EC
La Grande III A	209	Hourly from 1994 to 2012	Temperature Dew point Relative humidity Wind direction and speed Visibility Atmospheric pressure Wind chill	EC
La Grande IV A	285	Hourly from 1985 to 2012	Temperature Dew point Relative humidity Wind direction and speed Visibility Atmospheric pressure Wind chill	EC

Weather Station	Distance from the Mine Site (km)	Logging Frequency	Available Data	Source [1]
Lebel-sur-Quévillon	299	Twice daily from 1966 to 2012	Temperature Precipitation Wind Various phenomena Snow on the ground	MDDEFP
Nemiscau A	21	Hourly from 1994 to 2012	Temperature Dew point Relative humidity Wind direction and speed Visibility Atmospheric pressure Wind chill	EC
Pontax	137	Hourly from 1975 to 2012	Temperature	MDDEFP
Waswanipi	219	Hourly from 1966 to 2012	Temperature	MDDEFP
Wemindji A	236	Hourly from 1992 to 2012	Temperature Dew point Relative humidity Wind direction and speed Visibility Atmospheric pressure Wind chill	EC

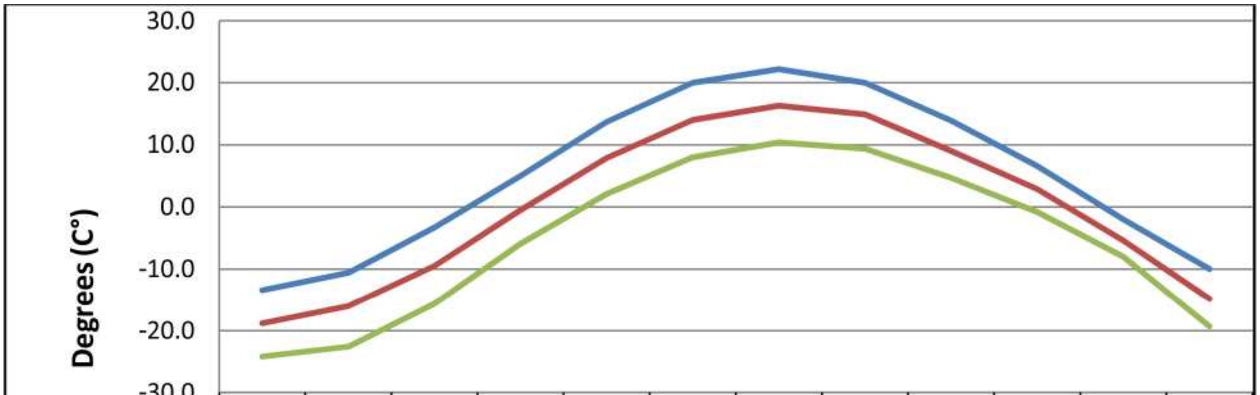
[1] MDDEFP: Ministère du Développement durable, de l'Environnement, de la Faune et des Parcs
EC: Environment Canada.

6.1.3.1 Temperature

The average and extreme temperatures obtained from the Chapais-2 and La Grande Rivière A stations illustrate the typical climate in the region: cold winters and cool summers (Figure 6-4 and 6-5). The average temperature in January at La Grande A is -23°C, with an extreme low of -41°C (Environnement Canada, 2012). In the summer, even if the extremes can exceed 30°C between May and August, the average temperature is cooler and varies between 4°C and 14°C.

In general, the average annual temperatures recorded at the Chapais-2 weather station are warmer than those at La Grande-Rivière A, located further north.

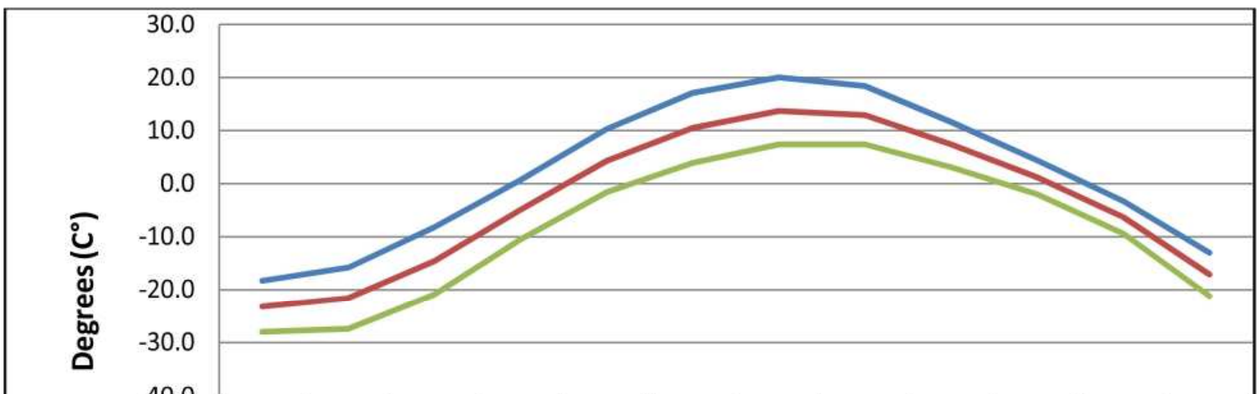
Figure 6-4 Monthly Temperatures (Maximum, Average and Minimum, at the Chapais-2 Weather Station (1971-2000))



	January	February	March	April	May	June	July	August	September	October	November	December
Maximum	-13.4	-10.6	-3.3	5.0	13.7	20.0	22.2	20.0	13.9	6.6	-2.0	-10.0
Average	-18.8	-16.0	-9.5	-0.5	7.9	14.0	16.3	14.9	9.0	2.9	-5.4	-14.8
Minimum	-24.2	-22.6	-15.6	-5.9	2.1	8.0	10.4	9.4	4.7	-0.8	-8.0	-19.3

Source: Environnement Canada, 2012.

Figure 6-5 Monthly Temperatures (Maximum, Average and Minimum, at the La Grande A Weather Station (1971-2000))



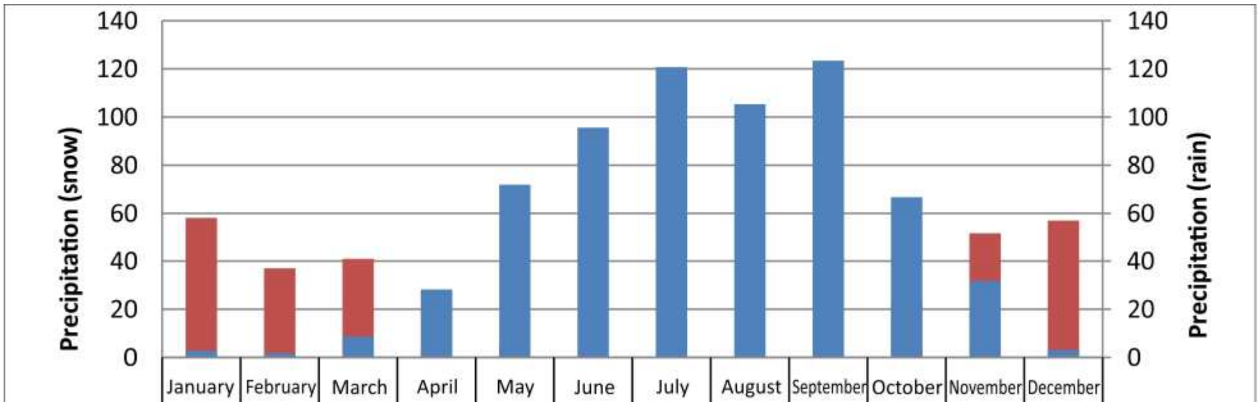
	January	February	March	April	May	June	July	August	September	October	November	December
Maximum	-18.3	-15.8	-8.2	0.7	10.3	17.1	20.0	18.4	11.6	4.4	-3.3	-13.0
Average	-23.2	-21.6	-14.6	-4.9	4.3	10.5	13.7	12.9	7.4	1.2	-6.3	-17.1
Minimum	-28.0	-27.4	-20.9	-10.5	-1.6	3.9	7.4	7.4	3.1	-2.0	-9.4	-21.2

Source: Environnement Canada, 2012.

6.1.3.2 Precipitation

Precipitation of both snow and rain at the Chapais-2 and La Grande A stations are presented in Figure 6-6 and Figure 6-7.

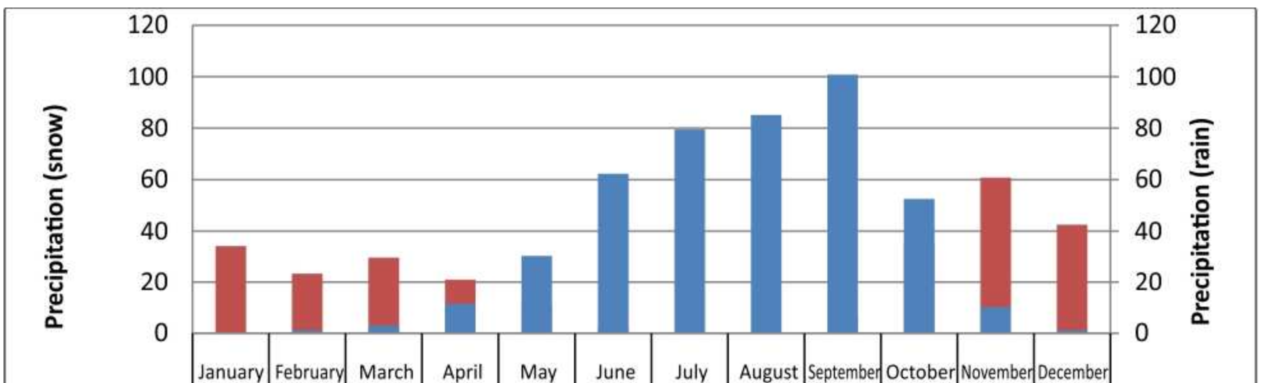
Figure 6-6 Average Monthly Precipitation Recorded at the Chapais-2 Weather Station (1971-2000)



	January	February	March	April	May	June	July	August	September	October	November	December
Snow (cm)	58.1	37.0	40.9	27.2	5.6	0.4	0.0	0.0	1.5	22.4	51.7	57.0
Rain (mm)	2.8	1.7	8.6	28.2	71.9	95.6	120.7	105.3	123.4	66.7	31.7	3.1

Source: Environnement Canada, 2012

Figure 6-7 Average Monthly Precipitation Recorded at the La Grande A Weather Station (1971-2000)



	January	February	March	April	May	June	July	August	September	October	November	December
Snow (cm)	34.2	23.3	29.5	20.9	11.1	2.5	0.0	0.1	6.4	35.5	60.8	42.5
Rain (mm)	0.1	1.2	3.0	11.5	30.2	62.3	79.5	85.1	100.8	52.5	10.2	1.2

Source: Environnement Canada, 2012.

The annual average precipitation data for the site were estimated by comparing values from several sources (WESA, 2012a). An average value of 772 mm was retained for the purposes of the impact assessment.

6.1.3.3 Evapotranspiration

According to information from the Hydrological Atlas of Canada (Ministère de l'Approvisionnement et Services Canada, 1978), the annual evaporation of lakewater at the latitude of the Whabouchi project varies between 300 mm/year and 400 mm/year. The average evaporation in the Nemiscau area would therefore be of the order of 335 mm/year (WESA, 2012b).

6.1.3.4 Wind

The weather data about the speed and origin of the wind are provided by the Nemiscau A weather station. They were compiled for the period between 1994 and 2000.

The data presented in Table 6-3 show that the prevailing winds are from the west (18.4% of observations), northwest (18.9%) and southwest (17.0%), with average speeds between 15 km/h and 18 km/h. The annual average wind speed from all directions is 15 km/h.

Table 6-3 Relative Distribution of Wind Origin and Speed Recorded at the Nemiscau A Weather Station between 1994 and 2000

Origin of the Wind	Relative Frequency	Average Speed (km/h)
Northeast	5.2	14.8
East	8.9	13.8
Southeast	9.2	14.4
South	7.9	14.4
Southwest	17.0	15.1
West	18.4	18.2
Northwest	18.9	18.1
North	5.9	16.6
All directions		**14.8**

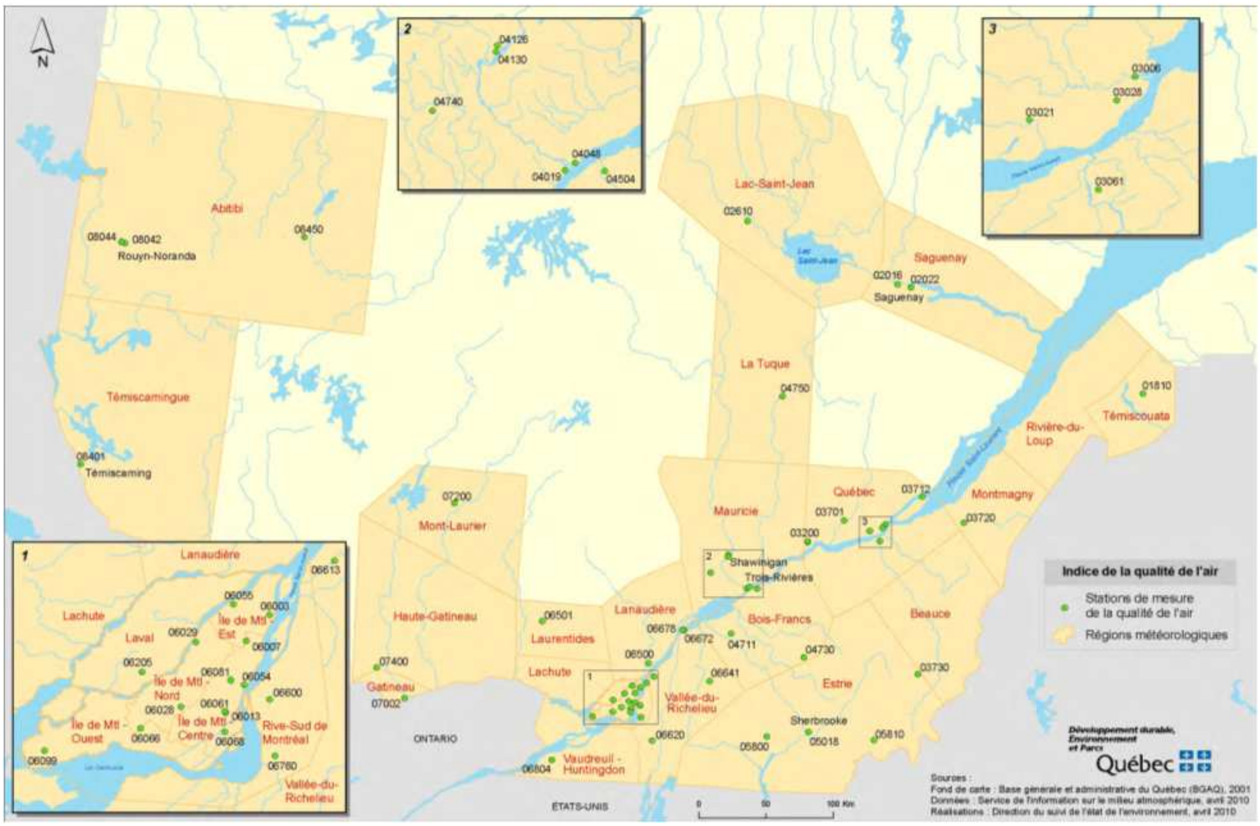
6.2 Air Quality

6.2.1 Description of the Environment

The Whabouchi project site is located near the Route du Nord, in a remote area with relatively little industrial activity. In the vicinity of the project site, the land and its resources are used mainly by the tallyman of trapline R20 and his family for hunting, fishing and trapping activities. A few Cree camps are located near the mine site, notably along the Route du Nord, and the Cree community of Nemaska is approximately 30 km west of the mine site. Therefore, the main sources of anthropogenic emissions near the project site are associated with the presence of the Route du Nord, where vehicular traffic generates emissions of dust and exhaust gases. It should be noted that the mining exploration activities for the Whabouchi project are now completed, and there is no regular presence of vehicles or machinery at the site.

The MDDEFP set up an air quality monitoring network in Quebec. Air quality measurement stations are thus operating in strategic locations on the territory of Quebec. However, the stations are generally concentrated in the southern part of the province, where the major sources of pollutant emissions are found. Figure 6-8 shows the location of the MDDEFP air quality monitoring stations. The stations closest to the mine site are those located in the municipalities of La Doré and Senneterre. These two stations measure the concentrations of ozone and of particulates smaller than 2.5 microns ($PM_{2.5}$). However these air quality monitoring stations are too far from the project site to be considered in the assessment of baseline conditions (background).

Figure 6-8 Location of Air Quality Monitoring Stations in Quebec



In Quebec, the Clean Air Regulation (CAR) is a consolidation of the Regulation respecting the quality of the atmosphere (RQA) that dated from 1979 (MDDEFP, undated). Among others, the CAR aims to protect the quality of the air through the reduction and control of atmospheric contaminants. The provincial air quality criteria applicable to the Whabouchi project are presented in Table 6-4, while the national objectives related to the quality of the atmospheric environment are presented in Table 6-5.

Table 6-4 Air Quality Criteria – MDDEFP

Parameter	Air Quality Criteria	Source
Total suspended particulates (TSP) (24 hours)	120 µg/m^3	1
Suspended particulates smaller than 2.5 microns ($PM_{2.5}$) (24 hours)	30 µg/m^3	1
Nitrogen dioxide (NO_2) (1 hour)	414 µg/m^3	1
Nitrogen dioxide (NO_2) (24 hours)	207 µg/m^3	1
Nitrogen dioxide (NO_2) (annual)	103 µg/m^3	1
Sulphur dioxide (SO_2) (4 minutes)	1,050 µg/m^3	1
Sulphur dioxide (SO_2) (24 hours)	288 µg/m^3	1
Sulphur dioxide (SO_2) (annual)	52 µg/m^3	1
Carbon monoxide (CO) (1 hour)	34,000 µg/m^3	1
Carbon monoxide (CO) (8 hours)	12,700 µg/m^3	1
Barium (annual)	0.05 µg/m^3	1
Beryllium (annual)	0.0004 µg/m^3	1
Cadmium (annual)	0.0036 µg/m^3	1
Chromium (annual)	0.004 µg/m^3	1
Cobalt (annual)	0.1 µg/m^3	2
Copper (24 hours)	2.5 µg/m^3	1
Lead (annual)	0.1 µg/m^3	2
Manganese (annual)	0.025 µg/m^3	1
Nickel (1 hour)	6 µg/m^3	1
Nickel (annual)	0.012 µg/m^3	1
Zinc (24 hours)	2.5 µg/m^3	1

Note 1: Ministère du Développement durable, de l'Environnement, de la Faune et des Parcs. 2010. Mise à jour des critères de qualité de l'air. Direction du suivi de l'état de l'environnement.

Note 2: M. Jean-François Brière, MDDEFP, personal communication , October 31, 2012

Source: SENES Consultants Limited, 2013a

Table 6-5 National Objectives for Ambient Air Quality

Parameter	Air Quality Criteria
Total suspended particulates (TSP) (24 hours)	120 $\mu g/m^3$
Total suspended particulates (TSP) (annual)	60 $\mu g/m^3$
Nitrogen dioxide (NO_2) (1 hour)	400 $\mu g/m^3$
Nitrogen dioxide (NO_2) (annual)	60 $\mu g/m^3$
Sulphur dioxide (SO_2) (1 hour)	450 $\mu g/m^3$
Sulphur dioxide (SO_2) (24 hours)	150 $\mu g/m^3$
Sulphur dioxide (SO_2) (annual)	30 $\mu g/m^3$
Carbon monoxide (CO) (1 hour)	15,000 $\mu g/m^3$
Carbon monoxide (CO) (8 hours)	6,000 $\mu g/m^3$

Source: SENES Consultants Limited, 2013b

As part of the present project, air quality measurements were taken in the summer of 2012 in two different locations on the mine site, identified as the Air1 and Air2 stations. The Air1 station is located near the future open pit, while Air2 is just north of the Route du Nord. The exact location of the two air quality sampling stations is shown in Figure 4.3 of Appendix 6.1. The sampling work was carried out to obtain baseline data about the quality of ambient air before the development of the project. The air sampling was performed with the methods and equipment approved by the United States Environmental Protection Agency (US EPA). The results of the sampling show that the Route du Nord has incidences on the air quality at station Air2, which is installed near this road infrastructure (SENES Consultants Limited, 2013a). Table 6-6 and Table 6-7 present the concentrations of particulates and metals measured by the air quality sampling. The values obtained for suspended particulate (24 hours) and $PM_{2.5}$ (24 hours) are below the criteria recommended by the MDDEFP, which are presented in Table 6-8. For the purpose of the atmospheric emissions modeling, the baseline concentrations used are those of the MDDEFP.

Table 6-6 Concentrations of Particulate Fractions Measured by the Sampling

Parameter	Concentrations
Total suspended particulates (24 hours)	30.2 $\mu g/m^3$
Suspended particulates smaller than 10 microns (PM_{10}) (24 hours)	15.1 $\mu g/m^3$
Suspended particulates smaller than 2.5 microns ($PM_{2.5}$) (24 hours)	7.6 $\mu g/m^3$

Source: SENES Consultants Limited, 2013a and 2013b

Table 6-7 Concentrations of Metals Measured by the Sampling

Metal	Concentrations
Barium (annual)	3.1E-04 $\mu g/m^3$
Beryllium (annual)	3.1E-04 $\mu g/m^3$
Cobalt (annual)	6.3E-04 $\mu g/m^3$
Cadmium (annual)	6.3E-04 $\mu g/m^3$
Chromium (annual)	8.4E-04 $\mu g/m^3$
Copper (24 hours)	3.1E-04 $\mu g/m^3$
Lead (annual)	9.4E-04 $\mu g/m^3$
Nickel (1 hour)	5.3E-04 $\mu g/m^3$
Nickel (annual)	1.2E-04 $\mu g/m^3$
Zinc (24 hours)	9.4E-04 $\mu g/m^3$

Source: SENES Consultants Limited, 2013a

Nemaska produced two separate reports on the modeling of atmospheric emissions to comply with the provincial and federal directives issued for the present project. However, only one impact assessment was completed. The atmospheric emissions modeling reports are presented in Appendices 6-1 and 6-2 (SENES Consultants Limited, 2013a and 2013b).

The baseline (background) concentrations of the different air quality parameters applicable to northern regions were supplied by the MDDEFP (Brière, 2012). These concentrations are given in Table 6-8. In the case of metals, atmospheric modeling used the values recommended by the MDDEFP in Appendix K of the Clean Air Regulation. Table 6-9 presents the baseline (background) concentrations used for the metals. The detailed results of the modeling based on provincial requirements are presented in Appendix 6-1 (SENES Consultants Limited, 2013a).

Table 6-8 Baseline (Background) Concentrations of Air Quality Parameters

Parameter	Concentrations
TSP (24 hours)	***40 μg/m³***
TSP (annual)	*8 μg/m³*
PM_{10} (24 hours)	*27.5 μg/m³*
$PM_{2.5}$ (24 hours)	***15 μg/m³***
SO_2 (4 minutes)	***40 μg/m³***
SO_2 (24 hours)	***10 μg/m³***
SO_2 (annual)	***2 μg/m³***
NO_2 (1 hour)	***50 μg/m³***
NO_2 (24 hours)	***40 μg/m³***
NO_2 (annual)	***10 μg/m³***
CO (1 hour)	***600 μg/m³***
CO (8 hours)	***400 μg/m³***

Bold: Modeling based on provincial requirements – MDDEFP (SENES Consultants Limited, 2013a)

Italics: Modeling based on the federal requirements (SENES Consultants Limited, 2013b)

Table 6-9 Baseline (Background) Conditions for Metals

Metal	Concentrations
Barium (annual)	0.025 μg/m³
Beryllium (annual)	0 μg/m³
Cobalt (annual)	0 μg/m³
Cadmium (annual)	0.003 μg/m³
Chromium (annual)	0.0037 μg/m³
Copper (24 hours)	0.2 μg/m³
Lead (annual)	0.025 μg/m³
Nickel (1 hour)	0.25 μg/m³
Nickel (annual)	0.01 μg/m³
Manganese (annual)	0.02 μg/m³
Zinc (24 hours)	0.1 μg/m³

Source: SENES Consultants Limited, 2013a

6.2.2 Impacts Assessment

The atmospheric emissions modeling were completed for the construction and operations phases of the Whabouchi project. For the purposes of the present assessment, in addition to the phase associated with the construction of the mine, the analysis considered two periods during the operation of the mine, in year 10 and year 12. These two years correspond to the peak activities at the mine site. To evaluate the potential impacts on air quality, a total of 23 sensitive receptors were positioned in the modeled zone near the mine site. Sensitive receptor R1 corresponds to the Bible Camp located west of the site on the shore of Lac des Montagnes, while sensitive receptors R2 to R23 correspond to the Cree camps located in the vicinity of the mine site. The location of these 23 receptors is shown in Figure 6.2 of Appendix 6-1.

The modeling of the atmospheric emissions dispersal was performed with the AERMOD software (Appendices 6-1 and 6-2). This model was developed by a committee formed by the American Meteorological Society (AMS) and the United States Environmental Protection Agency (US-EPA) (AERMIC[1]). The modeling used weather data from 2007 to 2011, a period of five years.

The results of the atmospheric emissions modeling indicate that all the MDDEFP air quality criteria and the national air quality objectives are respected at all times at the location of the 23 sensitive receptors, at all phases of the project (construction phase and years 10 and 12 of the operation phase). However, at the limits of the project footprint (corresponding to a distance of 300 m from any source of potential contaminants), the digital simulations showed that the criteria for total suspended particulates (24 hours), $PM_{2.5}$ (24 hours) and PM_{10} (24 hours) could be occasionally exceeded. These occurrences are infrequent, arising only nine days per year, and they are located near the limits of the project footprint, mostly to the southeast.

It should be noted, however, that only workers will be authorized to access the locations where exceedances are anticipated in the course of their duties. These workers will be provided with personal protective equipment if required. Over the life of the project, the users of the land, and particularly those of trapline R20, will not have access to these locations, mainly for safety reasons. It should also be noted that as part of its environmental monitoring and follow-up programs (presented in Chapter 11), Nemaska Lithium will maintain monitoring and follow-up of air quality.

The detailed results of the numerical simulations are presented in the atmospheric emissions reports in Appendices 6-1 and 6-2 (SENES Consultants Limited, 2013a and will 2013b).

The following sections cover the identification of impact sources, the description of these impacts, the description of the mitigation measures and the significance of the residual impact.

[1] AMS/EPA Regulatory Model Improvement Committee

6.2.2.1 Identification of the Impact Sources

Construction Phase

The main activities of the Whabouchi project that could constitute sources of impacts on the air quality during the construction phase are the following:

- Sites clearing and preparation (excavation, stripping, backfilling, blasting and overburden management)
- Use, maintenance and circulation of heavy machinery and vehicles

Operation Phase

The main activities of the Whabouchi project that could constitute sources of impacts on the air quality during the operation phase are the following:

- Sites clearing and preparation (excavation, stripping, backfilling, blasting and overburden management)
- Excavation, storage and processing of the ore
- Use, maintenance and circulation of heavy machinery and vehicles
- Progressive rehabilitation of the waste rock and tailings pile

Closure Phase

The main activities of the Whabouchi project that could constitute sources of impacts on the air quality during the closure phase are the following:

- Use, maintenance and circulation of heavy machinery and vehicles
- Site rehabilitation
- Dismantling of the infrastructures and installations

6.2.2.2 Description of the Impacts

Construction Phase

Sites Clearing and Preparation (Excavation, Stripping, Backfilling, Blasting and Overburden Management)

The deforestation work on the mine site will increase the wind erosion and thus, the emission of dust. Also, the loss of vegetation can result in a reduction of the carbon absorption capacity of the environment. The excavation, backfilling and blasting work for the preparation of the sites will cause a reworking of soils that could result in increased emissions of dust and particulates in the atmosphere. An increase in aerial contaminants, notably CO, NO_x and SO_2, is also anticipated as a result of the blasting activities. The action of wind on the surface of the storage areas (e.g. the overburden pile and the waste rock and tailings pile) could also mobilize dust and thus affect air quality.

Use, Maintenance and Circulation of Heavy Machinery and Vehicles

The use and circulation of heavy machinery and vehicles on unpaved service roads will increase dust emissions. Also, an increase in the emissions of greenhouse gases and other contaminants such as NO_x is also predicted.

Operation Phase

All the impact sources listed for the construction phase also apply to the operation phase. The following additional impact sources will occur during the operation phase:

Excavation, Storage and Processing of the Ore

The generators that will be used to power heavy machinery and other equipment in the pit will emit exhaust gases and other fine particulates. Also, the drilling and blasting operation carried out to extract the ore will generate emissions of dust, CO, NO_x and SO_2.

The haulage of the ore between the pit and the stockpile, as well as the unloading of the trucks, will generate dust emissions. The ore stockpile near the concentrator could also be subject to wind erosion. This wind erosion could therefore increase emissions of dust and other particulates at the mine site. The haulage of waste rock and tailings and the unloading of the trucks at the waste rock and tailings pile will increase the emissions of dust and fine particulates. As with the ore stockpile, wind erosion could also increase the emissions of dust and fine particulates from the waste rock and tailings pile.

Additionally, the processing of the ore, and particularly the crushing operations, will generate emissions of dust and other fine particulates.

Progressive Rehabilitation of the Waste Rock and Tailings Pile

The progressive rehabilitation of the waste rock and tailings pile will require the transportation and reworking of soils such as the stockpiled overburden to be used in the revegetation of the waste rock and tailings pile. Thus, this rehabilitation work could increase dust emissions. It should be noted, however, that the progressive revegetation of the waste rock and tailings pile will limit the emissions due to wind erosion.

Closure Phase

All the impacts sources listed for the operation phase apply to the closure phase, where appropriate. The following additional impact sources will occur during the closure phase:

Site Rehabilitation

In general, the site rehabilitation activities will ensure that the areas disturbed by the mining project are restored. For example, the service roads on the mine site will be scarified and the ditches will be filled. These activities require the transportation and reworking of soil in different areas of the mine site. This haulage and reworking could increase dust emissions.

Dismantling of the Infrastructures and Installations

The dismantling of the infrastructures and facilities, particularly the use of excavators and jackhammers, could increase emissions of dust and exhaust gases.

6.2.2.3 Description of the Mitigation Measures

Construction Phase

In order to limit the impact of the project on air quality during the construction phase, the following mitigation measures will be implemented:

- Ensure that the heavy machinery, vehicles and equipment are in proper operating order (adequate maintenance)
- Ensure that the antipollution systems of the heavy machinery and vehicles are operational
- Avoid unnecessary idling of the heavy machinery, vehicles and equipment when not in use
- Use electrical equipment as much as possible
- Promote energy efficiency and prefer green technologies wherever possible
- Prefer the use of diesel fuel meeting Environment Canada standards for highway vehicles
- Apply MDDEFP-approved dust reducers or water on the service roads, including the ramps, if necessary
- Limit at 30 km/h the speed of vehicles on the project site
- When possible, limit the heavy machinery and vehicle movements, as well as the distances traveled
- Ensure adequate maintenance of the service roads and ramps
- Establish a dust management program including the appropriate use of dust suppressants

Operation Phase

The mitigation measures applied during the construction phase will be maintained during the operation phase to limit the impacts of the project on air quality. Additionally, the following mitigation measures will be implemented:

- Install dust scrubbers at the air vents of the crusher and concentrator buildings
- Progressively restore the waste rock and tailings pile

Closure Phase

In order to limit the impact of the project on air quality during the closure phase, the mitigation measures implemented for the construction and operations phases will be maintained where relevant.

6.2.2.4 Significance of the Residual Impact

The social value of this component is high, notably because of the presence of sensitive receptors near the mine site (the Cree camps and the Bible Camp) and the concerns expressed by the community during the consultation activities. Furthermore, this component is subjected to formal regulation (Clean Air Regulation). The ecosystem value of the component is moderate, since it is necessary for other components such as the wildlife and users of the land and its resources, but it is not of special concern within the study area. Therefore, the value of this component is high.

After application of the mitigation measures, the significance of the residual impact on air quality is considered as moderate. The intensity of the impact is considered moderate because, although some exceedances of the criteria are anticipated near the project footprint, these will be infrequent, i.e. 2.5% of the time. Furthermore, the air quality criteria will be respected at all times at the location of the 23 sensitive receptors.

The nature of the impact on air quality is negative. The frequency of the impact is considered as continuous since the impact will occur over the entire life of the project. The extent of the impact is local since the atmospheric emissions are not limited to the project footprint. However, this is a reversible impact since the atmospheric emissions associated with the mine activities will cease at the end of the project.

Table 6-10 presents the values assigned to each indicator and the resulting significance of the residual impact.

Table 6-10 Significance of the Residual Impact – Air Quality

Intensity	Extent	Duration	Significance of the Residual Impact
High	Regional	Long	High
Moderate	**Local**	**Medium**	**Moderate**
Low	Punctual	Short	Low

6.3 Noise Level

6.3.1 Description of the Environment

In order to determine the current noise level that characterizes the project site before its development, a field campaign was undertaken in the summer of 2012. This fieldwork was considered necessary as no data about the noise level were available for the project site. This campaign was carried out in conformity with the *Note d'instructions sur le bruit* from the MDDEFP (MDDEFP, 2006).

The current ambient noise level is attributable mainly to typical natural sounds such as wind and wildlife, to the circulation of vehicles on the Route du Nord and to passing aircraft (the Nemiscau airport is 19 km west of the project site).

In order to describe the current noise level, measurements were taken by SENES Consultants Limited at two different locations on the site, i.e. the location of the future open pit and near the Route du Nord. These noise surveys were carried out over a period of seven days between June 27 and July 5, 2012 (SENES Consultants Limited, 2013c).

The ambient noise level recorded at the project site is 43.5 dB(A) by day (7am to 7pm) and 36.4 dB(A) by night (7pm to 7am). According to the *Note d'instructions sur le bruit* (MDDEFP, 2006), the maximum noise level permitted during the mine operation is 55 dB(A) by day and 50 dB(A) by night. These values are those that are authorized in a Category IV zone, corresponding to an industrial zone with the presence of habitations. It should be mention that dB(A) is the abbreviation of the weighted decibel, the unit of measurement used for environmental sounds.

6.3.2 Impacts Assessment

A modeling of the impacts of the project on the noise level was completed in order to evaluate the impacts during the construction, operation and closure phases (SENES Consultants Limited, 2013c).

For the purposes of this modeling, 23 sensitive receptors were considered on the project site. These receptors correspond to the Bible Camp (R1) and other Cree camps (R2 to R23). The location of these 23 sensitive receptors is shown in Appendix 6-3 (Figure 5.1).

The following sections cover the identification of impact sources, the description of these impacts, the description of the mitigation measures for each project phase (construction, operation and closure) and the significance of the residual impact the noise level component.

6.3.2.1 Identification of the Impact Sources

Construction Phase

The main activities of the Whabouchi project that could constitute sources of impacts on the noise level during the construction phase are the following:

- Sites clearing and preparation (excavation, stripping, backfilling, blasting and overburden management)
- Construction of the temporary and permanent infrastructures and facilities
- Use, maintenance and circulation of heavy machinery and vehicles
- Presence of workers and purchasing of goods and services

Operation Phase

The main activities of the Whabouchi project that could constitute sources of impacts on the noise level during the operation phase are the following:

- Sites clearing and preparation (excavation, stripping, backfilling, blasting and overburden management)
- Presence and operation of the infrastructures and buildings
- Extraction, storage and processing of the ore
- Use, maintenance and circulation of heavy machinery and vehicles
- Presence of workers and purchasing of goods and services

Closure Phase

The main activities of the Whabouchi project that could constitute sources of impacts on noise level during the closure phase are the following:

- Use, maintenance and circulation of heavy machinery and vehicles
- Dismantling of the infrastructures and installations
- Presence of workers and purchasing of goods and services

6.3.2.2 Description of the Impacts

Construction Phase

The above-mentioned impact sources represent activities that will alter the existing noise level. Effectively, these activities will cause an overall increase in ambient noise level. The main sources of noise are the preparation activities, such as the operation of machinery to grade the surfaces, prepare and pour concrete, strip the pit, prepare the waste rock and tailings pile, build the sedimentation basins and haul granular material and construction materials. These activities require specialized equipment that can be noisy, such as trucks, loaders, graders, drill rigs, as well as other activities associated with blasting. The presence of workers on the site also constitutes a source of noise.

Table 6-11 presents the equipment constituting the main sources of noise during the construction phase. The noisiest equipment is the drilling rig, with a noise level that reaches 120.3 dB(A).

Table 6-11 Equipment Noise Level during the Construction Phase

Description of the Source	Noise Level (dB(A))
Mining Equipment	
CAT 988 H Wheeled Loader	115.0
CAT 772 Haulage Truck	115.8
DTH QXR 920 Drill Rig	120.3
FIeld Equipment	
CAT 834H Wheeled Dozer	115.0
CAT D7 Bulldozer	111.7
CAT 14M Grader	112.1
Peterbilt 348 Water Tanker	110.8
Auxiliary Equipment	
CAT730 Fuel/Lubricant Tanker	111.0
Utility Truck	110.0
Lighting System	94.3
Portable Pump	114.0
Other Auxiliary Mining and Construction Equipment	
Peterbilt 367 Explosives Carrier	113.4
Zoomlion QUY200 Mobile Crane	111.3
Concrete Plant	117.1
Concrete Truck	107.8
Transportation Equipment – Route du Nord	
Peterbilt 389 Semi-Trailer	113.8
Workers Shuttle Bus (40+ Passengers) (ISB-10)	110.1
Crusher, Concentrator and Related Operations	
Transformer	94.5
Fuel Transfer Pump	98.6

The modeling of the noise and intensity on the site during the construction work assumed that all the construction activities are at their maximum and simultaneous. This hypothetical situation represents the worst case. The results show that, at all the 23 sensitive receptors that were identified, the noise level during the construction phase is in all cases below the maximum authorized limits by MDDEFP, which are 55 dB(A) in daytime and 50 dB(A) during the night. Map 6-1 presents the noise level during the construction phase, as modeled in the vicinity of the mine and at the location of the sensitive receptors. The noise level modeled on this map are attributable exclusively to the mine and do not take into account the current sound level. Table 6-12 presents the predicted noise level for the 23 sensitive receptors during the construction phase, but including the sounds already present on the site. This represents the increase in the noise amplitude that will be caused by the construction work during the day (between 7am and 11pm) and by night (between 11pm and 7am).

Table 6-12 Projected Noise Level and Expected Difference during the Construction Phase

Sensitive Receptor	Total Daytime Noise Level (dB(A))	Total Nighttime Noise Level (dB(A))	Expected Difference by Day (dB(A))	Expected Difference by Night (dB(A))
R1	43.9	38.2	0.4	1.8
R2	46.6	44.4	3.1	8.0
R3	46.1	43.6	2.6	7.2
R4	44.0	38.5	0.5	2.1
R5	43.9	38.2	0.4	1.8
R6	43.8	37.6	0.3	1.2
R7	43.8	37.6	0.3	1.2
R8	43.8	37.6	0.3	1.2
R9	43.9	38.1	0.4	1.7
R10	43.9	38.2	0.4	1.8
R11	43.9	38.3	0.4	1.9
R12	43.9	38.3	0.4	1.9
R13	44.0	38.3	0.5	1.9
R14	44.0	38.3	0.5	1.9
R15	43.9	38.1	0.4	1.7
R16	43.9	38.1	0.4	1.7
R17	43.9	38.2	0.4	1.8
R18	43.9	38.2	0.4	1.8
R19	44.0	38.6	0.5	2.2
R20	43.8	37.7	0.3	1.3
R21	43.7	37.4	0.2	1.0
R22	43.8	37.9	0.3	1.5
R23	43.9	38.3	0.4	1.9

As mentioned earlier, the current ambient noise level measured at the project site is 43.5 dB(A) during the day (between 7am and 7pm) and 36.4 dB(A) at night (between 7pm and 7am). The largest increase in noise level concerns sensitive receptor R2, which is a permanent Cree camp. An increase in noise level of 3.1 dB(A) by day and 8.0 dB(A) by night is anticipated at this receptor.

An evaluation of the anticipated sound levels was also completed with regard to the federal recommendations. More specifically, this evaluation considered the percentage of people highly annoyed (%HA) by the noise, an indicator used by Health Canada. Table 6-13 presents the predicted noise levels for the 23 sensitive receptors during the construction phase, but including the sounds already present on the site. This represents the increase in the noise amplitude that will be caused by the construction work during the day (between 7am and 11pm) and by night (between 11pm and 7am). As in the evaluation based on provincial criteria, the most significant anticipated increase in ambient noise level concerns sensitive receptor R2, a permanent Cree camp. The predicted increase over the current noise levels is 3.2 dB(A) by day and 8.2 dB(A) by night. The results are presented on map D1 in Appendix 6-3.

Table 6-13 Projected Noise Level and Expected Difference during the Construction Phase – Federal

Sensitive Receptor	Total Daytime Noise Level (dB(A))	Total Nighttime Noise Level (dB(A))	Expected Difference by Day (dB(A))	Expected Difference by Night (dB(A))	Expected Difference in %HA[2]
R1	43.9	38.3	0.4	1.9	0.2
R2	46.7	44.6	3.2	8.2	1.5
R3	46.3	43.9	2.8	7.5	1.3
R4	45.1	41.6	1.6	5.2	0.7
R5	44.0	38.3	0.5	1.9	0.2
R6	43.8	37.7	0.3	1.3	0.1
R7	43.8	37.6	0.3	1.2	0.1
R8	43.8	37.6	0.3	1.2	0.1
R9	44.4	39.9	0.9	3.5	0.4
R10	44.3	39.6	0.8	3.2	0.4
R11	44.2	39.1	0.7	2.7	0.3
R12	44.2	39.0	0.7	2.6	0.3
R13	44.2	39.1	0.7	2.7	0.3
R14	44.2	39.2	0.7	2.8	0.3
R15	44.4	39.7	0.9	3.3	0.4
R16	44.5	39.9	1.0	3.5	0.4
R17	44.5	40.0	1.0	3.6	0.4
R18	44.4	39.9	0.9	3.5	0.4

[2] According to Health Canada, a noise is considered severe when the %HA exceeds the existing conditions by more than 6.5% (SENES Consultants Limited, 2013c).

Sensitive Receptor	Total Daytime Noise Level (dB(A))	Total Nighttime Noise Level (dB(A))	Expected Difference by Day (dB(A))	Expected Difference by Night (dB(A))	Expected Difference in %HA[2]
R19	44.1	39.0	0.6	2.6	0.3
R20	43.9	38.0	0.4	1.6	0.2
R21	43.7	37.5	0.2	1.1	0.1
R22	43.8	37.9	0.3	1.5	0.2
R23	44.2	39.0	0.7	2.6	0.3

Operation Phase

During the exploitation of the deposit, the extraction of ore, particularly drilling and blasting and the crushing and milling activities at the concentrator, will represent the most powerful sources of noise. The transportation of the ore, waste rock and tailings to the concentrator or the waste rock and tailings pile will be another activity causing increased noise. As in the construction phase, the presence of workers also represents a source of noise.

Table 6-14 presents the different sources of noise during the operation phase. As mentioned for the construction phase, the drill rig is the noisiest equipment, with noise level reaching 120.3 dB(A).

Table 6-14 Equipment Noise Level during the Operation Phase

Description of the Source	Noise Level (dB(A))
Mining Equipment	
CAT 390 D Hydraulic Excavator	115.2
CAT 988 H Wheeled Loader	115.0
CAT 772 Haulage truck	115.8
DTH QXR 920 Drill Rig	120.3
Field Equipment	
CAT 834H Wheeled Dozer	115.0
CAT D7 Bulldozer	111.7
CAT 14M Grader	112.1
Peterbilt 348 Water Tanker	110.8
Auxiliary Equipment	
CAT730 Fuel/Lubricant Tanker	111.0
Utility Truck	110.0
Lighting System	94.3
Portable Pump	114.0

Description of the Source	Noise Level (dB(A))
Other Auxiliary Mining and Construction Equipment	
Peterbilt 367 Explosives Carrier	113.4
CAT 390 D Hydraulic Excavator	115.2
CAT 988 H Wheeled Loader	115.0
CAT 772 Haulage Truck	115.8
CAT 834H Wheeled Dozer	115.0
Crusher, Concentrator and Related Operations	
Transformer	94.5
Fuel Transfer Pump	98.6
Primary Jaw Crusher (CJ412)	110.8
Secondary Cone Crusher (CH440)	118.1
Tertiary Cone Crusher (CH660)	118.1
Conveyor System	89.9
Dust Collector	118.6
Bucket Elevator	98.7
Fine Particulate Thickener	89.5
Ball Mill	112.8
Cyclone	101.6
Air Compressor	99.1
Delivery Truck	88.9
HVAC System	109.0

Reference: SENES Consultants Limited, 2013c

For the purpose of the modeling, the mining operation was divided into phases. The first phase covers production years 1 to 12, while the second phase includes years 12 to 19. The differences between these two phases are related to the construction of a section of the Route du Nord and to the movement of activities on the waste rock and tailings pile, as well as to the increased depth of operation in the pit.

The results of the numerical simulations showed that, like in the construction phase, the noise levels at the 23 sensitive receptors are all below 50 dB(A), both in the first and in the second phases of operation. Here again, the maximum anticipated value during the first operation phase concerns sensitive receptor R2, which is a Cree camp. This value is 48.6 dB(A) during the day and 47.4 dB(A) at night, which corresponds to an increase over the current noise level of 5.1 dB(A) during the day and 11.0 dB(A) at night. In the second phase of operation, the maximum anticipated increase concerns sensitive receptors R2 and R3, both permanent Cree camps. These values are 44.1 dB(A) during the day and 38.8 dB(A) at night, for both sensitive receptors. These values represent an increase over the current ambient noise level of 0.6 dB(A) during the day and 2.4 dB(A) at night.

Maps 6-2 and 6-3 present the location of the sensitive receptors and the modeled noise level in the vicinity of the mine during the first and second phases of operation. The noise level shown on the maps corresponds only to the mining activities, without considering current ambient noise level. To evaluate the impact of the mine on the current situation, it is important to compare the amplitude of the noise before and during the activities. Table 6-15 and Table 6-16 present the modeled noise level at the 23 sensitive receptors during the two phases of operation, coupled with the ambient sound level.

Table 6-15 Projection of Daytime and Nighttime Noise Levels and Expected Difference in Years 1 to 12

Sensitive Receptor	Projected Daytime Noise Level (dB(A))	Expected Difference by Day (dB(A))	Projected Nighttime Noise Level (dB(A))	Expected Difference by Night (dB(A))
R1	44.6	1.1	40.3	3.9
R2	48.6	5.1	47.4	11.0
R3	48.1	4.6	46.7	10.3
R4	45.0	1.5	41.4	5.0
R5	44.6	1.1	40.2	3.8
R6	44.3	0.8	39.5	3.1
R7	44.3	0.8	39.5	3.1
R8	44.3	0.8	39.4	3.0
R9	45.0	1.5	41.3	4.9
R10	45.0	1.5	41.4	5.0
R11	45.2	1.7	41.8	5.4
R12	45.2	1.7	41.8	5.4
R13	45.2	1.7	41.9	5.5
R14	45.2	1.7	41.9	5.5
R15	45.0	1.5	41.4	5.0
R16	45.0	1.5	41.4	5.0
R17	45.0	1.5	41.4	5.0
R18	44.8	1.3	40.8	4.4
R19	44.8	1.3	40.9	4.5
R20	44.4	0.9	39.8	3.4
R21	44.2	0.7	39.1	2.7
R22	44.3	0.8	39.6	3.2
R23	44.8	1.3	40.8	4.4

Table 6-16 Projection of Daytime and Nighttime Noise Levels and Expected Difference in Years 12 to 19

Sensitive Receptor	Projected Daytime Noise Level (dB(A))	Expected Difference by Day (dB(A))	Projected Nighttime Noise Level (dB(A))	Expected Difference by Night (dB(A))
R1	44.0	0.5	38.4	2.0
R2	44.1	0.6	38.8	2.4
R3	44.1	0.6	38.8	2.4
R4	43.9	0.4	38.2	1.8
R5	43.9	0.4	38.2	1.8
R6	43.9	0.4	38.2	1.8
R7	43.9	0.4	38.2	1.8
R8	43.9	0.4	38.2	1.8
R9	43.9	0.4	38.2	1.8
R10	43.9	0.4	38.2	1.8
R11	43.9	0.4	38.2	1.8
R12	43.9	0.4	38.2	1.8
R13	43.9	0.4	38.3	1.9
R14	43.9	0.4	38.3	1.9
R15	43.9	0.4	38.2	1.8
R16	43.9	0.4	38.2	1.8
R17	43.9	0.4	38.2	1.8
R18	43.9	0.4	38.1	1.7
R19	43.9	0.4	38.2	1.8
R20	43.9	0.4	38.0	1.6
R21	43.8	0.3	37.8	1.4
R22	43.8	0.3	37.9	1.5
R23	43.9	0.4	38.1	1.7

As mentioned earlier, the current ambient noise level measured at the project site is 43.5 dB(A) during the day (between 7am and 7pm) and 36.4 dB(A) at night (between 7pm and 7am).

Table 6-17 and Table 6-18 present the noise levels at the 23 sensitive receptors during the two phases of operation, as modeled according to federal requirements, coupled with the ambient noise level. During the first phase of operation, the most significant increase in the noise level would be at sensitive receptor R2, a permanent Cree camp. The anticipated increase is 5.2 dB(A) during the day and 11.1 dB(A) at night. This sensitive receptor is also where the %HA is expected to increase the most (2.6). During the second phase of operation, the most significant increase in noise level would be at sensitive receptor R4, which is also a permanent Cree camp. The anticipated increase is 1.5 dB(A) during the day and the 5.0 dB(A) at night. This sensitive receptor is also where the %HA is expected to increase the most (0.7). The results are presented on the maps D2 and D3 of Appendix 6-3.

Table 6-17 Projection of Daytime and Nighttime Noise Levels and Expected Difference in Years 1 to 12 – Federal

Sensitive Receptor	Projected Daytime Noise Level (dB(A))	Expected Difference by Day (dB(A))	Projected Nighttime Noise Level (dB(A))	Expected Difference by Night (dB(A))	Expected Difference in %HA
R1	44.6	1.1	40.3	3.9	0.5
R2	48.7	5.2	47.5	11.1	2.6
R3	48.2	4.7	46.8	10.4	2.3
R4	46.0	2.5	43.3	6.9	1.1
R5	44.6	1.1	40.3	3.9	0.5
R6	44.3	0.8	39.5	3.1	0.4
R7	44.3	0.8	39.5	3.1	0.4
R8	44.3	0.8	39.4	3.0	0.4
R9	45.4	1.9	42.2	5.8	0.9
R10	45.4	1.9	42.1	5.7	0.9
R11	45.4	1.9	42.1	5.7	0.9
R12	45.4	1.9	42.1	5.7	0.9
R13	45.4	1.9	42.2	5.8	0.9
R14	45.4	1.9	42.2	5.8	0.9
R15	45.4	1.9	42.1	5.7	0.9
R16	45.4	1.9	42.3	5.9	0.9
R17	45.5	2.0	42.4	6.0	0.9
R18	45.2	1.7	41.8	5.4	0.8
R19	44.9	1.4	41.2	4.8	0.7
R20	44.5	1.0	40.0	3.6	0.4
R21	44.2	0.7	39.2	2.8	0.3
R22	44.4	0.9	39.7	3.3	0.4
R23	45.0	1.5	41.3	4.9	0.7

Table 6-18 Projection of Daytime and Nighttime Noise Levels and Expected Difference in Years 12 to 19 – Federal

Sensitive Receptor	Projected Daytime Noise Level (dB(A))	Expected Difference by Day (dB(A))	Projected Nighttime Noise Level (dB(A))	Expected Difference by Night (dB(A))	Expected Difference in %HA
R1	44.0	0.5	38.5	2.1	0.2
R2	44.3	0.8	39.4	3.0	0.3
R3	44.4	0.9	39.7	3.3	0.4
R4	45.0	1.5	41.4	5.0	0.7
R5	44.0	0.5	38.4	2.0	0.2
R6	43.9	0.4	38.3	1.9	0.2
R7	43.9	0.4	38.3	1.9	0.2
R8	43.9	0.4	38.2	1.8	0.2
R9	44.5	1.0	39.9	3.5	0.4
R10	44.4	0.9	39.7	3.3	0.4
R11	44.2	0.7	39.0	2.6	0.3
R12	44.1	0.6	38.9	2.5	0.3
R13	44.2	0.7	39.0	2.6	0.3
R14	44.2	0.7	39.2	2.8	0.3
R15	44.4	0.9	39.7	3.3	0.4
R16	44.5	1.0	40.0	3.6	0.4
R17	44.5	1.0	40.1	3.7	0.5
R18	44.4	0.9	39.8	3.4	0.4
R19	44.0	0.5	38.6	2.2	0.2
R20	43.9	0.4	38.3	1.9	0.2
R21	43.8	0.3	37.9	1.5	0.2
R22	43.9	0.4	38.0	1.6	0.2
R23	44.1	0.6	38.9	2.5	0.3

Closure Phase

During the closure phase, noise will be generated by the dismantling of the infrastructures and facilities present on the mine site, notably the concentrator, sedimentation basins, maintenance garage, administration, engineering and services buildings, etc. The rehabilitation of the site, particularly the work on the waste rock and tailings pile, will be a source of noise. The rehabilitation of the waste rock and tailings pile will involve seeding the flat surfaces and, possibly, re-profiling to ensure proper drainage of the site. As in the construction and operation phases, the circulation of heavy machinery and vehicles, as well as the presence of workers, will constitute sources of noise. The noise amplitude modeling was not completed for the closure work, since the noisiest equipment used in the other phases will not operate during the restoration of the site. It appears that the restoration scenario would not have a more significant impact on noise level than the previous phases.

6.3.2.3 Description of the Mitigation Measures

Construction Phase

The following mitigation measures will be implemented during the construction phase in order to reduce impacts on noise level.

- Provide operational and effective mufflers for the equipment, heavy machinery and vehicles, and maintain them in proper working order
- Install noise reducing devices on the pneumatic and/or hydraulic jackhammers
- Equip the trucks with a white-noise (multi-frequency sound) reversing alarm
- Enclose or soundproof fixed motorized equipment such as generators
- Position the equipment as far as possible from sensitive receptors
- Ensure regular maintenance of all equipment, including lubrication and replacement of worn parts, particularly the exhaust systems
- Limit the travel speed on service roads to 30 km/h
- Limit the circulation of vehicles to approved service roads
- When possible, schedule the noisiest work during daytime
- When possible, avoid idling motors uselessly or leaving unused equipment turned on
- When possible, avoid using generators and prefer equipment that is powered from the grid
- When possible, use equipment that emits lower noise levels
- When possible, use high STC[3] construction materials in the infrastructures

Operation Phase

The measures that are proposed to mitigate noise level during the construction phase also apply to the operation phase.

Closure Phase

The measures that are proposed to mitigate noise level during the construction phase also apply to the closure phase.

6.3.2.4 Significance of the Residual Impact

The social value of this component is moderate, since sensitive receptors, notably the Cree camps and the Bible Camp, are present near the mine site. Furthermore, this component is not subject to legal or regulatory protection measures. The ecosystemic value of the component is

[3] Sound Transmission Class

low, as it does not play an essential role in the ecosystem as such and that there is no scientific consensus about the potential effects of noise on terrestrial or halieutical animals. Therefore, the value of this component is low.

After application of the mitigation measures, the significance of the residual impact on noise level is considered as moderate. The intensity of the impact is considered low since, although a maximum increase of 5.1 dB(A) by day and 11 dB(A) by night is anticipated at the level of sensitive receptor R2 at all phases of the project, the noise limits authorized by the MDDEFP in their *Note d'instructions 98-01* (55 dB(A) in the daytime and 50 dB(A) at night) will be respected at all times (MDDEFP, 2006).

According to the federal requirements, the intensity of the impact remains low since, although a maximum increase of 5.2 dB(A) by day and 11.1 dB(A) by night is anticipated at the level of sensitive receptor R2 at all phases of the project, the corresponding %HA are 1.5 and 2.6, well below the authorized 6.5%.

The nature of the impact on the noise level is negative. The frequency of the impact is considered continuous, as the ambient noise level will be altered for the entire duration of the project. The extent of the impact is considered local, as the increased noise will be perceived beyond the footprint of the facilities and mining infrastructures. The duration of the increase in noise level is considered medium, as it will last for the three phases of the project, from construction to closure, stopping at the end of the project. However, this is a reversible impact, since the noise level will return to its original values at the end of the project.

Table 6-19 presents the values assigned to each indicator and the resulting significance of the residual impact.

Table 6-19 Significance of the Residual Impact – Noise Level

Intensity	Extent	Duration	Significance of the Residual Impact
High	Regional	Long	High
Moderate	**Local**	**Medium**	**Moderate**
Low	Punctual	Short	Low

6.4 Ambient Light

6.4.1 Description of the Environment

The existing ambient light at the site of the Whabouchi project is mainly attributable to daylight, i.e. natural sunlight. At night, except for exterior light fixtures at some Cree camps and the occasional light generated by passing recreational vehicles (snowmobiles, ATVs, etc.) or by vehicles traveling on the Route du Nord, there is no permanent source of light other than what could be qualified as natural, e.g. moonlight. Therefore, the installation of a lux meter to measure light intensity would not be relevant for this project.

6.4.2 Impacts Assessment

The following sections describe the impacts on ambient light level during the different phases of the project and present the applicable mitigation measures.

6.4.2.1 Identification of the Impact Sources

The main activities of the Whabouchi project that could constitute sources of impacts on the ambient light level during the construction phase are the following:

Construction Phase

- Construction of the temporary and permanent infrastructures and facilities
- Use, maintenance and circulation of heavy machinery and vehicles

Operation Phase

- Presence and operation of the infrastructures and buildings
- Use, maintenance and circulation of heavy machinery and vehicles

Closure Phase

- Use, maintenance and circulation of heavy machinery and vehicles

6.4.2.2 Description of the Impacts

Construction Phase

The above-mentioned impacts sources represent activities that somehow alter the existing ambient light conditions. These activities will effectively increase the emission of light on the mine site. Among others, the illumination required during the construction of certain infrastructures and facilities will modify the ambient light, as will the illumination produced by heavy machinery and vehicles. Therefore, an intensification of the ambient light can be anticipated.

Operation Phase

During the operation phase, the presence of buildings and the operation of certain mine infrastructures will alter the ambient light level. Effectively, light fixtures will be installed in specific areas of the mine site to facilitate and ensure the safety of circulating heavy machinery, vehicles and personnel. The pit will also be illuminated to ensure the safety of the operation. As already mentioned, the use and circulation of heavy machinery and vehicles on the mine site roads will also modify the ambient light level.

Closure Phase

During the closure phase, the use and circulation of heavy machinery and vehicles on the mine site roads will constitute a light source. No other source of impact on ambient light is foreseen, since these activities associated with the closure phase, notably the dismantling of the infrastructures and facilities, will be carried out exclusively in daytime.

6.4.2.3 Description of the Mitigation Measures

Construction Phase

In order to limit the impact of the project on ambient light during the construction phase, the following mitigation measures will be implemented:

- Keep light fixtures oriented toward the ground in the work areas, rather than skyward
- Where possible, use of low-intensity lights to reduce the illumination range
- Avoid illuminating areas where light is not required
- Where possible, use timers to limit unnecessary artificial lighting

Operation Phase

The measures that are proposed to mitigate impacts on ambient light during the construction phase also apply to the operation phase. The following additional mitigation measure will be implemented during the operation phase:

- When possible, reduce the level of illumination during evenings

Closure Phase

The measures that are proposed to mitigate impacts on ambient light during the construction phase also apply to the closure phase.

6.4.2.4 Significance of the Residual Impact

The social value of the component is low, since no concern was expressed by the population on this subject; it is not highly valued and there are no laws or regulations on this matter. The ecosystemic value is moderate, as the component is significant for certain wildlife species, such as nocturnal species. Therefore, the value of this component is low.

After application of the mitigation measures, the significance of the residual impact on ambient light is considered as moderate.

The nature of the impact on ambient light is negative. The frequency of the impact is considered continuous, as the ambient light level will be modified over the entire life of the project.

The extent of the impact is considered local, as the intensification of the ambient light will be perceived beyond the footprint of the facilities and mining infrastructures. The duration of the increase in ambient light level is considered medium, as it will last for the three phases of the project, from construction to closure, stopping at the end of the project. However, this is a reversible impact because the ambient light will return at the end of the project to the conditions prevailing before it.

Table 6-20 presents the values assigned to each indicator and the resulting significance of the residual impact.

Table 6-20 Significance of the Residual Impact – Ambient Light

Intensity	Extent	Duration	Significance of the Residual Impact
High	Regional	Long	High
Moderate	**Local**	**Medium**	**Moderate**
Low	Punctual	Short	Low

6.5 Soils

6.5.1 Description of the Environment

Map 6-4 shows the distribution of surface deposits in the study area. It is an excerpt from the 1/50,000 scale map produced by the Service de l'inventaire forestier of the ministère de l'Énergie et des Ressources du Québec (Guimond, 2000). The legend of this map is morphogenetic, i.e. based on the origin of the materials (e.g. glacial, fluvioglacial, etc.) and, incidentally, on their thickness and morphology.

The study area is characterized by a loose deposit cover that shows little variety, essentially of glacial and fluvioglacial origin, that hides the bedrock over most of the surface. Landscape is dominated by rocky hills with a preferred northeast/southwest orientation. The highest have steep to sheer slopes where the bedrock outcrops (R) or is covered only by a thin layer of discontinuous till (1AR). Mount Chinuchi, 4 km northwest of the mining property, on the western shore of the Nemiscau River, is typical of those hills. Most of the rocky hills, however, are of smaller amplitude (< 50 m in elevation) and present a thin and discontinuous till cover (1AR).

Undifferentiated till (1A) covers most of the study area. It consists in heterogeneous material deposited directly by the glacier, without significant intervention of meltwater. The James Bay Highlands till was placed by the New Quebec glacier, which flowed toward the west or southwest over the crystalline rocks of the Canadian Shield. Typically, it is a coarse and massive non-carbonated material containing 3% to 7% clay, 15% to 35% silt, 30% to 60% sand, and 15% to 30% gravel, pebbles and boulders (Hardy, 1982b).

The till cover generally follows the bedrock topography or presents no particular morphology. Its thickness varies from 1 m or 2 m to more than 10 m. The till was regularly profiled following the direction of the ice flow and forms a number of well-developed drumlins, some of which are crossed by the Route du Nord, immediately west of the Nemiscau River. Locally, till deposits that accumulated in a context of stagnant ice form zones of disintegration moraine (1P), notably in the area comprised between 3 km and 4 km northeast of Lac du Spodumène. Boulders are abundant in such areas, and they are generally quite frequent at the surface of the till in the study area.

Narrow segments of the Sakami Moraine are present at the western limit of the study area, on either side of the Nemiscau River (between Lac des Montagnes and Lac Valiquette). The main moraine components in the area are slightly further north, and have been widely exploited as sources of borrow material.

The fluvioglacial materials were deposited by the glacier meltwater. They are granular materials varying from sandy gravel to sandy stratified. They are a group of ice-marginal deposits (2A) placed in contact with the glacier, generally coarser and presenting frequent variations in particle size (e.g. esker), as well as proglacial deposits (2BE) deposited some distance from the glacier and less coarser, mainly sandy silt to gravel material (e.g. outwash). The ice-marginal deposits are frequently punctuated with small closed depressions (kettles) resulting from the melting of ice plugs buried in sediments during its emplacement. Three fluvioglacial axes formed of esker segments and outwashed sediments cross the study area from northeast to southwest. They follow the axis of the Nemiscau River, along a tributary of Lac du Spodumène and south of Lac des Montagnes. The fluvioglacial deposits that cross and border the project site have already been used as borrow materials and there remains only small residual volumes.

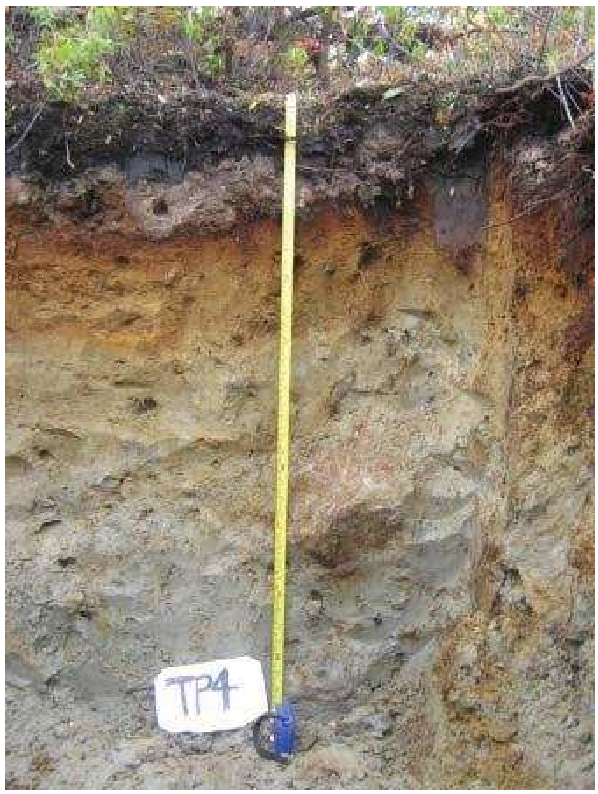
Fluvial deposits (3) were identified in the study area by Guimont (2000), exclusively along Creek D, which connects Lac du Spodumène and Lac des Montagnes. Given the flat topographic context in which flows Creek D, they are probably sand or sandy silt alluvium.

Large bogs (7) have developed in the low and poorly drained zones in the study area, mainly along the Nemiscau River where the elevation is below 300 m. An extensive peatland lies between Lac des Montagnes and Lac du Spodumène, directly south of the project. The central portion of this peatland is raised and it is highly probable that the peat layer is more than 2 m to 3 m thick.

Monochrome aerial photographs at 1/15,000 scale taken in 2002 were screened to further analyze the nature of the surface materials at the location of the main project infrastructures and facilities. In general, the main infrastructures, notably the pit, the waste rock and tailings pile and the concentrator, will be built in areas that are rocky (outcropping or subcropping rock) or covered with a relatively thin layer of till (< 1-2 m). The risk of erosion is therefore very low as there is very little soil present at the location of the infrastructures.

Test pits (21) were also dug at the location of the proposed infrastructures. The complete description and photographs of each test pit are presented in the geotechnical investigation report (Journeaux, 2011) in Appendix 4-3. According to the observations made during the excavation of the test pit, in general, the first unit of loose deposits that is encountered is a layer of topsoil and dry to moist peat (sand and organic matter) measuring from a few decimeters to one meter in thickness. This is followed by a layer of till, between 0.2 m and 3.8 m thick and composed of silty sand with some gravel and traces of clay and pebbles. A fine layer of sand (5 cm to 30 cm) occasionally lies between the layer of organic matter and the till. Figure 6-9 shows the various soil layers intercepted during the excavation of a test pit. Overall, the thickness of unconsolidated deposits on the site is less than 4 m, except for an area northwest of Lac du Spodumène, where the thickness can reach some 15 m.

Figure 6-9 Test Pit BBAF-TP-04



Map 6-12 shows the locations of the 21 test pits with the thickness of unconsolidated deposits in each. The 29 samples analyzed for the geochemical characterization of the soil (metals and phenols) are also identified on this map. Table 6-21 presents the results of the geochemical analyzes on these soil samples. The results were compared to the *Politique de protection des sols et de rehabilitation des terrains contaminés* criteria (MDDEFP, 1998). Criterion A represents the background concentration of metals in the Superior geologic province. Only one sample exceeds criterion A for sulfur (concentration of 0.05% while the criterion is 0.04%). The geochemical characterization of the soil therefore concludes that there is no contamination in the unconsolidated deposits on the site.

Table 6-21 Soil Analysis Results

Parameter	Unit (cm)	PPSRTC criteria[1]			RDL[3]	Sample																												
		A[2]	B	C		BBA-TP-03				BBA-TP-04				BBA-TP-07			BBA-TP-08		BBA-TP-09					BBA-TP-10				BBA-TP-12			BBA-TP-17		BBA-TP-20	
Easting						442218				442320				441572			441426		440089					439592				440298			441266		442125	
Northing						5726696				5726650				5726570			5726526		5725366					5726173				5726734			5727864		5727992	
Depth						(20-30)	(30-60)	(60-90)	(90-135)	(10-20)	(20-40)	(40-60)	(60-100)	(10-15)	(15-30)	(30-100)	(10-40)	(40-125)	(30-80)	(80-110)	(110-150)	(230-250)	(250-300)	(20-30)	(30-60)	(60-100)	(100-115)	(10-30)	(30-100)	(210-270)	(10-20)	(20-80)	(10-30)	(30-100)
Date						2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01
INORGANIC																																		
Moisture (water content)	% g/g	NA	NA	NA	0.5	10	11	7	7.7	23	21	17	16	19	13	4.8	20	5.7	73	17	8.8	22	20	11	6.5	21	19	27	2.8	14	24	10	21	12
METALS																																		
Mercury (Hg)	mg/kg	0.3	2	10	0.02	0.02	0.03	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.03	<0.02	0.03	<0.02	0.15	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.02	<0.02	<0.02	0.03	<0.02	<0.02	<0.02
Total phosphorus	mg/kg	NA	NA	NA	20	21	200	150	270	71	190	110	190	25	290	190	500	240	580	37	260	190	120	<20	270	230	460	310	260	200	320	70	110	190
Silver (Ag)	mg/kg	0.5 *	20	40	0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8
Arsenic (As)	mg/kg	5	30	50	5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Barium (Ba)	mg/kg	200	500	2,000	5	<5	6	<5	5	5	<5	<5	5	<5	6	6	6	7	37	24	21	15	24	<5	13	11	20	8	13	11	9	15	11	6
Cadmium (Cd)	mg/kg	0.9	5	20	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cobalt (Co)	mg/kg	20	50	300	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	2	<2	<2	<2	<2	2	<2	<2
Chromium (Cr)	mg/kg	85	250	800	2	<2	13	8	6	2	15	7	4	<2	12	4	25	12	8	6	9	5	6	<2	6	4	8	13	5	6	21	8	11	5
Copper (Cu)	mg/kg	50	100	500	2	<2	15	12	10	<2	5	5	6	<2	4	7	6	13	29	<2	5	6	15	<2	2	2	8	<2	8	12	5	11	4	8
Tin (Sn)	mg/kg	5	50	300	4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
Manganese (Mn)	mg/kg	1,000	1,000	2,200	2	<2	23	23	27	2	21	20	20	5	34	27	19	43	3	39	69	34	55	<2	45	29	56	11	52	33	43	65	37	31
Molybdenum (Mo)	mg/kg	6	10	40	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Nickel (Ni)	mg/kg	50	100	500	1	<1	3	3	3	<1	2	2	2	1	3	3	2	5	5	2	4	2	3	<1	3	2	4	1	3	6	4	5	4	3
Lead (Pb)	mg/kg	40	500	1,000	5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	8	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	7	<5	<5	<5
Selenium (Se)	mg/kg	3	3	10	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Zinc (Zn)	mg/kg	120	500	1,500	10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	13	14	<10	12	<10	<10	<10	10	<10	<10	<10	10	12	<10	<10
Aluminum (Al)	mg/kg	NA	NA	NA	20	830	12,000	6,400	3,300	1,700	16,000	3,300	1,700	780	13,000	2,200	28,000	2,800	8,200	2,300	3,800	1,700	2,200	800	6,800	2,300	4,300	12,000	2,800	1,600	23,000	5,300	12,000	2,500
Antimony (Sb)	mg/kg	NA	NA	NA	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Beryllium (Be)	mg/kg	NA	NA	NA	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Boron (B)	mg/kg	NA	NA	NA	5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Iron (Fe)	mg/kg	NA	NA	NA	10	310	7,400	3,100	2,300	780	7,600	2,800	1,700	580	6,100	1,900	12,000	2,600	2,000	4,600	6,200	2,200	3,600	170	4,600	2,400	4,200	7,500	3,600	2,100	12,000	5,200	9,800	2,400
Lithium (Li)	mg/kg	NA	NA	NA	10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10	<10	11	<10	<10	<10	10	<10	<10	<10	11	17	13	<10
Potassium (K)	mg/kg	NA	NA	NA	40	44	120	110	170	57	120	110	160	<40	75	200	65	250	54	850	1300	520	990	41	350	360	700	46	510	400	210	500	320	230
Sodium (Na)	mg/kg	NA	NA	NA	40	60	41	67	130	55	<40	42	63	54	<40	92	<40	140	<40	43	<40	41	<40	61	<40	<40	65	<40	<40	40	<40	<40	<40	72
Strontium (Sr)	mg/kg	NA	NA	NA	10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Titanium (Ti)	mg/kg	NA	NA	NA	5	110	300	160	160	79	390	230	130	60	300	120	560	200	130	390	370	200	270	13	290	210	330	310	180	120	520	490	780	180
Vanadium (V)	mg/kg	NA	NA	NA	5	<5	14	<5	<5	<5	12	<5	<5	<5	12	<5	20	<5	<5	10	12	<5	6	<5	8	<5	7	17	5	<5	16	10	24	<5
Thallium (Tl)	mg/kg	NA	NA	NA	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Uranium (U)	mg/kg	NA	NA	NA	5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
CONVENTIONAL																																		
Total cyanide	mg/kg	2	50	500	0.5	1.3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
pH	pH	NA	NA	NA	NA	4.65	4.71	4.74	5.15	4.6	4.67	4.93	4.36	4.64	4.49	5.42	5.09	5.26	4.24	5.02	5.04	5.29	5.37	4.74	5.05	5.29	5.22	5.33	5.28	5.22	4.96	5.35	5.72	4.64
Sulfur (S)	%	0.04	0.1	0.2	0.01	0.02	0.03	0.02	0.02	0.03	0.04	0.03	0.02	0.02	0.04	0.02	0.04	0.02	0.2	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.04	0.03	0.02	0.04	0.02	0.05	0.02
Available cyanide (CN-)	mg/kg	2	10	100	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Nitrate (N) and Nitrite (N)	mg/kg	NA	NA	NA	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Sulphates (SO_4)	mg/kg	NA	NA	NA	5	<5	<5	<5	<5	9	10	<5	<5	<5	22	<5	14	<5	180	<5	<5	<5	<5	<5	<5	<5	<5	7	<5	<5	13	<5	10	<5
PHENOLS																																		
o-Cresol	mg/kg	0.1	1	10	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
m-Cresol	mg/kg	0.1	1	10	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
p-Cresol	mg/kg	0.1	1	10	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
2,4-Dimethylphenol	mg/kg	0.1	1	10	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
2-Nitrophenol	mg/kg	0.5	1	10	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
4-Nitrophenol	mg/kg	0.5	1	10	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenol	mg/kg	0.1	1	10	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
2-Chlorophenol	mg/kg	0.1	0.5	5	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
3-Chlorophenol	mg/kg	0.1	0.5	5	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
4-Chlorophenol	mg/kg	0.1	0.5	5	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

Parameter	Unit (cm)	PPSRTC criteria[1]			RDL[3]	Sample																												
						BBA-TP-03				BBA-TP-04				BBA-TP-07			BBA-TP-08		BBA-TP-09					BBA-TP-10				BBA-TP-12			BBA-TP-17		BBA-TP-20	
Easting		A[2]	B	C		442218				442320				441572			441426		440089					439592				440298			441266		442125	
Northing						5726696				5726650				5726570			5726526		5725366					5726173				5726734			5727864		5727992	
Depth						(20-30)	(30-60)	(60-90)	(90-135)	(10-20)	(20-40)	(40-60)	(60-100)	(10-15)	(15-30)	(30-100)	(10-40)	(40-125)	(30-80)	(80-110)	(110-150)	(230-250)	(250-300)	(20-30)	(30-60)	(60-100)	(100-115)	(10-30)	(30-100)	(210-270)	(10-20)	(20-80)	(10-30)	(30-100)
Date						2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01	2011-09-01
2,3-Dichlorophenol	mg/kg	0.1	0.5	5	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
2,4 + 2,5-Dichlorophenol	mg/kg	0.1	0.5	5	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
2,6-Dichlorophenol	mg/kg	0.1	0.5	5	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
3,4-Dichlorophenol	mg/kg	0.1	0.5	5	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
3,5-Dichlorophenol	mg/kg	0.1	0.5	5	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Pentachlorophenol	mg/kg	0.1	0.5	5	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
2,3,4,5-Tétrachlorophenol	mg/kg	0.1	0.5	5	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
2,3,4,6-Tétrachlorophenol	mg/kg	0.1	0.5	5	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
2,3,5,6-Tétrachlorophenol	mg/kg	0.1	0.5	5	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
2,3,4-Trichlorophenol	mg/kg	0.1	0.5	5	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
2,3,5-Trichlorophenol	mg/kg	0.1	0.5	5	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
2,3,6-Trichlorophenol	mg/kg	0.1	0.5	5	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
2,4,5-Trichlorophenol	mg/kg	0.1	0.5	5	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
2,4,6-Trichlorophenol	mg/kg	0.1	0.5	5	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
3,4,5-Trichlorophenol	mg/kg	0.1	0.5	5	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
SURROGATES RECOVERY (%)																																		
D6-Phenol	%	NA	NA	NA	NA	102	103	112	95	96	99	99	99	90	97	99	100	101	86	106	108	106	103	94	102	104	107	106	106	103	104	105	104	107
Tribromophenol-2,4,6	%	NA	NA	NA	NA	99	101	106	91	98	100	99	94	95	96	96	96	98	116	103	103	101	98	96	93	96	101	105	101	105	105	103	101	104
Trifluoro-m-cresol	%	NA	NA	NA	NA	103	104	110	93	99	98	97	97	93	95	97	98	99	83	105	107	103	102	97	100	103	105	104	104	101	103	103	103	105

(1) The criteria are those given in Appendix 2 of the *Politique de protection des sols et de rehabilitation des terrains contaminés* (MDDEFP, 1998).
(2) Criteria A are for the Superior geological province.
(3) RDL: Reported detection limit
* The detection limit of the analysis does not allow this measurement.
<u>Underlined</u>: Value exceeding the criterion.

6.5.2 Impacts Assessment

The following sections describe the impacts on soils during the different phases of the project and present the applicable mitigation measures.

6.5.2.1 Identification of the Impact Sources

Construction Phase

The main activities of the Whabouchi project that could constitute sources of impacts on the soils during the construction phase are the following:

- Sites clearing and preparation (excavation, stripping, backfilling, blasting and overburden management)
- Construction of the temporary and permanent infrastructures and facilities
- Management of residual materials, hazardous materials and fuels
- Use, maintenance and circulation of heavy machinery and vehicles

Operation Phase

The main activities of the Whabouchi project that could constitute sources of impacts on the soils during the operation phase are the following:

- Sites clearing and preparation (excavation, stripping, backfilling, blasting and overburden management)
- Presence and operation of the infrastructures and buildings
- Extraction, storage and processing of the ore
- Management of residual materials, hazardous materials and fuels
- Use, maintenance and circulation of heavy machinery and vehicles

Closure Phase

The main activities of the Whabouchi project that could constitute sources of impacts on the soils during the closure phase are the following:

- Management of residual materials, hazardous materials and fuels
- Use, maintenance and circulation of heavy machinery and vehicles
- Site rehabilitation
- Dismantling of the infrastructures and installations

6.5.2.2 Description of the Impacts

Sites Clearing and Preparation (Excavation, Stripping, Backfilling, Blasting and Overburden Management)

The clearing and preparation work required for the construction of the infrastructures and facilities (waste rock and tailings pile, concentrator, pit, sedimentation basins, etc.) could increase the vulnerability of soil to erosion. Effectively, the removal of topsoil increases the risk of erosion by runoff, notably along the streams. Also, the stripping, excavation and filling activities rework the soil, thus increasing the possibility of erosion. Erosion can be caused by water, wind and the circulation of vehicles on the site.

Construction of the Temporary and Permanent Infrastructures and Facilities

The construction of permanent infrastructures and facilities, particularly the sedimentation basins near Lac des Montagnes, can increase the possibility of contamination of soils and water. The design of these facilities will take into account the nature and the permeability of the surface material, among other factors.

Borrow pits will be necessary to supply the required material for the construction of service roads on the site and for the raising of sedimentation basins dikes. Operating such borrow pits alters the characteristics of soils due to the displacement of large volumes of granular materials. However, no new borrow pits should be necessary. Nemaska Lithium will purchase its materials from a local supplier or will extract them from existing authorized borrow pits.

Management of Residual Materials, Hazardous Materials and Fuels

The management of residual materials, hazardous materials and fuels constitutes another source of impact on soils. Effectively, contamination of the soils by hydrocarbons or other contaminants is possible during their handling or as a result of localized spills. A contamination of soils can also occur during the transport, storage or use of chemicals at the concentrator.

Use, Maintenance and Circulation of Heavy Machinery and Vehicles

The circulation of heavy machinery and vehicles on the mine site can result in changes in the physical characteristics of the soil, notably by increasing compaction and erosion. It can also mobilize fine particles. Also, accidental spills can happen during the use, maintenance and fueling of the heavy machinery and vehicles, thus causing a localized contamination of the soil.

6.5.2.3 Description of the Mitigation Measures

Construction Phase

In order to limit the impact of the project on soils during the construction phase, the following mitigation measures will be implemented:

- When possible, carry out the work on frozen or solid ground to limit compaction and rutting
- When possible, avoid excavation work under heavy rainfall so as to limit erosion
- Use machinery and equipment that are adapted to ground conditions so as to reduce the physical disturbances
- If necessary, stabilize erosion-prone slopes of excavations and fills
- Limit the circulation of heavy machinery and vehicles to approved areas (e.g. service roads and work areas) so as to reduce the surface area of disturbed soil
- Clearly identify the limits beyond which heavy machinery and vehicles may not travel
- Limit to 30 km/h the speed of vehicles on the mine site so as to reduce erosion and dust
- Inasmuch as possible, use abrasives rather than melting salts in winter, and in summer, use water as dust reducers
- Stockpile the overburden for reuse in the reclamation of impacted areas during the restoration of the site

The following mitigation measures will be applied to limit the risk of accidental spills and their consequences on the soils:

- Provide specific locations for the storage of heavy machinery, vehicles and equipment
- Ensure that the heavy machinery, vehicles and equipment are in proper operating order (adequate maintenance)
- Perform the maintenance of heavy machinery and vehicles in the facilities provided for this purpose (garage)
- Minimize the number of fueling points
- Provide confinement systems in the storage areas to contain leaks or accidental spills
- Develop a prevention and intervention plan in case of accidental spills or leaks of hazardous substances
- Provide emergency oil and hazardous materials recovery kits (absorbents and appropriate containers) in strategic locations of the site (quick and easy access)
- Train the employees on quick, effective and safe intervention in case of a leak or accidental spill of oil products or hazardous materials
- Dispose of residual materials according to appropriate procedures

Operation Phase

The impact sources mentioned earlier for the construction phase, i.e. sites clearing and preparation, management of residual materials, hazardous materials and fuels, as well as the use, maintenance and circulation of heavy machinery and vehicles, constitute sources of impacts on the soil that will continue during the operation phase. The following additional sources of impacts will be introduced:

Presence and operation of the infrastructures and buildings

An increase in the flow of Creek C due to the discharge of runoff from the waste rock and tailings pile could increase erosion on the banks of this creek. Although this problem is not anticipated, timely corrective measures will be implemented should erosion problems arise.

Extraction, storage and processing of the ore

The development of the pit will require the displacement of large volumes of materials, which will have an impact on soils.

In addition to the mitigation measures provided for the construction phase, the following will be implemented to limit the impacts of the project on soils during the operation phase:

- Ensure regular maintenance of the service roads and work areas
- Carry out periodic maintenance and inspections to ensure the proper condition of the storage tanks and containers used to stock oil products and hazardous materials.

Closure Phase

The sources of impact described above for the construction and operation phases, i.e. the management of residual materials, hazardous materials and fuels, as well as the use, maintenance and circulation of heavy machinery and vehicles will continue during the closure of the mine site. The following additional sources of impacts will be introduced:

Site rehabilitation

The progressive rehabilitation of the waste rock and tailings pile and the rehabilitation of the mine site as a whole, particularly the revegetation and remodeling, will limit erosion and infiltrations in the soil. Globally, the rehabilitation of the site aims to restore the soils to the condition they were in before the project.

This rehabilitation activity therefore has a positive impact on soils, since it promotes the reestablishment of vegetation in areas where the soil was barren.

Dismantling of the infrastructures and installations

The dismantling of the infrastructures and installations actually has a positive impact on soils, as the surfaces that were previously occupied by buildings, for example, will be cleared. The removal of the infrastructures and facilities will allow the restoration of soils to its initial condition before the project.

In addition to the mitigation measures provided for the construction and operation phases, the following will be implemented to limit the impacts of the project on soils during the closure phase:

- Use indigenous plant species (e.g. black spruce and/or jackpine seedlings) in the revegetation of, among others, the waste rock and tailings pile and the overburden pile.
- Smooth and stabilize the slopes of excavated and backfilled areas
- Spread topsoil over the site

6.5.2.4 Significance of the Residual Impact

The social value of this component is low, as the soil is not highly valued and/or used directly by the population. The ecosystemic value of the component is also low, as its protection is not a subject of concern. Therefore, the value of this component is low.

Following the application of the mitigation measures, the significance of the residual impact on soils is considered low. The intensity of the impact is considered low since, among others, the site rehabilitation activities will be ongoing during the entire life of the project. More specifically, these activities will allow the restoration of the vegetation cover.

The nature of the impact on the soils is negative. The frequency of the impact is considered intermittent in the sense that the possible disturbances associated with leaks and or spills of petroleum products and chemicals will be isolated events. Also, the soil erosion and compaction caused by certain activities are considered as continuous impacts, since the soils will be altered for the entire duration of the project. The extent of the impact is considered punctual, since the physical and/or chemical modifications of the soil and surface deposits will be limited to the location of the infrastructures and facilities. The duration of the soil alteration is considered medium, since it extends over the three phases of the project, from construction to closure of the mine. This impact is reversible, however, as a restoration of the soil is planned at the end of the project.

Table 6-22 presents the values assigned to each indicator and the resulting significance of the residual impact.

Table 6-22 Significance of the Residual Impact – Soils

Intensity	Extent	Duration	Significance of the Residual Impact
High	Regional	Long	High
Moderate	Local	**Medium**	Moderate
Low	**Punctual**	Short	**Low**

6.6 Hydrogeology and Groundwater Quality

6.6.1 Description of the Environment

The hydrogeological data were acquired during the fieldwork completed in 2011 (WESA-Envir-Eau, 2012a) and 2012 (Qualitas, 2012). Little data about the hydrogeological characteristics of the site was available before these studies. Map 6-5 shows the location of the observation wells used to investigate the hydrogeological context.

The field data were used in a hydrogeological modeling study for the purpose of estimating the pit dewatering flow and the radius of influence of the pumping activities (Richelieu Hydrogéologie, 2012). The results of the fieldwork and modeling give a picture of the hydrogeological conditions at the project site and outline potential impacts on groundwater. The report on the hydrogeological modeling (Richelieu Hydrogéologie, 2012) is presented in Appendix 6-5.

6.6.1.1 Hydrogeological Context

In the study area, groundwater is found in the voids between the grains of the silt, sand and gravel that compose the unconsolidated deposits, and in the network of fractures and interstices in the Precambrian bedrock.

Due to the thinness of the unconsolidated deposits (with local exceptions), the aquifer contained therein is considered as very localized and discontinuous, while the aquifer constituted by the network of bedrock fissures is considered of regional extent.

In general, the piezometric surface conforms to the surface topography. Recharge is mainly by infiltration of precipitations on the hillcrests, while drawdown is by the surface water courses that drain the valleys toward the Nemiscau River, Lac des Montagnes and Lac du Spodumène. The groundwater flow velocity is controlled by the geological structures and by the granulometry of fine particles in the unconsolidated deposits (regional and local faults, geologic contacts and, locally, permeable unconsolidated deposits). Finally, the quality of the groundwater is characterized by a pH that varies from slightly acidic to alkaline, and a total dissolved solids content varying from low to intermediate. The natural concentrations of copper, zinc and mercury exceed the usage criteria for seepage into surface water and/or the warning threshold for surface water.

6.6.1.2 Hydraulic Properties

Table 6-23 presents the hydraulic conductivities measured in the boreholes drilled during the 2011 field campaign. The hydraulic conductivity of the bedrock varies between 1×10^{-8} m/s and 8.5×10^{-6} m/s, with a geometric average of 4.7×10^{-7} m/s. As for the till, it presents a hydraulic conductivity of the order of 1×10^{-6} m/s. An analysis of the data also shows that the hydraulic conductivity tends to diminish with depth, as can be seen in the bedrock quality data

(Journeaux, 2011). Finally, the examination of the data did not associate the hydraulic conductivity with the lithological units observed on the property.

Table 6-23 Hydraulic Conductivity Measured in the Observation Wells

Well	UTM East (m)	UTM North (m)	Depth (m)	Hydraulic Conductivity (m/s)	Intersected Unit
PO-1R	442435	5726938	20.45	1.00×10^{-07}	Weakly fractured basalt
PO-1S	442435	5726945	16.75	1.55×10^{-06}	Till
PO-2R	442203	5726561	8.25	5.48×10^{-07}	Weakly fractured basalt
PO-3R	442109	5726624	5.18	Not measured	Fractured pegmatite
PO-4R	441350	5726489	8.45	8.55×10^{-06}	Fractured basalt
PO-5R	441498	5726653	5.5	7.74×10^{-06}	Fractured pegmatite
PO-6S	440511	5725210	1.83	Not measured	Till
PO-7R	440595	5725288	2.59	1.41×10^{-07}	Weakly fractured metamorphosed basalt
PO-8R	441594	5726071	51.0	1.50×10^{-06}	Pillowed basalt
PO-9R	440865	5726243	11.5	Not measured	Weakly fractured metamorphosed gabbro
PO-9S	440859	5726275	3.0	3.11×10^{-06}	Till
PO-10R	440827	5726804	4.6	3.08×10^{-06}	Till and granite / meta-sediments
PO-11R	440651	5726817	4.9	1.83×10^{-07}	Till and pegmatite/granite/basalt
PO-12R	439819	5726529	9.0	6.74×10^{-06}	Granite
PO-13R	439557	5726118	6.7	1.30×10^{-06}	Sand and granite
PO-14R	440900	5725725	102.0	8.00×10^{-08}	Basalt and pegmatite
PO-15R	441042	5725825	102.0	3.00×10^{-07}	Basalt and pegmatite
PO-16R	440959	5726071	51.0	2.00×10^{-06}	Gabbro and pegmatite
PO-17-1	441227	5725917	152.5	6.00×10^{-08}	Very weakly fractured basalt
PO-17-2	441227	5725916	95.0	6.00×10^{-07}	Very weakly fractured basalt
PO-18-1	441065	5725851	183.0	1.00×10^{-08}	Very weakly fractured basalt / pegmatite
PO-18-2	441066	5725851	120.0	7.00×10^{-08}	Very weakly fractured basalt
PO-19	441140	5725588	1.5	Not measured	Peat
PO-20	441314	5725739	1.83	Not measured	Peat
PO-21	441821	5726080	1.5	Not measured	Peat
PP	441111	5725688	158.5	2.10×10^{-06}	Fractured basalt / pegmatite

6.6.1.3 Groundwater Flow

Table 6-24 presents the piezometric elevations measured in October and November 2011, and again in May and July 2012. The annual fluctuation reaches an average amplitude of 1.7 m between the recharge periods (October, November and May) and the drawdown periods (July). Map 6-6 shows the piezometric level of the aquifer contained in the bedrock, as interpreted by the modeling carried out with the measured data.

At locations where nests of observation wells were installed, the vertical hydraulic gradient can be measured. Thus, the measurements taken in wells PO-1R/PO-1S and wells PO-17-1/PO-17-2 show a downward flow, while in wells PO-09R/PO-09S, the interpreted direction of the flow is toward the surface. The topographic situation of these well nests allows us to deduce that the topographic highs are recharge areas, while the valleys are groundwater drawdown areas. Map 6-7 shows the aquifer recharge and drawdown zones, with estimated flows obtained by modeling and meteorological statistics.

Table 6-24 Water Level Measured in the Wells in 2011 and 2012

Well	Surface Elevation (m)	October 2011 (m)	November 2011 (m)	May 2012 (m)	July 2012 (m)
PO-1R	298.77	284.23	282.77	284.57	285.27
PO-1S	298.50	292.82	293.00	294.40	294.13
PO-2R	291.71	287.77	287.91	289.64	289.19
PO-3R	295.39	292.92	293.11	294.71	294.31
PO-4R	297.90	293.68	293.77	294.90	294.92
PO-5R	293.36	291.77	291.81	293.11	293.11
PO-6S	283.70	281.80	281.80	283.00	283.12
PO-7R	284.15	281.88	281.69	283.05	283.44
PO-8R	292.60	286.74	289.48	290.45	290.62
PO-9R	295.55	290.74	290.08	291.90	292.38
PO-9S	291.91	290.32	290.12	291.46	291.52
PO-10R	290.64	288.96	288.48	289.59	290.14
PO-11R	288.50	286.99	287.87	287.80	288.03
PO-12R	281.48	277.52	277.28	278.38	278.87
PO-13R	279.51	277.05	277.03	278.26	278.20
PO-14R	301.16	289.20	289.32	290.11	290.34
PO-15R	302.90	292.57	293.09	294.55	294.79
PO-16R	313.60	310.41	310.41	312.35	312.34
PO-17-1	300.81	291.26	293.06	293.46	293.46

Well	Surface Elevation (m)	October 2011 (m)	November 2011 (m)	May 2012 (m)	July 2012 (m)
PO-17-2	300.86	291.59	293.76	293.64	293.53
PO-18-1	303.06	296.75	297.64	296.61	295.10
PO-18-2	303.17	296.72	297.69	297.02	295.10
PO-19	286.59	285.54	285.49	286.47	286.48
PO-20	286.45	285.53	285.55	286.35	286.36
PO-21	284.83	283.73	283.77	284.81	284.82
PP	288.22	282.72	283.29	Not measured	Not measured

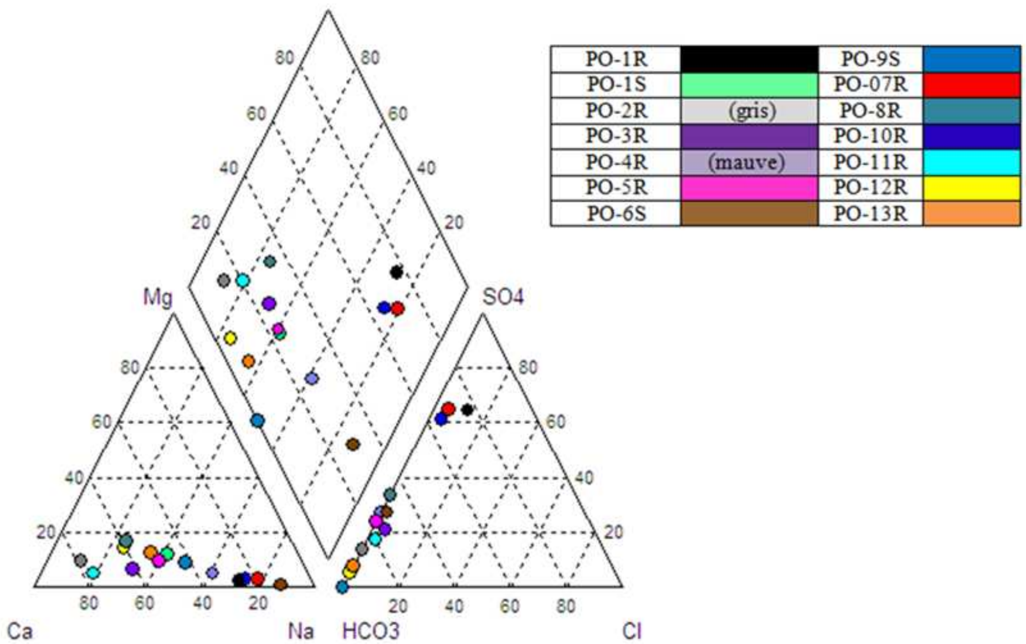
6.6.1.4 Groundwater Quality

Groundwater samples were collected in October 2011, November 2011, March 2012 and July 2012 in 21 wells intercepting units in the unconsolidated deposits and bedrock. The main observations from the sampling campaign are as follows:

- The water in six of the wells is of the sodium bicarbonate type ($Ca-HCO_3$), typical of young, recently infiltrated water. In three of the wells, the water is of the sodium-calcium bicarbonate type ($Ca-Na-HCO_3$), indicative of a slightly longer presence. Finally, the water in three of the wells is of the sodium sulfate type ($Na-SO_4$), which indicates that the samples had a relatively longer travel duration since their infiltration.
- The concentration of analyzed chemical components in each well varies over time between 2 to 10 times.
- The average pH of the groundwater is 6.71, while the average electrical conductivity is 120 µS/cm and the average temperature of 8.67^{o}C.
- Traces of C_{10}-C_{50} hydrocarbons are observed in several wells. These hydrocarbons could be attributable to the use of grease during the drilling, as no potential source of contamination was present at the surface.
- Exceedances of the warning thresholds set at half the criteria for seepage in groundwater are observed in the concentrations of aluminum (2 instances), silver (1 instance), copper (25 instances), zinc (9 instances) and mercury (12 instances).

All the water analyzes results available to this date are presented in Appendix 6-7, while the plot in Figure 6-10 is a Piper diagram of the types of water that were encountered.

Figure 6-10 Piper Diagram of Groundwater



6.6.1.5 Users of the Resource

The surveys identified no groundwater user within a 1 km radius from the project site.

6.6.1.6 Groundwater Classification

The groundwater was classified according to the procedure described by the MDDEFP in the *Guide de classification des eaux souterraines du Québec* (MDDEFP, 1999). Table 6-25 presents the water classification and its definitions.

Table 6-25 Classification of Groundwater According to Potential Uses or Vulnerability

Class	Keywords
I	Highly vulnerable and irreplaceable for a substantial population or one that is ecologically vital.
II A	Actual source of drinking water.
II B	Potential source of drinking water.
III A	Not a source of drinking water; intermediate to high degree of hydraulic connection; poor quality; not purifiable or insufficient potential quantity; cannot be considered as a valid economical substitute to all or part of the current source of supply.
III B	Not a source of drinking water; low degree of hydraulic connection; poor quality; cannot be purified.

Table 6-26 presents the results of the groundwater classification and their justification. On the basis of current knowledge, the groundwater contained in the glacial deposits of glacial origin would be Class III due to the relatively low permeability of the deposits, their limited thickness and their discontinuity. The insufficient quantity of water justifies this classification. The ground water contained in organic deposits is also Class III for the same reasons, in addition to being of insufficient quality for drinking purposes.

The groundwater contained in the network of bedrock fractures would correspond to Class II. Effectively, although the permeability is weak to medium, the significant thickness of the aquifer means that it may be possible to install a groundwater catchment. Also, the quality of the groundwater is adequate, though it might require treatment to make it potable.

Table 6-26 Groundwater Classification

Hydrogeological Unit	Class	Justification
Glacial unconsolidated deposits	III	Low permeability; discontinuous
Organic deposits	III	Low permeability; poor quality
Bedrock fractures network	II	Potential for catchment and treatment

6.6.1.7 Vulnerability of the Groundwater

The groundwater vulnerability index reflects the risk of contaminating the water by human activity. The MDDEFP refers to the DRASTIC method to evaluate this index. This method, which consists in a system of numerical grading system, is described in detail by document EPA/600-2-87-035 (Aller, 1987).

Table 6-27 shows the results of the assessment of the aquifer made by the DRASTIC method, according to the data collected by the hydrogeological investigations. These results show a vulnerability index of 136, typical of a vulnerable groundwater aquifer since the DRASTIC index is above 100.

Table 6-27 Vulnerability Index of the Fractured Aquifer

DRASTIC Parameter	Evaluation	Grade	Weighting	Weighted Grade
Groundwater depth	4 metres	9	5	45
Recharge	Approximately 160 mm/year	6	4	24
Aquifer	Granite , basalt	4	3	12
Soil	Silty till	6	2	12
Topography	Less than 2%	10	1	10
Vadose zone	Silty till	6	5	30
Hydraulic conductivity	$K = 3.2 \times 10^{-4}$ cm/sec	1	3	3
DRASTIC index				136

6.6.2 Impacts Assessment

6.6.2.1 Identification of the Impact Sources

The main project activities susceptible of constituting sources of impact on the groundwater during the construction, operation and closure phases are:

Construction Phase

- Sites clearing and preparation (excavation, stripping, backfilling, blasting and overburden management)
- Water management (runoff, drinking water, wastewater, etc.)
- Management of residual materials, hazardous materials and fuels
- Use, maintenance and circulation of heavy machinery and vehicles

Operation Phase

- Sites clearing and preparation (excavation, stripping, backfilling, blasting and overburden management)
- Presence and operation of the infrastructures and buildings
- Extraction, storage and processing of the ore
- Water management (runoff, drinking water, wastewater, etc.)
- Management of residual materials, hazardous materials and fuels
- Use, maintenance and circulation of heavy machinery and vehicles
- Progressive rehabilitation of the waste rock and tailings pile

Closure Phase

- Water management (runoff, drinking water, wastewater, etc.)
- Management of residual materials, hazardous materials and fuels
- Use, maintenance and circulation of heavy machinery and vehicles
- Site rehabilitation
- Presence of remnants on the site

The main impacts on groundwater resulting from these activities are described in the following paragraphs. The impacts of the project on groundwater are mainly of two types, i.e. impacts on groundwater quality, and impacts on the groundwater flow regime.

6.6.2.2 Description of the Impacts and Mitigation Measures

Construction Phase

During the construction, various activities will be carried out on the site and could influence the groundwater quality or flow regime.

Sites Clearing and Preparation (Excavation, Stripping, Backfilling, Blasting and Overburden Management)

The deforestation, clearing and stripping activities will impact mainly the rate of infiltration in the soil. The plant cover will be reduced, as well as the thickness of unconsolidated deposits in certain areas. Therefore, the infiltration of water toward the aquifer will tend to increase.

Water Management (Runoff, Drinking Water, Wastewater, etc.)

During the construction phase, a well will be installed to supply freshwater to the concentrator. This will have a local influence and will result in a drawdown proportional to the volume of pumped water. The construction of roads and ditches could also modify very locally the position of the water table.

Management of Residual Materials, Hazardous Materials and Fuels

Another potential impact on the quality of groundwater relates to the presence of a petroleum product storage area and of a mechanical shop. Effectively, notwithstanding the implemented measures, these facilities could contaminate the groundwater as a result of leaks of oil products or various other materials if such leaks are not contained rapidly.

Finally, another potential source of groundwater alteration is the infiltration in the aquifer of potentially contaminated water from the pit when it is flooded at the end of the project. Effectively, as long as the pit is in operation, it will constitute a focus for the convergence of groundwater. When the operations cease, groundwater will continue to converge in the pit until the water level in the pit reaches equilibrium with the ambient piezometry, at an elevation of approximately 288.5 m. From that time on, potential contaminants in the pit could flow with the groundwater into the hydrographical network.

Use, Maintenance and Circulation of Heavy Machinery and Vehicles

The quality of the groundwater could be modified by the use of heavy machinery, and by the storage and handling of fuel and other potential contaminants. The use, maintenance and circulation of such equipment will release certain substances in the environment. The stripping and reworking of soil by machinery could also facilitate the infiltration in the groundwater of potential contaminants such as those involved in the use of heavy machinery. The possibility of leaks or accidental spills will increase the risk of contaminating groundwater with hydrocarbons or other contaminants. In the case of the application of dust reducers or de-icing salts on the roads, such products could increase the turbidity and salinity of the runoff, part of which could infiltrate the soil and reach the groundwater, particularly in the case of superficial, unprotected granular hydrogeological systems. However, considering that the use of de-icing salts will be limited and taking into account the dilution and dispersion phenomena, it is unlikely that the salinity of groundwater would increase significantly.

To limit the impact of the project on the groundwater during the construction phase, the following mitigation measures will be implemented to limit the risk of accidental spills and their consequences on the groundwater:

- Provide specific locations for the storage of heavy machinery, vehicles and equipment
- Ensure that the heavy machinery, vehicles and equipment are in proper operating order (adequate maintenance)
- Perform the maintenance of heavy machinery and vehicles in the facilities provided for this purpose (garage)
- Minimize the number of fueling points
- Provide confinement systems in the storage areas to contain leaks or accidental spills
- Develop a prevention and intervention plan in case of accidental spills or leaks of hazardous substances
- Provide emergency oil and hazardous materials recovery kits (absorbents and appropriate containers) in strategic locations of the site (quick and easy access)
- Train the employees on quick, effective and safe intervention in case of a leak or accidental spill of oil products or hazardous materials
- Dispose of residual materials according to appropriate procedures

Operation Phase

During the operation phase, all the impacts sources listed for the construction phase will be present, in addition to the sources presented below:

Presence and Operation of the Infrastructures and Buildings

The operation in the pit and the emplacement of the waste rock and tailings pile are the two main infrastructures from which potential impacts on hydrogeology and groundwater quality are apprehended.

According to the geochemical characterization tests performed to date, part of the waste rock would be leachable in the sense of Directive 019. However, nearly half of the waste rock presents a low risk. Before deciding whether the waste rock is leachable or not, the rate of infiltration in the waste rock and tailings pile was estimated. Assuming that the maximum infiltration flow per surface unit corresponds to the annual precipitation, i.e. approximately 800 mm/year per surface unit, the daily infiltration rate would be 2.1 l/m^2. Considering the runoff and evapotranspiration phenomena that will occur at the surface of the pile, it is more likely that the actual infiltration rate will be half this estimate. Therefore, the infiltration rate in the waste rock and tailings pile is below the maximum daily value of 3.3 l/m^2 that corresponds to the Level A imperviousness values specified in Directive 019 for the protection of groundwater. Thus, no impact on groundwater is anticipated from the presence of the waste rock and tailings pile.

The exploitation of the deposit will require the excavation of a open pit that will gradually increase in depth. The pumping required to dewater this pit will cause an important drawdown of the water table, which could have impacts on the surrounding hydrographical network and wetlands. To evaluate these impacts, a numerical flow model was developed, incorporating the hydrogeological properties obtained from the fieldwork. These studies are presented in Appendix 6.5. The simulations projected the piezometry and the drawdown around the open pit, as well as the rate of seepage that will have to be pumped to keep the excavation dry. The detail of the modeling work is presented in the report prepared by Richelieu Hydrogéologie inc. (2012).

Map 6-8 presents the drawdown after 18 years of operation, at the end of the exploitation, when the pit reaches an elevation of 117.5 m. The drawdown area would reach a distance of 990 m along the longitudinal axis of the pit, and 727 m along the transverse axis. Including the pit, the total area of the drawdown zone would reach 3.6 km², including approximately 0.75 km² of wetlands located southeast of the pit. According to the hydrogeological model, the rate of groundwater seepage in the pit would be of the order of 2,075 m³/day. Compared to the results of the simulation of initial flow conditions, the hydrographical network would lose approximately 115 m³/day of inflow into the aquifer, which would be diverted toward the pit.

The surface streams that could be affected by the drawdown caused by the pit are Lac du Spodumène and its outlet, Creek D, as well as Creek C. In the case of Lac du Spodumène and Creek D, WESA estimated the low-water flow for a two-year recurrence over seven consecutive days (Q2-7) at 352 l/s or 30,400 m³/day. The Q2-7 low-water flow in Creek C was considered inexistent by WESA (2012a). If the mean specific discharge is applied to this creek, its low-water flow would be of the order of 5.4 l/s or 463 m³/day. It is therefore possible to assume that Lac du Spodumène and Creek D would not feel any impact. As for Creek C, the impact could correspond to a loss of approximately one third of its theoretical low-water flow. This apprehended impact is probably the worst case, as the model does not consider the inflow from the discharge of treated effluent in Creek C.

<u>Extraction, Storage and Processing of the Ore</u>

Geochemical characterization tests were performed on the ore. The spodumene pegmatite leaches copper under TCLP test conditions. However, drainage ditches will be dug around the site of industrial activities to collect runoff or seepage water.

The mitigation measures related to the alteration of groundwater quality by waste rock and tailings storage will comply with the MDDEFP Directive 019 for the mining industry. These measures are the following:

- Implement measures to collect and manage water entering in contact with the tailings, including drainage water from the mine and the waste rock and tailings pile
- Manage the runoff from the ore stockpile and the related activities near the concentrator and the garage, using a runoff collection network comprising drainage

ditches around the areas and pipes to transfer the collected water to the sedimentation ponds.

The mitigation measures applied to reduce potential impacts on groundwater resulting from the use and maintenance of machinery or from the storage and handling of hazardous substances and fuels are the same as those described for the protection of soils and unconsolidated deposits. They are summarized below:

- Limit the circulation of heavy machinery and other mobile equipment to the access roads and work areas
- Use abrasives rather than de-icing salts in winter
- Perform maintenance of heavy machinery and vehicles at the sites provided for this purpose
- Design the maintenance areas so as to avoid contamination of the environment in case of leaks or accidental spills
- Install hydraulic confinement works after flooding the pit, if required

6.6.2.3 Significance of the Residual Impact

The social value of the component is low, since it is not used much by the local population. Its ecosystemic value is moderate, as the component plays a non-negligible role in the ecosystem. Therefore, the value of this component is low.

After application of the mitigation measures, the significance of the residual impact on the hydrogeology and quality of the groundwater is considered as moderate. The intensity of the impact of mine dewatering on the groundwater is low, notwithstanding the extent of anticipated drawdown, as it would be possible to compensate the losses in the hydrographical network with treated process water. The intensity of the impact of the waste rock and tailings pile will also be low, considering the limited flow and the expected leaching rate.

The nature of the impact on the hydrogeology and groundwater quality is negative. The frequency of the impact is continuous, as it will last for the entire life of the project. The geographic extent of the impact is considered local, as it will be circumscribed within the study area or in specific portions thereof. Effectively, the extent of the anticipated drawdown will be limited to a few hundred metres. The duration of the impact is considered a long, as it will be felt beyond the life of the mine. It is a reversible impact, however, since the environment will return to equilibrium after the end of the project.

Table 6-28 presents the values assigned to each indicator and the resulting significance of the residual impact.

Table 6-28 Significance of the Residual Impact – Hydrogeology and Groundwater Quality

Intensity	Extent	Duration	Significance of the residual impact
High	Regional	**Long**	High
Moderate	**Local**	Medium	**Moderate**
Low	Punctual	Short	Low

6.7 Hydrology

6.7.1 Description of the Environment

The hydrology of the study area is characterized by the presence of many lakes, wetlands, rivers and streams. The project site is surrounded by water bodies, the most important of which are Lac des Montagnes, Lac du Spodumène and the Nemiscau River. Photo 6-1 is an aerial view of the site, looking north.

6.7.1.1 Description of the Watersheds

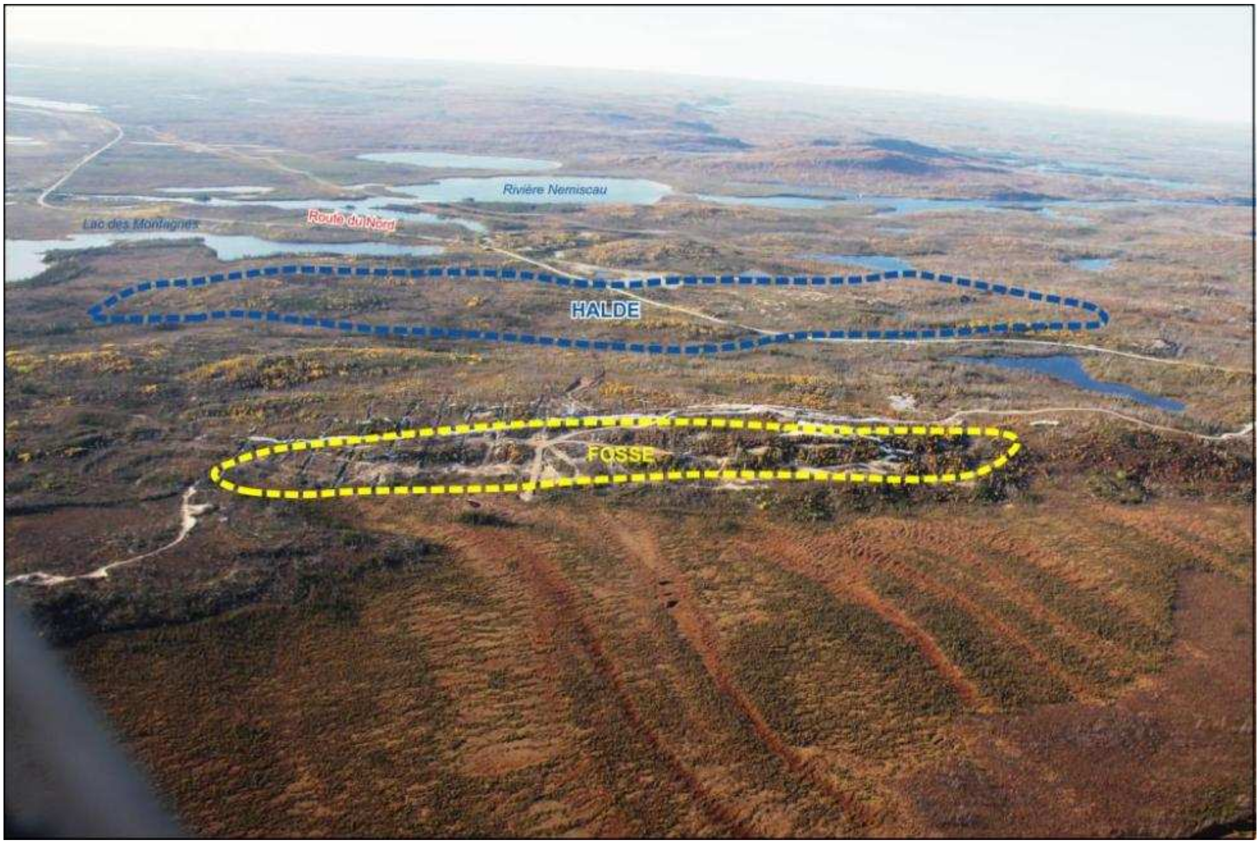
The identification and characterization of the streams and watersheds were carried out with topographic and thematic maps, elevation models (DEM), aerial photographs and field visits. The boundaries of the watersheds in the course of the streams located within the claims (1,716 ha) held by Nemaska Lithium were obtained by processing and analyzing topographic data from a LIDAR survey.

The mine site is located within the Rupert River watershed. This watershed covers a surface area of 43,400 km^2 and flows from east to west in direction of Rupert Bay. Upstream of the mine site, the watershed of the Nemiscau River, a tributary of the Rupert River, covers a surface of approximately 2,000 km^2. The confluence of the Nemiscau and Rupert rivers is located about 70 km downstream of the mine site.

More specifically, the mine site is located on the eastern shore of Lac des Montagnes, a lacustrine widening of the Nemiscau River. This 1,375 ha lake is the largest water body in the vicinity of the mine site. Lac du Spodumène, southeast of the site, is the second significant body of water in the area, with a surface area of 61 ha.

The hydrographical network in the immediate vicinity of the mine site comprises five streams, identified as Creeks A, B, C, D and E (map 6-9). These are shallowly incised streams with generally slow natural flow. The streams in watersheds BV1 and BV2 discharge in the Nemiscau River, while the three other creeks flow into Lac des Montagnes (watersheds BV3 to BV5).

Photo 6-1 Aerial View Looking North



Watershed 1 (BV1) has a surface of 1.6 km^2. Within the BV1 watershed, the estimated length of the main stream, Creek A, is 2,228 m with a mean gradient of 1.5% westward, in direction of the Nemiscau River. The hydrographical network of watershed BV1 comprises three lakes (approximately 4.3% of the surface of BV1): one main and two other smaller lakes. The surface area of the main lake (Lake 1) is approximately 6.4 ha. The two other lakes (23 and 24) have superficies of 3 ha and 2.1 ha. Also, a 2.8 ha wetland (1.7% of the surface of BV1) occupies the northern part of BV1. BV1 presents two flow pathways. The first origins from Lake 1, which drains through Creek A over a distance of approximately 1,030 m before reaching a second flow pathway. The latter one, approximately 106 m long, has its origin in a small body of water downstream of the wetland extending north of BV1.

Watershed 2 (BV2) has a surface of 2.6 km^2. The length of BV2 is estimated at 3,268 m with a mean gradient of 1.8% northwestward. The BV2 hydrographical network comprises two water bodies (Lakes 5 and 6) that occupy 1.9% of the total area of the watershed. Lake 5 has a surface area of approximately 1.7 ha, while Lake 6 area is approximately 3.3 ha. The latter one drains toward a second 261 m stream, which in turn drains Lake 5 before flowing in the Nemiscau River.

Watershed 3 (BV3), the largest of the five watersheds, is drained by Creek D and covers a surface area of approximately 95.6 km^2. The BV3 hydrographical network comprises several water bodies and streams of variable superficies and lengths, covering approximately 7.8% (75 ha) of the watershed total area. BV3 includes Lac du Spodumène (61 ha) and Creek D, flowing over a distance of 21 km. The wetlands, essentially concentrated downstream of Lac du Spodumène, total nearly 9.1% of the watershed surface area.

Watershed 4 (BV4) occupies a surface of 2.1 km^2, with a length estimated at 3,187 m and a mean gradient of 1%. Its hydrographical network includes Lake 2, with a surface area of approximately 5 ha. This lake covers 2.4% of the total area of BV4. Lake 2 drains through Creek C, which flows over a distance of approximately 2.4 km.

Watershed 5 (BV5) is the smallest of the five and is drained by Creek B; it covers an area of 0.8 km^2. The length of Creek B is estimated at approximately 1.4 km with a mean gradient of 2.2%. The BV5 hydrographical network comprises two lakes (Lakes 27 and 28), which cover 1.1% of the total area of the watershed.

6.7.1.2 Stream Flows

The flows in the streams on the project site were estimated from data obtained from the following four sources (WESA, 2012b):

- Centre d'expertise hydrique du Québec
- Water Survey of Canada
- Hydro-Québec
- Field measurement campaign

Data from the hydrometric stations installed and monitored by the MDDEFP were used to evaluate the low-water flows and the average flows of the streams on the project site. Three methods were used to estimate these flows; they are presented in the *Guide sommaire des méthodes d'estimation des débits d'étiage pour le Québec* (CEHQ, 2012). As recommended by this guide, the following assumptions were made:

- In watersheds smaller than 5 km^2, the low-water flow is theoretically null;
- For watersheds where no sampling station exists (which is the case for all the streams on the project site), the specific flow calculated at the existing hydrometric stations are transposed to the on-site streams in proportion to the surface area of the watershed;
- To estimate the flood flow, the rational method was applied to watersheds smaller than 25 km^2. In the case of the watershed of Creek D (outlet of Lac du Spodumène), i.e. BV3, the original method developed by Anctil and coll. (1998) was used (WESA, 2012b). The low water flow and annual average flow in the main streams of the site are presented in Table 6-29, while the flood flows in the same streams are presented in Table 6-30.

Table 6-29 Low-Water and Mean Annual Flow in the Main Streams on the Site

Watershed	Area (km^2)	Main Water Body	Low-Water Flow (l/s)			Mean Annual Flow (l/s)
			$Q_{2,7}$	$Q_{10,7}$	$Q_{5,10}$	
BV1	1.6	A	0	0	0	28.2
BV2	2.6	Lake 6	0	0	0	45.8
BV3	95.6	D	513	402	452	1,826.0
BV4	2.1	C	0	0	0	37.0
BV5	0.8	B	0	0	0	14.1

Table 6-30 High Water Flow in the Main Streams on the Site

Watershed	Main Water Body	Flood Flow (l/s) by Return Period						
		2	5	10	20	25	50	100
BV1	A	700	1,000	1,200	1,400	1,500	1,600	1,800
BV2	Lake 6	1,500	2,000	2,400	2,800	2,900	3,200	3,600
BV3	D	30,000	37,200	41,500	45,300	46,400	49,700	52,800
BV4	C	900	1,300	1,500	1,800	1,800	2,100	2,300
BV5	B	600	900	1,000	1,200	1,200	1,400	1,500

The bathymetric survey of the lakes and Nemiscau River was carried out with a boat equipped with a Garmin Model 178c GPS/Sonar instrument. The depth measurements were logged at regular intervals (varying between one and five seconds, depending on the area of the lake) along transects spaced by about 10 m. The transects covered the entire surface of the lakes.

The bathymetric data were mapped using the ArcGIS 9.2 software, including morphometric and volumetric analyzes of each lake and of the Nemiscau River. Thus, in addition to the total area, maximum depth and perimeter, the surface area and the volume of water were computed for each lake and for the Nemiscau River (see the bathymetric curves in the appended maps).

6.7.2 Impacts Assessment

6.7.2.1 Identification of the Impact Sources

Construction Phase

- Sites clearing and preparation (excavation, stripping, backfilling, blasting and overburden management)
- Water management (runoff, drinking water, wastewater, etc.)
- Construction of the temporary and permanent infrastructures and facilities

Operation Phase

- Sites clearing and preparation (excavation, stripping, backfilling, blasting and overburden management)
- Extraction, storage and processing of the ore
- Water management (runoff, drinking water, wastewater, etc.)

Closure Phase

- Water management (runoff, drinking water, wastewater, etc.)
- Site rehabilitation

6.7.2.2 Description of the Impacts and Mitigation Measures

Construction Phase

Sites Clearing and Preparation (Excavation, Stripping, Backfilling, Blasting and Overburden Management)

The sites clearing and preparation, notably the excavation and grading work, will modify the runoff coefficients on the mine site. Paved or stripped surfaces, necessary for the construction of the infrastructures and facilities (waste rock and tailings pile, overburden pile, etc.) are favorable to increased runoff. This increased runoff can result in greater water inflow in certain water bodies and streams on the mine site. An area of approximately 165 ha will be deforested during the construction phase (including both phases of the development of the waste rock and tailings pile).

The preparation of the site also requires modification of the watersheds. The BV4 and BV5 watersheds will be affected mainly by the presence of the waste rock and tailings pile and by the pit. Table 6-31 presents the surface areas of the watersheds before and after construction of the infrastructures. Map 6-10 shows the new watersheds.

Table 6-31 Identification of the Watersheds Affected by the Presence of Mine Infrastructures

Watershed	Initial area (ha)	Final area (ha)	Affected percentage
BV4	209	125	40%
BV5	71	42	40%

Construction of Permanent Infrastructures and Facilities

The construction of permanent infrastructures and facilities, notably the waste rock and tailings pile and the pit, requires the modification of the hydrologic regime of the mine site. The presence of buildings on the site (e.g. garage, the concentrator, administrative buildings, etc.) also modifies the runoff surface. Specifically, the hydrologic dynamics of Creek C will be altered. A significant portion of this creek watershed will be diverted by the presence of the waste rock and tailings pile and its perimeter ditches. The same applies to Creeks E and F. Over a distance of approximately 100 m, the flow of Creek C will be modified by the presence of the outfall of the sedimentation basin located southwest of the waste rock and tailings pile. The increased flow in Creek C will, however, have little effect on Lac des Montagnes since the total inflow of water will remain the same.

Water Management (Runoff, Drinking Water, Wastewater, etc.)

The site preparation work includes the construction of ditches that will modify watersheds BV4 and BV5. These ditches will be dug to collect the runoff from the waste rock and tailings pile and direct it toward a sedimentation basin, and then into Creek C. Other ditches will be dug to collect water from the pit and direct it to another sedimentation basin before it is released through an outlet channel into Lac des Montagnes.

In order to limit the impact of the project on the hydrology during the construction phase, the following mitigation measures will be implemented:

- Minimize clear cutting and restore vegetation areas, when possible
- Ensure free movement of water and prohibit disposal of residual materials or debris into the water bodies and water courses
- Conduct work in sensitive areas during winter, where possible
- Limit work along the shores of water bodies and streams

Operation Phase

Sites Clearing and Preparation (Excavation, Stripping, Backfilling, Blasting and Overburden Management)

The impacts are the same as those anticipated during the construction phase and are mainly related to the expansion of the waste rock and tailings pile and to the rerouting of the Route du Nord.

Extraction, Storage and Processing of the Ore

As already mentioned, the presence of stockpiling areas, notably the waste rock and tailings pile and the overburden pile, will result in a diminution of the areas draining in Creeks B, C, E and F. Since these streams drain superficies of less than 5 ha, their flow is already considered intermittent by the CEHQ. Reducing the inflow of water by removing part of their watershed will probably extend their low-flow period, in which the flow is already inexistent in theory.

The second phase of development of the waste rock and tailings pile will result in the drainage of Lake 29. The surface area of this lake is quite small, i.e. 1,440 m^2, and no hydraulic connection was observed in the field. Therefore the dewatering of this lake should not alter hydrologic dynamics in the vicinity.

Water Management (Runoff, Drinking Water, Wastewater, etc.)

As mentioned for the construction phase, the presence on the site of ditches to collect and direct the runoff and seepage water as well as the precipitation toward the receiving environment modifies the hydrologic dynamics.

The hydrologic pattern of Creeks B, C, E and F will be modified by the presence of ditches around the waste rock and tailings pile or by the presence of the outlet of a sedimentation basin located southwest of the pile.

In order to limit the impact of the project on the hydrology, the mitigation measures applied during the construction phase will be maintained during the operation phase. Additionally, the following mitigation measure will be implemented:

- Limit the erosion of the banks of Creek C, if required

Closure Phase

Water Management (Runoff, Drinking Water, Wastewater, etc.)

The flooding of the mine pit constitutes an activity that could modify the hydraulic regime in the vicinity. The assessment of the static level in relation with the topography after the operation phase has not been completed as of this date. A spillway may be required to direct excess water toward the environment. The details of this spillway will be evaluated in the detailed engineering of the project.

The ditches dug around the waste rock and tailings pile and the pit will be filled at the end of the operation to allow the water to return naturally in the receiving environment rather than being directed to specific locations. This will restore a measure of the hydraulic regime of the site what it was before the project.

Site Rehabilitation and Presence of Remnants

The site closure activities include the decommissioning of the sedimentation basins, the removal of most ditches and the flooding of the pit. As already mentioned, filling the ditches around the waste rock and tailings pile and the sites of the infrastructures will remove some of the watershed disturbances. As for the pit, it will be flooded and a spillway will be built to discharge its waters in the environment.

Revegetation of the disturbed areas, including the waste rock and tailings pile and the overburden pile, will restore the absorption and runoff capacities of the site.

In general, the site rehabilitation work will allow most of the affected water bodies and streams to return to the original flow regime that prevailed before the project.

6.7.2.3 Significance of the Residual Impact

The social value of the component is moderate, as it is non-negligible in the pursuit of certain activities in the territory, notably travel over the water bodies and streams. The ecosystemic value of the component is also moderate, since it has a degree of significance in the ecosystem. Therefore, the value of this component is moderate.

Following the application of the mitigation measures, the significance of the residual impact on the hydrology is considered low. The intensity of the impact is also considered low, notably because of the hydraulic dynamics, which will be altered only slightly over the entire study area.

The nature of the impact on the hydrology is negative. The frequency of the impact is considered as continuous since it will occur over the entire life of the project. The extent of the impact is punctual, since the modification of the hydraulic regime will be felt over a limited area, at the location of the infrastructures and facilities. The duration of the change in the hydrology component is considered long, as it will continue beyond the closure phase. This is an irreversible impact because the changes made the component will remain even after the end of the project. More specifically, the loss of Lake 29 will be definitive.

Table 6-32 presents the values assigned to each indicator and the resulting significance of the residual impact.

Table 6-32 Significance of the Residual Impact – Hydrology

Intensity	Extent	Duration	Significance of the Residual Impact
High	Regional	**Long**	High
Moderate	Local	**Medium**	Moderate
Low	**Punctual**	Short	**Low**

6.8 Quality of Surface Water and Sediments

The surface water and sediments in the water bodies and streams near the mine site were sampled. Map 6-11 shows the location of the surface water and sediment sampling stations.

6.8.1 Description of the Environment

6.8.1.1 Surface Water Quality

The surface water sampling stations were located in the aquatic environments susceptible of being affected by the future mine infrastructures, i.e. Lac du Spodumène, Lac des Montagnes, six small lakes (identified as Lakes 1, 2, 3, 27, 28 and 29), the Nemiscau River and three water courses, i.e. the outlet of Lac du Spodumène (Creek D), Creek B and Creek C. The surface water was sampled on four occasions between August 2010 and December 2012: August 26 to 30, 2010, February 12 to 13, 2012, June 21to July 4, 2012 and December 4, 2012).

The results of the surface water sampling campaigns were compared to the surface water quality criteria of the ministère du Développement durable, de l'Environnement, de la Faune et des Parcs (MDDEFP, 2009) and to the Canadian recommendations on water quality and the protection of aquatic life published by the Canadian Council of Ministers of the Environment (CCME, 2001a).

To ensure the short and long-term protection of all aquatic organisms, the MDDEFP (2009) defines two quality criteria, i.e. an acute aquatic life criterion and a chronic aquatic life criterion:

- The chronic aquatic life criterion (CVAA) is the maximum concentration of a substance to which aquatic organisms can be exposed for a short period of time without being severely affected;
- The chronic aquatic life criterion (CVAC) is the highest concentration of a substance that produces no harmful effect on the aquatic organisms (and their offsprings) that are exposed daily over their entire life.

At the federal level, the Canadian recommendations on water quality aim to ensure the protection of freshwater and marine organisms, considering short-term or long-term exposure. In the case of the Whabouchi project, the environment is of the freshwater type.

Physicochemical Parameters

Table 6-33 presents the results of the surface water quality analyzes. The laboratory certificates of analysis for each sampling period are presented in Appendix 6-8.

In all the analyzed samples, the pH varied between 4.7 and 7.1. In the majority of cases, the pH was below 7.0, or acidic. The MDDEFP (2009) water quality criterion is between 5 and 9.5 for an acute exposure (CVAA) and 6.5 to 9 for a chronic exposure (CVAC). The pH in Creeks C (East) and B is acidic, respectively at 4.71 and 4.78, which is below the criterion for acute exposure. It should be noted that, without regard to the sampling period, the pH in the majority of the surveyed water bodies and streams does not meet the water quality criteria, whether provincial (CVAC) or federal.

The total alkalinity (measured as the concentration of $CaCO_3$) illustrates the sensitivity of the environment to acidification. The lower the alkalinity, the easier the environment can acidify. There are no water quality criteria for total alkalinity. Low values (less than 10 mg/l $CaCO_3$) making the environment sensitive to acidification, which can cause mortality in aquatic species (if the pH drops below 5-6). The majority of the surface water samples showed alkalinity values of less than 10 mg/l $CaCO_3$, indicative of a high sensitivity to acidification. At 18 mg/l, the alkalinity of Lac du Spodumène falls between 10 mg/l and 20 mg/l $CaCO_3$, showing an intermediate sensitivity to acidification according to the MDDEFP (2009), while Lake 2 presents a low sensitivity (> 20 mg/l).

The turbidity of the surface water samples varied between 0.2 µTN and 1.2 µTN. The water in the surveyed area is therefore clear, as the turbidity of all the samples was 1.2 µTN or less. A significant increase in turbidity (the amplitude of which is a function of the depth and limpidity of the water) is harmful to aquatic organisms.

As for suspended matter, the concentrations measured in the samples varied between less than 2 mg/l and 22 mg/l. The highest value corresponds to a sample taken in Lake 3 in August 2010.

The conductivity of the samples varied between 0.013 µTN and 0.028 µTN. However, neither the MDDEFP (2009) nor the CCME (2001a) make any water quality recommendation with regard to conductivity.

The concentrations of dissolved oxygen measured in all the samples varied between 7.05 mg/l and 8.68 mg/l. These concentrations are all above the 6 mg/l threshold of the MDDEFP CVAC criterion and the CCME recommendation, which is 6.5 mg/l. The dissolved oxygen level varies according to many factors. The two most important factors are the temperature and salinity of the water.

Major Ions and Nutrients

The analysis results show that the most abundant elements observed in the surface water samples were sulfate, calcium, chloride and sodium. Significant concentrations of magnesium and potassium are also reported. Other elements such as phosphorus, nitrogen, nitrites and nitrates were much less abundant.

The majority of the nitrogen in surface water originates from nitrogenous organic debris (e.g. proteins, polypeptides, amino-acids and urea). The Kjedahl nitrogen concentrations (between 0.48 mg/l and 0.75 mg/l, median 0.51 mg/l – February 12 to 13, 2012) show that several of the surveyed environments receive a significant intake of organic matter. This measurement agrees with the abundance of peatlands and other wetlands that accumulate organic matter in the surveyed area. Globally, all the measurements of ammonia nitrogen were below the MDDEFP (2009) water quality criterion, which is 1.23 mg/l for the chronic aquatic life criterion (CVAC), which is generally the most restrictive.

The water in Lake 3 differs from that of the other sampled lakes in the high concentration of dissolved organic carbon (22.3 mg/l) and total organic carbon (22.4 mg/l) measured in 2010. The values measured in this lake are typical of small humic lakes in the process of forming a sphagnum bog. The largest sampled lakes, Lac des Montagnes and Lac du Spodumène, present lower values varying between 4.9 mg/l (in 2012 for total organic carbon) and 6.4 mg/l (in 2012 for dissolved organic carbon).

The results of the surface water sample analysis indicate that the calcium and magnesium concentrations varied between 1.0 mg/l and 3.6 mg/l in the case of calcium, and between 0.19 mg/l, and 1.8 mg/l for magnesium. For calcium, the values are similar to those of lakes near the La Grande reservoir (0.5 mg/l to 3.5 mg/l). In the case of magnesium, the concentrations in the vicinity of the La Grande reservoir are slightly inferior to those obtained in the sampled water bodies and streams (0.22 mg/l to 0.65 mg/l) (Schetagne and coll. 2005). However, neither the MDDEFP (2009) nor the CCME (2001a) have set surface water quality criteria for calcium and magnesium.

The chloride concentrations observed in the samples varied between 0.26 mg/l and 10 mg/l. These values are inferior to the surface water quality criteria (MDDEFP, 2009), in which the lowest critical threshold is 230 mg/l, and the CCME aquatic life protection criterion, which is 120 mg/l (CCME, 2001a).

The nitrite and nitrate concentrations in the samples were all below the detection limits, except that during the February 2012 sampling campaign. The highest concentration (0.15 mg/l) was measured at the Nemiscau River station during this period. This value satisfies the MDDEFP and CCME criteria.

All the values measured for total phosphorus were below the detection limit (0.01 mg/l to 0.02 mg/l), except for the February 2012 sampling campaign, when three water bodies (Lakes 1, 2 and Du Spodumène) presented values (between 0.02 mg/l and 0.03 mg/l) that were slightly higher than the detection limit (0.01 mg/l). According to the MDDEFP (2009), recurrent values in excess of 0.03 mg/l could promote excessive growth of some aquatic species. The low phosphorus contents are indicative of the oligotrophic character of the water (Wetzel, 2001).

The sodium and potassium present in the surface water generally originate, as in the case of calcium, from the soil and rocks bordering water bodies (lake, stream, river or wetland). The concentrations of sodium (0.42 mg/l to 1.30 mg/l) and potassium (0.18 mg/l to 0.47 mg/l) measured in the samples are similar to those reported for the surroundings of the La Grande complex (sodium: 0.8 mg/l to 1.8 mg/l; potassium: 0.2 mg/l to 0.4 mg/l). Neither the MDDEFP (2009) nor the CCME (2001a) have set surface water quality criteria for sodium and potassium.

Table 6-33 Surface Water Quality

PARAMETER		Water Quality Criteria			Sampling Station																						
Survey Period		Provincial (MDDEFP) Aquatic Life Protection		CCME Canadian Recommendation on Water Quality	August 26 to 30, 2010					February 12 and 13, 2012						June 21 to July 4, 2012								December 4, 2012			
Station Name					Lac des Montagnes	Lac du Spodumène	Lake 1	Lake 2	Lake 3	Lac des Montagnes	Lac du Spodumène	Lake 1	Lake 2	Nemiscau River	Creek D	Lac des Montagnes	Lac du Spodumène	Lake 1	Lake 2	Lake 27	Lake 28	Lake 29	Nemiscau River	Creek C (West)	Creek C (Centre)	Creek C (East)	Creek B
Sampling Date				Aquatic Life Protection (Freshwater; Long-Term)	2010-08-30	2010-08-27	2010-08-27	2010-08-26	2010-08-30	2012-02-12	2012-02-13	2012-02-13	2012-02-13	2012-02-12	2012-02-12	2012-07-04	2012-06-21	2012-06-21	2012-06-21	2012-06-21	2012-06-21	2012-06-21	2012-06-21	2012-12-04	2012-12-04	2012-12-04	2012-12-04
Easting		Acute (CVAA)	Chronic (CVAC)		436575		440827	441447	440336	438647	442490	440960	441621	439071		438647	442490	440960	441621				439071				
Northing					5722896		5727556	5726773	5724997	5725268	5726166	5727670	5726895	5727230		5725268	5726166	5727670	5726895				5727230				
Physicochemical Parameters	**Unit**																										
Total alkalinity	mg/l	NA	NA	NA	<5	6.4	<5	5.7	<5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total alkalinity (as $CaCO_3$) pH 4.5	mg/l	NA	NA	NA	-	-	-	-	-	6	18	3	21	5	4	8	2	2	2	1	2	<1	5	<1	<1	<1	<1
Conductivity	µS/cm	NA	NA	NA	13	20	13	43	13	20	49	14	84	19	20	15	12	10	28	9	19	12	15	16	20	20	10
Specific conductivity	µS/cm	NA	NA	NA	14	15	10	36	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Biological oxygen demand over 5 days	mg/l	NA	3 *	NA	3	<3	<3	<3	<3	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
Chemical oxygen demand	mg/l	NA	NA	NA	-	<5	6	<5	-	19	19	29	28	17	29	14	16	18	17	33	28	37	13	26	29	36	29
Total hardness ($CaCO_3$)	mg/l	NA	NA	NA	6.1	10.2	5.5	16.9	6	8.1	7.3	5.3	16	7.7	7.0	6.4	4.7	3.9	10.0	3.8	7.4	3.4	6.9	6.1	11	8.9	3.8
Suspended matter	mg/l	+ 25 [1]	+ 5 [1]	NA	2	3	<2	<2	22	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Volatile matter (550°C)	mg/l	NA	NA	NA	-	-	-	-	-	22	32	24	56	26	36	29	26	22	46	32	50	45	16	-	-	-	-
pH	-	5.0 to 9.5 [2]	6.5 to 9.0 [2]	6.5 to 9.0 [2]	7.14	6.5	6.78	*6.2*	*5.14*	6.66	*6.2*	*6.27*	*5.85*	6.59	*6.24*	7.13	*6.14*	*6.16*	*6.0*	*5.78*	*6.13*	*5.4*	6.65	*5.41*	*5.09*	*4.71*	*4.78*
Total dissolved solids	mg/l	NA	NA	NA	28	62	72	72	46	29	36	32	61	25	42	19	24	22	43	32	32	33	21	-	-	-	-
Total solids	mg/l	NA	NA	NA	<25	66	68	90	-	34	44	32	66	30	58	29	27	23	47	32	50	45	21	-	-	-	-
Total volatile solids	mg/l	NA	NA	NA	-	36	28	52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Temperature	°C	NA	NA	NA	17.46	17.018	18.22	18.36	17.44	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Transparency	m	NA	NA	NA	3.5	1.5	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Turbidity	uTN	+ 8 [1]	+ 2 [1]	+ 2 [1]	0.6	1.2	<0.3	0.8	1.1	0.2	0.6	0.6	0.5	0.4	0.7	0.6	0.6	1.0	0.7	0.6	1.0	0.5	0.6	0.7	0.3	0.3	0.3
Major Ions and Nutrients	**Unit**																										
Ammonia nitrogen ($N\text{-}NH_3$) [3]	mg/l	17.9	1.23	NA	<0.067	<0.067	<0.067	<0.067	<0.067	0.03	0.03	0.05	0.04	0.03	0.03	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	<0.05	<0.05	<0.05	<0.05
Kjeldahl nitrogen	mg/l	NA	NA	NA	<1	<1	<1	<1	<1	0.48	0.75	0.48	0.58	0.5	0.51	2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonates	mg/l	NA	NA	NA	-	-	-	-	-	6	18	3	18	5	4	8	2	2	2	1	2	<1	5	<1	<1	NA	NA
Bromide (Br-)	mg/l	NA	NA	NA	-	-	-	-	-	-	-	-	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1	<0.1	<0.1	<0.1	<0.1
Dissolved inorganic carbon	mg/l	NA	NA	NA	-	-	-	-	-	2	1.6	2	<0.4	1.8	0.9	1.7	1.3	1.5	1.6	0.8	3.3	1.7	1.8	3	3	3	4
Dissolved organic carbon	mg/l	NA	NA	NA	5.4	10.1	10.2	10.8	22.3	6.4	8.2	10.0	10.0	6.3	10.0	4.9	6.7	7	7	12	9.6	14	4.8	10	11	13	11
Total organic carbon	mg/l	NA	NA	NA	5.9	10.1	10.1	10.7	22.4	6.2	7.9	11.0	11.0	6.1	9.0	5	6.6	7	7	13	9.9	15	4.9	9	11	12	11
Chloride (Cl)	mg/l	860	230	120	<1	1	<1	8	<1	0.29	1.7	0.26	10	0.34	1.2	<0.5	1.2	<0.5	5.3	<0.5	2.7	<0.5	<0.5	1.7	3.2	3.2	0.25
Available cyanide (CN-)	mg/l	0.022	0.005 *	5	-	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	-	-
Total cyanide	mg/l	NA	NA	NA	<0.02	<0.02	<0.02	<0.02	<0.02	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	-	-
Fluoride (F)	mg/l	4	0.2 *	120	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1	<1	<1	<1	<1	<1	<1	<1	<0.1	<0.1	<0.1	<0.1
Nitrates (NO_3-)	mg/l	NA	2.9	13	-	-	-	-	-	0.03	0.07	0.02	0.04	0.04	0.04	-	-	-	-	-	-	-	-	-	-	-	-
Nitrites (NO_2-)	mg/l	0.06	0.02	0.06	-	-	-	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	-	-	-	-	-	-	-	-	-	-
Nitrates and nitrites	mg/l	NA	NA	NA	<0.07	<0.07	<0.07	<0.07	<0.07	0.06	0.07	0.02	<0.02	0.15	0.05	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.06	0.03	0.02	0.09
Dissolved O_2 (concentration)	mg/l	NA	6 [4]	6.5 [4]	8.68	8.05	7.94	7.48	7.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved O_2 (saturation)	% sat.	NA	54 [4]	NA	90.6	83.7	84.3	79.6	74.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total phosphorus	mg/l	NA	0.03	NA	-	<0.02	<0.02	<0.02		<0.01	0.02	*0.03*	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.014	0.027	0.012	0.01
Sulphates (SO_4) [5]	mg/l	500	500	NA	<2	2	<2	<2	<2	1.2	1.8	1.4	1.4	1.3	1.4	<1	1	1	1	<1	<1	<1	<1	1.2	1.1	1	1.3

PARAMETER		Water Quality Criteria			Sampling Station																						
Survey Period		Provincial (MDDEFP) Aquatic Life Protection		CCME Canadian Recommendation on Water Quality Aquatic Life Protection (Freshwater; Long-Term)	August 26 to 30, 2010					February 12 and 13, 2012						June 21 to July 4, 2012								December 4, 2012			
Station Name					Lac des Montagnes	Lac du Spodumène	Lake 1	Lake 2	Lake 3	Lac des Montagnes	Lac du Spodumène	Lake 1	Lake 2	Nemiscau River	Creek D	Lac des Montagnes	Lac du Spodumène	Lake 1	Lake 2	Lake 27	Lake 28	Lake 29	Nemiscau River	Creek C (West)	Creek C (Centre)	Creek C (East)	Creek B
Sampling Date		Acute (CVAA)	Chronic (CVAC)		2010-08-30	2010-08-27	2010-08-27	2010-08-26	2010-08-30	2012-02-12	2012-02-13	2012-02-13	2012-02-13	2012-02-12	2012-02-12	2012-07-04	2012-06-21	2012-06-21	2012-06-21	2012-06-21	2012-06-21	2012-06-21	2012-06-21	2012-12-04	2012-12-04	2012-12-04	2012-12-04
Easting					436575		440827	441447	440336	438647	442490	440960	441621	439071		438647	442490	440960	441621				439071				
Northing					5722896		5727556	5726773	5724997	5725268	5726166	5727670	5726895	5727230		5725268	5726166	5727670	5726895				5727230				
Metals and Metalloids	**Unit**																										
Aluminum (Al)	mg/l	0.75	0.087	0.1 or 0.005 (6)	0.033	0.176	0.179	0.176	0.191	0.05	0.17	0.23	0.23	0.051	0.17	0.046	0.13	0.15	0.14	0.24	0.2	0.13	0.042	0.16	0.25	0.24	0.19
Antimony (Sb)	mg/l	1.1	0.24	NA	<0.003	<0.003	<0.003	<0.003	<0.003	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0027	<0.001	<0.001	<0.01	<0.01	<0.01	<0.01
Silver (Ag) (7)	mg/l	0.000039 *	0.0001 *	0.0001 *	-	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00011	<0.001	<0.001	<0.001	<0.001
Arsenic (As)	mg/l	0.34	0.15	0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Barium (Ba) (7)	mg/l	0.11	0.038	NA	<0.03	<0.03	<0.03	<0.03	<0.03	0.0041	0.0051	0.0056	0.011	0.0043	0.005	0.0032	0.0037	0.0045	0.0064	0.0035	0.0094	0.0029	0.0034	<0.02	<0.02	<0.02	<0.02
Beryllium (Be) (7)	mg/l	0.000064 *	0.0000071 *	NA	-	-	-	-	-	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.005	<0.005	<0.005	<0.005
Bismuth (Bi)	mg/l	NA	NA	NA	-	-	-	-	-	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.0025	<0.0025	<0.0025	<0.0025
Boron (B)	mg/l	28	5	1.5	<0.06	<0.06	<0.06	<0.06	<0.06	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0056	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.05	<0.05	<0.05
Cadmium (Cd) (7)	mg/l	0.00021 *	0.000049 *	0.000004 *	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0003	<0.0003	<0.0003	<0.0003
Calcium (Ca)	mg/l	NA	NA	NA	<2	2.43	<2	3.87	<2	2.2	2.1	1.6	3.6	2	2	1.7	1.3	1.1	2.4	1.1	1.9	1	1.8	1.5	2.6	2.2	1.1
Chromium (Cr) (7)	mg/l	0.27	0.013	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.0005	0.00052	<0.0005	0.00059	<0.0005	0.00063	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.00061	<0.0005	<0.005	<0.005	<0.005	<0.005
Cobalt (Co)	mg/l	0.37	0.1	NA	<0.02	<0.02	<0.02	<0.02	<0.02	<0.0005	<0.0005	<0.0005	0.00059	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.005	<0.005	<0.005	<0.005
Copper (Cu) (7)	mg/l	0.0016 *	0.0013 *	0.002	<0.003	<0.003	<0.003	<0.003	<0.003	0.00058	0.00077	0.0011	0.0014	0.0033	0.00077	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.002	<0.002	<0.002	<0.002
Tin (Sn)	mg/l	NA	NA	NA	-	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.02	<0.02	<0.02	<0.02
Iron (Fe)	mg/l	3.4	1.3	0.3	<0.3	0.476	<0.3	<0.3	0.371	<0.1	0.37	0.12	0.23	0.13	0.54	<0.1	0.14	0.14	0.14	0.18	1.3	0.19	<0.1	0.27	0.35	0.35	0.24
Lithium (Li)	mg/l	0.91	0.44	NA	<0.035	<0.035	<0.035	<0.035	<0.035	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1	<0.1
Magnesium (Mg)	mg/l	NA	NA	NA	<2	<2	<2	<2	<2	0.66	0.53	0.3	1.8	0.65	0.47	0.53	0.31	0.25	1.1	0.23	0.62	0.19	0.58	0.57	1	0.83	<0.5
Manganese (Mn) (7)	mg/l	0.55	0.26	NA	0.0065	0.0079	0.0054	0.0166	0.0056	0.0022	0.0077	0.0029	0.018	0.0039	0.0081	0.0059	0.1	0.022	0.0078	0.0046	0.018	0.005	0.0057	0.0067	0.012	0.0091	<0.004
Mercury (Hg)	mg/l	0.0016	0.00091	0.000026 *	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00011	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Molybdenum (Mo)	mg/l	29	3.2	0.073	<0.01	<0.01	<0.01	<0.01	<0.01	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.005	<0.005	<0.005	<0.005
Nickel (Ni) (7)	mg/l	0.067	0.0074	0.025	<0.002	<0.002	<0.002	<0.002	<0.002	<0.001	<0.001	<0.001	0.0013	<0.001	<0.001	0.0011	<0.001	0.0013	<0.001	<0.001	0.0012	<0.001	<0.001	<0.002	<0.002	<0.002	<0.002
Lead (Pb) (7)	mg/l	0.0044	0.00017 *	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0001	0.00025	0.00028	0.0002	<0.0001	0.00019	0.0002	0.00024	0.00043	0.00024	0.00026	0.00051	0.00062	0.00019	<0.001	<0.001	<0.001	<0.001
Potassium (K)	mg/l	NA	NA	NA	<1	<1	<1	<1	<1	0.33	0.43	0.32	0.47	0.35	0.41	0.28	0.45	0.34	0.32	0.18	0.47	<0.1	0.28	<0.5	<0.5	<0.5	<0.5
Selenium (Se)	mg/l	0.062	0.005 *	0.001 *	<0.001	<0.001	<0.001	0.0012	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.01	<0.01	<0.01
Silicon (Si) soluble in HNO_3	mg/l	NA	NA	NA	-	-	-	-	-	1.8	4.4	1.6	3.3	1.7	4.2	1.4	1.9	0.82	1.9	1.6	1.1	1.5	1.4	4.2	5	3.8	4.4
Sodium (Na)	mg/l	NA	NA	NA	<2	<2	<2	<2	<2	0.77	1.1	0.8	1.3	0.94	1.1	0.65	0.74	0.78	0.84	0.65	0.82	0.42	0.63	0.93	1.2	0.88	0.83
Tellurium (Te)	mg/l	NA	NA	NA	-	-	-	-	-	-	-	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.01	<0.01	<0.01
Thallium (Tl)	mg/l	0.047	0.0072 *	0.0008 *	<0.003	<0.003	<0.003	<0.003	<0.003	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.02	<0.02	<0.02	<0.02
Titanium (Ti)	mg/l	NA	NA	NA	<0.003	0.0034	<0.003	<0.003	0.0034	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium (U)	mg/l	0.32 (8)	0.014 (8)	0.015	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-	-	-	-	-	-	<0.01	<0.01	<0.01	<0.01
Vanadium (V)	mg/l	0.11	0.012 *	NA	-	-	-	-	-	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.02	<0.02	<0.02	<0.02
Zinc (Zn) (7)	mg/l	0.017	0.017	0.03	<0.003	<0.003	<0.003	0.009	0.0049	<0.005	0.0053	0.0057	0.011	<0.005	0.0075	0.0098	0.0084	0.012	0.017	0.0059	0.61	0.0065	0.014	<0.007	0.024	0.02	<0.007
Biologic Parameters	**Unit**																										
Total coliforms	CFU/ 100 ml	NA	NA	NA	40	<100	1,300	3,200	2,500	4	110	1	16	12	180	-	-	-	-	-	-	-	-	-	-	-	-
Atypical bacteria	CFU/ 100 ml	NA	NA	NA	1,200	3,900	1,000	5,800	4,500	7	96	1	<1	98	80	-	-	-	-	-	-	-	-	-	-	-	-
Fecal coliforms	CFU/ 100 ml	NA	NA	NA	<1	<1	2	6	<1	<1	1	<1	<1	<1	1	1	<1	<1	1	<1	17	<1	2	-	-	-	-
Escherichia coli (E. coli)	CFU/ 100 ml	NA	NA	NA	<1	<1	1	6	<1	<1	1	<1	<1	<1	1	-	-	-	-	-	-	-	-	-	-	-	-
Total count (AAHB)	CFU/ml	NA	NA	NA	300	93	260	450	910	1	30	1	7	6	26	34	48	61	310	430	530	240	290	-	-	-	-

PARAMETER		Water Quality Criteria			Sampling Station																						
Survey Period		Provincial (MDDEFP) Aquatic Life Protection		CCME Canadian Recommendation on Water Quality Aquatic Life Protection (Freshwater; Long-Term)	August 26 to 30, 2010					February 12 and 13, 2012						June 21 to July 4, 2012								December 4, 2012			
Station Name					Lac des Montagnes	Lac du Spodumène	Lake 1	Lake 2	Lake 3	Lac des Montagnes	Lac du Spodumène	Lake 1	Lake 2	Nemiscau River	Creek D	Lac des Montagnes	Lac du Spodumène	Lake 1	Lake 2	Lake 27	Lake 28	Lake 29	Nemiscau River	Creek C (West)	Creek C (Centre)	Creek C (East)	Creek B
Sampling Date		Acute (CVAA)	Chronic (CVAC)		2010-08-30	2010-08-27	2010-08-27	2010-08-26	2010-08-30	2012-02-12	2012-02-13	2012-02-13	2012-02-13	2012-02-12	2012-02-12	2012-07-04	2012-06-21	2012-06-21	2012-06-21	2012-06-21	2012-06-21	2012-06-21	2012-06-21	2012-12-04	2012-12-04	2012-12-04	2012-12-04
Easting					436575		440827	441447	440336	438647	442490	440960	441621	439071		438647	442490	440960	441621				439071				
Northing					5722896		5727556	5726773	5724997	5725268	5726166	5727670	5726895	5727230		5725268	5726166	5727670	5726895				5727230				
Other Parameters	**Unit**																										
C_{10}-C_{50} petroleum hydrocarbons [9]	mg/l	0.11	0.011 *	NA	<0.1	<0.1	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-
1-Chlorooctadecane	mg/l	NA	NA	NA	-	-	-	-	-	105	99	83	86	102	84	95	102	109	94	116	93	115	96	-	-	-	-

Underlined: the value exceeds the CVAA criterion
Red italics: the value exceeds the CVAC criterion
Grey box: the value exceeds the CCME criterion

[1] The criteria do not apply to these analyzes because they determine background concentrations from which the criteria will apply in the future.
[2] For the pH, values must fall within these intervals to be compliant.
[3] The ammonia nitrogen criterion varies according to the pH and temperature. The values presented here are the most restrictive within the possible range according to a pH of 4.88 to 7.1 and in temperature between 9.6°C and 20°C.
[4] For dissolved oxygen, the values may not be inferior to the indicated criteria for temperatures of approximately 10°C to 15°C.
[5] This quality criterion applies to water with a hardness < 100 mg/l $CaCO_3$ and a chloride concentration < 5 mg/l.
[6] For aluminum, the criterion is 0.1 mg/l at a pH ≥ 6.5, and 0.005 mg/l at a pH < 6.5.
[7] The values of these criteria vary according to the hardness of the sample. The CVAA and CVAC presented here are for a hardness ≤ 10 mg/l $CaCO_3$, since the average hardness of all samples is 7.5 mg/l, with a minimum of 3.4 mg/l and a maximum of 16.9 mg/l. The CCME criteria presented here are for a hardness of 7.5 mg/l $CaCO_3$.
(Ministère du Développement durable, de l'Environnement, de la Faune et des Parcs du Québec. Critères de qualité de l'eau de surface au Québec - Annexe 12. http://www.mddep.gouv.qc.ca/eau/criteres_eau/annexe_12.htm)
[8] This quality criterion applies to water with a hardness varying between 20 mg/l and 100 mg/l $CaCO_3$.
[9] This quality criterion was defined for Bunker C oil.
* The detection limit of some or all analyzes does not allow the measurement of this value.

In the totality of samples, the values measured for sulfates varied between 1.0 mg/l and 1.8 mg/l. All the measurements are below the MDDEFP (2009) water quality criteria, which are set at 500 mg/l.

Metals and Metalloids

The concentration of metals and metalloids in the surface water of the surveyed area is low. Effectively, 15 of the analyzed elements (antimony, silver, arsenic, beryllium, bismuth, bromine, cadmium, available cyanides, tin, lithium, molybdenum, thallium, tellurium, uranium and vanadium) are present in concentrations lower than the limits of detection and the thresholds of the different surface water quality criteria. Among the metals present in concentrations higher than the limit of detection, 10 elements (barium, boron, chromium, cobalt, total cyanides, fluorides, nickel, silica, HNO_3-soluble silicon and titanium) returned concentrations below all established surface water quality criteria (for all environments and all sampling periods). Finally, concentrations exceeding the MDDEFP (2009) water quality criteria were observed for aluminum (August 2010: Lac du Spodumène, Lake 1, Lake 2 and Lake 3), copper (February 2012: Lake 2 and Nemiscau River), lead (February 2012: Lac du Spodumène, Lake 1, Lake 2 and Creek D; June-July 2012: Lac des Montagnes, Lac du Spodumène, Lake 1, Lake 2, Lake 27, Lake 28, Lake 29 and Nemiscau River) and zinc (June 2012: Lake 2 and Lake 28). The copper concentration measured in the sample collected in the Nemiscau River in February 2012 also exceeds the CCME criterion.

The aluminum concentrations measured in the various samples ranged between 0.046 mg/l (July 2012: Lac des Montagnes) and 0.25 mg/l (December 2012: Creek C (Centre)). Several of the sampled environments presented aluminum concentrations higher than the MDDEFP (2009) CVAC criterion (0.087 mg/l). It is important to note that in the case of aluminum, certain surface waters of good quality can contain natural concentrations higher than the quality criterion (MDDEFP, 2009). In such cases, the natural concentrations should be considered as baseline values for the environmental monitoring, if applicable.

The samples collected in August 2010 and June 2012 showed copper concentrations below the detection limit and below the surface water quality criteria. The concentrations measured in two samples (Nemiscau River: 0.0033 mg/l and Lake 2: 0.0014 mg/l) exceed the recommended value for the CVAC (0.0013 mg/l) and the CVAA (0.0016 mg/l), as well as the CCME recommendation (0.002 mg/l).

The concentrations of iron and manganese measured in all the collected samples are below the MDDEFP criteria (CVAC and CVAA), except for one sample from Lake 28 collected in June 2012, which returned a value of 1.3 mg/l for iron, equal to the CVAC criterion. Also, the CCME Canadian recommendations for the protection of water quality applicable to copper were exceeded in the following water bodies and streams: Lac du Spodumène (August 2010 and February 2012), Lake 3 (August 2010), Creek D (February 2012), Lake 28 (June 2012), Creek C (Centre) (December 2012) and Creek C (East) (December 2012).

All the values obtained for mercury are generally below the detection limit (< 0.0001 mg/l). No exceedances of the MDDEFP and CCME water quality criteria were observed in any sample.

The lead concentrations in the samples varied between 0.0001 mg/l and 0.0015 mg/l. The CVAC criteria were exceeded in samples taken in February 2012 from Lac du Spodumène, Lake 1, Lake 2, Creek D, and in July 2012 in all the sampled environments. Since the threshold value for this criterion changes according to hardness, some samples exceeded the threshold with concentrations lower than the baseline value presented in Table 6-33.

Only two samples (Lakes 1 and 28 in June 2012) showed zinc concentrations in excess for the MDDEFP water quality criteria. Since the threshold value of the MDDEFP (2009) CVAA and CVAC criteria varies according to the hardness of the water, the Lake 1 sample exceeded both criteria with a value that was less than those presented in Table 6-33. The zinc concentration in the sample taken from Lake 28 (June 2012) also exceeded the CCME recommendations.

Biological Parameters

The CVAC threshold for five-day biological oxygen demand (BOD_5) is 3 mg/l (MDDEFP, 2009). None of the analyzed sample exceeded this value. The value obtained from the sample taken in August 2010 in Lac des Montagnes is 3 mg/l. All the other results are below the limit of detection.

Other Parameters

Among the other parameters that were analyzed, only the C_{10}-C_{50} petroleum hydrocarbons are subject to surface water quality criteria, i.e. the CVAA and CVAC (MDDEFP, 2009). All the concentrations measured in the samples are below the limit of detection.

In all the samples analyzed in 2010, monocyclic aromatic hydrocarbons (MAH), polycyclic aromatic hydrocarbons (PAH) and chlorinated aliphatic hydrocarbons (CAH) were found in concentrations inferior to the analytical limit of detection. The same applies to phenolic substances, except for pentachlorophenol, which was detected at the Lake 1 sampling station. The pentachlorophenol concentration detected at this location was higher than the CVAC. The pentachlorophenol could be of anthropogenic or natural origin. Since this organic compound is used as a wood preservative (e.g. posts) or as a biocide, notably for right-of-way maintenance, and that Lake 1 is near a power line, it is possible that the pentachlorophenol detected in the sample could be associated with power line right-of-way maintenance work. The pentachlorophenol could also be of natural origin, produced by degrading wood. Note that these results are not shown in Table 6-33, but rather in Appendix 6-6.

6.8.1.2 Sediment Quality

Only one sediment sampling campaign was completed during the summer of 2010 (Genivar, 2010). The sediment sampling stations were positioned in the aquatic environments most susceptible of being affected by the future mine infrastructures. A total of five samples were taken in the five lakes (Lac des Montagnes, Lac du Spodumène, Lake 1, Lake 2 and Lake 3) from

August 26 to 30, 2010 (Table 6-34). The sediment samples were taken at the same stations and on the same dates as the 2010 surface water sampling, except for the Lac des Montagnes station. At this station, the surface water sampling was too deep (> 30 m) to allow the collection of sediments. Thus, the sediment sample at this station was collected closer to shore. Map 6-11 shows the location of the five sediment sampling stations.

The values measured in the sediment samples were compared to the thresholds defined in the Criteria for the Assessment of Sediment Quality in Quebec and Application Frameworks: Prevention, Dredging and Remediation (Environment Canada and MDDEFP, 2007). Thus, five categories of criteria are defined, from the most restrictive (rare effect level) to the least (frequent effect level).

- Rare effect level (REL)
- Threshold effect level (TEL)
- Occasional effect level (OEL)
- Probable effect level (PEL)
- Frequent effect level (FEL)

According to CCME Canadian recommendations on sediment quality, the sediment quality analysis results were also compared to the provisional recommendation on the quality of freshwater sediments (ISQG) and the probable effect level (PEL) (Table 6-34) (CCME, 2001b).

Both the provincial and federal guidelines provide criteria only for the following metals: arsenic, cadmium, chromium, copper, mercury, nickel, lead, zinc and Aroclor 1254. All the analysis results for these metals are below the corresponding limit of detection, except for the copper concentration in the Lake 3 sample. Effectively, this sample shows a concentration of 60 mg/kg, which is higher than the threshold effect level (36 mg/kg) defined by Environment Canada and the MDDEFP. This value also exceeds the ISQG criterion from CCME recommendation, which is 35.7 mg/kg. As for metals that are not subject to quality criteria, significant differences in concentrations can be observed among the sampled water bodies in the case of aluminum, calcium, tin, iron, manganese, magnesium, molybdenum and potassium.

As for organic compounds, the percentage of total organic carbon is higher in the sample from Lake 3, at 52%, while the Lac du Spodumène sample returns the lowest percentage, at 0.26%. This indicates the presence of important quantities of organic matter in the Lake 3 sediments. The concentration of total volatile solids is greater in the sample from Lake 2 (43,800 mg/kg) and lower in the Lac des Montagnes sample (2,650 mg/kg).

6.8.2 Impacts Assessment

The following paragraphs identify the sources of impacts on surface water and sediment quality during the construction, operation and closure phases, describe these impacts and the associated mitigation measures, and evaluate the impacts.

6.8.2.1 Identification of the Impact Sources

The sources of impact on the quality of surface water and sediments are presented hereunder for each phase of the Whabouchi project, from construction to closure.

Construction Phase

The main activities of the Whabouchi project that could constitute sources of impacts on the quality of surface water and sediments during the construction phase are the following:

- Sites clearing and preparation (excavation, stripping, backfilling, blasting and overburden management)
- Water management (runoff, drinking water, wastewater, etc.)
- Management of residual materials, hazardous materials and fuels
- Use, maintenance and circulation of heavy machinery and vehicles

Operation Phase

The main activities of the Whabouchi project that could constitute sources of impacts on the quality of surface water and sediments during the operation phase are the following:

- Sites clearing and preparation (excavation, stripping, backfilling, blasting and overburden management)
- Extraction, storage and processing of the ore
- Water management (runoff, drinking water, wastewater, etc.)
- Management of residual materials, hazardous materials and fuels
- Use, maintenance and circulation of heavy machinery and vehicles

Closure Phase

The main activities of the Whabouchi project that could constitute sources of impacts on the quality of surface water and sediments during the closure phase are the following:

- Water management (runoff, drinking water, wastewater, etc.)
- Management of residual materials, hazardous materials and fuels
- Use, maintenance and circulation of heavy machinery and vehicles
- Site rehabilitation

Table 6-34 Sediment Analysis Results

Parameter (mg/kg)	ADL [1]	Station (Sampling Date)					Sediment Quality Criteria						
		Lac des Montagnes	Lac du Spodumène	Lake 1	Lake 2	Lake 3	EC-MDDEFP [2]					CCME [3]	
		2010-08-30	2010-08-27	2010-08-26	2010-08-26	2010-08-30	REL [4]	TEL [5]	OEL [6]	PEL [7]	FEL [8]	ISQG [9]	PEL [10]
Metals													
Aluminum	30	< 30	1,400	4,840	- [11]	3,370	-	-	-	-	-	-	-
Antimony	20	< 20	< 20	< 20	-	< 20	-	-	-	-	-	-	-
Arsenic	5	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	4.1 *	5.9	7.6	17	23	5.9	17
Silver	0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	-	-	-	-	-	-	-
Barium	20	21	< 20	39	32	41	-	-	-	-	-	-	-
Beryllium	10	< 10	< 10	< 10	-	< 10	-	-	-	-	-	-	-
Boron	20	< 20	< 20	< 20	-	< 20	-	-	-	-	-	-	-
Cadmium	0.9	< 0.9	< 0.9	< 0.9	< 0.9	< 0.9	0.33 *	0.6 *	1.7	3.5	12	0.6 *	3.5
Calcium	100	2,070	707	2,680	-	11,500							
Chromium	45	< 45	< 45	< 45	< 45	< 45	25 *	37 *	57	90	120	37.3 *	90
Cobalt	15	< 15	< 15	< 15	< 15	< 15							
Copper	40	< 40	< 40	< 40	< 40	60	22 *	36 *	63	200	700	35.7 *	197
Tin	5	< 5	< 5	< 5	< 5	6	-	-	-	-	-	-	-
Iron	500	< 500	5,330	3,190	-	6,110	-	-	-	-	-	-	-
Manganese	10	191	57	28	24	114	-	-	-	-	-	-	-
Magnesium	100	1,620	498	728	-	761	-	-	-	-	-	-	-
Total mercury	0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	0.094 *	0.17 *	0.25	0.49	0.87	0.17 *	0.486
Molybdenum	2	< 2	3	< 2	< 2	11	-	-	-	-	-	-	-
Nickel	30	< 30	< 30	< 30	< 30	< 30	-	-	47	-	-	-	-
Potassium	100	875	121	295	-	102	-	-	-	-	-	-	-
Lead	30	< 30	< 30	< 30	< 30	< 30	25 *	35	52	91	150	35	91.3
Selenium	1	< 1	< 1	1	< 1	2	-	-	-	-	-	-	-
Sodium	100	159	< 100	< 100	-	184	-	-	-	-	-	-	-
Strontium	10	< 10	< 10	14	-	32	-	-	-	-	-	-	-
Thallium	15	< 15	< 15	< 15	-	< 15	-	-	-	-	-	-	-
Titanium	10	< 10	140	146	-	92	-	-	-	-	-	-	-
Uranium	20	< 20	< 20	< 20	-	< 20	-	-	-	-	-	-	-
Vanadium	15	< 15	< 15	< 15	-	< 15	-	-	-	-	-	-	-
Zinc	100	< 100	< 100	< 100	< 100	< 100	80 *	120	170	310	770	123	315
BPC Aroclor													
Aroclor 1242	0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	-	-	-	-	-	-	-
Aroclor 1248	0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	-	-	-	-	-	-	-
Aroclor 1254	0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	-	-	-	-	-	0.06 *	0.34 *
Aroclor 1260	0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	-	-	-	-	-	-	-

Parameter (mg/kg)	ADL [1]	Station (Sampling Date)					Sediment Quality Criteria						
		Lac des Montagnes	Lac du Spodumène	Lake 1	Lake 2	Lake 3	EC-MDDEFP [2]					CCME [3]	
		2010-08-30	2010-08-27	2010-08-26	2010-08-26	2010-08-30	REL [4]	TEL [5]	OEL [6]	PEL [7]	FEL [8]	ISQG [9]	PEL [10]
Organic Compounds													
Total organic carbon (%)	0.3	0.59	0.26	11.4	16.5	52	-	-	-	-	-	-	-
Mineral oil and grease	3,000	-	-	< 3,000	< 3,000	-	-	-	-	-	-	-	-
Total oil and grease [12]	-	< 5,500	< 1,400	< 6,000	< 6,000	< 20,000	-	-	-	-	-	-	-
Total volatile solids	2,000	2,650	4,660	25,500	43,800	19,300	-	-	-	-	-	-	-

Grey cell: The value exceeds one or more quality criteria.

(1) ADL: Analytical detection limit.

(2) Criteria for the Assessment of Sediment Quality in Quebec and Application Frameworks: Prevention, Dredging and Remediation (Environment Canada and Ministère du Développement durable, de l'Environnement, de la Faune et des Parcs du Québec, 2007).

(3) Canadian Environmental Quality Guidelines. Canadian Sediment Quality Guidelines for the Protection of Aquatic Life (CCME, 2002)

(4) REL : Rare effect level.

(5) TEL: Threshold effect level.

(6) OEL: Occasional effect level.

(7) PEL: Probable effect level.

(8) FEL: Frequent effect level.

(9) ISQG: Interim sediment quality guidelines.

(10) PEL: Probable effect level.

(11) - : Not analysed or no criterion for this parameter.

(12) The analytical detection limit for this parameter varies according to the percentage of moisture in the sample.

* The criterion may not apply because it is below the analytical detection limit.

Source: Genivar, 2010

6.8.2.2 Description of the Impacts and Mitigation Measures

The following sections describe the impacts on the quality of surface water and sediments during the different phases of the project and the applicable mitigation measures.

Construction Phase

Sites Clearing and Preparation (Excavation, Stripping, Backfilling, Blasting and Overburden Management)

The deforestation and site preparation work preceding the construction of infrastructures and facilities could alter the quality of the surface water. Effectively, such activities can weaken the soil and increase its exposure to erosion.

The site clearing and preparation activities can spread wood debris and suspended matter in the water bodies and the streams. An increase in suspended matter can also alter the turbidity of the water. In the same manner, other nutrients such as phosphorous can be transported and alter the quality of surface water. During heavy rainfall, an increased in the quantity of suspended matter can be observed in the water bodies and streams near the worksite.

The exploitation of borrow pits, specifically the excavation, crushing and blasting activities can increase the quantity of suspended matter in the water bodies and streams nearby, thus altering the water quality.

Water Management (Runoff, Drinking Water, Wastewater, etc.)

Water management can be the source of changes in the quality of the surface water and sediments. During the construction phase, only the runoff needs to be managed, since the mining operations have not begun.

Because it can come into contact with potentially contaminated surfaces, the runoff from the mine site could impact the quality of the surface water in the water environment by introducing contaminants. The runoff can also carry particulate matter toward the surrounding water bodies and streams, altering their turbidity.

Management of Residual Materials, Hazardous Materials and Fuels

The management of residual materials, hazardous materials and fuels can cause changes in the quality of the surface water and sediments. Contamination of the surface water and sediments could occur mainly during the handling of hazardous materials and fuels. A failure in the storage system could release substances that could reach the surrounding water bodies and streams, thus affecting their quality.

Use, Maintenance and Circulation of Heavy Machinery and Vehicles

The circulation of heavy machinery and vehicles on the site can result in an increase of suspended matter in the water bodies and streams. Effectively, due to the reworking of the soil, suspended matter can enter the runoff and be transported toward the water bodies and streams. This can therefore affect the quality of the surface water. As already mentioned, an increase in suspended matter in the water can also affect its turbidity.

The use, maintenance and circulation of heavy machinery and vehicles can also modify the quality of the surface water and sediments as a result of contamination due to leaks or accidental spills of hazardous substances.

In winter, the use of de-icing salts to ensure the safety of vehicles traveling on the mine site roads can also be a source of changes in the quality of surface water. Specifically, this can lead to a possible increase in the salinity of runoff near the areas of application.

In order to limit the impact of the project on the quality of surface water and sediments during the construction phase, the following mitigation measures will be implemented:

- Collect and treat all contaminated water before release in the aquatic environment
- Minimize deforestation and, inasmuch as possible, restore the disturbed areas
- Use manual methods to cut vegetation on the banks of water bodies and streams
- Avoid introducing debris in the water bodies and streams, and in such events, remove them promptly
- Stabilize the slopes
- Avoid working on steep slopes wherever possible
- Avoid major work near water bodies and streams under heavy rainfall whenever possible
- Install sediment barriers where foreign material could be introduced in water bodies and streams
- Avoid installing fueling points near water bodies or streams
- Park the heavy machinery, vehicles and equipment in designated areas
- Ensure that the heavy machinery and vehicles are in proper working order
- Prohibit the fording of streams by heavy machinery
- Implement a prevention and intervention program for accidental releases in the environment
- Provide emergency oil and hazardous materials recovery kits (absorbents and appropriate containers) in strategic locations of the site (quick and easy access)
- Train the employees on quick, effective and safe intervention in case of a leak or accidental spill of oil products or hazardous materials
- Dispose of residual materials according to appropriate procedures

Operation Phase

Sites Clearing and Preparation (Excavation, Stripping, Backfilling, Blasting and Overburden Management)

The description of the impacts associated with site clearing and preparation activities on the quality of surface water and sediments during the construction phase remains valid for the operation phase. During the operation phase, the diversion of a section of the Route du Nord and the Phase 2 development of the waste rock and tailings pile will require deforestation work.

Extraction, Storage and Processing of the Ore

The development of the pit will result in the exposure of soil, thus increasing the potential for erosion. Particulate matter could be transported in the surrounding water bodies and streams, altering their quality.

Due to the use of explosives in the mining operations, ammonia and nitrates can be present and may be carried by runoff toward the surrounding water bodies and streams. However, emulsion-type explosives will be preferred because of their low solubility in water. They also generate less ammonia than other types of explosives.

The quality of the water that will come into contact with the materials in the stockpiles, notably the waste rock, tailings, ore and overburden, could be altered. However, the results of the tests performed on the waste rock and tailings show that these are not considered as acid generators or leachable material. The ore, however, will be managed as a leachable material.

The use of generators in the pit could represent a source of changes in the quality of water and sediments in the nearby water bodies and streams. Effectively, inadequate operation or maintenance of such generators could release hydrocarbons that would be pumped and transferred to the sedimentation basin.

Water Management (Runoff, Drinking Water, Wastewater, etc.)

The runoff and seepage water from the stockpiles (waste rock and tailings pile, overburden pile, etc.) could be a source of changes in the quality of surface water and sediments. The runoff from the waste rock and tailings pile could flow into surrounding water bodies and streams, thus increasing the quantity of suspended matter.

More specifically, the release of water (runoff and seepage from the waste rock and tailings pile) from the sedimentation basin into Creek C could increase erosion in the former, thus altering its quality.

The pit runoff could also transport particulate matter toward the nearby water bodies and streams, increasing their turbidity. Also, the water that will be pumped for dewatering the pit during operation could be characterized by a high concentration of suspended matter and contain contaminants generated by the blasting.

The waste rock and tailings pile runoff could also alter the quality of surface water and sediments in the water bodies and streams nearby, notably Creek C and Lac des Montagnes.

However, this runoff water will be collected in a sedimentation basin before being released in the environment.

The release of mine water (i.e. groundwater seepage and precipitation over the pit footprint) via a sedimentation basin into Lac des Montagnes could affect the quality of its water. Effectively, an increase in the concentration of suspended matter near the discharge points is possible if the retention time is insufficient.

Management of Residual Materials, Hazardous Materials and Fuels

The description of the impacts of the management of residual materials, hazardous materials and fuels presented for the construction phase remains valid for the operation phase.

Use, Maintenance and Circulation of Heavy Machinery and Vehicles

The description of the impacts of the use, maintenance and circulation of heavy machinery and vehicles presented for the construction phase remains valid for the operation phase.

The mitigation measures that will be applied during the construction phase will be maintained during the operation phase. Additionally, the following mitigation measures will be implemented:

- Inspect the hazardous substances and petroleum product containers and storage tanks regularly and take the appropriate corrective measures as required
- Provide drainage ditches to collect the runoff from the waste rock and tailings pile, the overburden pile and the pit, and ensure that they flow freely during the operations
- Limit erosion in the storage areas by maintaining a stable design
- Inspect the containment structures regularly to ensure their physical stability

Closure Phase

Water Management (Runoff, Drinking Water, Wastewater, etc.)

The facilities installed to collect and treat the runoff and seepage water from the mine site will remain in operation during the closure phase. However, the release of mine water in the water environment would be reduced because the mining work will have ceased. These collection and treatment facilities will remain in service until the environmental follow-up confirms that the quality of water on the mine site meets the applicable criteria.

The flooding of the pit will create a new water body on the site. Over time, this water body will integrate in the surrounding water environment.

At the conclusion of the closure work, they will no longer be any release of effluent in the water environment. Thus, the quality of the surface water and sediments will be similar to what it was before the project.

Management of Residual Materials, Hazardous Materials and Fuels

The description of the impacts of the management of residual materials, hazardous materials and fuels presented for the construction and operation phases remains valid for the closure phase. However, the quantity of residual materials, hazardous materials and fuels present on the site will be minimized, as the level of activity will diminish considerably. Therefore, the risk of leaks or accidental spills, which are the potential sources of contamination of the surface water and sediments, will be reduced.

Use, Maintenance and Circulation of Heavy Machinery and Vehicles

The description of the impacts of the use, maintenance and circulation of heavy machinery and vehicles presented for the construction and operation phases remains valid for the closure phase. However, the quantities and the travel of heavy machinery and vehicles on the site will be considerably reduced during the closure phase.

Site Rehabilitation

The site rehabilitation work could have incidences on the quality of surface water and sediments by introducing particulate matter in the water bodies and streams. However, this disturbance of the quality would be temporary since the purpose of the site rehabilitation work is to restore the conditions on the site. For example, the revegetation of the waste rock and tailings pile could release particulate matter in the surrounding water bodies and streams, thus altering their quality. On the other hand, the presence of new vegetation will limit soil erosion.

The reclamation of the site will restore the environment as it was before the project. The interruption of effluent releases in the water environment will, among other benefits, reduce the erosion induced in the receiving water bodies and streams. The supply of suspended matter will also diminish, which will improve the quality of the surface water.

The mitigation measures implemented to manage water, residual materials, hazardous materials and fuel, as well as the use, maintenance and circulation of heavy machinery and vehicles during the construction and operation phases will also be applied during the closure phase. Further mitigation measures will also be implemented, including:

- Implement an environmental follow-up program
- Restore the surface drainage network

6.8.2.3 Significance of the Residual Impact

The social value of the component is high, since it is valued by the local population and is the subject of protective measures. The ecosystemic value of the component is also high, as it plays an important role in the ecosystem and that several other components are dependent on it, notably the fish. Therefore, the value of this component is high.

After application of the mitigation measures, the significance of the residual impact on the quality of the surface water and sediments is considered as moderate. The intensity of the impact is considered moderate, as it will modify the surface water and sediment quality component, but without altering it significantly over the entire study area. Thus, although the project activities could alter the quality of water and sediments, they will not compromise it in any way.

The nature of the impact on the quality of surface water and sediments is negative. The frequency of the impact is considered as continuous since it will last for the entire life of the project. The geographic extent of the impact is considered local, as it will be circumscribed within the study area or in specific portions thereof. The duration of the changes in the quality of surface water and sediments is medium, as they will continue for all the project phases, from construction to closure. However, this is a reversible impact, as the component will return to its initial condition at the end of the project.

Table 6-35 presents the values assigned to each indicator and the resulting significance of the residual impact.

Table 6-35 Significance of the Residual Impact – Surface Water and Sediment Quality

Intensity	Extent	Duration	Significance of the Residual Impact
High	Regional	Long	High
Moderate	**Local**	**Medium**	**Moderate**
Low	Punctual	Short	Low

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CHAPTER 7

BIOLOGICAL ENVIRONMENT

Environmental and Social Impact Assessment

March 28, 2013

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7. DESCRIPTION OF THE BIOLOGICAL ENVIRONMENT AND IMPACTS ANALYSIS

This chapter presents a description of the baseline conditions of the components of the biological environment retained:

- Vegetation and wetlands;
- Fish and its habitat;
- Herpetofauna;
- Mammals;
- Avifauna.

The impacts on each component and sub-component are also analysed.

7.1 Study and Survey Areas

Generally, the study area considered for the biological environment corresponds to a circle of 10 km radius centered on the mine site. When necessary, the boundaries of this study area were adjusted for certain components. For each biological component, survey zones were delimited to refine the description of the environment at the mine site and in the adjacent zones. The survey zones retained for the fieldwork on each component are described in the corresponding section.

7.2 Vegetation and Wetlands

This section presents a description of the vegetation and wetlands present in the study area as well as the impacts assessment of the project on these components.

7.2.1 Study and Survey Areas

A study area corresponding to a circle of 10 km radius centered on the mine site (Map 7-1) covering a surface of 31,416 ha was defined to complete a summary characterization of the vegetation and wetlands in order to describe the regional setting.

A survey area was also defined in order to characterize more precisely the potentially affected vegetation and wetlands in the immediate vicinity of the planned mine infrastructures. This survey area encompasses the mine site and its surroundings (Map 7-2) and covers a surface of approximately 800 ha.

7.2.2 Literature Review

7.2.2.1 Methods

Informations on the vegetation and forest stands availables from the ministère du Développement durable, de l'Environnement, de la Faune et des Parcs (MDDEFP) and the ministère des Ressources naturelles du Québec (MRN) was consulted.

The following sources were consulted to compile a list of the special-status plant species potentially present in the study area, with their preferred conditions:

- Les plantes vasculaires menacées ou vulnérables du Québec, 3e édition (CDPNQ, 2008);
- Liste des plantes menacées ou vulnérables selon la présence et potentiel de présence dans les régions administratives (CDPNQ, 2012a);
- Liste des plantes vasculaires menacées ou vulnérables selon la phénologie et l'habitat (CDPNQ, 2012b);
- Guide de reconnaissance des habitats forestiers des plantes menacées ou vulnérables. Côte-Nord et Saguenay–Lac-Saint-Jean (Dignard, N., and coll., 2009);
- Committee on the Status of Endangered Wildlife in Canada (COSEWIC, 2013);
- Liste des espèces floristiques menacées et vulnérables (MDDEFP, 2013a);
- Species at Risk Public Registry (Government of Canada, 2013).

A request was also submitted to the regional direction of the MDDEFP to know the recorded occurrences of such species in the Centre de données sur le patrimoine naturel du Québec (CDPNQ) database (Appendix 7-1; Larouche (MDDEFP), 2013, personal communication).

The informations about the exceptional forest ecosystems inventoried by the MRN was also consulted to verified for their presence in the study area (Perron (MDDEFP), 2013, personal communication; MRN, 2013a).

7.2.2.2 Results

Ecoregion

The Whabouchi project is located at the northern limit of the spruce-moss forest domain (Western sub-domain), in the continuous boreal forest sub-zone (MRN, 2013b). The forest cover is dominated by black spruce (*Picea mariana*) that can be occasionally associated with different companion species such as balsam fir (*Abies balsamea*) (MRN, 2013b). White birch (*Betula papyrifera*), trembling aspen (*Populus tremuloïdes*) and balsam poplar (*Populus balsamifera*) are also present in the spruce-moss forest domain. The undergrowths are characterized by the presence of mosses (*Hypnaceae*) and species of the Ericaceae family. Herbaceous species are generally scarce (MRN, 2013b).

The study area is situated within ecoregion 6d-S – Coteaux des lacs Telhard et Baudeau (Blouin and Berger, 2004). According to these authors, there is very little diversity in the vegetation because of the harsh climatic conditions. The landscape is dominated by spruce forest, which grows in wet depressions and on relatively even sites where jackpine (*Pinus banksiana*) cohabits with black spruce. Poplar, with black spruce and jackpine, occupies relatively even thin deposits that are subject to forest fires. White birch and balsam fir are found on the hillsides. The abundance of organic deposits in this ecoregion is favorable to the strong presence of wetlands.

The forest fire cycle models the forest dynamic of the region. These fires tend to favor the expansion of the spruce-lichen forest (Girard and coll., 2008, 2009; Veilleux-Nolin, 2011), a domain situated north of the spruce-moss forest and of the study area. Large surfaces of forest were recently (2002) affected by fires in the region of Nemiscau and in the study area. In fact, the region may be experiencing a higher recurrence of forest fires due to the precipitation regime, which is one of the driest in Quebec (Blouin and Berger, 2004; Richard (SOPFEU), 2013, personal communication).

The review of the databases provided a list of 26 special-status plant species that could potentially be present in the study area.

Protected Areas and Special Interest Natural Environments

The researchs has not revealed the presence of exceptional forest ecosystem or of interest in the study area.

Additionally, there is no protected area in the vicinity of the study area. The nearest, the Albanel-Mistassini-and-Waconichi-Lakes Wildlife Sanctuary, is more than 50 km east.

7.2.3 Vegetation Inventory

The objectives of the vegetation inventory were the following:

- Describe and circumscribe the plant communities;
- Document the presence of wetlands;
- Verify the presence of special-status plant species;
- Verify the presence of interest or rare natural environments.

The description of the vegetation was carried out in two phases in order to obtain a picture of the vegetation at the regional scale, and to characterize more precisely the vegetation found near the infrastructures and susceptible of being affected by the project.

7.2.3.1 Methods

Study Area

The characterization of the vegetation in the study area is primarily based on the interpretation of satellite imagery[1]. Due to do the low resolution of the image (30 m), the characterization of the plant community is necessarily general. The image was processed by spectral analysis and segmentation methods using the eCognition software.

The interpretation of these images (forest stands, burns and peatlands) was validated with various sources of data (orthophotographs, vector data, etc.) and with aerial transects conducted in February 2012 during the helicopter fly-over for the large wildlife. The environments observed in the aerial survey were compared to those identified by the satellite classification.

Survey Zone

In the survey zone, the vegetation was first mapped by interpreting aerial photographs. Subsequently, typical parcels were positioned so as to cover the different identified plant communities in order to validate the photo-interpretation (Bastien, 2012). The inventory efforts were determined according to the number of environments and their surface area, as defined by the photo-interpretation. The terrestrial and the wetland environment characterization efforts were concentrated on the footprint of the planned infrastructures and on the peatland located south of the planned pit (Map 7-2). These inventories aimed to:

- Validate the photo-interpretation of plant communities and wetlands;
- Obtain a detailed description of each plant community;
- Identify special-status plant species.

The location of the parcels was validated in the field and, when necessary, they were relocated to well represent the vegetation of the targetted plant community.

For each survey station, the information collected about the vegetation included:

- The type of environment (forest, scrubland alder forest, peatland, etc.);
- The percentage of cover of the tree stratum, shrub stratum, herb layer and muscinal layer (mosses, lichens, etc.);
- The dominant species in each strata and their percentage of cover;
- The stage of succession: primary or secondary (Saucier and coll., 1994);
- The associated forest type (major species by stratum);
- The drainage class : classes 1 to 6 (Saucier and coll., 1994);

[1] Landsat TM5 scene, recorded on June 6, 2010 under cloud-free conditions

- The exposure (cardinal points);
- The slope (in percentage);
- Open water (as class of cover percentage);
- The type and thickness of humus.

This approach is inspired by *Le Point d'observation écologique, normes techniques* (Saucier and coll., 1994), which recommends a characterization of most of these variables. Inventory stations 1, 2, 36 and 37 were located outside the survey area, but were nonetheless considered in the description of the plant communities.

The wetlands were delineated by photo-interpretation, and then validated during the field inventory according to the abundance of typical wetland species, the edaphic characteristics and the water regime (surface deposit, drainage class, etc.). In presence of a complex of dry and wet lands, the boundary between the dry and wet environments was delineated according to the predominance of one or the other water regimes.

The shores of Lac du Spodumène and Lac des Montagnes were inventoried from a boat in order to identify and delineate the aquatic grass beds.

The field inventories in the typical parcels were carried out between June 23 and 27, 2012.

Special-Status Plant Species

The search for special-status plant species concentrated in the environments offering the greatest potential for such species in the survey sector. These environments correspond to peatlands, exposed rocks and cliffs. During the inventories, all the plants of interest or those that could not be identified with certitude were collected for subsequent validation.

7.2.3.2 Results

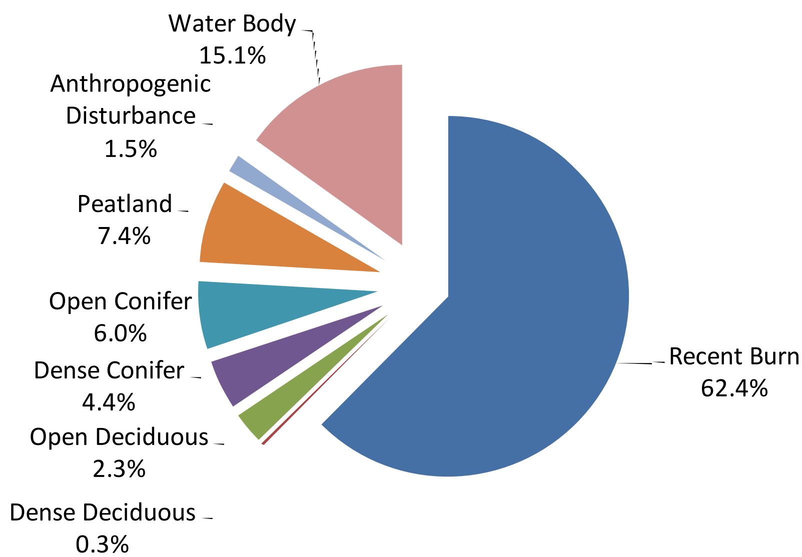
Study Area

The image processed by spectral analysis and segmentation methods distinguished eight terrestrial, wetland or aquatic environments in the study area:

- Open conifer forest (density < 50%);
- Dense conifer forest (density < 50%);
- Open deciduous forest (density < 50%);
- Dense deciduous forest (density < 50%);
- Recent burn;
- Peatland;
- Water body;
- Disturbed environment (anthropogenic disturbance).

Recent burns cover of the largest surface in the study area (62.4%, Map 7-1; Figure 7-1). They are distributed over all the study area, except in the southwestern portion. Open and dense stands of conifers dominate the forested landscape and represent 10.4% of the study area. Deciduous stands are present in a few areas. The largest of these stands can be seen in the northwestern portion of the study area, near Lake Saint-Simon. The deciduous stands cover 3.1% of the study area and appear in the form of islands mainly in the northern portion of the study area. These are mostly open stands. Peatlands are the only type of wetland identified through the satellite imagery classification. These environments cover 7.4% of the study area, while water bodies represent 15.1% of the surface. Finally, disturbed environments cover only 1.5% of the study area.

Figure 7-1 Percentage of Study Area Covered by the Different Vegetation Classes



Survey Zone

The interpretation of aerial photographs and the field surveys allowed a mapping of the distribution of plant communities in the survey area (Map 7-2). The photo-interpretation circumscribed the environments with greater precision than the satellite imagery mapping of the entire study area. The different plant communities were delineated digitally by analyzing the aerial photo with the Manifold GIS software. The terrestrial environments and wetlands are often part of a vegetal continuum where the boundary is more gradual than definite. Furthermore, the communities may sometimes be present in the form of a mosaic.

The inventory allows to describe seven different vegetal communities, in addition to the sectors disturbed by human activity:

- Recent burn;
- Black spruce-moss stand;
- Jackpine forest;

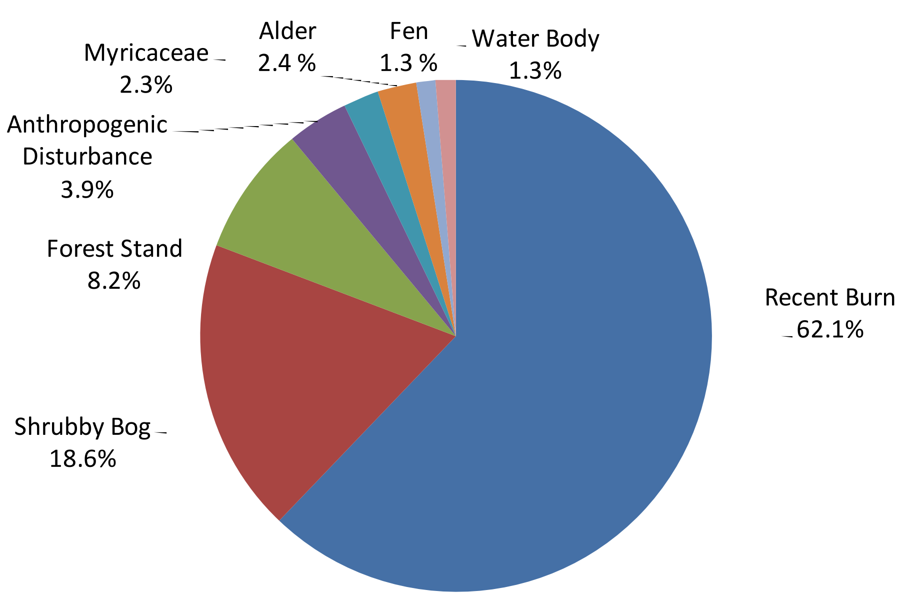
- Birch forest;
- Bog;
- Fen;
- Shrubby riparian swamp;
- Disturbed environments (anthropogenic disturbance).

The black spruce-moss stand, jackpine forest and birch forest were grouped on the map under the designation of "forest stand" (Map 7-2) due to the small size and overlapping of the cartographic units.

The survey area constitutes a very open environment, marked by forest fires. In fact, fire devastated large portions of the Nemiscau region in the summer of 2002. As in the study area, the majority of the survey area is characterized by recent burn, which represents 62.1% of the survey area (Figure 7-2). This recent burn is likely a result of the forest fire that affected the region in 2002, since the vegetation is still in the regeneration stage. Bogs represent the second most common vegetal community (18.6% of the surface) in the survey area. These bogs, as the other wetlands (fens and shrubby riparian swamps) did not burn and were maintained in the landscape. The rest of the survey area is a shared between forest stands (spruce forest, pine forest and birch forest) that were spared by the fire and occupy 8.2% of the survey area, the environments disturbed by human activity and water bodies.

The different environments identified in the survey area are described in further detail hereunder.

Figure 7-2 Distribution (%) of Environments in the Survey Area



As mentioned previously, recent burn is the most extensive terrestrial environment in the study area and the survey area. The dominant specie in this regenerating environment is shrubby jackpine, accompanied by a sometimes very dense cover of Labrador tea (*Rhododendron groenlandicum*) and lambkill (*Kalmia angustifolia*). Green alder (*Alnus viridis subsp. crispa*) can also be observed in the shrub layer, but in a discontinuously manner. Ground lichens (*Cladina spp*. and *Trapeliopsis granulosa*) are generally abundant. Occasionally, small surface of deciduous trees (trembling aspen and white birch) concentrations locally replace jackpine as shrub. This environment is in the transition and its composition will change over the next decades.

Black spruce-moss stand is present mainly on the shores of Lac des Montagnes. Elsewhere, it form small stands either alone or mixed with jackpines. Black spruce forms the tree layer of this forest stand. The following Ericaceae dominate the shrub stratum: lambkill, Labrador tea and low sweet blueberry (*Vaccinium angustifolium*). In the dry areas, lichens (*Cladina rangiferina*, *C. mitis*, *C. stellaris*) form the moss layer, but they are replaced by sphagnum (*Sphagnum fuscum*, *S. capillifolium*) in more wet areas.

Jackpine forest is disseminated throughout the survey area, in the form of small islands. It is probably sectors spared by the forest fires of 2002. The tree layer is characterized by a scattered cover of jackpine. The low shrub layer is dominated either by lambkill or, less often, by low sweet blueberry and black crowberry (*Empetrum nigrum*). The herbaceous layer is composed mainly of Canadian bunchberry (*Cornus canadensis*), while the moss layer comprises mosses (*Sphagnum capillifolium*, *Pleurozium schreberi*, *Dicranum undulatum*) and lichens.

The birch forest is the only deciduous forest stand identified in the survey area. This stand is observed only very locally. Its tree layer is low (± 10 m) and dominated by white birch and trembling aspen may be present sporadically. Black spruce and green alder are the main species in the shrub layer of this stand, while Canadian bunchberry is the main herbaceous plant.

Bog covers a large part of the survey area. In fact, a large peatland extends between Lac du Spodumène and Lac des Montagnes, southeast of the survey area, and some scattered islands can be observed in the rest of the area. These are open shrubby bogs characterized by a shrub cover (less than 7 m) of black spruce and a lower shrub layer composed of Ericaceae (leatherleaf, lambkill and Labrador tea). The herbaceous layer is not very developed, though cloudberry (*Rubus chamaemorus*) is often present. The shrubby bog presents an almost uninterrupted carpet of sphagnum.

Fen is closely associated with the water flow lines within the extensive shrubby bog. This is a poor fen, thus weakly minerotrophic, open and dominated by Cyperaceae such as fewseed sedge (*Carex oligosperma*), starved sedge (*Carex exilis*) and white beak-sedge (*Rhyncospora alba*). The herbaceous layer also includes buckbean (*Menyanthes trifoliata*) and sundews such as round-leaved sundew (*Drosera rotundifolia*) and Spoonleaf sundew (*Drosera intermedia*). The moss layer is almost continuous and is composed of various species of sphagnum. The tree layer is absent and shrubs are rare. The fen also comprises small shallow pools that are colonized by herbaceous species, notably northern mannagrass (*Glyceria borealis*) and fewseed sedge.

The stream banks are generally occupied by shrubby riparian swamps that belong to two plant communities: alder and myricaceae. The alder forms a band of riparian scrubland approximately 5 m wide on the bank of most of the small streams in the survey area. The dominant species, speckled alder (*Alnus incana subsp. rugosa*), is accompanied by several Ericaceae (leatherleaf (*Chamaedaphne calyculata*), Labrador tea and lambkill). The other type of riparian shrubby swamp, the myricaceae, is found almost exclusively on fluviatile deposits along the outlet of Lac du Spodumène (Creek D), which forms the southeastern limit of the survey area. The dominant species in this riparian scrubland is sweet gale (*Myrica gale*) accompanied by speckled alder and broad-leaved meadowsweet (*Spiraea latifolia*) and includes a scattered herbaceous layer as well as sphagnum.

The anthropogenic environments comprise mainly the roads, gravel pits and areas disturbed by mining prospection activities.

Following the inventory of the shores of Lac du Spodumène and Lac des Montagnes, it is shows that emergent plants are common but that their presence remains sporadic to the point where they can hardly be qualified as vegetal communities or aquatic grass beds. For example, northern mannagrass can be observed occasionally in the riparian zones of these lakes. This type of colony is generally monospecific, but variable-leaved pondweed (*Potamogeton gramineus*), narrowleaf bur-reed (*Sparganium angustifolium*) and sphagnum (*Sphagnum cuspidatum*) can be observed nearby. On the shore of Lac du Spodumène, a small size fewseed sedge bed was also observed.

The bogs, fens and shrubby riparian swamps form the majority of the wetlands in the survey area and occupy almost a fourth (24.6%) of the survey area. All these environments are common and occupy a large part of the territory in the Nemiscau region.

Photographs illustrating the various natural environments identified in the survey area are presented below.

Photo 7-1 Black Spruce-Moss Stand

Photo 7-2 Jackpine Forest

Photo 7-3 Birch Forest

Photo 7-4 Recent Burn

Photo 7-5 Alder Type of Shrubby Riparian Swamp

Photo 7-6 Myricaceae Type of Shrubby Riparian Swamp

Photo 7-7 Shrubby Bog

Photo 7-8 Fen

Photo 7-9 Northern Mannagrass Bed in a Peatland Pool

Photo 7-10 Fewseed Sedge Bed in a Riparian Environment

Special-Status Plant Species

The review of the databases provided a list of 26 special-status plant species that could potentially be present in the study area (Appendix 7-2). All of these species are susceptible of being designated as threatened or vulnerable in Quebec, and three of them, Robinson's hawkweed (*Hieracium robinsonii*), Norwegian cudweed (*Omalotheca norvegica*) and vanilla-scented bog orchid (*Pseudorchis albida ssp. straminea*), are candidates to a species at risk status (COSEWIC , 2013).

We consider that the presence of ten of the species is unlikely due to the lack of favorable habitats (Appendix 7-2). In nine of the cases, they are calcicole species and the geological data (Equapolar Consultants Limited, 2011) reports no calcareous rock outcrop in the study area. The other species found is habitat in the cliffs, and there are none in the survey area.

In the study area, these species are mostly susceptible of being found in the peatlands, notably the large ones situated south of the proposed pit.

Given the plant communities that are present and the fires that affected the majority of the survey area, the main special-status species susceptibles of being found in the study area are those that are found in peatlands:

- Dragon's mouth (*Arethusa bulbosa*);
- Slender-leaf sundew (*Drosera linearis*);
- Hiddenfruit bladderwort (*Utricularia geminiscapa*).

Despite the searches efforts that covered notably the peatlands, no special-status species was observed.

No exotic invasive species were observed in the study area.

7.2.4 Terrestrial Vegetation Impact Assessment

To evaluate the impacts, the Vegetation and Wetlands component was divided in two sub-components: terrestrial vegetation and wetlands. This section presents the impact assessment on the terrestrial vegetation associated with each phase of the project (construction, operation and closure) and discusses, in sequence, the following elements:

- Identification of the impact sources;
- Description of the impacts;
- Description of the mitigation measures;
- Significance of the residual impact.

7.2.4.1 Identification of the Impact Sources

Over the different phases of the Whabouchi project, several activities could constitute sources of impact for the terrestrial vegetation. These impacts sources, for the different project development phases, are as follows:

Construction Phase

- Sites clearing and preparation (excavation, stripping, backfilling, blasting and overburden management)
- Construction of the temporary and permanent infrastructures and facilities
- Water management (runoff, drinking water, wastewater, etc.)
- Management of residual materials, hazardous materials and fuels
- Use, maintenance and circulation of heavy machinery and vehicles

Operation Phase

- Sites clearing and preparation (excavation, stripping, backfilling, blasting and overburden management)
- Presence and operation of the infrastructures and buildings
- Water management (runoff, drinking water, wastewater, etc.)
- Management of residual materials, hazardous materials and fuels
- Use, maintenance and circulation of heavy machinery and vehicles
- Progressive rehabilitation of the waste rock and tailings pile

Closure Phase

- Management of residual materials, hazardous materials and fuels
- Site rehabilitation

7.2.4.2 Description of the Impacts

These impact sources are described below in the order of the project development phases.

Construction Phase

Sites Clearing and Preparation (Excavation, Stripping, Backfilling, Blasting and Overburden Management)

The activities associated with the clearing and preparation of the sites will result in permanent or temporary losses of terrestrial vegetation. The grading, excavation and backfilling of the infrastructure sites for their construction or operation (pit) are activities that will cause terrestrial land vegetation losses. The management of the overburden will also have an impact on terrestrial vegetation. To reach the ore deposit, the overburden will be excavated and stored near the pit, in the overburden pile. The clearing of the surface of the overburden pile will begin during the construction phase and will continue during the operation phase.

The stripping, filling and backfilling activities increase the risk of erosion due to the reworking of the soils. Erosion can also be caused by wind and precipitations as well as by the circulation of heavy machinery and vehicles on the mine site. This phenomenon could potentially modify the composition and productivity of the plant community around the project site.

Construction of the Temporary and Permanent Infrastructures and Facilities

The construction and presence of the infrastructures will result in the temporary loss of vegetation (over the life of the project). The construction activities can also result in accidental spill of substances harmful to vegetation.

Water Management (Runoff, Drinking Water, Wastewater, etc.)

The construction of the project infrastructures could modify the water circulation pattern at the borders of certain plant communities, which could cause a modification of their composition and productivity.

Management of Residual Materials, Hazardous Materials and Fuels

The management of residual materials, hazardous substances and fuels could constitute a source of impact on terrestrial vegetation. Effectively, contamination of the soils by hydrocarbons or other contaminants could be possible during the transport, storage or use of chemicals. An accidental spill could contaminate the soils and affect the terrestrial vegetation in the vicinity.

Use, Maintenance and Circulation of Heavy Machinery and Vehicles

The circulation of heavy machinery and vehicles on the mine site can modify the physical characteristics of the soil and increase notably erosion rates, which could have an impact on terrestrial vegetation near the access and service roads.

Vehicles traveling over unpaved service roads can lift dust. Transported by the wind, this dust could affect the photosynthetic capacity and productivity of the terrestrial vegetation nearby, as well as the chemical conditions of the soils on which the plants depend.

Accidental spills of petroleum products and other contaminants can also occur during the use, maintenance and fueling of heavy machinery and vehicles. A potential contamination of the soils could therefore affect the nearby terrestrial vegetation.

It is a common practice in northern regions to use all-terrain vehicles (ATVs) for work-related travels. This type of vehicle can allow travelling almost anywhere and it use is not limited to roads. Its use affected the vegetation and surfaces could be lost in certain areas.

Operation Phase

During the operation phase, the impact sources presented for the construction phase will remain when relevant (see Section 7.2.4.1). Some additional impact sources will occur during the operation phase and are describes here under.

<u>Sites Clearing and Preparation (Excavation, Stripping, Backfilling, Blasting and Overburden Management)</u>

Sites clearing and preparation will continue during the operation phase to expand the pit, the waste rock and tailings pile, and the deviation of the Route du Nord layout.

<u>Presence and Operation of the Infrastructures and Ore Extraction, Storage and Processing</u>

The presence of the infrastructures, particularly the waste rock and tailings pile, could constitute a source of dust emissions, notably due to the wind (wind erosion). The extraction and stockpiling activities could also generate occasionnaly dust emissions. This dust could be transported by wind and affect the surrounding terrestrial vegetation, potentially modifying its photosynthetic capacity and productivity, as well as the chemical conditions of the soils on which the plants depend.

<u>Water Management (Runoff, Drinking Water, Wastewater, etc.)</u>

The presence of the project infrastructures will modify the pattern of water circulation around, which could affect the conditions of the environment and modify their composition and productivity of the plant communities.

Runoff from the waste rock and tailings pile could, because of its physicochemical characteristics, affect the composition and productivity of the plant communities situated between the pile and the perimeter collector ditches.

Closure Phase

During the closure phase, the impact sources presented for the construction and operation phase will also be applied when relevant (see Section 7.1.4.1).

Site Rehabilitation

The site closure works include among others the decommissioning of the sedimentation basins, the removal of most ditches, and the vegetation of disturbed surfaces and the pit flooding. The works associated with this activity represents a source of impact on the terrestrial vegetation. The rehabilitation of the site will consist in restoring the areas disturbed by the project development to characteristics that are comparable to the original conditions, in as much as possible. Although this activity is a source of impact, the overall effect of the works are however considered positive, since it aims to restore degraded or disturbed environments to their natural state.

7.2.4.3 Description of the Mitigation Measures for Terrestrial Vegetation

The following mitigation measures will be implemented in order to reduce the impacts on terrestrial vegetation.

Construction Phase

- Prefer surfaces already disturbed by the exploration works for the circulation of machinery and the temporary materials storage areas construction.
- Clearly identified and delineate the construction zones so as to reduce the affected surface area of terrestrial vegetation.
- Limit the circulation of heavy machinery and vehicles to predetermined areas (e.g. service roads and work areas) so as to reduce the superficies of affected terrestrial vegetation.
- Limit speeds on service roads to 30 km/h to reduce the amount of dust generated during travels.
- Limit the circulation of heavy machinery to areas that must be deforested, inasmuch as possible.
- Prioritized the use of abrasives rather than melting salts in winter, inasmuch as possible.
- In the summer, use water as dust control on the service roads (including the ramps) as necessary.
- Replant the disturbed areas promptly at the end of the works so as to restore natural conditions as soon as possible; use indigenous plant species and, where necessary, temporary surface protection materials during the revegetation.
- Prohibit the use of herbicides to control vegetation growth; prioritized mechanical or manual methods.
- Ensure that emergency spill kit is available on site to control and to recover harmful substances (oil, fuel, chemicals, etc.), and ensure that the personnel is adequately trained on its use.

- Comply with harmful substances storage and handling standards, and ensure that the personnel is adequately trained.

Operation Phase

All the mitigation measures listed for the construction phase also apply to the operation phase, when they concern the same impact sources. The following additional mitigation measures will be implemented during the operation phase:

- Use the stockpiled overburden in the gradual rehabilitation of the waste rock and tailings pile.
- Progressively restore the waste rock and tailings pile (as the operating conditions allow).
- Implement a follow-up program on erosion and vegetation in areas susceptible of being affected and, if necessary, applied corrective measures.

Closure Phase

All the mitigation measures listed for the construction and operation phases also apply to the closure phase, when they concern the same impact sources.

7.2.4.4 Significance of the Residual Impact

The significance of the residual impact was evaluated by considering all three phases of the project and compiling the area of terrestrial vegetation that will be lost temporarily or permanently during the project realization (Table 7-1).

The development of the project will cause a temporary loss of approximately 200 ha of terrestrial environments. Three types of terrestrial environments will be affected by the project activities: the forest stands, the recent burns and the existing disturbed areas. The forest stands are composed of black spruce-moss stands, jackpine stands and, to a lesser extent, birch forests. The combined temporary loss of these three stands represents approximately 11 ha. The recent burn represent more than 70% (141.24 ha) of the terrestrial vegetation affected in the survey area.

Table 7-1 Superficies of Terrestrial Environments Affected by the Project during the Construction, Operation and Closure Phases, Prior to Site Rehabilitation

Facilities and Infrastructures	Terrestrial Environment (ha)			
	Forest Stand	Recent Burn	Anthropogenic Disturbance	All Environments
Service Roads	0.88	4.17	0.05	5.1
Explosives Store	-	0.92	-	0.92
Pit	5.05	13.98	12.16	31.19
Waste Rock and Tailings Pile	3.52	82.59	2.33	88.44
Overburden Pile	0.49	10.32	-	10.81
Diversion of the Route du Nord	0.05	7.00	32.00	39.05
Sedimentation Basins	0.99	8.28	-	9.27
Industrial Complex	-	13.98	0.63	14.61
All Facilities and Infrastructures	**10.98**	**141.24**	**47.17**	**199.39**

After the complete rehabilitation of the site, the surface of unrestored environments will be of 31.19 ha. It should be noted that this surface area includes more than 12 ha that are actually disturbed areas. Only the pit operation will result in permanent loss of terrestrial vegetation, as all the other sites will be restored.

Locally, users of the land gather the small fruits that are present in the burns. However, there are considerable surfaces of this type of environment in the region, as a result of recent forest fires. Comparable and accessible environments cover extensive areas near the community of Nemaska. Therefore, the project will have a negligible impact on the users of the territory. The social value of the component is therefore considered low. The ecosystemic value of the terrestrial vegetation component is low and its protection is not a subject of concern. The combined social and ecosystemic values thus give this component a low value. After application of the mitigation measures, the significance of the residual impact is moderate.

The nature of the impact on terrestrial vegetation is negative. The frequency of the impact is considered low, as it will occur only once during the construction of the land-based facilities. The degree of disturbance of the component is considered high, since the majority of the affected terrestrial vegetation surfaces will be lost temporarily or permanently. Considering that the value of the component is low and the degree of disturbance is high, the intensity of the residual impact is moderate (Table 7-2). Since the impact will be limited to the mine site, and generally at the location of the facilities and infrastructures, its extent is punctual. Because the terrestrial vegetation over the pit surface will be lost, the duration of the impact is considered long. This impact will be irreversible, since the superficies of terrestrial vegetation lost during the project realization will remains but will however be compensated by the rehabilitation works planned for the closure phase.

Table 7-2 presents the values assigned to each indicator and the resulting, the significance of the residual impact.

Table 7-2 Significance of the Residual Impact – Terrestrial Vegetation

Intensity	Extent	Duration	Significance of the Residual Impact
High	Regional	**Long**	High
Moderate	Local	Medium	**Moderate**
Low	**Punctual**	Short	Low

7.2.5 Description of the Impacts on Wetlands

The following sections discuss:

- Identification of the impact sources;
- Description of the impacts;
- Description of the mitigation measures;
- Significance of the residual impact.

7.2.5.1 Identification of the Impact Sources on Wetlands

Over the different phases of the Whabouchi project, several activities could constitute an impact source for the wetlands. These impacts sources, for the different project development phases, are the following:

Construction Phase

- Sites clearing and preparation (excavation, stripping, backfilling, blasting and overburden management)
- Water management (runoff, drinking water, wastewater, etc.)
- Management of residual materials, hazardous materials and fuels
- Use, maintenance and circulation of heavy machinery and vehicles

Operation Phase

- Sites clearing and preparation (excavation, stripping, backfilling, blasting and overburden management)
- Water management (runoff, drinking water, wastewater, etc.)
- Management of residual materials, hazardous materials and fuels
- Presence and operation of the infrastructures and buildings
- Use, maintenance and circulation of heavy machinery and vehicles

Closure Phase

- Water management (runoff, drinking water, wastewater, etc.)
- Management of residual materials, hazardous materials and fuels
- Use, maintenance and circulation of heavy machinery and vehicles
- Site rehabilitation

7.2.5.2 Description of the Impacts on Wetlands

The above-mentioned impact sources represent activities that will modify the existing condition of the wetlands. These impact sources are described below in the order of the project development phases.

Construction Phase

Sites Clearing and Preparation (Excavation, Stripping, Backfilling, Blasting and Overburden Management)

The construction of the mine infrastructures (service roads, drainage ditches, stockpiles, sedimentation basins, pit and explosives store) will cause the loss of several wetlands. Other wetlands could also be affected by the drawdown of the water table associated with the drainage ditches and other excavations.

Water Management (Runoff, Drinking Water, Wastewater, etc.)

The construction of infrastructures could modify the runoff drainage pattern, thus disturbing the supply of water to certain wetlands.

Management of Residual Materials, Hazardous Materials and Fuels

The management of residual materials, hazardous substances and fuels could constitute a source of impact on wetlands. Effectively, potential contamination of the soil and water by hydrocarbons or other contaminants could occur during the transport, storage or use of chemicals. An accidental spill could therefore impact wetlands.

Use, Maintenance and Circulation of Heavy Machinery and Vehicles

The circulation of heavy machinery and vehicles on the mine site can modify the physical characteristics of the soil, increasing erosion levels, which could have an impact on wetlands near the access and service roads.

Accidental spills of petroleum products and other contaminants can also occur during the use, maintenance and fueling of heavy machinery and vehicles. A potential contamination of the soils could therefore affect the nearby wetlands.

It is a common practice in northern regions to use all-terrain vehicles for work-related travel. This type of vehicle can travel almost anywhere and it use is not limited to roads. Its use could affect wetlands in certain areas of the territory.

Operation Phase

During the operation phase, the impact sources presented for the construction phase will also apply when relevant. Some additional impact sources will occur during the operation phase. They are described hereunder.

Presence and Operation of the Infrastructures and Buildings

The progressive expansion of the pit and of the operation of the waste rock and tailings pile will cause wetland losses.

The exploitation of the deposit will require the excavation of a pit that will gradually increase in depth. The pumping activities required to dewater the pit will cause a drawdown of the underground water table. The drawdown could modify the surrounding wetlands by modifying the pattern of water circulation in the watersheds. After 18 years of operation, at the end of the pit exploitation, the drawdown area would reach a distance of 990 m along the longitudinal axis, and 727 m along the transversal axis. Including the pit, the total area of the drawdown zone would reach 3.6 km², with approximately 0.75 km² (75 ha) under the wetland located southeast of the pit. In principle, bogs such as the shrubby bog are not hydrologically connected with the underground aquifer and would not be affected by the groundwater drawdown. However, the fen could be affected.

The pit is directly upstream of a large complex of wetlands comprising a shrubby bog and fens. The presence of the pit will modify the supply of surface water to these wetlands.

Closure Phase

During the closure phase, the impact sources presented for the construction and operation phases will applied when relevants.

Site Rehabilitation

The site closure activities include, among others, the decommissioning of the sedimentation basins, the filling most ditches, the replanting disturbed surfaces and the flooding of the pit. The required works associated with this activity represents a potential source of impacts on wetlands. The rehabilitation of the site will consist in restoring the areas disturbed by the project to characteristics that are comparable to the original conditions, inasmuch as possible. The rehabilitation will include the restoration of the wetlands. Although this activity is a source of impact, the overall effect of this work is considered however positive, since it aims to restore degraded or disturbed environments to their natural state.

7.2.5.3 Description of the Mitigation Measures

The following mitigation measures will be implemented to reduce the impacts on wetlands:

Construction Phase

- Prefer surfaces already disturbed by the exploration works for the circulation of heavy machinery and the temporary storage areas of construction materials.
- Clearly identify the limits beyond which circulation of heavy machinery and vehicles is forbidden.
- Limit the circulation of heavy machinery and vehicles to predetermined areas (e.g., service roads and work areas) so as to reduce the affected wetland surfaces.
- Limit speeds on service roads to 30 km/h to reduce the amount of dust generated during travel.
- Prioritize the use abrasives rather than melting salts on the roads in winter, inasmuch as possible.
- In the summer, use water as dust control on the service roads (including the ramps) as necessary.
- Provide specific locations for the storage of heavy machinery, vehicles and equipments.
- Ensure that the heavy machinery, vehicles and equipments are in proper operating order (adequate maintenance).
- Perform the maintenance of heavy machinery and vehicles in the planned locations for this purpose (garage).
- Minimize the number of fueling points for heavy machinery and vehicles.
- Develop a prevention and intervention plan in case of accidental spills or leaks of hazardous products.
- Train the employees on quick, effective and safe intervention in case of a leak or accidental spill of petroleum products or hazardous materials.
- Dispose wastes according to appropriate procedures.
- Use machinery and equipments that are adapted to ground conditions so as to reduce the physical disturbances.
- As much as possible, favour winter time to carry out works near wetlands.
- Ensure that emergency spill kit is available on site to control and recover harmful substances (oils, fuel, chemicals, etc.), and ensure that the personnel is adequately trained on its use.
- Comply with storage and handling standards for harmful substances, and ensure that the personnel is adequately trained.
- Install culverts to maintain the circulation of surface water whenever a service road crosses a wetland.

- Avoid over excavating the drainage ditches near wetlands so as to limit the water table drawdown.

Operation and Closure Phases

During the operation and closure phases, all the mitigation measures described for the construction phase will apply, as relevant. The following measure is added:

- Consider the surface drainage and the supply of water to wetlands when developing the waste rock and tailings pile, so as to avoid draining or flooding these wetlands.

7.2.5.4 Significance of the Residual Impact on Wetlands

The assessment of the residual impact took into account the wetland superficies that are directly in the footprint of the project infrastructures and facilities. The areas are considered as wetlands in the project area are the shrubby riparian swamps (alder and myricaceae) and the peatlands (shrubby bogs and fen). The superficies of these environments that will be affected during the construction, operation and closure phases are presented in Table 7-3, for the infrastructures and facilities of the project.

The development of the project will result in the loss of 9.39 ha of wetlands. The most affected environment will be shrubby bog, with a loss of 7.01 ha. The alder is the other type of wetland that will be affected (loss of 2.4 ha).

Some 75 ha of the fen and shrubby bog located southeast of the pit could be affected by the drawdown of the water table. It is very difficult to evaluate this impact since shrubby bogs such as the one covering the majority of this wetland are often fed only by surface water. Furthermore, any potential impact would be temporary, since the flooding of the pit at closure phase will restore the water table level. This impact is therefore not considered in the evaluation of affected surfaces and in the residual impact.

Table 7-3 Surface of Wetlands Affected by the Project Development during the Construction, Operation and Closure Phases, Prior to Site Rehabilitation

Facilities and Infrastructures	Wetlands (ha)		
	Alder	Shrubby Bog	All Environments
Service Roads	0.07	0.24	0.31
Explosives Store	0.01	0.31	0.32
Pit	-	0.12	0.12
Waste Rock and Tailings Pile	2.11	2.55	4.66
Overburden Pile	-	2.72	2.72
Diversion of the Route du Nord	0.06	0.91	0.97
Sedimentation Basins	0.13	0.16	0.29
Industrial Complex	-	-	-
All Facilities and Infrastructures	**2.38**	**7.01**	**9.39**

After application of the mitigation measures, the residual impact of the project on wetlands is estimated at 9.39 ha. The wetland surfaces lost as a result of the project development could be compensated by the creation or restoration of wetlands during the closure phase, so that there would be no net loss of this type of environment.

The social value of the component is low, since it is not used much by the local population. Its ecosystemic value is high, however, since wetlands play a major role in the ecosystem and are very significant in terms of biodiversity. Therefore, the value of this component is considerate as moderate. After application of the mitigation measures, the significance of the residual impact is low.

The nature of the impact on the wetlands is negative. The frequency of the impact is considered low, as it will occur only once during the construction of the terrestrial facilities. The degree of disturbance is qualified as low, since wetlands will be created during the closure phase. Considering that the value of the component is moderate and the degree of disturbance is low, the intensity of the residual impact is low. The extent of the impact is considered punctual, as it will be felt only on small surface of the mine site. Since the evolution of developed wetlands into functional ecosystems takes many years, the duration of the impact is considered long. This impact will be irreversible, since the surfaces of wetlands lost during the project development will remain but they will be compensated by the rehabilitation works planned during the closure phase.

Table 7-4 presents the values assigned to each indicator and the resulting significance of the residual impact.

Table 7-4 Significance of the Residual Impact – Wetlands

Intensity	Extent	Duration	Significance of the Residual Impact
High	Regional	**Long**	High
Moderate	Local	Medium	Moderate
Low	**Punctual**	Short	**Low**

7.3 Fish and its Habitat

This section presents the description of the ichthyofauna and its habitat within the study area, as well as the assessment of the project impacts on this biological component.

7.3.1 Survey Area

The survey area for the works conducted on the fish and its habitat covers a surface area of approximately 6,350 ha (Map 7-3). The inventories were taken in the lakes and streams susceptible of being directly or indirectly influenced by the project activities, and in certain aquatic environments that could be used as controls in the potential environmental follow-up.

7.3.2 Literature Review

7.3.2.1 Methods

The available informations about the ichthyofauna in the James Bay territory were consulted. The most significant documents in this review were produced as part of the baseline and follow-up studies on the hydroelectric or mining projects in the region.

The MRN database was consulted to obtain references about special-status fish species (Boudreault (MRN), 2013, personal communication).

7.3.2.2 Results

As mentioned in Chapter 6, the project study area lies within the Nemiscau River sub-watershed, part of the Rupert River watershed. According to the Commission régionale sur les ressources naturelles et le territoire de la Baie-James, 33 freshwater fish species visit hydrogeographic region 08 (Hanna and Rupert bays) in the James Bay territory (CRRNTBJ, 2010). These species are distributed among 11 families (Table 7-5).

Table 7-5 Freshwater Fish Species Present in Hydrogeographic Region 08 in the James Bay Territory

Family	Common Name	Scientific Name
Acipenseridae	Lake sturgeon	*Acipenser fulvescens*
Catostomidae	Longnose sucker White sucker	*Catostomus catostomus* *Catostomus commersoni*
Cottidae	Mottled sculpin Slimy sculpin Spoonhead sculpin	*Cottus bairdi* *Cottus cognatus* *Cottus ricei*
Cyprinidae	Lake chub Pearl dace Emerald shiner Spottail shiner Northern redbelly dace Blacknose dace Longnose dace Creek chub Fallfish	*Couesius plumbeus* *Margariscus margarita* *Notropis atherinoides* *Notropis hudsonius* *Phoxinus eos* *Rhinichthys atratulus* *Rhinichthys cataractae* *Semotilus atromaculatus* *Semotilus corporalis*
Esocidae	Northern pike	*Esox lucius*

Family	Common Name	Scientific Name
Gasterosteidae	Brook stickleback Threespine stickleback Ninespine stickleback	*Culaea inconstans* *Gasterosteus aculeatus* *Pungitius pungitius*
Hiodontidae	Goldeye Mooneye	*Hiodon alosoides* *Hiodon tergisus*
Lotidae	Burbot	*Lota lota*
Percidae	Johnny darter Yellow perch Logperch Sauger Walleye	*Etheostoma nigrum* *Perca flavescens* *Percina caprodes* *Sander canadensis* *Sander vitreus*
Percopsidae	Trout-perch	*Percopsis omiscomaycus*
Salmonidae	Lake cisco Lake whitefish Round whitefish Brook trout Lake trout	*Coregonus artedi* *Coregonus clupeaformis* *Prosopium cylindraceum* *Salvelinus fontinalis* *Salvelinus namaycush*

Source: CCRNTBJ, 2010

There is no mention of special-status fish species in the CDPNQ database (Boudreault (MRN), 2013, personal communication).

The concentration of mercury in fish flesh was the subject of many studies carried out for the major hydroelectric projects conducted in the region. Appendix 7-3 presents a list of these studies and their results concerning the mercury levels in fish flesh in the James Bay region. The mercury levels vary greatly according to the species, its size and the condition of the water body (natural state or reservoir). The highest mercury levels are present in the flesh of northern pikes (up to 1.16 mg/kg of wet weight fish flesh, on average).

7.3.3 Inventory of the Ichthyofauna and Aquatic Habitats

The fieldworks on ichthyofauna and aquatic habitats were carried out in 2010, 2011 and 2012 in the Whabouchi project study area. The purposes of these fieldworks were to document the fish populations and characterize the fish habitats in the survey area. The specific objectives were to:

- Identify the present fish species;
- Characterize the fish communities;
- Assess the health status of the fish (presence of internal and external parasites);
- Determine the concentration of certain metals in the flesh of the fish;

- Characterize the fish habitat;
- Verify the presence of special-status species.

7.3.3.1 Methods

The fish inventory and the habitat characterization were carried out at different periods, i.e. August 26 to 30 2010, September 13 to 19 2011, November 2 to 11 2011 and June 19 to July 6 2012 (Table 7-6). Map 7-3 shows the lakes and water courses subject to fishing or characterization works.

Fisheries

The fish populations were inventoried with gill nets, bait traps, hoop nets, shore seines and electrofishing (Table 7-6).

Table 7-6 Fishing Periods and Gear Used in the Surveyed Lakes and Water Courses

Lake or Water Course	Survey Period	Fishing Gear
Lac des Montagnes	August 26 to 30, 2010	Experimental gill net, bait trap
	November 2 to 11, 2011	Experimental gill net
Lac du Spodumène	August 26 to 30, 2010	Experimental gill net, bait trap, shore seine
	November 2 to 11, 2011	Experimental gill net
Lake 1	November 2 to 11, 2011	Experimental gill net
	September 13 to 19, 2011	Bait trap
Lake 2	November 2 to 11, 2011	Experimental gill net
	September 13 to 19, 2011	Hoop net
Lake 3	September 13 to 19, 2011	Bait trap and hoop net
Lake 5	September 13 to 19, 2011	Bait trap
Lake 6	September 13 to 19, 2011	Bait trap
Lake 16	September 13 to 19, 2011	Shore seine net and bait trap
	June 19 to July 5, 2012	Experimental gill net
Lake 24	September 13 to 19, 2011	Bait trap
Lake 27	September 13 to 19, 2011	Bait trap
	June 19 to July 5, 2012	Experimental gill net
Lake 28	September 13 to 19, 2011	Bait trap
	June 19 to July 5, 2012	Experimental gill net
Lake 29	September 13 to 19, 2011	Bait trap
	June 19 to July 5, 2012	Experimental gill net
Lake 30	September 13 to 19, 2011	Bait trap
	June 19 to July 5, 2012	Experimental gill net

Lake or Water Course	Survey Period	Fishing Gear
Lake 31	September 13 to 19, 2011	Bait trap
	June 19 to July 5, 2012	Experimental gill net
Nemiscau River	November 2 to 11, 2011	Experimental gill net
Creek A	August 26 to 30, 2010	Electrofishing device
	September 13 to 19, 2011	Bait trap
Creek B	August 26 to 30, 2010	Electrofishing device
	September 13 to 19, 2011	Bait trap
Creek C	August 26 to 30, 2010	Electrofishing device
	September 13 to 19, 2011	Bait trap
	June 19 to July 5, 2012	Electrofishing device
Creek D	August 26 to 30, 2010	Electrofishing device
	September 13 to 19, 2011	Bait trap and hoop net
Creek E	June 19 to July 5, 2012	Electrofishing device
Creek F	September 13 to 19, 2011	Dip net
	June 19 to July 5, 2012	Electrofishing device
Creek G	September 13 to 19, 2011	Bait trap and hoop net
	June 19 to July 5, 2012	Electrofishing device

The fishing gears were installed in various types of environments so as to catch a maximum of the species present.

In lake, the fishing was carried out mainly with experimental gill nets. The gill net fishing effort corresponded to one night/net, a period of 18 to 24 hours, and covered at least the period between 6 pm to 9 am the next morning. The bait traps were installed for a period varying between 19 and 39 hours, and the hoop nets, for a period varying between 23 to 26 hours.

In the streams, most of the catches were made with an electric fishing (Smith-Root, model LR-24). The duration of the electrofishing sessions varied between 30 seconds and 14 minutes. Bait traps and hoop nets were also used and installed in certain water courses for a period of at least 20 hours.

The captured fish were counted and their species identified. Also, the length, weight and sex of certain specimens were recorded, as well as the presence of internal or external parasites. The live specimens were released at the capture site after identification.

Metals in Fish Flesh

The flesh of three fish species was analyzed to measure the concentrations of mercury and 23 other metals: aluminum, antimony, silver, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, tin, iron, lithium, manganese, molybdenum, nickel, lead, selenium, strontium, uranium, vanadium and zinc.

The species targeted for the metal analyzes were lake whitefish, white sucker and brook trout. These species were selected for the following reasons:

- Species valued by the Crees;
- Abundant species and generally common in the survey area;
- Species in different trophic levels of the food chain: non-piscivorous (lake whitefish and white sucker) and piscivorous (lake trout).

The samples were frozen and delivered to the analytical laboratory. The sample collection and preservation methods are in accordance with the recommendations of the *Démarche méthodologique relative au suivi des teneurs en mercure des poissons* (Tremblay and coll., 1996). For the analysis of the results, the averages for each species and each lake or water course were calculated by using an egal value of 50% of the detection limit when the measured concentrations were below this limit.

Characterization of the Aquatic Habitats

The characterization of aquatic habitats concentrated in areas of interesting potential in terms of fish habitat (Table 7-7).

In lake, the characteristics of the littoral zone and the shore were evaluated by traveling along the shore aboard a boat or on foot. The following criteria were recorded during the characterization:

- Erosion rate;
- Type of substrate;
- Slope of the shore;
- Percentage of overhanging riparian vegetation cover (herbaceous, shrubby);
- The percentage of canopy coverage (deciduous, conifers);
- The percentage of coverage of the littoral zone by submerged and emergent aquatic vegetation.

Bathymetric measurements were also recorded in the lakes. The details of the methods and the results are presented in Chapter 6.

In the water courses, the habitat characterization was carried out on foot by walking along the shore and taking a series of measurements. The characterization is based on the following biophysical elements:

- Slope of the shore;
- Erosion rate;
- Type of shore plant cover and percentage of coverage;
- Width;

- Water level in relation to the natural high water line (NHWL);
- Type of substrate;
- Depth;
- Flow velocity.

The presence of obstacles to migration (permanent or temporary) and of potential spawning grounds was also noted.

The following physico-chemical parameters were noted in most lakes and water courses in November 2011 and/or June and July 2012:

- Temperature;
- Dissolved oxygen (only in lake);
- pH;
- Conductivity.

In the lakes and the Nemiscau River, the measurements were taken at 1 m intervals, from the surface to the bottom. In the water courses, the measurements were taken at the surface. The measurements were taken with a Hanna probe connected by cable.

Table 7-7 presents the lakes and water courses that were characterized in the survey area, the survey periods and the type of works completed.

Table 7-7 Lakes and Water Courses Characterized in the Survey Area

Lake or Water Courses	Survey Period	Type of Works
Lac des Montagnes[1]	November 2 to 11, 2011	Characterization and limnology[2]
Lac du Spodumène	November 2 to 11, 2011	Characterization and limnology
Lac 1	November 2 to 11, 2011	Characterization and limnology
Lac 2	November 2 to 11, 2011	Characterization and limnology
Nemiscau River[3]	November 2 to 11, 2011	Characterization and limnology
Lac 16	June 19 to July 5, 2012	Characterization
Lac 27	June 19 to July 5, 2012	Characterization
Lac 28	June 19 to July 5, 2012	Characterization
Lac 29	June 19 to July 5, 2012	Characterization
Lac 30	June 19 to July 5, 2012	Characterization
Lac 31	June 19 to July 5, 2012	Characterization
Creek A	November 2 to 11, 2011	Characterization
	June 19 to July 5, 2012	Characterization and limnology
Creek B	June 19 to July 5, 2012	Characterization and limnology
Creek C	November 2 to 11, 2011	Characterization
	June 19 to July 5, 2012	Characterization and limnology

Lake or Water Courses	Survey Period	Type of Works
Creek D	November 2 to 11, 2011	Characterization
	June 19 to July 5, 2012	Characterization and limnology
Creek E	June 19 to July 5, 2012	Characterization and limnology
Creek F	June 19 to July 5, 2012	Characterization and limnology
Creek G	June 19 to July 5, 2012	Characterization and limnology
Creek H	November 2 to 11, 2011	Characterization
Creek I	June 19 to July 5, 2012	Characterization and limnology

[1] A 4,080 m portion of the shore was characterized.
[2] Limnology: measurement of temperature, dissolved oxygen contentration, pH and conductivity.
[3] A 5,554 m section was characterized.

7.3.3.2 Results

A total of 330 specimens of the following 13 fish species were captured during the fieldworks: mottled sculpin, lake cisco, walleye, brook stickleback, northern pike, lake whitefish, burbot, white sucker, longnose sucker, lake chub, pearl dace, brook trout and yellow perch.

All these species have already been inventoried in the James Bay region (Table 7-5). Among them, brook trout, northern pike, yellow perch, walleye, burbot and lake whitefish are considered of interest to sport anglers. Also, the white sucker and longnose sucker are also valued fishes in the traditional Cree culture.

Lakes and Nemiscau River

A total of 294 catches were taken in the lakes and 20 in the Nemiscau River (Appendix 7-4).

Among the 13 species observed, the northern pike was caught in the greatest number of water bodies. Catches were reported in Lac des Montagnes, Lac du Spodumène, lakes 3, 16 and 31, as well as in the Nemiscau River. Brook trout was also captured in several lakes (lakes 1, 2 and 24). Several species were caught in one lake only: burbot (Lac des Montagnes), pearl dace (Lake 30), lake chub (Lac des Montagnes), yellow perch (Lac du Spodumène), brook stickleback (Lake 27) and mottled sculpin (Lake 24).

Lake whitefish is the most abundant sport interest species among the captures. All 64 individuals were caught in Lac des Montagnes, Lac du Spodumène and the Nemiscau River. Walleye (55 individuals), brook trout (21 individuals) and northern pike (17 individuals) were also abundant.

The greatest specific richness was observed in the larger lakes. Eight and six fish species were caught respectively in Lac des Montagnes and Lac du Spodumène. A single species was captured in the smaller lakes (lakes 2, 3, 16, 27, 30 and 31). Two species (brook trout and mottled sculpin) were inventoried in Lake 24, but there were no catches in lakes 5, 6, 28 and 29.

In Lac des Montagnes, lake whitefish is the most abundant species, representing 43% of the catches (Appendix 7-5). White sucker (21% of the catches), walleye (11% of catches) and longnose sucker (10% of catches) are the other common species in this lake. In Lac du Spodumène, walleye and lake whitefish represent respectively 49% and 31% of the captures. In Lake 2, the 8 brook trout constitute the totality of catches. Walleye and lake whitefish are also the most frequent catches in the Nemiscau River.

For the gill nets, the catches per unit effort (CPUE) are presented in Appendix 7-6. The most intensive gill net fishing efforts were made in the greater lakes, i.e. Lac des Montagnes, Lac du Spodumène and lakes 1 and 2. The gill nets fishing effort in the lakes varied between 16 and 132 hours.

The highest gill netting CPUE were recorded in Lac des Montagnes, Lac du Spodumène and the Nemiscau River (Appendix 6-7).

Water Courses

Burbot, brook trout, northern pike and brook stickleback were the only species captured in the streams during the four inventories (Appendix 7-7).

The number of catches in water courses is relatively low. A total of 16 fishes were caught in Creeks A, C, D, F and G. Only one fish species was captured in each of these streams. No fish was caught in Creeks B and E.

Assessment of Fish Captures

Certain characteristics of the captured fishes were noted. The weight, length, sex, maturity stage and the presence of internal and external parasites are presented in appendix 7-8.

A visual examination verified the presence of external parasites or anomalies (malformations, injuries, diseases) on the body and particularly on the eyes. An internal examination was also performed on all fishes designated for chemical analyzes of tissues. No external or internal anomaly was observed in the analyzed fishes. However, parasites were observed in the abdominal cavity of several brook trout and white sucker caught in Lake 2.

Heavy Metals Concentrations

Flesh samples from a total of 39 specimens were analyzed to determine their heavy metals content (Table 7-8). The analyzed specimens were captured in Lac des Montagnes, Lac du Spodumène, Lake 1, Lake 2 and the Nemiscau River in November 2011.

Table 7-8 Fish Species Selected for Flesh Chemical Analysis

Sampling Site	Species	Number of Specimens	Size Interval
Nemiscau River	Lake whitefish	7	30 to 43 cm
Lac des Montagnes	Lake whitefish	8	16 to 34 cm
Lac du Spodumène	Lake whitefish	8	20 to 28 cm
Lake 1	White sucker	8	14 to 27 cm
Lake 2	Brook trout	8	23 to 35 cm

Table 7-9 presents the parameters for which the measured average concentrations in the flesh of at least one specimen were higher than the detection limit. The analysis certificates are presented in Appendix 7-9.

Several parameters presented flesh concentrations below the detection limit in all samples (antimony, silver, barium, beryllium, boron, cobalt, lithium, manganese, uranium, vanadium, cadmium, molybdenum, nickel, lead and chromium).

All the analyzed specimens showed mercury concentrations below the Health Canada standard establish for human consumption (0.5mg/kg of wet weight) (Santé Canada, 2012). The average mercury concentrations measured in the flesh of the analyzed fishes were relatively low, ranging from 0.01 mg/kg to 0.05 mg/kg of wet weight, according to the species and lake.

These concentrations are lower than those measured in the Rupert diversion bay section and in the Rupert, Lemare and Nemiscau rivers (environmental impact assessment on the Eastmain-1-A power station and Rupert diversion; GENIVAR et Hydro-Québec, 2004): 0.11 mg/kg of wet weight in lake whitefish and white sucker (length standardized at 40 cm) and 0.13 mg/kg of wet weight in brook trout (length standardized at 30 cm).

It is important to note that in the present study, the average concentrations were not standardized for fish length. The mercury concentration varies according to the age and size of the fishes, since this metal accumulates gradually over their entire life. The lake whitefish and white suckers captured in Lac des Montagnes, Lac du Spodumène, Lake 1 and the Nemiscau River were generally smaller than the standard length used in the Eastmain-1-A power station and Rupert diversion environmental impact assessment (40 cm). In the case of brook trout, the 30 cm standardized length generally matches the mean length of catches in Lake 2 (see Table 7-9).

Table 7-9 Average Concentrations of Heavy Metals in Analyzed Fish Flesh

Metals	Reported Detection Limit	Concentration (mg/kg)[1]				
		Nemiscau River (n = 7)	Lac du Spodumène (n = 8)	Lac des Montagnes (n = 8)	Lake 1 (n = 8)	Lake 2 (n = 8)
		Lake Whitefish	Lake Whitefish	Lake Whitefish	White Sucker	Brook Trout
Aluminum	1	2 ± 0.4	1 ± 0.5	3 ± 3	NA	NA
Arsenic	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Copper	1	< 1	< 1	< 1	< 1	< 1
Tin	1	< 1	< 1	< 1	NA	NA
Iron	10	< 10	< 10	< 10	NA	NA
Mercury (dry weight)	0.010	0.134 ± 0.049	0.252 ± 0.045	0.122 ± 0.038	0.091 ± 0.032	0.070 ± 0.018
Mercury (wet weight[2])	-	0.03 ± 0.01	0.05 ± 0.01	0.02 ± 0.01	0.02 ± 0.001	0.01 ± 0.003
Selenium	0.2	0.6 ± 0.1	0.4	0.6 ± 0.2	NA	NA
Strontium	0.2	0.2 ± 0.1	1.0 ± 1.5	< 0.2	NA	NA
Zinc	0.6	4.8 ± 1.8	8.1 ± 5.2	7.2 ± 4.2	NA	NA

[1] Unless otherwise specified, the concentration is based on dry weight; NA: Not analyzed.

[2] Assuming a 80% moisture content.

Fish Habitat

Lakes

Most of the lakes in the survey area present small superficies (<6,500 m^2) and their maximum depth is often less than 5 m (Table 7-10). Lac des Montagnes and Lac du Spodumène are the largest lakes and their maximum depth in the survey area exceeds 10 m (Table 7-10).

Table 7-10 Morphometric Characteristics of the Inventoried Lakes

Lake	Maximum Depth (m)[1]	Perimeter (m)	Surface Area (m^2)	Volume (m^3)
Lac des Montagnes[2]	19.6	NA	NA	NA
Lac du Spodumène	10.6	3,966	606,040	1,911,164
Lake 1	4.0	1,472	62,837	115,596
Lake 2	4.2	1,449	47,247	62,576
Lake 16	6.2	695	21,475	39,540
Lake 27	4.4	294	5,453	8,135
Lake 28	1.2	209	2,315	1,370
Lake 29	5.2	146	1,440	3,614
Lake 30	4.9	367	6,319	8,746
Lake 31	3.0	326	6,085	9,899

[1] For the lake bathymetry, see chapter 6.

[2] NA: Does not apply because only part of the lake was inventoried.

In general, the lakes are characterized by a low erosion rate and gently sloping shores (0% to 25%). However, Lake 30 presents a steep shore on the northern side. The tree density around the lakes is generally low. The low vegetation on the shore of lakes 27, 28, 29 and 31 was composed exclusively of sphagnum.

The lake substrate is generally composed of a mixture of sand and organic matter, with sporadic presence of blocks and cobbles. On the other hand, the substrate in Lac du Spodumène is mainly composed of blocks, cobbles and pebbles. Appendix 7-10 presents the complete characteristics of the inventoried lakes.

Appendices 7-11 and 7-12 present the physicochemical characteristics of the inventoried lakes and of the Nemiscau River.

In November 2011, temperatures in the lakes and the Nemiscau River varied between 2.11°C and 4.84°C. The dissolved oxygen rates were generally high. The pH varied between 5.56 and 8.10, with lakes 1 and 2 being the most acidic water bodies.

In summer 2012, the temperature in Lac des Montagnes ranged between 17.56°C at the surface and 16.4°C at the bottom. The dissolved oxygen concentration also varied with depth. A similar pattern was observed in Lac du Spodumène.

The other lakes are shallower and, except for Lake 29, little temperature and dissolved oxygen concentration variations were observed in the water column. The temperatures and dissolved oxygen concentration in Lake 29 dropped rapidly below the surface. Below two metres, conditions were hypoxic.

In the Nemiscau River, the average temperature was 17.7°C and the saturation percentage was approximately 90%.

The pH varied between 4.21 and 7.93 in all the inventoried water bodies. Lake 29 is the most acidic, with pH values below 5.00 over the entire water column.

Searches for potential spawning grounds were carried out in Lac des Montagnes, Lac du Spodumène and lakes 1 and 2. The only potential spawning grounds that were identified are in Lac des Montagnes and Lake 1, respectively for walleye and brook trout (map 7-4). The potential spawning grounds in Lac des Montagnes were at a maximum depth of 1.5 m and were mostly composed of gravel, pebbles and cobbles.

Nemiscau River

The Nemiscau River was characterized over a total distance of 5.6 km. The river reaches a maximum depth of 27.2 m in the surveyed sector (see Chapter 6 for the bathymetry).

The width of the Nemiscau River varies between 73 m and 250 m. The slope of its banks varies from gentle to moderately steep. The banks are generally covered by alder, Labrador tea, young jackpines and spruces. The substrate near the river is generally composed of sand and organic matter, with a few areas of gravel and pebbles. Further north, the substrate is mainly composed of bedrock and larger blocks. A sand beach can be found in the survey area. The shores of the islands are mainly composed of a block and cobble substrate.

Water Courses

The shore of the surveyed water courses is characterized by generally dense vegetation composed of green alder, Labrador tea and black spruces. The shoreline slope ranges from low to none. At the time of the surveys, the channel width generally varied between 1 m and 2 m, and the depth generally varied between 0.3 m and 1 m.

Creek D, outlet of Lac du Spodumène, is one of the widest surveyed water courses. It is meandering, with a flat profile. Its facies is of the channel type and the substrate, mainly composed of blocks and large cobbles, is covered with fine sediments. It is often wider than 7 m, while its depth can reach almost 0.9 m in places. The mean velocity measured near its mouth in Lac des Montagnes was 1.44 m/s in November 2011.

The other characterized water courses are generally constituted with a channel-type facies and their substrate is composed of sand and organic matter. Most water courses have an average depth of less than 1 m. The velocities measured in these water courses varied between zero and 0.56 m/s.

As shown in Table 7-11, the physicochemical parameters varied from one water course to the other during the 2012 summer.

Table 7-11 Water Courses Physicochemical Parameters in 2012 Summer

Water Courses	A	B	C	D	E	F	G	I
Air Temperature (°C)	16.6	18.5	21.0	NA	16.2	25.1	25.1	NA
Water Temperature (°C)	18.6	17.8	9.8	19.1	12.2	14.50	21.6	NA
pH	6.11	5.44	5.16	6.32	5.03	5.85	6.50	NA
Conductivity (µS/cm)	5.0	5.0	13.0	9.0	19.0	27.0	8.0	NA

Potential brook trout spawning grounds were identified in Creeks D and G. The velocity in these zones is appropriate for spawning, and the substrate is composed of 70% gravel.

Potential obstacles to fish movements were observed (Map 7-4):

- A section of Creek A runs underground for approximately 50 m;
- Several wood debris were observed in a section of Creek B, which could potentially limit the movements of certain species;
- A cascade running through dense wood debris was observed in Creek C;
- A large proportion of Creek E flows underground.

Appendix 7-13 presents the characteristics of the water courses surveyed in June and July 2012.

7.3.4 Special-Status Species

No special-status fish species under the Species at Risk Act and the Act Respecting Threatened or Vulnerable Species is mentioned in the CDPNQ database (Boudreault (MRN), 2013, personal communication). The only species susceptible of being present in the study area is lake sturgeon (*Acipenser fulvescens*). According to some Cree users, this species is present in the James Bay territory and may frequent the Nemiscau lake and river (upstream of the study area).

No special-status species was captured during the inventories taken in August 2012, September 2011, November 2011 and June/July 2012.

It is also mentioning that no invasive exotic fish species was reported in the study area.

7.3.5 Benthos

Sediment samples were collected in various water bodies in August 2010 in order to characterize the benthic community. The water bodies that were inventoried are the following: Lac du Spodumène, Lake 1, Lake 2 and Lake 3. The analytical results are presented in the Genivar 2010 report (Appendix 6-6).

These data will be used, notably, to establish the baseline conditions and to select stations for the environmental effects follow-up studies (EEFS) required by the Metal Mining Effluent Regulations.

7.3.6 Assessment of the Impacts on Ichthyofauna

This section presents the assessment of the impacts on the ichthyofauna and its habitat. For each project phase (construction, operation and closure), the following elements are presented:

- Identification of the impact sources;
- Description of the impacts;
- Description of the mitigation measures;
- Significance of the residual impact.

7.3.6.1 Identification of the Impact Sources

During the different phases of the Whabouchi project, several activities could modify the conditions in the aquatic environments and constitute potential sources of impacts on the ichthyofauna. These impacts sources, according to the project development phases, are the following:

Construction Phase

- Sites clearing and preparation (excavation, stripping, backfilling, blasting and overburden management)

- Water management (runoff, drinking water, wastewater, etc.)
- Management of residual materials, hazardous materials and fuels
- Use, maintenance and circulation of heavy machinery and vehicles
- Presence of workers and purchasing of goods and services

Operation Phase

- Sites clearing and preparation (excavation, stripping, backfilling, blasting and overburden management)
- Presence and operation of the infrastructures and buildings
- Water management (runoff, drinking water, wastewater, etc.)
- Management of residual materials, hazardous materials and fuels
- Use, maintenance and circulation of heavy machinery and vehicles
- Presence of workers and purchasing of goods and services

Closure Phase

- Water management (runoff, drinking water, wastewater, etc.)
- Management of residual materials, hazardous materials and fuels
- Use, maintenance and circulation of heavy machinery and vehicles
- Presence of workers and purchasing of goods and services

7.3.6.2 Description of the Impacts

These impact sources are described below in the order of the project phases.

Construction Phase

<u>Sites Clearing and Preparation (Excavation, Stripping, Backfilling, Blasting and Overburden Management)</u>

During the preparation of the sites and the construction of the infrastructures, the works could cause erosion and increase the sediment load in the water courses, particularly during heavy rainfall. An increase in the sedimentary regime could cause a modification of the surface water quality and of the water course beds, indirectly affecting the fish communities. These modifications are more susceptible of occurring in Creeks B, C and E, due to their location along the waste rock and tailings pile, as well as at their outlets in Lac des Montagnes. Some impacts are also susceptible of occurring in the lakes and water courses around the concentrator area, including Lac du Spodumène.

The preparation of the site that will receive the bridge crossing Creek C to reach the waste rock and tailings pile could be a source of impact on fish habitat if the work causes erosion. This structure could also potentially affect the fish circulation.

Water Management (Runoff, Drinking Water, Wastewater, etc.)

The mine site runoff could modify the quality of water in aquatic environments and affect the ichthyofauna.

These modifications are more susceptible of occurring in creeks B, C and E, due to their location along the waste rock and tailings pile, as well as at their outlet in Lac des Montagnes. Some potential impacts are also susceptible of occurring in the lakes and water courses near the concentrator, notably Lac du Spodumène.

Management of Residual Materials, Hazardous Materials and Fuels

The management of residual materials, hazardous substances and fuels could constitute a source of impact on fishes and the fish habitat. Effectively, an accidental contamination of the aquatic environment by hydrocarbons or other contaminants is possible during the transport, storage or use of chemicals. A spill near a water body or water course could constitute a source of impact on the ichthyofauna and aquatic habitats.

The majority of residual materials, hazardous materials and fuels will be managed in the area of the concentrator and garage. The risk of accident is therefore greater for the lakes and water courses in this sector.

Use, Maintenance and Circulation of Heavy Machinery and Vehicles

Accidental spills of petroleum products and other contaminants could also occur during the use, maintenance and fueling of heavy machinery and vehicles. Such an event could modify the characteristics of the aquatic environments, thus altering the fish habitat.

The use of dust suppressants and de-icing salts on the service roads could also modify the water quality, notably by increasing its turbidity and salinity, therefore altering the fish habitat.

New service roads will be built near Lake 2 and Creek C, and the new alignment of a section of the Route du Nord will be closer to Lakes 1 and 27 and their tributaries. These lakes and water courses will therefore be potentially affected by these impacts.

Presence of Workers and Purchasing of Goods and Services

The presence of workers could increase the fishing pressure and modify the structure and abundance of local fish populations. The fishing pressure would increase mainly in the major water bodies in the area, i.e. Lac des Montagnes, Lac du Spodumène and the Nemiscau River.

Operation Phase

During the operation phase, the impact sources described for the construction phase will also remain when relevant. Some additional impact sources will occur during the operation phase. They are described below.

Presence and Operation of the Infrastructures and Buildings

The presence of the infrastructures and buildings will change the hydrologic regime of certain water courses by modifying their watershed. This impact concerns particularly Creeks C, E and F near the waste rock and tailings pile.

The exploitation of the deposit will require the excavation of a pit that will gradually increase in depth with the extraction activities. The pumping activities required to dewater the pit will cause drawdowns of the water table. The drawdown could modify the surrounding aquatic environments, mainly the Creek C, where the impact could correspond to a loss of approximately one third of its theoretical low-water flow (see Chapter 6). According to the estimations made, no impact is anticipated in the case of Creek D.

The use of Creek C as the outlet of the waste rock and tailings pile runoff sedimentation basin will result in increased flow over a distance of approximately 150 m, up to its mouth in Lac des Montagnes. The daily flow released will be nil in winter period, and vary between 349 m^3 and 1,194 m^3 on average during the rest of the year.

The progressive expansion of the waste rock and tailings pile will cause the loss of an 85 m section of Creek F. This is a small stream and the only species captured during the June/July 2012 inventories was the brook stickleback.

The development of the waste rock and tailings pile will also result in the disappearance of Lake 29. However, this water body is not considered as a fish habitat for the following reasons:

- There is no apparent hydrological connection.
- The lake is very small (0.16 ha).
- In June 2012, the pH varied between 4.21 and 4.96.
  - The MDDEFP recommendations for the protection of aquatic life specify a pH between 6.5 and 9.5 (MDDEP, 2009).
  - Most fish species, including salmonids (such as the brook trout, which is an important species in the sector) cannot reproduce or even survive in a water body presenting the observed pH range.
- The concentration of dissolved oxygen, varying between 7.01 mg/l at the surface and 0.08 mg/l in greater depth, shows that this environment was hypoxic.
- No capture was recorded during the September and November 2011 fishing campaigns.

Water Management (Runoff, Drinking Water, Wastewater, etc.)

The stockpiling of waste rock and tailings can also modify the quality of the runoff water. Effectively, the water that will run off over the waste rock and tailings pile and percolate through it or over it could transport suspended matters and affect the aquatic environment by modifying the current conditions.

This impact concerns particularly Creeks C, E and F near the waste rock and tailings pile.

Closure Phase

During the closure phase, the description of the impact sources presented for the construction and operation phases will also applied, when relevant.

7.3.6.3 Description of the Mitigation Measures

The following mitigation measures will be applied to reduce the impacts on the ichthyofauna and its habitat. Most of these measures relate to the management of the runoff and of hazardous substances and fuel, so as to limit the modification in the aquatic environment caused by the transport of sediments or contaminants.

Construction Phase

- Favor surfaces already disturbed by the exploration works for the circulation of machinery and the temporary construction materials storage areas.
- Clearly identify and delimit the heavy machinery and vehicle circulation zones.
- Prioritize the use of abrasives rather than melting salts in winter, inasmuch as possible.
- In the summer, use water to control dust on the service roads (including the ramps) as necessary.
- Replant the disturbed sites when the works are completed in order to limit erosion.
- Provide confinement system for the storage areas in case of leaks or accidental spills.
- Design the maintenance areas so as to avoid contamination of the environment in case of leaks or accidental spill.
- Limit to the minimum the number of machinery fueling points.
- Ensure that the heavy machinery, vehicles and equipments are adequately maintained.
- Develop a prevention and intervention plan in case of accidental spill or leak of hazardous substances.
- Provide training to the employees on quick, effective and safe intervention in case of a leak or accidental spill of petroleum products or hazardous materials.
- Dispose of wastes according to appropriate procedures.
- Implement an employee awareness program on the effects of recreational fishing.
- Forbid fishing within the limits of the mining lease and use leases.

Operation Phase

During the operation phase, all the mitigation measures described for the construction phase will apply, as relevant. The following additional mitigation measure will be implemented during the operation phase:

- Collect all potentially contaminated water and treat it if necessary before its release in the aquatic environment.

Closure Phase

During the closure phase, all the impact sources presented for the construction and operation phases applied, where relevant. The following additional mitigation measure will be implemented during the closure phase:

- Rehabilitate the affected section of Creek C (section receiving the waste rock and tailings pile runoff) by reproducing its original characteristics (shore, slope, dimension, vegetation and particle size).

7.3.6.4 Significance of the Residual Impact

The significance of the residual impact was evaluated in consideration of the three project phases combined. The loss in fish habitat area corresponds to the section of Creek F in the waste rock and tailings pile footprint (85 m). Generally, the ichthyofauna would potentially be indirectly affected, through the modification of the habitat.

The social value of this component is high, as it is highly valued by the users of the land. The ecosystemic value is also high, since fish play a major role in the aquatic ecosystems and the fish habitat is subject to protected. Therefore, the value of the component is high. After the application of the mitigation measures, the significance of the residual impact is moderate.

The nature of the impact on the ichthyofauna and its habitat is negative. The frequency of the impact is considered intermittent. The degree of disturbance of the component is considered low, as very little of the fish habitat area will be lost directly as a result of the project development, and because the potential impacts will be mostly indirects. Considering that the value of the component is high and the degree of disturbance is low, the intensity of the residual impact is moderate. The extent of the impact will be punctual, as the habitat losses and modifications will be only circumscribed to the mine site. The majority of the anticipated impacts will occur during the construction and operation phases; the duration of the impact is therefore medium. The nature of the impact is negative. The impact is irreversible because the disturbances caused by the project development in certain water bodies and water courses will persist after the end of the project.

Table 7-12 presents the values assigned to each indicator and the resulting significance of the residual impact.

Table 7-12 Significance of the Residual Impact – Ichthyofauna and its Habitat

Intensity	Extent	Duration	Significance of the Residual Impact
High	Regional	High	High
Moderate	Local	**Medium**	**Moderate**
Low	**Punctual**	Low	Low

7.4 Herpetofauna

This section presents the description of the herpetofauna in the study area, and the assessment of the impacts of the project on this component of the biological environment.

7.4.1 Survey Area

The herpetofauna survey area covers approximately 820 ha and encompasses the mine site and its surroundings (Map 7-5). This area includes the major wetlands and aquatic environments in the vicinity of the mine site that offer potential habitat for amphibians and reptiles.

7.4.2 Literature Review

7.4.2.1 Methods

The *Atlas des amphibiens et des reptiles du Québec* was consulted in order to determine the species of herpetofauna potentially present in the study area (AARQ, 2012). The CDPNQ database was also consulted (Boudreault (MRN), 2013, personal communication).

7.4.2.2 Results

The Whabouchi project study area could be frequented by ten species of amphibians and reptiles, according to the interpretation of the distribution maps in the *Atlas des amphibiens et des reptiles du Québec* (AARQ, 2012) (Table 7-13). The potentially present species are divided into three groups: Caudata (salamanders and newts), Anurans (frogs and toads), and Squamata (snakes).

No special-status species is reported in the project area (Boudreault (MRN), 2013, personal communication).

Table 7-13 Likely Amphibian and Reptile Species in the Project Study Area

Common Name	Scientific Name
Caudata	
Blue-spotted salamander	*Ambystoma laterale*
Yellow-spotted salamander	*Ambystoma maculatum*
Two-lined salamander	*Eurycea bislineata*
Anuran	
American toad	*Anaxyrus americanus*
Northern spring peeper	*Pseudacris crucifer*
Wood frog	*Lithobates sylvaticus*
Northern leopard frog	*Lithobates pipiens*
Green frog	*Lithobates clamitans*
Mink frog	*Lithobates septentrionalis*
Squamata	
Common garter snake	*Thamnophis sirtalis*

Source: AARQ, 2012

Among these species, the northern spring peeper probably frequents the wetlands in the study area, as it has previously been observed in the region (Bouchard and coll., 2004). This type of environments covers extensive surfaces in the study area. The other species reported near the study area are the green frog and the blue-spotted salamander (Bouchard and coll., 2004). These two species could also frequent the terrestrial, wetland and aquatic environments of the study area.

7.4.3 Herpetofauna Inventories

A study of the amphibians and reptiles in the survey area was carried out in the summer of 2012. The specific objectives of this study were to:

- Evaluate the abundance of herpetofauna;
- Determine which environments are frequented by the various species;
- Verify the presence of special-status species.

7.4.3.1 Methods

Survey Period

The herpetofauna inventory was conducted between June 23 and July 1 2012.

Sampling Plan

The selection of the sampling stations was based on the map of natural environments in the survey area. The stations were distributed among the different aquatic, wetland and terrestrial environments in the survey area, so as to inventory all potential habitats for the herpetofauna.

A total of nine sampling stations were visited to search for the presence of amphibians and reptiles. The area surveyed at each station varied according to the topography of the site and the presence of wetlands or aquatic environments.

Counting Method

The method used to count the amphibian and reptile species consisted in actively searching for the presence of individuals by lifting the features (rocks, plant debris, etc.) that they can use for shelter. Also, a search for egg packages, larvae and adults was carried out in the aquatic environments present at the stations. Each sampling station was visited on foot by one or two observers. The captured individuals were released after their identification.

At each sampling station, in addition to recording the individuals or signs of presence, a brief description was noted to identify the type of environment.

7.4.3.2 Results

The wood frog, mink frog, American toad and common garter snake were observed during the fieldworks (Table 7-14, Map 7-5). No individual of the Caudata group (salamanders and newts) were detected during the field surveys. The species most often observed were respectively the wood frog and mink frog. Only one American toad was seen during the survey, but several other individuals of the species were observed during other wildlife inventories completed for the project. Two common garter snakes were seen during the fieldworks.

Table 7-14 Species and Number of Amphibians and Reptiles Observed in the Survey Area in June and July 2012

Environment	Sampling Station	Date (day/month)	Species (Number of Individuals)				
			Wood Frog	Mink Frog	American Toad	Common Garter Snake	Total
Recent Burn	HP-9	01/07	0	0	0	1	1
Lake and Recent Burn	HP-2	24/06	2	4	1	1	8
Lake and Recent Burn	HP-3	25/06	0	0	0	0	0
Lake and Shrubby Bog	HP-4	26/06	0	0	0	0	0
Pond and Shrubby Bog	HP-5	27/06	0	0	0	0	0
Water Course and Alder Stand	HP-6	28/06	1	0	0	0	1
Water Course and Anthropogenic Disturbance	HP-1	23/06	11	2	0	0	13
Anthropogenic Disturbance	HP-8	30/06	0	0	0	0	0
Forest Stand	HP-7	29/06	0	0	0	0	0
All Environments			**14**	**6**	**1**	**2**	**23**

The four species observed during the field works are considered as generalist species, both in terms of habitat and feeding. These species have quite a large distribution range in North America, from the temperate zone to the subarctic zone. Their diet is composed of invertebrates, insects, tadpoles and insect larvae (Desroches and Rodrigue, 2004). None of the observed species has a special status (MRN, 2013c; Gouvernement du Canada, 2013).

The wood frog is a terrestrial species that frequents forest stands (deciduous, mixed and conifer) almost exclusively. It is sometimes found in wetlands and wet fields, environments that are more open. The breeding period is in early spring (beginning of April), in temporary forest pools, wooded swamps, pools in flooded fields and certain calm and permanent water bodies (Desroches and Rodrigue, 2004; AARQ, 2012). At the adult stage, it is prey to a multitude of predators including heron, raccoon and American mink.

The American toad is a terrestrial species that can live in many different environments including forests, wild lands and peatlands. It is resistant to dehydration but however requires loose or moist soil to burrow (Desroches and Rodrigue, 2004; AARQ, 2012). Reproduction generally occurs in May in practically any shallow temporary or permanent aquatic environment (ponds, lake and river banks, flooded fields, wetlands). Its main predator is the common garter snake.

The mink frog has a greater need for an aquatic environment than the wood frog and American toad. This frog rarely leaves the water. It reproduces in permanent aquatic environments (lake, beaver pond, peatland, etc.). The reproduction occurs from June to August. The predators of this species are notably herons, raccoon, brook trout and pike.

The common garter snake favors a variety of terrestrial and wet environments, including forests and open areas along ponds, lakes and rivers. The common garter snake reproduces as soon as snow melts, but can also breed in the fall, before entering is hibernacula. It has many predators among birds and mammals, as well as some fish species (Desroches and Rodrigue, 2004; AARQ, 2012).

7.4.4 Assessment of the Impacts

7.4.4.1 Identification of the Impact Sources

Over the different phases of the Whabouchi project, many activities represent sources of impacts on the herpetofauna, since they could reduce the superficies of aquatic, terrestrial and wetland environments, or modify its conditions. The impacts sources, for the different project development phases, are the following:

Construction Phase

- Sites clearing and preparation (excavation, stripping, backfilling, blasting and overburden management)
- Construction of the temporary and permanent infrastructures and facilities
- Water management (runoff, drinking water, wastewater, etc.)
- Management of residual materials, hazardous materials and fuels
- Use, maintenance and circulation of heavy machinery and vehicles

Operation Phase

- Sites clearing and preparation (excavation, stripping, backfilling, blasting and overburden management)
- Presence and operation of the infrastructures and buildings

- Water management (runoff, drinking water, wastewater, etc.)
- Management of residual materials, hazardous materials and fuels
- Use, maintenance and circulation of heavy machinery and vehicles

Closure Phase

- Water management (runoff, drinking water, wastewater, etc.)
- Management of residual materials, hazardous materials and fuels
- Use, maintenance and circulation of heavy machinery and vehicles
- Site rehabilitation
- Dismantling of the infrastructures and installations

7.4.4.2 Description of the Impacts

The impact sources are described below in the order of the project development phases.

Construction Phase

Sites Clearing and Preparation (Excavation, Stripping, Backfilling, Blasting and Overburden Management)

The activities relating to the clearing and preparation of the sites will cause losses of terrestrial environments. The grading, excavation and backfilling of the infrastructure sites, in preparation for their construction or emplacement, will result in losses during the construction phase.

To reach the deposit, the overburden will be excavated, removed and stored near the pit, in the overburden stockpile. The presence of this stockpile will cause the loss of 2.72 ha of wetlands, in addition to the terrestrial environments present in the footprint of the pile. Wetlands constitute important habitats for herpetofauna in general.

Water Management (Runoff, Drinking Water, Wastewater, etc.)

For the water management, Creek C will have to be modified to receive the water from the waste rock and tailings pile runoff sedimentation basin. This transformation will modify the water course and its aquatic and riparian habitats in a 150 m section. This modification could modify the amphibian occupancy of this water course.

Management of Residual Materials, Hazardous Materials and Fuels

A potential contamination of the soils by hydrocarbons or other contaminants is possible during the transport, storage or use of chemicals. Should such a spill of these products occurred, it could be a source of impact on amphibians by modifying the water quality and their habitats.

Construction of the Temporary and Permanent Infrastructures and Facilities

The service roads that will be built during the construction phase could constitute barriers that might limit and modify the movements of herpetofauna on the mine site. These barriers could potentially block access to reproduction sites and affect the abundance of local amphibian and reptile populations during the mine life.

Use, Maintenance and Circulation of Heavy Machinery and Vehicles

The circulation of heavy machinery and vehicles could potentially be a cause of mortality among the herpetofauna populations that must cross the mine site service roads. The mortality could be more significant in the spring, during the reproductive travel.

Since the mine will operate 24 hours a day, the noise caused by the use and circulation of heavy machinery and vehicles, as well as the different preparation activities, could interfered with anouran mating songs and then harm their spring breeding.

Operation Phase

During the operation phase, the impact sources presented for the construction phase will apply as relevant. Certain additional impact sources will occur during the operation phase and they are described hereunder.

Presence and Operation of the Infrastructures and Buildings

The presence of the pit and the expansion of the waste rock and tailings pile will cause a loss of terrestrial habitats and of aquatic and wetland environments for the herpetofauna.

The presence of these infrastructures will also constitute an impassable barrier for herpetofauna, which could potentially have impacts on the local population dynamics if breeding grounds become inaccessible to part of the population.

The dewatering of the pit could result in a drawdown of the surrounding water table. This drawdown could have incidences on the nearby wetlands, notably on the extensive peatland (mainly a shrubby bog) located south of the pit. Peatlands are favorable environments for the reproduction and hibernation of amphibians. However, it is uncertain whether the drawdown of the water table will have an effect on the shrubby bog. In principle, bogs such as the shrubby bog are not hydrologically connected with the underground aquifer and would not be affected by the groundwater drawdown.

The drawdown of the water table could also affect the outlet of Lac du Spodumène, i.e. Creek D, as well as Creek C. On the basis of current estimates, it is reasonable to believe that Creek D will feel no impact. Creek C could lose approximately one third of its theoretical winter low-water flow. Herpetofauna habitats could therefore be modified.

Water Management (Runoff, Drinking Water, Wastewater, etc.)

The use of Creek C as the outlet of the waste rock and tailings pile runoff sedimentation basin will result in a modification of the water regime in part of this water course. Specifically, this modification will increase the flow in a section of approximately 150 m of Creek C, downstream of the outfall and up to its mouth. The development of the Creek C will modify this environment for the amphibians and reptiles.

Closure Phase

During the closure phase, the description of the impact sources presented for the construction phase will remain valid, where applicable.

7.4.4.3 Description of the Mitigation Measures

The following mitigation measures will be implemented to reduce the impacts on the herpetofauna. Most of these measures concern the use of heavy machinery and vehicles, the management of runoff and the handling of hazardous materials and fuel, in order to limit changes in terrestrial, wetland and aquatic environments.

Construction Phase

- Favor surfaces already disturbed by the exploration works for the circulation of machinery and the temporary construction materials storage areas
- Clearly identify the limits beyond which heavy machinery and vehicles is prohibited
- Limit the circulation of heavy machinery and vehicles to predetermined areas (e.g. service roads and work areas) so as to reduce the surface area of disturbed environments
- Limit the travel speed on the mine site service roads to 30 km/h
- Prioritize the use of abrasives rather than melting salts in winter, inasmuch as possible
- In the summer, use water to control dust on the service roads (including the ramps) as necessary
- Replant the disturbed areas at the end of the works so as to re-create as quickly as possible the original natural conditions and to avoid erosion
- Provide confinement systems in the storage areas in case of leaks or accidental spills
- Design the heavy machinery and vehicle maintenance areas so as to avoid contamination of the environment in case of leaks or accidental spill
- Develop a prevention and intervention plan in case of accidental spill or leak of hazardous substances
- Maintain a buffer strip of at least 30 m along the shores of water courses and water bodies (Directive 019) in order to protect the environment and preserve a corridor allowing animals to travel

Operation Phase

During the operation phase, all the mitigation measures described for the construction phase will apply, as relevant. The following additional mitigation measure will be implemented during the operation phase:

- Proceed with a progressive revegetation of the waste rock and tailings pile so as to offer new herpetofauna environments as soon as possible.

Closure Phase

During the closure phase, all the mitigation measures presented for the construction and operation phases will be applied as relevant.

7.4.4.4 Significance of the Residual Impact

The residual impact assessment considered the three phases of the project and was based mainly on the superficies of aquatic, wetland and terrestrial environments lost during the project development (several herpetofauna species frequent one or the other of these environments during their life cycle). The superficies of the environments affected during the three project phases are presented in Table 7-15, broken down according to the major buildings and infrastructures of the Whabouchi project.

The development of the project, more specifically the installation of the various infrastructures and facilities, will cause a loss of 209 ha of terrestrial, wetland and aquatic environments. The peatlands (shrubby bog and fen) are important environments in the herpetofauna life cycle. These environments represent an area of approximately 7 ha.

After the rehabilitation of the site, the area of disturbed environments will be reduced to 31.16 ha, the equivalent of the pit footprint.

The social value of the component is low, because no special-status species is reported on the mine site and it is of limited use by the land users. Its ecosystemic value is considered moderate. Therefore, the value of the component is considered low. After application of the mitigation measures, the significance of the residual impact is low.

Table 7-15 Areas of Herpetofauna Environments Affected by the Construction, Operation and Closure Phases of the Project, Prior to Site Rehabilitation

Facilities and Infrastructures	Environment (ha)								
	Forest Stand	Recent Burn	Alder Forest	Myricaceae	Shrubby Bog	Fen	Anthropogenic Disturbance	Water Body	All Environments
Service Roads	0.88	4.17	0.07	-	0.24	-	0.05	0.00	5.41
Explosives Store	-	0.92	0.01	-	0.31	-	0.00	0.00	1.24
Pit	5.05	13.98	0.00	-	0.12	-	12.16	0.00	31.31
Waste Rock and Tailings Pile	3.52	82.59	2.11	-	2.55	-	2.33	0.16	93.26
Overburden Pile	0.49	10.32	0.00	-	2.72	-	0.00	0.00	13.53
Diversion of the Route du Nord	0.05	7.00	0.06	-	0.91	-	32.00	0.00	40.02
Sedimentation Basins	0.99	8.28	0.13	-	0.16	-	0.00	0.00	9.56
Industrial Complex	-	13.98	0.00	-	0.00	-	0.63	0.00	14.61
All Facilities and Infrastructures	**10.98**	**141.24**	**2.38**	**0.00**	**7.01**	**-**	**47.17**	**0.16**	**208.94**

The nature of the impact on the herpetofauna is negative. The frequency of the impact is considered low because the impact on habitats will occur during the construction of the infrastructures and facilities. The degree of disturbance of the component is considered moderate, as only part of the amphibian and reptile populations in the study area will be affected. Considering that the value of the component is low and the degree of disturbance is moderate, the intensity of the residual impact as a result of the above considerations is low. The extent of the impact will be punctual, since the loss of environments is limited to the mine site only. As the impact will persist after the closure of the mine, its duration is considered long. The impact is reversible because the rehabilitation of the site at the end of the project will restore the original environmental conditions.

Table 7-16 presents the values assigned to each indicator and the resulting significance of the residual impact.

Table 7-16 Significance of the Residual Impact – Herpetofauna

Intensity	Extent	Duration	Significance of the Residual Impact
High	Regional	**Long**	High
Moderate	Local	Medium	Moderate
Low	**Punctual**	Short	**Low**

7.5 Mammals

This section presents a picture of the presence, habitat and abundance of mammals in the study area, and identifies the four following subcomponents:

- Large mammals;
- Small mammals;
- Chiropterans (bats);
- Micromammals.

The potential impacts assessment of the project on these four subcomponents is also presented.

7.5.1 Study and Survey Areas

The mammals study area corresponds to a 10 km radius centered on the mine site (map 7-6), covering a total area of 31,415 ha. The large mammals, small mammals, chiropterans and micromammals survey areas were defined as follows:

- For the large mammals inventories, 20 transects (equidistant of 1 km) were flyover within the study area (Map 7-6).

- For the small mammal inventories, transects in four zones (total of two ground transects and 12 aerial transects) were surveyed in the study area (Map 7-8).
- For the Chiroptea inventories, the survey area included five stations distributed over the study area (Map 7-5).
- For the micromammals, 10 transects in the survey area were inventoried in the study area (Map 7-5).

7.5.2 Literature Review

A literature review was done to document the mammal species potentially present in the project area and identified their preferred habitats. Data about the population density of certain species of interest are also presented.

7.5.2.1 Methods

Request for informations about the wildlife observations reported in the study area and about the hunting and trapping statistics for the Nemaska territory were addressed respectively to the MRN (Direction des opérations intégrées du Nord-du-Québec) and to the Cree Trappers' Association (CTA). A detailed list of the persons who were contacted is presented in Appendix 7-14.

Scientific articles, reference documents and wildlife identification and classification atlases were also consulted. The following documentation is the main sources of information used to describe the presence, habitat and the relative abundance of mammal populations in the study area:

- The environmental studies completed in the vicinity of the Whabouchi project, notably:
  - The impact assessments on the following projects:
    - Eastmain-1-A and La Sarcelle power stations and Rupert diversion projects (generally located approximately 30 km east of the Whabouchi project; Del Degan, Massé et Associés, 2004);
    - Matoush Uranium project (at 260 km northeast of the Whabouchi project; Ressources Strateco, 2009);
    - Extension of Highway 167 North to the Otish Mountains (at 230 km southeast of the Whabouchi project; Roche –SNC Lavalin, 2010); and
    - Renard diamond project (at 280 km northeast of the Whabouchi project; Roche, 2011);
  - The reports on the environmental activities for the Eastmain-1-A and La Sarcelle power stations and Rupert diversion projects (Hydro-Québec, 2010a and 2010b).
- The hunting and trapping statistics published on the MRN website for furbearer management unit 90 and for hunting zone 22 (MRN, 2013d);

- The information on traditional ecological knowledge collected for the description of the social environment (see Chapter 8);
- The lists of species at risk and the relevant information about these species (e.g. the list of threatened or vulnerable wildlife species in Quebec, descriptive profiles and other relevant documents (MRN, 2013c; MRN, 2013e to 2013m), the Species at Risk Public Registry, species profiles and COSEWIC reports (Gouvernement du Canada, 2013);
- The range of mammals in Quebec in order to identify species whose distribution range overlap the study area (Prescott and Richard. 2004; MRN, 2013e to 2013m; Gouvernement du Canada, 2013; Desrosiers and coll. 2002);
- The observations noted during the 2012 the field surveys (presented in Section 7.6.3).

7.5.2.2 Results

This section presents, when available, the density of mammal populations in the region, the vital characteristics and main habitat requirements of the major species susceptible of frequenting the Whabouchi project study area. There is little data about the density of wildlife species in the study area. However, studies completed in the vicinity, as well as the hunting and trapping statistics can provide indications about the population trends.

Large Mammals

According to the consulted sources, three species of large mammals (Appendix 7-15) are susceptible of visiting the study area: moose (*Alces alces*), woodland caribou (*Rangifer tarandus caribou*; forest and barren-ground ecotypes), and black bear (*Ursus americanus*).

Moose

Moose is present up to the treeline limit, but the density of moose populations in northern territories is often much lower than in southern Quebec (CRRNTBJ, 2010). According to previous studies (Table 7-17), the density of moose populations in the James Bay territory is generally approximately 0.20 moose/10 km^2. These densities can, however, be higher in certain areas (e.g. 1.1 moose/10 km^2 between the Eastmain River and Lake Clarkie in March 2002; Del Degan, Massé et Associés inc., 2004). Near the Whabouchi project study area, the presence of the species has been confirmed in the study area of the Renard project (Roche, 2011) and of the Highway 167 extension towards the Otish Mountains (Roche-SNC Lavalin, 2010).

Table 7-17 Densities of Moose Populations in the James Bay Territory

Territory/Location	Source	Survey Date	Distance from Whabouchi Project	Moose Density (Mean qty/ 10 km^2)
Nottaway, Broadback, Rupert Complex	*Le Groupe Boréal, 1992a* from Del Degan, Massé et Associés inc., 2004	Not available	N/A	0.15
Hunting zone 22	*Maltais and coll., 1993* from Del Degan, Massé et Associés inc., 2004	February and March 1991	N/A	0.23
Survey area centered on the Rupert diversion bay section	Del Degan, Massé et Associés inc., 2004	March 2002	30 km east and 16 km northwest	0.35
Rupert diversion bay section	Del Degan, Massé et Associés inc., 2004	March 2002	30 km east	0.13
Planned Rupert diversion bays	Del Degan, Massé et Associés inc., 2004	March 2002	40 km east	0.00
Eastmain-1	*Nault and Martineau, 1983; Veillet and Vézina, 1991* in Del Degan, Massé et Associés inc., 2004	Not available	60 km north-northwest	0.23
Eastmain River/Lake Clarkie	Del Degan, Massé et Associés inc., 2004	March 2002	60 km north-northwest	1.1
La Grande Complex	*Martineau, 1980* in Del Degan, Massé et Associés inc., 2004	Not available	240 km north-northwest	0.21
Southern portion of the municipality of Baie-James territory	*Grenier, 1974; Morasse, 1975; Audet, 1976; Joly and Brassard, 1979* in Del Degan, Massé et Associés inc., 2004	Not available	300 km south	0.24
Renard project control area	Roche, 2011	September 2010	280 km northeast	0.40
Proposed Highway 167 extension toward the Otish Mountains survey area	Roche-SNC Lavalin, 2010	March 2010	230 km southeast	0.02

N/A: Not applicable (the Whabouchi project is located inside)

Hunting statistics in the hunting zone 22 and the Nemaska territory suggest that there is a steady harvest of moose in the region (MRN, 2013d, Association des trappeurs cris, 2013). The average harvest between 1999 and 2012 in zone 22 was 130 individuals (MRN, 2013d). In hunting zone 22, the majority of the moose harvest is attributable to the Crees (Lamontagne and Lefort, 2004). On average, the number of declared moose catches in the Nemaska territory between 1989 and 2012 was 29 individuals (Table 7-18; Association des trappeurs cris, 2013). The Cree users, who often observe moose along the Route du Nord and its access roads, generally hunt the species in the Lac des Montagnes area and along the navigation route that follows the Nemiscau River, as well as in the northern part of trapline R20.

Table 7-18 Subsistence Harvesting of Large Mammals in the Nemaska Territory

Year	Moose	Caribou	Black Bear	Total
1989-1990	57	6	0	63
1990-1991	38	4	7	49
1991-1992	28	28	12	68
1992-1993	45	36	4	85
1993-1994	12	21	1	34
1994-1995	16	0	0	16
1995-1996	33	15	3	51
1996-1997	27	0	1	28
1997-1998	36	12	4	52
1998-1999	47	14	3	64
1999-2000	25	24	0	49
2000-2001	35	8	6	49
2001-2002	26	11	4	41
2002-2003	25	20	2	47
2003-2004	51	45	3	99
2004-2005	35	26	6	67
2005-2006	10	28	13	51
2006-2007	31	9	2	42
2007-2008	9	0	0	9
2008-2009	14	0	0	14
2009-2010	4	0	0	4
2010-2011	42	0	2	44
2011-2012	26	0	0	26
Grand Total	**672**	**307**	**73**	**1,052**
Maximum	**57**	**45**	**13**	**99**
Minimum	**4**	**0**	**0**	**4**
Average	**29**	**13**	**3**	**46**

Source: Association des trappeurs cris, 2013

The size of the moose home range varies between 2 km^2 and 10 km^2, depending on the availability of food, deciduous trees and winter habitats offering protective cover, on the presence of areas with thin snow cover and of summer habitats offering protection against heat and insects (Courtois, 1993; Samson and coll., 2002). Generally, dense mixed forests of conifers and deciduous trees, particularly balsam fir-white birch stands, offer favorable habitats for moose (MRN, 2013e). The species also frequents clearings, burns and clearcut areas, as well as swamps, ponds and water bodies, particularly in summer (Prescott and Richard, 2004).

Woodland Caribou

The data received from satellite collars worn by individuals presumed to be woodland caribou of the forest ecotype (Rudolph and coll. 2012) and barren-ground ecotype (MRN, 2013f) show that both caribou ecotypes can frequent the study area in winter.

Between 1991 and 2011, a single woodland caribou kill was reported by recreational hunters in the study area (in 2009, near Lac des Montagnes; Gauthier (MRN), 2013, personal communication). Table 7-19 present the woodland caribou densities evaluated by various inventories taken in the James Bay territory.

Table 7-19 Densities of Caribou Populations in the James Bay Territory, Quebec

Territory/Location	Source	Survey Date	Distance from Whabouchi Project	Caribou Density (Mean qty/ 10 km^2)	Caribou Ecotype
Distribution range of the Nottaway population/herd	Rudolph and coll. 2012	Spring 2011	N/A	0.01	**Forest**
Eastmain 1-A / La Sarcelle and Rupert diversion project area	Hydro-Québec, 2010a	May to October 2008	30 km east	5 caribou observed in the project area (fortuitous observations)	**Forest**
Eastmain 1-A / La Sarcelle and Rupert diversion project area	Hydro-Québec, 2010b	May to October 2008	30 km east	19 caribou observed in the project area (fortuitous observations)	**Forest**
Proposed Highway 167 extension toward the Otish Mountains survey area	Roche-SNC Lavalin, 2010	March 2010	230 km southeast	0.00*	**Forest**
Renard project study area	Roche, 2011	March 2011	280 km northeast	0.00	**Forest**
Study area (planned Rupert diversion bays and 30 km strip)	Hydro-Québec, 2010a	March 2008	5 km east	7.9	**Barren-ground**
Study area (planned Rupert diversion bays and 30 km strip)	Hydro-Québec, 2010b	March 2009	5 km east	3.3	**Barren-ground**

Territory/Location	Source	Survey Date	Distance from Whabouchi Project	Caribou Density (Mean qty/ 10 km^2)	Caribou Ecotype
Peripheral strip (30 km wide) around the planned Rupert diversion bays	Hydro-Québec, 2010a	March 2008	5 km east	8.1	**Barren-ground**
Peripheral strip (30 km wide) around the planned Rupert diversion bays	Hydro-Québec, 2010b	March 2009	5 km east	3.4	**Barren-ground**
Planned Rupert diversion bays	Hydro-Québec, 2010a	March 2008	40 km east	2.6	**Barren-ground**
Planned Rupert diversion bays	Hydro-Québec, 2010b	March 2009	40 km east	0.50	**Barren-ground**
Survey area centered on the Rupert diversion bay sector	Del Degan, Massé et Associés inc., 2004	March 2002	30 km east and 16 km northwest	0.39	**Barren-ground**
Renard project study area	Roche, 2011	March 2011	280 km northeast	0.04	**Barren-ground**
Rupert diversion bay sector	Del Degan, Massé et Associés inc., 2004	March 2002	30 km east	0.13	Not available
Planned Rupert diversion bays	Del Degan, Massé et Associés inc., 2004	March 2002	40 km east	0.22	Not available
Nottaway, Broadback, Rupert Complex	*Le Groupe Boréal, 1992a* in Del Degan, Massé et Associés inc., 2004	Not available	N/A	0.14	Not available
Eastmain-1	*Veillet and Vézina, 1991* in Del Degan, Massé et Associés inc., 2004.	Not available	60 km north-northwest	1.10	Not available
Matoush project survey area	Ressources Strateco, 2009	January 2009	260 km northeast	0.36	Not available
Southwest portion of the Baie-James municipality territory	*Paré and Jourdain, 2002* in Del Degan, Massé et Associés inc., 2004	Not available	300 km south	0.35	Not available

* Woodland caribou were observed in the course of other surveys (spring and summer 2010) in the south, center and north of the study area.

Woodland Caribou

The woodland caribou, designated as a vulnerable species in Quebec under the Threatened or Vulnerable Species Act (TVSA) and as threatened in Canada under the Species at Risk Act (SARA; Schedule 1, L.C. 2002, ch. 29), can be observed in a band approximately 500 km wide between the 49th and 55th parallels (MRN, 2013g). Also, there subsist isolated herds south of the 49th parallel, known as the Val-d'Or herd (estimated at about 20 individuals) and Charlevoix herd (estimated at 84 individuals). In the north, the distribution of forest ecotype caribou overlaps with the barren-ground ecotype, which complicates the estimation of populations in the region (Table 7-19; CRRNTBJ, 2010).

The woodland caribou are distributed in small, isolated herds in the boreal forest, and the observed densities are generally low (1-2 individuals/100 km^2; Courtois and coll., 2003). In September 2012, the working group on the reestablishment of woodland caribou issued a report on the situation of the woodland caribou in the James Bay territory (Rudolph and coll, 2012). According to these works, the study area is regularly visited by the Nottaway population, one of the three local woodland caribou populations south of the 52nd parallel in the James Bay region of Quebec. The spring aerial inventories completed in 2003, 2007, 2009 and 2011 estimated the Nottaway population at respectively 137, 50, 26 and 17 individuals (Rudolph and coll., 2012). The distribution range of the Nottaway population was estimated at approximately 36,400 km^2, which represents a density of approximately 0.01 woodland caribou/10 km^2 in 2011.

Between May 2008 and October 2009, fortuitous observations of woodland caribou were reported as part of the environmental follow-up for the Eastmain 1-A / La Sarcelle power stations and Rupert diversion project (Hydro-Québec, 2010a and 2010b). A total of 5 woodland caribou observations were reported in 2008, and 19 in 2009. These individuals were probably part of the Nottaway population (Hydro-Québec, 2010a and 2010b).

No woodland caribou from the Témiscamie herd was sighted during the aerial inventories carried out for the proposed extension of Highway 167 toward the Otish Mountains or for the Renard project, respectively in March 2010 and 2011 (Roche-SNC Lavalin, 2010; Roche, 2011).

The hunting statistics do not distinguish the ecotype of the harvested caribou. Recreational caribou hunting is practiced in the northern portion of the study area in zones 22A and 22B, but it is prohibited in the portion of the study area included in the Weh Sees Indouhoun section of hunting zone 22 (MRN, 2013h). The caribou harvest statistics published by the MRN for hunting zone 22 are therefore not indicative of the local woodland caribou populations, but rather reflect the harvest of barren-ground caribou in further northern regions (MRN, 2013d).

The large mammal's subsistence harvest in the Nemaska territory provides a local picture of the caribou populations that could potentially frequent the study area (Association des trappeurs cris, 2013). However, the forest ecotype of the harvested animals is uncertain. On average, a harvest of 13 caribou was declared in the Nemaska territory between 1989 and 2012 (Table 7-18). More locally, an average harvest of six caribou was declared for trapline R20. However, no animal was harvest in the majority of the years in this period (Association des trappeurs cris, 2013).

The home range of the woodland caribou, which satisfy its requirement habitats in the boreal forest, can vary between 32 km^2 and 1,470 km^2, depending on the individuals and populations

(MRN, 2013g). Over the seasons, the woodland caribou use of the different habitats (Table 7-20) is strongly influenced by the predation risks, availability of food, tranquility of the environment and, possibly, the number of stinging insects (MRN, 2013g). The woodland caribou therefore avoids disturbed areas, either because the risk of predation is higher or because the ground lichens that constitute its main food source in winter have been destroyed (Courtois, 2003). Similarly, the females travel to wetlands to calve, largely to reduce the predation risks. Also, lone caribou avoid road networks to reduce the risk of meeting predators (Rudolph and coll., 2012).

Table 7-20 Northern Quebec Habitats Used and Avoided by Woodland Caribou at Various Stages of its Life Cycle

Season	Beginning	Ending	Preferred Habitat	Avoided Habitat
Spring	April 7	May 20	Dry barrens, treed peatlands, mixed open forests and wetlands.	6-20 year burn, riparian environments, water.
Calving	May 21	June 12	Open conifer forests.	6-20 year burn, 20-50 year burn, deciduous forests, low vegetation, riparian environments, water.
Post-calving	June 13	July 26	Treed peatlands and wetlands (females and calves remain isolated).	6-20 year burn, 20-50 year burn, 0-5 year clearcut, 6-20 year clearcut, 20-50 year clearcut, water.
Summer	July 27	October 11	Open conifer forests, treed peatlands, dense mixed forests, young and open forests and wetlands (females and calves remain isolated).	6-20 year burn, 0-5 year clearcut, 6-20 year clearcut, 20-50 year clearcut, water.
Fall/Rut	October 12	December 16	Reproductive congregation in homogenous and mature conifer forests and wetlands.	0-5 year burn, 6-20 year burn, dense conifer forests, 0-5 year clearcut, 20-50 year clearcut, deciduous forests, low vegetation, riparian environments, water.
Early winter	December 17	January 28	Form larger groups in mature conifer forests and open environments rich in ground lichens.	6-20 year burn, dense conifer forests, 0-5 year clearcut, riparian environments, water.
Late winter	January 29	April 6	Dense conifer forests, open conifer forests, barrens and wetlands.	6-20 year burn, 20-50 year burn, 0-5 year clearcut, water.

Sources: Rudolph and coll., 2012; MRN, 2013g

Barren-Ground Caribou (Migratory)

The barren-ground ecotype included two herds in Quebec: the Georges River herd and the Rivière aux Feuilles herd (MRN, 2013i; Jean and Lamontagne, 2004). Although the migration route of barren-ground caribou varies, the Rivière aux Feuilles herd generally travels from the tundra to the limits of the James Bay boreal forest during the fall migration (MRN, 2013j). The Rivière aux Feuilles herd could therefore potentially use the study area as wintering area. A 1991 survey estimated that the Rivière aux Feuilles herd comprised 269,000 individuals. In fact, the recruitment and survival data showed that the herd would have reached approximately 600,000 heads in 2001. Following a decrease in the population, the herd was estimated at approximately 403,000 heads in 2011 (MRN, 2013j). According to the regional studies (Table 7-19), the barren-ground caribou population density varies between 0.04 caribou/10 km^2 and 8.1 caribou/10 km^2 in the wintering areas.

The caribou population hunted in Quebec is associated to the barren-ground ecotype (MRN, 2013j). The hunting statistics show that between 3,023 (2011-2012) and 15,234 (2004) caribou were harvested annually between 1998 and 2012 in hunting zone 22 (MRN, 2013d).

Gregarious, nomadic and with no define home range, the barren-ground caribou move continuously from one pasture to another. Depending on the season, they can form herds of 10 to 50 individuals of the same sex, or congregate into dispersed herds of 50,000 to 100,000 animals of different sex and age (e.g. before the spring migration, immediately after calving, or before the fall migration and rutting period; MRN, 2013i).

In winter, the barren-ground caribou feeds on ground or arboreal lichens, horsetails, dried sedges and willow or birch twigs. In the summer, its diet is composed of herbaceous plants and roots, twigs of many trees and shrubs (willow, perch, blueberry), mushrooms and fruits (MRN, 2013i).

Black Bear (*Ursus americanus*)

Black bear is common in almost all the territory of Quebec, including the James Bay region (MRN, 2013k; Lamontagne and al., 2006). In hunting zone 22, the black bear density was around 0.20 bear/10 km^2 in 2003, which corresponds to a population of approximately 5,600 bears (Lamontagne and al., 2006). In the vicinity of the Grande-Baleine Complex, further north, the observation of 20 black bears during a survey of caribou calving grounds in June 1990 allowed to estimate their density as approximately 0.04 individual/10 km^2. Also, signs of presence (e.g. individuals, tracks, feces, fortuitous observations) were reported in the study areas of several projects (e.g. Matoush project (Ressources Strateco, 2009); extension of Highway 167 (Roche-SNC Lavalin, 2010); Renard project (Roche, 2011)).

Recreational hunting of black bear is prohibited in zone 22 and trapping is the main method used by the Crees to capture black bears (Lamontagne and al., 2006). The trapping statistics for the study area show that the quantity of fur raw sales from furbearer management unit 90 varied between one and three in the 2002-2003 to 2005-2006 seasons (MRN, 2013d). The average number of harvest and reported black bear for the subsistence harvesting on the Nemaska territory was of 3 bears between 1989 and 2012 (maximum of 13 animals in 2005-2006; Table 7-18), and only one black bear pelt was declared for trapline R20 between 1999 and 2012 (Association des trappeurs cris, 2013).

The black bear home range covers between 60 km^2 and 173 km^2 (MRN, 2013k). It frequents dense deciduous or conifer forests, burns and scrublands. In these forests, bear particularly prefer streams, rivers, lakes and swamps. It hibernate in dens (cavern, crevasse, hollow tree, upturned stump or under a conifer) between October and April. Black bear is omnivore (MRN, 2013k). Its diet is mostly based on vegetation, but meat is also an integral part of its food (Larivière, 2001).

<u>Small Mammals</u>

According to Prescott and Richard (2004), the small mammal species susceptible of being observed in the study area are: gray wolf, American beaver, muskrat, snowshoe hare, red fox, American marten, fisher, ermine, long-tailed weasel, least weasel, American mink, wolverine, river otter and Canada lynx.

Gray Wolf (*Canis lupus*)

In the northern part of Quebec, gray wolf is considered as a relatively common species (Hénault and Jolicoeur, 2003). According to the consulted sources, the range of the Eastern wolf (*Canis lycaon*), a legally protected species, does not overlap the study area (Samson, 2000; SBAA, 2013).

The aerial surveys taken in the James Bay territory during the last 10 years have shown that the gray wolf density varies from one region to another, depending on the type of environments (Del Degan, Massé et Associés, 2004). The highest density of signs of presence was reported in the Nemiscau River area, i.e. 1.25 sign/100 km^2 (Del Degan, Massé et Associés, 2004). In the Rupert diversion bay section, the density of signs of presence was 0.90 sign/100 km^2, and it was 0.73 sign/100 km^2 in the Eastmain 1-A power station and Rupert diversion study area (Del Degan, Massé et Associés, 2004). The number of gray wolf tracks noted during the aerial inventories of the James Bay riparian environments varied between 0 track (lakes in the Eastmain 1 and 1-A region in 1991 and 2002 respectively) and 17.4 tracks per 100 km of shore (e.g. River in the Eastmain 1-A study area in 2012; Del Degan, Massé et Associés, 2004). Gray wolves and tracks in the snow and mud were observed during the 2010 inventories for the extension of Highway 167 project (Roche-SNC Lavalin, 2010). A dozen of gray wolf tracks were observed in the regional study area of the Matoush project in March 2009 (Ressources Strateco, 2009). Finally, gray wolf tracks were observed in 23% of the shoreline transects and 0% of the forest transects in the Renard project study area (Roche, 2011).

On average, three raw wolf pelts were sold in furbearer management unit 90 from 2000 to 2012 (Table 7-21; MRN, 2013d). In the Nemaska territory, the reported average was one wolf between 1989 and 2012 (Table 7-22). Specifically, a single wolf was declared for trapline R20 in 1994-1995 (Association des trappeurs cris, 2013).

The gray wolf home range can cover from 130 km^2 to 13,000 km^2 (Mech, 1974). According to a study completed in Quebec during the 1990s (Jolicoeur and Hénault, 2002), the average size of the wolf packs varied between 3.5 and 3.7 individuals in hunting and trapping areas, and 5.5 to 5.7 individuals in unexploited areas. The gray wolf regulates populations of big game animals such as moose and caribou, and also preys on a variety of small mammals and birds (CRRNTBJ, 2010). In general, the gray wolf frequents the same habitats as ungulates, their main prey, such as large deciduous and conifer forests, as well as the tundra (MRN, 2013l). The den of the gray wolf is established in the hollow of large tree, rock crevice or depression in the ground (at the foot of a sand or earth mound).

American Beaver (*Castor canadensis*)

The beaver is a nocturnal herbivore that feeds on the leaves, roots, twigs and bark of most forest tree species, notably poplars and willows (Jenkins and Busher, 1979). It accumulates branches and logs, sticking them in the mud at the bottom of the bond to feed during the winter. It builds dams to facilitate access to the trees and to keep the entrances of its hut under the water. Its hut is made of intertwined branches and mud.

Beaver is the most commercially harvested furbearing species (Table 7-21). Table 7-22 presents the furbearing animal harvest in the Nemaska territory.

Table 7-21 Quantities of Raw Fur Sales from Furbearer Management Unit 90 between 2000 and 2012

Year	Beaver	Canada Lynx	Marten	Mink	Otter	Fisher	Weasels	Muskrat	Squirrel	Wolf	Black Bear	Polar Bear	Red Fox	Silver Fox	Arctic Fox	Patched Fox
2000-2001	294	0	362	1	21	0	3	16	9	1	0	0	9	0	2	2
2001-2002	241	1	203	3	17	0	0	10	0	1	0	0	6	1	0	1
2002-2003	139	14	79	4	12	0	1	9	0	8	1	0	4	0	0	0
2003-2004	307	9	72	13	16	0	0	68	8	13	0	0	23	0	23	1
2004-2005	154	5	191	2	17	0	0	43	0	0	2	0	8	0	0	0
2005-2006	313	1	417	9	32	0	3	202	23	1	3	0	34	0	0	8
2006-2007	229	2	140	6	14	0	6	24	2	7	0	1	23	2	0	3
2007-2008	153	3	135	2	10	0	23	87	19	0	0	0	56	0	6	9
2008-2009	107	0	42	6	0	2	0	0	0	6	0	0	1	0	0	1
2009-2010	129	2	47	0	4	0	0	0	0	1	0	0	7	0	0	0
2010-2011	44	1	44	0	3	0	0	1	0	1	0	0	2	0	0	0
2011-2012	222	2	49	19	4	1	0	14	0	0	0	0	41	2	0	5
Maximum	**313**	**14**	**417**	**19**	**32**	**2**	**23**	**202**	**23**	**13**	**3**	**1**	**56**	**2**	**23**	**9**
Minimum	**44**	**0**	**42**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**
Average	**194**	**3**	**148**	**5**	**13**	**0**	**3**	**40**	**5**	**3**	**1**	**0**	**18**	**0**	**3**	**3**

Source: MRN, 2013d

Table 7-22 Furbearing Animal Harvest in the Nemaska Territory

Year	Beaver	Lynx	Marten	Mink	Otter	Fisher	Skunk	Weasel	Muskrat	Squirrel	Wolf	Red Fox	Silver Fox	Arctic Fox	Patched Fox
1989-1990	76	4	75	19	3	0	0	3	17	0	1	1	0	0	0
1990-1991	156	2	86	22	4	0	0	5	19	2	4	2	0	0	0
1991-1992	301	11	96	25	16	0	0	13	3	7	5	10	0	0	2
1992-1993	181	4	119	20	12	0	0	3	7	0	2	10	0	0	2
1993-1994	230	3	59	3	10	0	0	0	36	0	1	0	0	0	0
1994-1995	95	0	43	15	5	0	0	11	43	2	1	2	0	0	0
1995-1996	121	0	192	8	7	0	0	6	10	0	1	2	0	0	2
1996-1997	93	2	116	5	5	0	0	12	12	2	0	8	0	0	0
1997-1998	205	0	69	79	13	0	0	0	22	10	2	1	0	0	0
1998-1999	132	0	58	13	1	0	0	1	26	4	0	3	0	0	0
1999-2000	130	0	52	5	5	0	0	16	38	1	0	12	0	0	1
2000-2001	240	0	256	2	12	0	0	1	6	0	1	27	1	0	2
2001-2002	167	1	154	3	6	0	0	0	2	0	1	1	0	0	1
2002-2003	91	0	49	2	1	0	1	0	0	0	0	3	0	0	0
2003-2004	221	7	45	3	8	0	0	0	13	0	0	5	0	0	1
2004-2005	128	0	80	2	12	0	0	0	11	0	0	4	0	0	1
2005-2006	211	1	160	1	7	0	0	0	0	0	0	0	0	0	0
2006-2007	180	0	34	0	11	0	0	0	5	0	0	0	0	0	0
2007-2008	98	1	34	0	0	0	0	0	7	0	1	5	0	0	0
2008-2009	103	0	44	6	0	2	0	0	0	0	0	1	1	0	2
2009-2010	90	2	21	0	3	0	0	0	0	0	1	4	0	0	0
2010-2011	85	1	53	1	1	0	0	0	1	0	0	0	0	0	0
2011-2012	61	0	12	1	2	0	0	0	2	0	0	1	0	0	0
Total	**3,395**	**39**	**1,907**	**235**	**144**	**2**	**1**	**71**	**280**	**28**	**21**	**102**	**2**	**0**	**14**
Maximum	**301**	**11**	**256**	**79**	**16**	**2**	**1**	**16**	**43**	**10**	**5**	**27**	**1**	**0**	**2**
Minimum	**61**	**0**	**12**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Average	**148**	**2**	**83**	**10**	**6**	**0**	**0**	**3**	**12**	**1**	**1**	**4**	**0**	**0**	**1**

Source: Association des trappeurs cris, 2013

Muskrat (*Ondatra zibethicus*)

Muskrats inhabit ponds, calm water courses, shallow lake bays, swamps and ditches along fields and roads, as long as there is water all year long (particularly where vegetation is dense). Its burrow or hut is located in the bank and has several underwater entrances. Its territory has a diameter of approximately 60 m, centered on the burrow (Wilner and coll., 1980).

Snowshoe Hare (*Lepus americanus*)

In the boreal forest, the snowshoe hare frequents mixed conifer and deciduous forests (trembling aspen and balsam poplar) with dense undergrowth that protects it from predators and provides food (MRN, 2013m). Its home range covers approximately 60,000 m^2 to 100,000 m^2. Its burrow is generally under a shrub, stump or log (Sullivan, 1995).

Red Fox (*Vulpes vulpes*)

The red fox home range can cover up to 20 km^2 when the environments are fragmented and heterogenous (Larivière and Pasitschniak-Arts, 1996). Its burrow is a former woodchuck burrow, a cavern, a hollow tree trunk or a dense thicket.

American Marten (*Martes americana*)

The home range of the American marten extends over approximately 8 km^2 in conifer forests or mixed forests offering a 30% to 50% plant cover (Clark and coll., 1987). Its shelter is a dead tree, stump or tunnel (FTGQ, 2003).

This species is the object of many fur sales (Table 7-21).

Fisher (*Martes pennanti*)

The home range of the fisher varies from 6 km^2 to 40 km^2. It frequents dense conifer and deciduous forests. It often changes shelter and prefers hollow tree, hole under stump or abandoned burrow (Meyer, 2007).

Ermine (*Mustela erminea*)

The ermine frequents regenerating areas, bushes, peatlands and shrubby prairies. Its nest can be built in hollow trees, under roots or in a rockfall, but it can also inhabit chipmunk burrows (King, 1983).

Long-Tailed Weasel (*Mustela frenata*)

The long-tailed weasel frequents practically any type of environments, except arid areas. The diet of this carnivore is composed mainly of rodents and other small mammals. It is always installed near a source of water (Newell, 2002).

Least Weasel (*Mustela nivalis*)

The least weasel home range covers an area of 6,000 m^2 to 200,000 m^2 (Sheffield and King, 1994). The species lives in swampy areas, wet prairies, fields and scrubs. It generally uses vole or chipmunk burrows. Its diet is composed of mice, voles, eggs, small birds, insects and young hares and rabbits (Newell, 1999). The least weasel rarely ventures further than 100 m from its den. It is active all year long, mostly at night, and is solitary. It produces two or three litters per year (Sheffield and King, 1994). Its main predators are the red fox, long-tailed weasel, owls and human.

The least weasel ranges in all parts of Quebec and Canada, but is very seldom reported in Quebec. Although the reported distribution range covers the Whabouchi project to study area, it is unlikely that this species frequents the study area.

American Mink (*Mustela vison*)

The American mink is a solitary carnivore that frequents wetlands, the shores of rivers, streams and lakes, drainage ditches, ponds, peatlands and marshes. Most often, it uses abandoned burrows in tree root cavities or directly in a bank escarpment (Larivière, 1999).

Wolverine (*Gulo gulo*)

Its home range covers approximately 400 km^2. It lives in conifer forests and the tundra. Its shelter is often a stump, a shrub or an animal carcass. It is active day and night (Luensmann, 2008).

Its diet is constituted mainly of large animals killed by wolves or bears, or that have died of natural causes (Luensmann, 2008). It is not a very effective hunter, but it is well adapted to the scavenger lifestyle. Its predators are the human, gray wolf and cougar (*Puma concolor*).

The presence of wolverine in the study area is unlikely, considering its diet. Effectively, the small number of ungulates reported by the fieldworks suggests that the study area offers little potential for this species.

River Otter (*Lontra canadensis*)

The river otter frequents all territories located south of the treeline. It is associated with aquatic environments and their edge (Larivière and Watson, 1998). It appreciates particularly beaver ponds. The otter regularly changes its den, which often consists in the hut or burrow of another animal (mostly beaver and muskrat dens) or other natural shelter.

Canada Lynx (*Felis lynx*)

The home range of the Canada lynx varies from 15 km^2 to 220 km^2. It frequents conifer forests and scrublands where hare is abundant (Uley, 2007). A crevice, hollow log, stump and even a thicket are is main shelters.

In addition to the above-mentioned species, the willow ptarmigan and grouse observed in the course of the inventories for the present project were included in this group of mammals for analysis purposes, since these avian species are considered as game.

Chiropterans

Little information is available about the chiropterans in the study area. Most of the mentions concerning the James Bay territory are reported south of the 54^{th} parallel. In Quebec, all bat species are insectivores. The little brown bat, big brown bat and northern long-eared bat must find a winter shelter where they can live off their lipid reserves for the entire winter (CRRNTBJ, 2010).

The six bat species susceptible of being observed in the study area are:

- Northern long-eared bat (*Myotis septentrionalis*);
- Little brown bat (*Myotis lucifugus*);
- Eastern red bat (*Lasiurus borealis*);
- Hoary bat (*Lasiurus cinereus*);
- Silver-haired bat (*Lasionycteris noctivagans*);
- Big brown bat (*Eptesicus fuscus*).

Northern Long-Eared Bat

The northern long-eared bat is a typical species of the boreal forest. It lives near clearings, rivers and water bodies. It nests in rock crevices, caverns and under the bark of trees (Caceres and Barclay, 2000; Ollendorff, 2002).

Little Brown Bat

The little brown bat frequents forests near water bodies. It hibernates in caverns or old mine shafts. The hibernation last from September to mid-May (Fenton and Barclay, 1980; Havens, 2006).

Eastern Red Bat

The eastern red bat is a migratory species in our regions. Its preferred environments are conifer or mixed forests near clearings, rivers or water bodies. By day, it hangs from a shrub or tree (Shump and Shump, 1982a; Myers and Hatchett, 2000).

Hoary Bat

The hoary bat lives in conifer or deciduous forests. By day, it stays suspended in the foliage of a tree. It feeds late in the evening, over clearings and water bodies. In our regions, this bat is a migratory species (Shump and Shump, 1982b).

Silver-Haired Bat

The silver-haired bat is another migratory species in our regions. Like the previous species, it inhabits forest stands near water courses and lakes. During the day, it is suspended in the foliage of a tree or in a trunk crevice (Kunz, 1982; Naumann, 1999).

Big Brown Bat

The big brown bat nests in a hollow tree, under a bridge or behind the shutter of a house. It feeds in pastures, ponds or near streetlights, since it has adapted to urban environment (Kurta and Baker, 1990; Mulheisen and Berry, 2000).

Micromammals

According to the *Atlas des micromammifères du Québec* (Desrosiers and coll. 2002), 13 species may frequent the Whabouchi project study area.

Micromammals include small mammals such as mice, voles and shrews. The micromammals play an important role in the terrestrial and wetland environments. They feed on many insect and vegetal species and provide food for many other birds and terrestrial predators. By their behavior, they contribute to the dissemination of plant seeds. There is little documentation about micromammals in the region of the Whabouchi project.

Table 7-23 Likely Micromammal Species in the Whabouchi Project Study Area

Common Name	Scientific Name
Southern red-backed vole	*Clethriomys gapperi*
Meadow vole	*Microtus pennsylvanicus*
Rock vole	*Microtus chrotorrhinus*
Northern bog lemming	*Synaptomys borealis*
Southern bog lemming	*Synaptomys cooperi*
Eastern heather vole	*Phenacomys intermedius*
Deer mouse	*Peromyscus maniculatus*
Meadow jumping mouse	*Zapus hudsonius*
Common shrew	*Sorex cinereus*
Water shrew	*Sorex palustris*
Arctic shrew	*Sorex arcticus*
Pygmy shrew	*Sorex hoyi*
Star-nosed mole	*Condylura cristata*

Southern Bog Lemming

The home range of the southern bog lemming varies from 400 m^2 to 3,200 m^2 in sphagnum-heath bogs, grassy marshes and mixed forests near peatlands (Prescott and Richard, 2004; Desrosiers and coll., 2002; Fortin and Doucet, 2003). It lives in small colonies where each individual protects its nest. The species is active all year long and makes reserves of sedge seeds for winter. It is highly prolific (two to four litters per year). The average litter comprises between two and five offsprings. It is, however, the prey of many predators such as snakes, carnivorous mammals and raptors (Prescott and Richard, 2004; Desrosiers and coll., 2002).

In Canada, the southern bog lemming is considered a rare species. Its presence in the favorable environments is observed only sporadically. In Quebec, there is little data available about the species, and its distribution range corresponds to the southern portion of the province. However, the presence of this micromammal has been reported in three instances, near the Eastmain River and Lake Boyd, in the preliminary Eastmain-1-A studies of 2002 (Fortin and coll., 2004). The species is currently subject of monitoring in Quebec (CRRNTBJ, 2010).

Rock Vole

The preferred environment of the rock vole is the conjuncture of a rocky substrate and water (Kirkland and Jannet, 1982; Orrock and Pagels, 2003). It also inhabits environments with abundant mosses, rocky outcrops, clearing edges, mountainous areas and humid slopes. It also finds cover between moss-covered rocks and near water points (Kirkland and Jannett, 1982). It eats the twigs, leaves and fruits of various plants (Prescott and Richard, 2004). It is active day and night, all year long, and lives in small isolated colonies. From March to October, the species can breed two or three times, and the average of each of litters is from three to four individuals. Its predators are raptors, bobcat and northern short-tailed shrew.

The rock vole is considered as a rare species. Very little studies have focused on this species (Desrosiers and coll., 2002). It is present in Quebec up to the south of James Bay, and eastward up to Labrador (55th parallel) (Lansing, 2005). Its presence has been confirmed on the Otish Mountains plateau, at the level of km 130 of the extention of the Highway 167 North (Roche-SNC Lavalin, 2010). The species is currently subject of monitoring in Quebec (CRRNTBJ, 2010).

7.5.3 Mammals Inventory

As part of the present project, mammal field surveys were carried out in the study area and in several survey areas. The specific objectives of these fieldworks were to:

- Identify the species that are present;
- Determine the habitat used;
- Locate large mammals wintering grounds, notably those of moose;
- Verify the presence of special-status species.

7.5.3.1 Methods

Large Mammals

The large mammal's survey was taken on February 12, 2012. The study area was covered by helicopter. A total of 20 transects, equidistant by 1 km, were covered. The flyover was carried out in a single day. The area covered by the observers during this flyover was limited to a band of approximately 250 m on either side of the helicopter. Thus, the territory covered by the survey represents approximately 50% of the total study area.

The survey consisted in noting large mammal tracks in the snow and observing individuals along the transects. The surveys were undertaken more than 12 hours after snowfall, in order to allow enough time for animals to leave their tracks. The wintering grounds were delineated on the basis of fresh tracks observed during the flyover.

Mr. James Wapachee, the tallyman of trapline R20, took part in the large mammal census.

Small Mammals

The small mammal surveys were carried out on February 7 and 12, 2012. Aerial transects were flown in two quadrants of approximately 5 km wide. The first was located at the mine site, and a second northeast of the mine site, within the study area (Map 7-8). Also, two additional aerial transects covering approximately 3.5 km were surveyed to the southwest of the mine site. Finally, two transects were covered on the ground, southwest of Lake Saint-Simon. A total of approximately 62 km of helicopter flyover transects and 10 km of ground transects were inventoried. The portion of territory surveyed during the flyover was estimated at 250 m on either side of the helicopter. Thus, the covered territory represented approximately 50% of the quadrant area. The survey was completed in a single day.

Animal tracks in the snow and animals sightings along the transects were recorded. The surveys were carried out more than 12 hours after a snowfall in order to allow enough time for animals to leave tracks.

Note that in the ground surveys, all the signs of fauna presence (large or small) within 2.5 m on either side of the transect were recorded.

Mr. James Wapachee, the tallyman of trapline R20, also took part in the small mammal census.

The observations from all surveys (aerial and ground) were compiled for each species in order to determine the relative abundance of each small mammal species in the study area. The tracks left in the snow by ermine and weasel are very similar. It was then impossible to differentiate between them during the aerial survey. For analysis purposes, the two species are compiled under the ermine/weasel name.

Chiropterans

The chiropteran survey was carried out between June 20 and July 5, 2012. Five listening stations were distributed in potential habitats of these species within the survey area, notably near water bodies (Table 7-24). Station CS-1 was installed in a burn, at the bottom of a slope with scattered small trembling aspens. Stations CS-2 and CS-3 present similar vegetation, both near a lake shore (respectively Lac du Spodumène and Lac des Montagnes). Stations CS-4 and CS-5 were installed within 5 m of each other near a building owned by the MDDEFP near the northern shore of Lac du Spodumène.

Table 7-24 Chiropteran Listening Stations

Station	Environment
CS-1	Recent burn
CS-2	Edge of a forest stand and recent burn
CS-3	Edge of a forest stand and recent burn
CS-4	Forest stand and section in anthropogenic disturbance; prospection, roads
CS-5	Forest stand and section in anthropogenic disturbance; prospection, roads

A Wildlife Acoustics SMBAT2+ instrument was installed at a station for three consecutive nights to record ultrasounds from 10pm to midnight and from 3am to 5am. Additionally, a visual census was taken at station CS-5 between 9pm and 10pm on June 27, 2012. This visual census consisted in counting the bats with a lamp pointing out to the sky.

The frequency and amplitude of the recorded ultrasounds were used to differentiate the different species of bats. The recordings were analysed with the Sonobat software. To identify the species, the recorded signals were compared with those in the software's bank of reference signals and with several reference criteria for North American species.

Micromammals

The principal objective of the study was to learn the diversity of the micromammal species present in the mine survey area, and to verify the presence of rock vole and southern bog lemming, two species likely to be designated as threatened or vulnerable under the SARA (MRN, 2013c).

The survey was taken between June 23 and 27, 2012. Ten sampling stations were distributed among the different environments in the mine survey area (Map 7-5). The location of these sampling stations (transects) was selected on the basis of potential habitats for the targeted species, i.e. rock vole and southern bog lemming. The stations were distributed over wetlands, riparian, forest and open environments. Wetlands constitute preferred environments for the southern bog lemming (Krupa and Haskins, 1996), while the rock vole prefers rockfalls, particularly if the rocky slope is near water (Orrock and Pagels, 2003).

Each station consisted in a 110 m long transect, except for station MM-2, which extended over 220 m (Map 7-5). At each 110 m station, 15 snap traps and 5 pitfall traps were installed (the double for the 220 m station). The pitfall traps were made with a 2 L plastic bucket buried in the ground and filled with approximately 10 cm of water.

The captured micromammals were kept frozen until their analysis in the laboratory. The species were identified according to the criteria given by Lupien (2001, 2002). The identification of a few specimens is being validated with the MDDEFP.

7.5.3.2 Results

Large Mammals

<u>Moose</u>

A total of five moose wintering grounds were observed during the flyover (Map 7-6). Seven individuals, four males, two females and a calf, were observed within the limits of these wintering grounds. A female was also observed traveling, but could not be associated with a specific wintering ground. The density observed during the aerial survey is therefore 0.5 individual/10 km^2 (8 individuals over 157 km^2). This value is comparable with those observed in the different surveys completed in the James Bay territory (Table 7-17).

Moose tracks were also observed near Lake 2 in another census (fortuitous observations, Map 7-7).

The different wintering grounds have similar characteristics. All have a southern exposure. The slope is gentle, with a slightly undulating topography. The forest cover is mainly dense and open deciduous stands, open conifer stands (spruce), regenerating conifer and deciduous trees, mature mixed stands and burns.

Woodland Caribou

No caribou was sighted in the study area during the wildlife surveys completed for the Whabouchi project.

The woodland caribou, potentially present in the study area, is probably scarce. It has been observed that Northern Quebec woodland caribou manifest an aversion for road networks, over distances that can reach 10 km (Rudolph, 2011). The presence of the Route du Nord could therefore limit this species' frequentation of the area. The woodland caribou also generally avoids burned areas, which are abundant in the study area.

Black Bear

No black bear was sighted during the aerial survey. However, bear tracks were observed very close to Lake 2 (Map 7-7).

Gray Wolf

Two gray wolf track observations were reported in the aerial survey. One was seen along Creek D (outlet of Lac du Spodumène), while the second was in the northeastern sector of the study area (Map 7-6). Signs of the presence of the species were also observed in the sector of the proposed waste rock and tailings pile (Map 7-7).

Small Mammals

Comparison Table with Regional Studies

The surveys reported evidence or direct observations of the presence of nine small mammal species: red squirrel, snowshoe hare, river otter, American marten, American porcupine, red fox, American mink, ermine/weasel (impossible to differentiate tracks) and American beaver. The American marten represents more than 50% of all small mammal observations (Table 7-25).

Surveys completed for hydroelectric projects in the region (Del Degan, Massé et Associés, 2004) report the same small mammal species as those observed in the present study. Works on the proposed extension of Highway 167 (Roche-SNC Lavalin, 2010) also confirms the presence of most of the same species. The wolverine, long-tailed weasel, least weasel, northern flying squirrel, woodchuck, striped skunk, eastern chipmunk and fisher were not observed during the different studies.

The majority of small mammal species were observed in the same environments. They frequent mainly burned areas, forest stands and alder stands. The recent burn effectively cover the majority of the study area.

Table 7-25 Number of Observations and Relative Abundance of Small Mammal Species in the Study Area

Species	Number	Relative Abundance
American beaver	1	1%
Red squirrel	9	11%
Ermine	1	1%
Snowshoe hare	4	5%
Wolf sp.	1	1%
River otter	8	9%
American marten	43	51%
Porcupine	3	4%
Fox	15	18%
Total	**85**	**100%**

Chiropterans

During the surveys, several ultrasounds were recorded at stations CS-4 and CS-5. However, no ultrasound was recorded at stations CS-1, CS-2 and CS-3.

The analysis of the ultrasounds identified the presence of *Myotis spp.* and *Lasiurus spp.* They are probably the following species (Fabianek (Université de Laval), 2013, personal communication):

- Little brown bat (*Myotis lucifugus*) and/or northern long-eared bat (*Myotis septentrionalis*);
- Hoary bat (*Lasiurus cinereus*) and/or eastern red bat (*Lasiurus borealis*).

Hoary bats have been reported in the Lac du Spodumène area (Boudreault (MRN), 2013, personal communication). The ultrasounds recorded at stations CES-4 and CS-5 could therefore be produced by this species. However, the species was not observed during the visual survey.

A nursery roost of approximately 300 little brown bats is reported in the survey area. The MDDEFP has been following the evolution of this nursery roost for several years (Bouchard (MRN), 2013, personal communication).

Micromammals

A total of 51 specimens of four different species were captured by 440 trap-nights, or 11.6 captures/100 trap-nights (Table 7-26). The highest successful catches were recorded at stations MM-1, MM-2 and MM-5, located in anthropogenic disturbance environment type, as well as in station MM-6 located in a recent burn. The lowest catch rate was noted in the shrubby bog environment type (stations MM-3 and MM-4).

Table 7-26 Species and Number of Micromammals Captures, by Environment and Sampling Station

Environment	Station	Species				Catches Number per 100 Trap-Nights[1]
		Deer Mouse	Shrew spp.	Southern Bog Lemming	Total	
Recent Burn	MM-6	8	-	-	8	20.0
	MM-7	4	-	-	4	10.0
	MM-8	2	3	-	5	12.5
	MM-9	4	-	-	4	10.0
	MM-10	1	-	-	1	2.5
All Recent Burn Stations		19	3	-	22	11.0
Shrubby Bog	MM-3	1	-	1	2	5.0
	MM-4	-	-	-	-	0.0
All Shrubby Bog Stations		1	-	1	2	2.5
Recent Burn and Anthropogenic Disturbance	MM-2	8	1	-	9	11.2
	MM-5	8	-	-	8	20.0
All Recent Burn and Anthropogenic Disturbance Stations		16	1	-	17	14.2
Anthropogenic Disturbance	MM-1	8	2		10	25.0
All Stations (MM-1 to MM-10)		**44**	**6**	**1**	**51**	**11.6**

[1] One trap-night corresponds to one open trap during one night. The survey lasted for 40 trap-nights (2 days X 20 trap-nights) at each station except station MM-2 where 80 trap-nights were completed (2 days X 40 trap-nights).

The deer mouse represents more than 86% of all captured specimens (44 out of 51). Eight deer mice were captured at each of the stations MM-1, MM-5 and MM-6. These three stations were in areas of anthropogenic disturbances. A total of six shrews were captured at stations MM-1, MM-2 and MM-8. No specimen was captured at the station MM-4, located in a wetland (shrubby bog). It should be noted that a southern bog lemming (identification currently being validated with the MDDEFP), a species likely to be designated threatened or vulnerable, could have been captured in station MM-3 located in a shrubby bog.

Micromammals are generally more active at twilight and during the night. As the nights were relatively cool (between 6°C and 13°C), it is possible that the temperature limited the movements of these species and contributed to reducing the catch rate (Table 7-27). Due to rain, the surveys carried out at twilight and during the nights of June 25 and 26 could be more favorable to micromammal movements. Effectively, the catch rate for micromammals is higher when rain falls during the first hours after sunset (Kirkland and coll. 1998).

Table 7-27 Summary of Weather Conditions during the 2012 Micromammal Survey

Date (June)	Weather Conditions	Temperature (°C)[1]	
		6am	3pm
22	Sunny with cloudy periods/high wind	11.0	16.0
23	Sunny	13.0	NA[2]
24	Sunny with cloudy periods and showers	NA	NA
25	Cloudy	6.0	14.8
26	Sunny with cloudy periods/rain during the night	8.2	19.2
27	Sunny	12.0	23.0

[1] Temperature measured at the Nemiscau airport (Environnement Canada, 2012a).
[2] Not available.

7.5.3.3 Special-Status Species

Special-status species include those species classified as "endangered", "threatened" or "of special concern" under the Canadian Species at Risk Act, as well as those that are "threatened", "vulnerable" and "likely to be designated threatened or vulnerable" under the Quebec Act Respecting Threatened or Vulnerable Species, which includes notably the Regulation Respecting Threatened or Vulnerable Species and their Habitats (c. E-12.01, r. 2).

According to the CDPNQ, a recording of hoary bat, a species likely to be designated threatened or vulnerable under the SARA was reported in 2001 at a station located in a black spruce-jack pine stand, approximately 2 km northeast of the mine site (Boudreault (MRN), 2013, personal communication). No other observation of special-status mammals has been reported in the study area according to the CDPNQ (Boudreault, MRN, 2013, personal communication). However, the distribution range of the 10 following special-status mammal species encompasses the Whabouchi project study area (MRN, 2013d; Gouvernement du Canada, 2013):

- Least weasel (*Mustela nivalis*): likely to be designated threatened or vulnerable under the TVSA;
- Rock vole (*Microtus chrotorrhinus*): likely to be designated threatened or vulnerable under the TVSA;
- Southern bog lemming (*Synaptomys cooperi*): likely to be designated threatened or vulnerable under the TVSA;
- Wolverine (*Gulo gulo*): designated as threatened (TVSA); designated as endangered (SARA);
- Woodland caribou, forest ecotype (*Rangifer tarandus caribou*): designated as vulnerable (TVSA) and designated as threatened (boreal population; SARA);
- Silver-haired bat (*Lasionycteris noctivagans*): likely to be designated threatened or vulnerable (TVSA);

- Hoary bat (*Lasiurus cinereus*): likely to be designated threatened or vulnerable (TVSA);
- Northern long-eared bat (*Myotis septentrionalis*): designated as endangered (COSEWIC);
- Eastern red bat (*Lasiurus borealis*): likely to be designated threatened or vulnerable (TVSA);
- Little brown bat (*Myotis lucifugus*): designated as endangered (COSEWIC).

The conducted surveys showed that the northern long-eared bat, little brown bat and eastern red bat could possibly be present in the study area, near Lac du Spodumène.

As mentioned above, a southern bog lemming, a species likely to be designated threatened or vulnerable under the TVSA might have been captured in the study area, but the identification of the species is currently being validated.

7.5.4 Impacts Assessment on Large Mammal

The following sections cover the identification of impact sources, the description of the impacts and the mitigation measures for each project phase (construction, operation and closure) as well as the significance of the residual impact on large mammal.

7.5.4.1 Identification of the Impact Sources

Over the different phases of the project, several activities represent sources of impacts on large mammal, as they could modify the conditions in the environments frequented by these animals. These impacts sources, for the different project phases, are the following:

Construction Phase

- Sites clearing and preparation (excavation, stripping, backfilling, blasting and overburden management);
- Construction of the temporary and permanent infrastructures and facilities;
- Use, maintenance and circulation of heavy machinery and vehicles;
- Presence of workers and purchasing of goods and services.

Operation Phase

- Sites clearing and preparation (excavation, stripping, backfilling, blasting and overburden management);
- Presence and operation of the infrastructures and buildings;
- Use, maintenance and circulation of heavy machinery and vehicles;
- Presence of workers and purchasing of goods and services;
- Progressive rehabilitation of the waste rock and tailings pile.

Closure Phase

- Use, maintenance and circulation of heavy machinery and vehicles;
- Site rehabilitation;
- Dismantling of the infrastructures and facilities;
- Presence of workers and purchasing of goods and services.

7.5.4.2 Description of the Impacts

The impact sources mentioned previously correspond to activities that would potentially modify large mammal's habitats, disturb their behaviors, notably because of the noise, and affect their movements on the project site. These impact sources are described below in the order of the project development phases.

Construction Phase

Sites Clearing and Preparation (Excavation, Stripping, Backfilling, Blasting and Overburden Management)

The activities relating to the clearing and preparation of the sites will cause losses of terrestrial environments. The grading, excavation and backfilling of the infrastructure sites in preparation for their construction or development (pit) are activities that will result in losses of terrestrial environments during the construction phase. These environments are occupied by large mammal, notably moose.

The management of overburden will also cause a loss of terrestrial environments. To reach the deposit, the overburden will be excavated, removed and stored near the pit, in the overburden stockpile. The development of this pile will therefore cause a loss of terrestrial environments.

However, since the terrestrial environments in the study area are relatively homogenous, individuals will be able to move to similar environments at the edge of the mine site, in the study area or in the surrounding region.

Construction of the Temporary and Permanent Infrastructures and Facilities

The construction and the presence of infrastructures will result in increased noise, more particularly on the mine site. This activity will also require the lighting of the sites, thus modifying the natural light levels. These changes will have incidences on the large mammal that frequents the mine site. Certain behaviors such as the search for food, reproduction and rearing of the young could be disturbed in areas near construction sites. The large mammal could also avoid lighted areas.

Use, Maintenance and Circulation of Heavy Machinery and Vehicles

The circulation of heavy machinery and vehicles on the mine site could cause an increase in the number of accidents involving large mammal. These accidents could be a cause of large mammal mortality. The noise caused by the use and circulation of heavy machinery and vehicles could also increase the stress level and/or modified the movements of the large mammal.

Presence of Workers and Purchasing of Goods and Services

The presence of workers could increase the harvesting pressure on wildlife (mainly on moose, which may be hunted by non-native). This increased hunting pressure could modify the large wildlife population structure in the study area.

The waste generated by the workers will have to be managed on-site. Its presence could attract gray wolf and black bear to the mine site. Workers could also feed the animals, thus potentially modifying their natural behaviors.

Operation Phase

During the operation phase, the description of impact sources presented for the construction phase also applied, where relevant. Certain additional impact sources will occur during the operation phase and are described hereunder.

Presence and Operation of the Infrastructures and Ore Extraction, Storage and Processing

During the exploitation of the deposit phase, the progressive expansion and operation of the waste rock and tailings pile, as well as the diversion of the Route du Nord will result in habitat losses for the large mammal. These activities will also increase the noise level on the mine site. This noise increase could ward off large mammal from the mine site during its operation.

Progressive Rehabilitation of the Waste Rock and Tailings Pile

The waste rock and tailings pile will be graded and replanted progressively during its exploitation. The rehabilitation works will be a source of impact, but since the activity aims to restores the affected environment the overall effect of this activity is considered positive because they will be a gain of terrestrial environments for large mammal.

Closure Phase

During the closure phase, the description of the impact sources presented for the construction and operation phases will also applied, where relevant. Certain additional impact sources will occur during the closure phase and are described hereunder.

Site Rehabilitation

The rehabilitation of the site will consist in restoring the disturbed areas to similar natural characteristics as possible to the original conditions. Although this activity is a source of impact, the overall effect is considered positive because it aims to restore the disturbed environment to its natural conditions. The replanted areas will again provide potential habitats for large mammal.

Dismantling of the Infrastructures and Facilities

The activities associated with the dismantling of the infrastructures and facilities (circulation and use of machinery, water management, etc.) will be a source of potential impact on the terrestrial habitats used by large mammal. However, this dismantling will restore the accessibility of these territories for large mammal.

7.5.4.3 Description of the Mitigation Measures

The following mitigation measures will be applied to reduce the impacts on terrestrial environments, and therefore on large mammal. Most of these measures relate to the use and circulation of heavy machinery and vehicles, and with the overburden management.

Construction Phase

- Favor the use of surfaces already disturbed by the exploration works for the circulation of machinery and the temporary construction materials storage areas
- Clearly identify the limits beyond which the circulation of heavy machinery and vehicles is prohibited
- Limit the circulation of heavy machinery and vehicles to predetermined areas (e.g. service roads and work areas) so as to reduce the areas of impacted terrestrial environments
- Limit the circulation of machinery only in areas designated for clearing
- Prioritize, inasmuch as possible, the use abrasives rather than melting salts in winter, and in summer, use water as a dust reducer as needed
- Replant the disturbed areas at the end of the works so as to re-create as quickly as possible the original natural conditions
- Limit the travel speed on the mine site service roads to 30 km/h
- Establish procedures for the adequate management of wastes on the mine site
- Raise the awareness of workers about not feeding the animals and not leaving food, so as to avoid attracting them on the mine
- Forbid hunting activities to employees within the limits of the mine lease and the use leases

Operation Phase

During the operation phase, all the mitigation measures described for the construction phase will apply, as relevant. The following additional mitigation measure will be implemented during the operation phase:

- Gradually restore the waste rock and tailings pile as soon as it reaches its final elevation

Closure Phase

During the closure phase, all the mitigation measures presented for the construction and operation phases will applied, as relevant. The following additional mitigation measures will be implemented during the closure phase:

- Replant the site with indigenous plant species (grasses, shrubs and trees).
- Install a fence around the pit to limit access to large mammal.

7.5.4.4 Significance of the Residual Impact on the Large Mammal

The significance of the residual impact was evaluated in consideration of the three combined project phases, by compiling the areas of the terrestrial and wetland environments lost in the course of the project. The areas that will be affected during the construction, operation and closure phases are presented in Table 7-28, for the main infrastructures and facilities of the Whabouchi project.

Before the revegetation of the mine site, the project will have caused a loss of 200.8 ha of wetlands and terrestrial environments. Five types of environment will be affected by the project activities: forest stands, recent burn, alder stand, shrubby bog and anthropogenic disturbance. The forest stand comprises jack pine, black spruce-moss and, to a lesser extent, birch. More specifically, the project will result in the loss of less than 11 ha of these three forest stands. There will be a loss of 141.2 ha of the recent burn.

Table 7-28 Areas of Large Mammal Terrestrial and Wetland Habitats Affected by the Construction, Operation and Closure Phases of the Whabouchi Project

Facilities and Infrastructures	Environment (ha)					
	Forest Stand	Recent Burn	Alder Forest	Shrubby Bog	Anthropogenic Disturbance	All Environments
Service Roads	0.88	4.17	0.07	0.24	0.05	5.41
Explosives Store	0.00	0.92	0.01	0.31	0.00	1.24
Pit	5.05	13.98	0.00	0.12	12.16	31.31
Waste Rock and Tailings Pile	3.52	82.59	2.11	2.55	2.33	93.10
Overburden Pile	0.49	10.32	0.00	2.72	0.00	13.53
Diversion of the Route du Nord	0.05	7.00	0.06	0.91	32.00	40.02
Sedimentation Basins	0.99	8.28	0.13	0.16	0.00	9.56
Industrial Complex	0.00	13.98	0.00	0.00	0.63	14.61
All Facilities and Infrastructures	**10.98**	**141.24**	**2.38**	**7.01**	**47.17**	**208.78**

Following the site rehabilitation at the closure phase and the application of the other mitigation measures, the area of unrestored environments will be of 31.3 ha. In fact, the only irreversible loss will be the pit, as all other disturbed areas will have been rehabilitated.

The social value of large mammal is high, because species such as moose, bear and woodland caribou are highly valued by the different land users. The ecosystemic value of this component is also high, notably because the forest ecotype woodland caribou is a protected species. The value of this component is therefore high. After application of the mitigation measures, the significance of the residual impact is moderate.

The nature of the impact on large mammal is negative. The frequency of the impact is considered as continuous since the impact will occur over the entire life of the project. The degree of disturbance is low, since large mammal is not abundant at the project site and because it will find similar habitats outside of the area influenced by the project. Furthermore, the moose wintering grounds are at a certain distance of the mine site. The noise of the mining activities will therefore have little effect on them. Considering that the value of the component is high and the degree of disturbance is low, the intensity of the impact according to the previous considerations is moderate. Since the impact will be limited to a small proportion of the home range of certain individuals, its geographic extent is local. The duration of the impact is considered medium, as the site rehabilitation activities will restore the disturbed environments. These restored environments will be again available for large mammal. The impact is reversible because at the end of the mining activities, the site rehabilitation will restore original environmental conditions so that the large wildlife can return again to the site.

Table 7-29 presents the values assigned to each indicator and the resulting significance of the residual impact.

Table 7-29 Significance of the Residual Impact – Large Mammal

Intensity	Extent	Duration	Significance of the Residual Impact
High	Regional	Long	High
Moderate	**Local**	**Medium**	**Moderate**
Low	Punctual	Short	Low

7.5.5 Impacts Assessment on Small Mammal

The following sections cover the identification of impact sources, the description of the impacts and the mitigation measures for each project phase (construction, operation and closure) and the significance of the residual impact on small mammal.

7.5.5.1 Identification of the Impact Sources

Over the different development phases of the Whabouchi project, several activities could constitute source of impact on small mammal. These impacts sources, for the project development phases, are described below.

Construction Phase

- Sites clearing and preparation (excavation, stripping, backfilling, blasting and overburden management)
- Construction of the temporary and permanent infrastructures and facilities
- Use, maintenance and circulation of heavy machinery and vehicles
- Presence of workers and purchasing of goods and services

Operation Phase

- Sites clearing and preparation (excavation, stripping, backfilling, blasting and overburden management)
- Presence and operation of the infrastructures and buildings
- Ore extraction, storage and processing
- Use, maintenance and circulation of heavy machinery and vehicles
- Presence of workers and purchasing of goods and services
- Progressive rehabilitation of the tailings and waste rock pile

Closure Phase

- Use, maintenance and circulation of heavy machinery and vehicles
- Site rehabilitation
- Dismantling of the infrastructures and facilities
- Presence of workers and purchasing of goods and services

7.5.5.2 Description of the Impacts on Small Mammal

The impact sources mentioned represent activities that modify the existing conditions in environments that are potentially occupied by small mammal. These impact sources are described below in the order of the project development phases.

Construction Phase

<u>Sites Clearing and Preparation (Excavation, Stripping, Backfilling, Blasting and Overburden Management)</u>

The clearing, deforestation, excavation, backfilling and blasting works could disturb small mammal because these activities will result in losses of habitats for the different species. These activities could affect mostly the species that need a small home range. However, since the environments in the study area are relatively homogenous, the individuals whose home range will be disturbed could move to similar environments nearby. However, this relocation could cause stress (e.g. increased energy demand, predation) for certain individuals and locally increase intra- and interspecies competition for resources.

Construction of the Temporary and Permanent Infrastructures and Facilities

The construction of the temporary and permanent infrastructures and facilities will increase the noise level. These changes could have incidences on the small mammal that frequent the mine site. Certain species of small mammal could avoid noisy areas or modify certain behaviors (e.g. search for food, reproduction and rearing).

Use, Maintenance and Circulation of Heavy Machinery and Vehicles

The noise generated by the use and circulation of heavy machinery and vehicles could be a stress factor for the small mammal species that frequent the mine site. Additionally, the frequent passage of vehicles on the service roads could be a cause of mortality in certain species.

Presence of Workers and Purchasing of Goods and Services

The presence of workers could increase the hunting pressure on wildlife resources. This pressure could cause modifications of the population structure of game species such as snowshoe hare at the mine site and in its surroundings.

The waste generated by the workers will need to be managed on-site. Their presence could attract a certain species of small mammal, such as red fox, to the mine site. Workers could also feed the animals, thus potentially modifying their behavior.

Operation Phase

During the operation phase, the description of impact sources for the construction phase also applied, where relevant. Certain additional impact sources will occur during the operation phase and are described hereunder.

Presence and Operation of the Infrastructures and Buildings; Ore Extraction, Storage and Processing

During the operation phase, the progressive expansion of the pit and the operation of the waste rock and tailings pile will cause loss of small mammal habitats. Also, the noise increase could keep away certain small mammal species from the mine site.

Progressive Rehabilitation of the Waste Rock and Tailings Pile

The waste rock and tailings pile will be graded and replanted progressively during its exploitation. The rehabilitation works will be a source of impact, but since the activity will revegetate the affected environment, the overall effect of this activity is considered positive.

Closure Phase

During the closure phase, the description of the impact sources presented for the construction and operation phases will also applied, where relevant. Certain additional impact sources will occur during the operation phase and are described hereunder.

Site Rehabilitation

The rehabilitation of the site will consist in restoring the areas disturbed by the project development to natural characteristics that are similar to the original conditions, inasmuch as possible. Although this activity is an impact source, its overall effect is considered positive because it will restore natural conditions in the affected environment.

Dismantling of the Infrastructures and Facilities

The activities associated with the dismantling of the infrastructures and facilities (circulation and use of machinery, water management, etc.) will be a source of potential impact on the terrestrial habitats used by small mammal. However, this dismantling will restore the accessibility of these territories for small mammal.

7.5.5.3 Description of the Mitigation Measures

The following mitigation measures will be applied to reduce the impacts on terrestrial environments, and therefore on small mammal. Most of these measures relate to the use and circulation of heavy machinery and vehicles, and with the management of overburden.

Construction Phase

- Favor the use of surfaces already disturbed by the exploration works for the circulation of heavy machinery and the temporary storage of construction materials
- Clearly identify the limits beyond which heavy machinery and vehicles may is prohibited
- Limit the circulation of heavy machinery and vehicles to predetermined areas (e.g. service roads and work areas) so as to reduce the areas of impacted terrestrial environments
- Limit the circulation of heavy machinery only in areas designated for clearing
- Prioritize, inasmuch as possible, the use abrasives rather than melting salts in winter, and in summer, use water as a dust reducer as needed
- Replant the disturbed sites at the end of the works so as to re-create as quickly as possible the original natural conditions
- Limit the travel speed on mine site service roads to 30 km/h
- Establish procedures for the adequate management of wastes on the mine site
- Raise the awareness of workers about not feeding the animals and not leaving food, so as to avoid attracting them on the mine

- Forbid hunting and trapping activities to employees within the limits of the mine lease and the use leases

Operation Phase

During the operation phase, all the mitigation measures described for the construction phase will apply, as relevant. The following additional mitigation measure will be implemented during the operation phase:

- Progressively restore the waste rock and tailings pile, as soon as possible

Closure Phase

During the closure phase, all the mitigation measures presented for the construction and operation phases will be applied, where relevant. The following additional mitigation measures will be implemented during the closure phase:

- Replant disturbed areas of the mine site with indigenous plant species (grasses, shrubs and trees)

7.5.5.4 Significance of the Residual Impact on Small Mammal

The significance of the residual impact was evaluated in consideration of the three project phases combined. The areas of terrestrial environments that will be affected are presented in Table 7-30, for the main facilities and infrastructures of the Whabouchi project.

A total of 208.8 ha of favorable environments for small mammal will be modified over the course of the project development. Recent burn is the most affected environment, with 141.2 ha. The anthropogenic disturbances (47.2 ha), forest stands (110 ha) and shrubby bog (7.0 ha) are the other environments lost during the project development.

During the operation and closure phases, the waste rock and tailings pile will be profiled and revegetated during its exploitation. This activity will re-create a terrestrial environment.

Table 7-30 Areas of Small Mammal Terrestrial and Wetland Habitats Affected by the Construction, Operation and Closure of the Whabouchi Project

Facilities and Infrastructures	Environment (ha)					All Environments
	Forest Stand	Recent Burn	Alder Forest	Shrubby Bog	Anthropogenic Disturbance	
Access Roads	0.88	4.17	0.07	0.24	0.05	5.41
Explosives Store	0.00	0.92	0.01	0.31	0.00	1.24
Pit	5.05	13.98	0.00	0.12	12.16	31.31
Waste Rock and Tailings Pile	3.52	82.59	2.11	2.55	2.33	93.10
Overburden Pile	0.49	10.32	0.00	2.72	0.00	13.53
Diversion of the Route du Nord	0.05	7.00	0.06	0.91	32.00	40.02
Sedimentation Basins	0.99	8.28	0.13	0.16	0.00	9.56
Industrial Complex	0.00	13.98	0.00	0.00	0.63	14.61
All Facilities and Infrastructures	**10.98**	**141.24**	**2.38**	**7.01**	**47.17**	**208.78**

The social value of this component is high, since several species are hunted and/or trapped by members of the Cree community of Nemaska. The ecosystemic value is considered moderate because there are no reported threatened or special-status species. Therefore, the value of the component is high. After application of the mitigation measures, the significance of the residual impact is moderate.

The nature of the impact on small mammal is negative. The frequency of the impact is considered as continuous since the impact will occur over the entire life of the project. The degree of disturbance is considered low, as the small mammal can relocate at the periphery of the site during the mine life, and return after its closure. Following these considerations, the intensity of the impact is moderate. Since the impact will be limited to the mine site, its extent is punctual. The duration of the impact is considered long because the project (pit mine) will cause permanent losses of habitat. The impact is irreversible because, as previously mentioned, the project will result in permanent habitat losses. However, the majority of the affected areas will be rehabilitated at the closure phase.

Table 7-31 presents the values assigned to each indicator and the resulting significance of the residual impact.

Table 7-31 Significance of the Residual Impact – Small Mammal

Intensity	Extent	Duration	Significance of the Residual Impact
High	Regional	**Long**	High
Moderate	Local	Medium	**Moderate**
Low	**Punctual**	Short	Low

7.5.6 Impacts Assessment on Chiropterans

The following sections cover the identification of impact sources, the description of the impacts and the mitigation measures for each project phase (construction, operation and closure) and the assessment of the impact significance on chiropterans.

7.5.6.1 Identification of the Impact Sources

Over the different development phases of the Whabouchi project, several activities will represent sources of impact on chiropterans, depending on the development phases of the project.

Construction Phase

- Sites clearing and preparation (excavation, stripping, backfilling, blasting and overburden management)
- Construction of the temporary and permanent infrastructures and facilities
- Use, maintenance and circulation of heavy machinery and vehicles

Operation Phase

- Sites clearing and preparation (excavation, stripping, backfilling, blasting and overburden management)
- Presence and operation of the infrastructures and buildings
- Extraction, storage and processing of the ore
- Use, maintenance and circulation of heavy machinery and vehicles

Closure Phase

- Use, maintenance and circulation of heavy machinery and vehicles
- Site rehabilitation
- Dismantling of the infrastructures and facilities
- Presence of workers and purchasing of goods and services

7.5.6.2 Description of the Impacts

The impact sources mentioned above correspond with activities that will modify existing environments that could be favorable to chiropterans. These impact sources are described below in the order of the project development phases.

Construction Phase

Sites Clearing and Preparation (Excavation, Stripping, Backfilling, Blasting and Overburden Management)

The clearing, deforestation, excavation, backfilling and blasting works, as well as the construction of service roads and infrastructures could potentially cause mortalities among arboreal chiropteran species such as the hoary bat.

The environment losses will occur mainly during the clearing works and sites preparation. The loss will occur mainly during the development of the waste rock and tailings pile. These activities will be carried out in environments that are favorable to bats (forest stand).

The increased activity on the future mine site could disturb the chiropterans whose home range overlaps the project footprint. They might have to relocate to similar environment nearby. The conducted activities could therefore have incidences on bat behaviors such as feeding, reproduction and rearing of the offsprings.

Construction of the Temporary and Permanent Infrastructures and Facilities

The sources of light and noise could affect the feeding, reproduction and rearing behaviors. According to Schaub and coll. (2008) and Siemers and Schaub (2011), bats avoid noisy areas when searching for food because the noise reduces their hunting performance. Mann and coll. (2002) and Fure (2006) consider that lighting would be more disturbing than noise. The chiropterans could therefore move to new feeding area. Stone and coll. (2009) mention that anthropogenic disturbances can, among others, shrink the feeding areas, change flight paths, reduce reproductive success and increase the predation rate.

Use, Maintenance and Circulation of Heavy Machinery and Vehicles

The noise and lighting generated by the circulation of heavy machinery and vehicles on the mine site could result in changes in the feeding, reproduction and rearing habit behaviors. The bats could potentially have to relocate if the disturbance is too intensive.

Operation Phase

During the operation phase, the description of impact sources for the construction phase also applied, where relevant. Certain additional impact sources will occur during the operation phase and are described hereunder.

Sites Clearing and Preparation (Excavation, Stripping, Backfilling, Blasting and Overburden Management)

A section of the Route du Nord will be diverted during the operation phase. The deforestation, backfilling and filling works could potentially cause disturbance among the arboreal chiropteran species such as the hoary bat.

Presence and Operation of the Infrastructures and Buildings; Ore Extraction, Storage and Processing

These activities will increase a noise and ambient light on the mine site and in the vicinity, which could disturb chiropteran behavior.

Closure Phase

During the closure phase, the description of the impact sources presented for the construction and operation phases will also applied, where relevant. Certain additional impact sources will occur during the closure phase and are described hereunder.

Site Rehabilitation

The rehabilitation of the site will consist in restoring the areas disturbed by the project development to characteristics that are similar to the original conditions, inasmuch as possible. Although this activity is considered as an impact source, its overall effect is considered positive for the chiropterans because it will restore natural conditions in the affected environment.

Dismantling of the Infrastructures and Facilities

These activities will increase noise and ambient light on the mine site and in the vicinity during the works, which could disturb chiropteran behavior.

7.5.6.3 Description of the Mitigation Measures

The following mitigation measures will be applied to limit the impacts on chiropterans. Most of these measures relate to the use and circulation of heavy machinery and vehicles. The mitigation measures described in Chapter 6 concerning noise and ambient light will also apply to chiropterans.

Construction Phase

- Favor the use of surfaces already disturbed by the exploration works for the circulation of heavy machinery and the temporary storage of construction materials
- Clearly identify the limits beyond which the circulation of heavy machinery and vehicles is forbidden
- Limit the circulation of heavy machinery and vehicles to predetermined areas (e.g. service roads and work areas) so as to reduce the surface area of disturbed environments

- Limit the travel speed on mine site service roads to 30 km/h
- Replant the disturbed areas at the end of the works so as to re-create as quickly as possible the original natural conditions and to avoid erosion
- Protect the vegetation and limit deforestation and clearing to pre-established areas
- Inform the workers and raise their awareness about the presence of a little brown bat nursery roost near the Route du Nord

Operation Phase

During the operation phase, all the mitigation measures described for the construction phase will apply, as relevant. The following mitigation measure will be added during the operation phase:

- Progressive rehabilitation of the waste rock and tailings pile

Closure Phase

During the closure phase, all the mitigation measures presented for the construction and operation phases will applied, as relevant. The following additional mitigation measure will be added during the closure phase:

- Replant disturbed areas of the mine site with indigenous plant species (grasses, shrubs and trees)

7.5.6.4 Significance of the Residual Impact

The significance of the residual impact was evaluated in consideration of the three project phases combined. The areas of chiropteran environments that will be affected during the construction, operation and closure phases are presented in Table 7-32, according to the main infrastructures and buildings of the Whabouchi project.

Before the site revegetation activities, the project will cause a loss of 20.5 ha of environments favorable to chiropterans. Forest stands are particularly important for arboreal species. The loss of vegetation in this type of environment totals almost 11 ha. The three other disturbed environments are wetlands or aquatic environments.

Table 7-32 Areas of Chiropteran Environments Affected by the Construction, Operation and Closure Phases of the Project, Prior to Site Rehabilitation

Facilities and Infrastructures	Environment (ha)				All Environments
	Forest Stand	Alder Forest	Shrubby Bog	Water Body	
Service Roads	0.88	0.07	0.24	0.00	1.19
Explosives Store	0.00	0.01	0.31	0.00	0.32
Pit	5.05	0.00	0.12	0.00	5.17
Waste Rock and Tailings Pile	3.52	2.11	2.55	0.16	8.34
Overburden Pile	0.49	0.00	2.72	0.00	3.21
Diversion of the Route du Nord	0.05	0.06	0.91	0.00	1.02
Sedimentation Basins	0.99	0.13	0.16	0.00	1.28
Industrial Complex	0.00	0.00	0.00	0.00	0.00
All Facilities and Infrastructures	**10.98**	**2.38**	**7.01**	**0.16**	**20.53**

During the operation and closure phases, the waste rock and tailings pile will be profiled and revegetated during its exploitation. The effect of this activity will be to re-create a favorable environment for the chiropterans.

The social value of the component is high because several chiropteran species present in the study area are protected by legislation and regulation. The ecosystemic value is also high, because the component is of major interest in terms of biodiversity. Therefore, the value of the component is high. After application of the mitigation measures, the significance of the residual impact is moderate.

The nature of the impact on the chiropterans is negative. The frequency of the impact is considered as continuous since the impact will occur throughout the entire project. The degree of disturbance is considered low, as the reported nursery roast is located outside the mine site and because the bats will be able to travel toward other environments to feed during the development of the project. Following the previous considerations, the intensity of the impact is moderate. As the effect of the impact on the potential bat environments will not be limited to the project footprint, its extent is considered local. The duration is medium, since the majority of the bat habitat will be restored after the rehabilitation of the site; the flooded pit could potentially become a feeding area. The impact is reversible, however, because the sources of impact on chiropterans, particularly those relating to noise and lighting, will cease at the end of the project.

Table 7-33 presents the values assigned to each indicator and the resulting significance of the residual impact.

Table 7-33 Significance of the Residual Impact – Chiropterans

Intensity	Extent	Duration	Significance of the Residual Impact
High	Regional	Long	High
Moderate	**Local**	**Medium**	**Moderate**
Low	Punctual	Short	Low

7.5.7 Impacts Assessment on Micromammal

The following sections cover the identification of impact sources, the description of the impacts, the description of the mitigation measures by project phase (construction, operation and closure) and the assessment of the residual impact significance on micromammal.

7.5.7.1 Identification of the Impact Sources

Over the different phases of the Whabouchi project, several activities represent sources of impacts on micromammal, as they could modify the conditions of the terrestrial and wetland environments. These impacts sources, for the project development phases, are as follows.

Construction Phase

- Sites clearing and preparation (excavation, stripping, backfilling, blasting and overburden management)
- Construction of the temporary and permanent infrastructures and facilities
- Use, maintenance and circulation of heavy machinery and vehicles

Operation Phase

- Sites clearing and preparation (excavation, stripping, backfilling, blasting and overburden management)
- Presence and operation of the infrastructures and buildings
- Use, maintenance and circulation of heavy machinery and vehicles
- Progressive rehabilitation of the waste rock and tailings pile

Closure Phase

- Use, maintenance and circulation of heavy machinery and vehicles
- Site rehabilitation

7.5.7.2 Description of the Impacts

These impact sources are described below in the order of the project development phases.

Construction Phase

Sites Clearing and Preparation (Excavation, Stripping, Backfilling, Blasting and Overburden Management)

The activities relating to the clearing and preparation of the sites will cause losses of terrestrial environments. The overburden of the pit will be excavated and piled on the overburden stockpile. The necessity for an overburden storage facility development will cause the loss of a wetland and terrestrial environments.

These losses represent a reduction in the available micromammal habitat area.

Construction of the Temporary and Permanent Infrastructures and Facilities

The construction activities will generate noise and dust that could affect the feeding and reproduction activities of the micromammals present on the worksite.

Use, Maintenance and Circulation of Heavy Machinery and Vehicles

The circulation of machinery on the mine site will potentially create a risk of mortality by roadkill when micromammals cross the work areas as well as service roads.

Operation Phase

During the operation phase, the description of impact sources for the construction phase will also apply, where relevant. Certain additional impact sources will be added during the operation phase and are described hereunder.

Presence and Operation of the Infrastructures and Buildings

The expansion of the pit during the operation phase will cause additional loss of the terrestrial and wetland micromammal habitats.

Progressive Rehabilitation of the Waste Rock and Tailings Pile

The progressive revegetation of the waste rock and tailings pile could create favorable terrestrial environments for micromammal feeding and reproduction. Therefore, this progressive rehabilitation could constitute a source of positive impact for micromammal.

Closure Phase

During the closure phase, the description of the impact sources presented for the construction and operation phases will also apply, where applicable. Certain impact sources will be added during the closure phase and are described hereunder.

Site Rehabilitation

The revegetation of disturbed areas will provide new terrestrial environments for the feeding and reproduction of micromammal. The rehabilitation of the site would therefore be a source of positive impact source on micromammal.

7.5.7.3 Description of the Mitigation Measures

The following mitigation measures will be applied to reduce the impacts on micromammal. Most of these measures relate to the use and circulation of heavy machinery and vehicles in order to limit the modification of the environments.

Construction Phase

- Favor the use of surfaces already disturbed by the exploration works for the circulation of heavy machinery and the temporary storage of construction materials
- Clearly identify the limits beyond which the circulation of heavy machinery and vehicles may is forbidden
- Limit the circulation of heavy machinery and vehicles to predetermined areas (e.g. service roads and work areas) so as to reduce the surface area of disturbed environments
- Limit the travel speed on mine site service roads to 30 km/h
- Prioritize the use abrasives rather than melting salts on the roads in winter, inasmuch as possible
- In summer, use water as a dust reducer
- Replant the disturbed areas at the end of the works so as to re-create as quickly as possible the original natural conditions and avoid erosion
- Provide confinement system in the storage areas in case of leaks or accidental spills
- Design the maintenance areas so as to avoid contamination of the environment in case of leaks or accidental spill
- Develop a prevention and intervention plan in case of accidental spill or leak of hazardous substances

Operation Phase

During the operation phase, the mitigation measures described for the construction phase will apply, as relevant. The following additional mitigation measure will be added during the operation phase:

- Progressive rehabilitation of the waste rock and tailings pile so as to offer new micromammal environments as soon as possible

Closure Phase

During the closure phase, the mitigation measures presented for the construction and operation phases will be applied, where applicable. The following additional mitigation measure will be added during the closure phase:

- Replant disturbed areas of the site with indigenous plant species (grasses, shrubs and trees)

7.5.7.4 Significance of the Residual Impact

The significance of the residual impact was evaluated in consideration of the three combined phases of the project, by compiling the areas of the terrestrial and wetland environments lost in the course of the project development. These environments represent favorable habitats for the micromammal. Table 7-34 presents the environment areas affected, according to the main infrastructures and buildings of the Whabouchi project.

The development of the project will cause a loss of 161.6 ha of terrestrial and wetland environments that are favorable to micromammal.

Table 7-34 Areas of Micromammal Environments Affected by the Construction, Operation and Closure of the Project, Prior to Site Rehabilitation

Facilities and Infrastructures	Environment (ha)				All Environments
	Forest Stand	Recent Burn	Alder Forest	Shrubby Bog	
Service Roads	0.88	4.17	0.07	0.24	5.36
Explosives Store	0.00	0.92	0.01	0.31	1.24
Pit	5.05	13.98	0.00	0.12	19.15
Waste Rock and Tailings Pile	3.52	82.59	2.11	2.55	90.77
Overburden Pile	0.49	10.32	0.00	2.72	13.53
Diversion of the Route du Nord	0.05	7.00	0.06	0.91	8.02
Sedimentation Basins	0.99	8.28	0.13	0.16	9.56
Industrial Complex	0.00	13.98	0.00	0.00	13.98
All Facilities and Infrastructures	**10.98**	**141.24**	**2.38**	**7.01**	**161.61**

Following the rehabilitation of the site, the areas of micromammal environments will have diminished by 19.15 ha, the equivalent of a part of the pit footprint.

The social value of the component is low, notably due to its limited use and/or value by the local population. Its ecosystemic value is high because a special-status species, the southern bog lemming, is potentially present in the study area. Therefore, the value of the component is considered moderate. After application of the mitigation measures, the significance of the residual impact is low.

The nature of the impact on the micromammal is negative. The frequency of the impact is considered low because the majority of the impacts will occur during the construction of the infrastructures and facilities. The degree of disturbance of the component is considered low because, while the impact alters its abundance and distribution, it does not compromise its integrity in the study area. Considering that the value of the component is moderate and its degree of disturbance is low, the intensity of the residual impact following the previous considerations is low. The extent of the impact is punctual, since the loss of environments is located only at the mine site. As the impact will persist after the closure of the mine, its duration is considered long. The impact is irreversible because at the end of the project, the flooded pit will not provide habitat for micromammal.

Table 7-35 presents the values assigned to each indicator and the resulting significance of the residual impact.

Table 7-35 Significance of the Residual Impact – Micromammal

Intensity	Extent	Duration	Significance of the Residual Impact
High	Regional	**Long**	High
Moderate	Local	Medium	Moderate
Low	**Punctual**	Short	**Low**

7.6 Avifauna

The avian fauna can be divided into four different groups: waterfowl (geese, ducks and loons), other aquatic birds (gulls, herons, shorebirds, etc.), raptors (falcons, eagles, owls, etc.), and terrestrial birds (grouse, nighthawks, woodpeckers, sparrows, warblers, etc.).

This section presents an estimation of the avian densities based on the interpretation of various sources of data collected mostly for the major hydroelectric projects in the region. Although the present study does not present bird census data, the chance sightings noted during the fieldworks carried out for other biological components are taken into account.

7.6.1 Literature Review

7.6.1.1 Methods

Various sources of information were used to describe the avian fauna portrait in the Whabouchi project study area. First, the ornithological studies completed by Hydro-Québec for the Eastmain 1-A - Rupert impact assessment, as well as the environmental follow-up studies on the same hydroelectric project were consulted to identify which species could potentially be present in the study area.

Waterfowl and Other Aquatic Birds

The observations of waterfowl and other aquatic species noted in the 2002 aerial surveys of the Eastmain 1-A - Rupert impact assessment (Tecsult Environnement, 2004) were used to quantify the waterfowl occupancy of the project study area. The selected surveys were taken during the migration and reproduction periods along the Rupert and Nemiscau rivers and in the Rupert diversion bay section. The sections surveyed along the Nemiscau River encompass part of the Whabouchi project study area.

The density (number of individuals, breeding pairs or clutches per kilometre of shore) of each species and populations was calculated using the works of Tecsult Environnement (2004) (Appendix 7-17). The abundance of populations on the mine site was then calculated by multiplying their density by the number of kilometres of shore within a 5 km radius around the mine site. This sector includes the area susceptible of being influenced by mining activities (circulation, noise, light and dust, etc.).

Raptors

The chance sightings reported during the 2012 fieldworks concerning the different biological components and the mentions of raptors by Benoit and Ibarzabal (2004) and Morneau (2004) were used to document the occupancy of the study area by raptors. The surveyed sectors are similar to those of previous groups.

Terrestrial Birds

The densities of terrestrial bird species evaluated for each habitat type during the bird call surveys completed in the Rupert diversion bay section for the 2002 Eastmain 1-A - Rupert impact assessment (Mousseau and Benoit, 2004) were used to document the occupancy of the study area by forest birds.

The types of environments identified (alder forest, shrubby bog, burn and forest stand) in the present study (see Section 7.2) correspond respectively to the following environment types in the Mousseau and Benoit study (2004): riparian scrubland, peatland, old and recent burns, and spruce/pine forest. Appendix 7-18 gives the densities used to estimate the populations of forest birds potentially affected by the Whabouchi project, broken down by species and environment.

7.6.1.2 Results

According to Hydro-Québec works, at least 24 species of waterfowl (including common loon), 27 species of other aquatic birds, 19 species of raptors and 61 species of terrestrial birds could frequent the study area (Benoit and Ibarzabal, 2004; Benoit and Létourneau, 2004; Morneau, 2004; Mousseau, 2004; Mousseau and Benoit, 2004; Tecsult Environnement, 2004; AECOM Tecsult, 2010; Benoit and Bourguelat, 2012; Kaweshekami Environnement, 2012). Appendix 7-19 lists the species in each of these groups according to their taxonomic rank. Appendix 7-20 presents the correspondence between the environments of the Whabouchi project and those of the Rupert diversion bays.

Waterfowl

Spring Migration Period

During the spring migration in early May, the Canada goose is the most abundant species, with more than 60% of all bird observations in the Rupert River area (Tecsult Environnement, 2004; Appendix 7-21). The other abundant species during this period are the northern pintail, common goldeneye and green-winged teal. These four species constitute more than 82% of the relative abundance of all species.

During the spring migration, the number of Anatidae on the mine site would be approximately 70 individuals, on the basis of the densities calculated by Tecsult Environnement (2004) (Appendix 7-22).

Nesting and Rearing Period

During the nesting period (late May), the principal nesting species in the study area during this period would be, in decreasing order, American black duck, common merganser and green-winged teal. The number of indicated breeding pairs (IBP) of waterfowl on the mine site would be approximately 5 to 6 pairs, according to the densities calculated by Tecsult Environnement (2004) (Appendix 7-23).

The total number of clutches during the rearing period (late July) in the mining activities area of influence would be between 7 and 8 clutches, according to the densities calculated by Tecsult Environnement (2004) (Appendix 7-24). The main nesting species would be American black duck and common merganser.

Fall Migration Period

During the fall migration (mid-September), the most abundant species is the American black duck. With the Canada goose, the two species represent approximately 70% of the Anatidae present during this period.

The total waterfowl population in the mining activity area of influence during the fall migration would be approximately 92 individuals, according to the densities calculated by Tecsult Environnement (2004) (Appendix 7-25).

During the 2012 fieldworks, nine waterfowl species were observed in the study area at the end of June (Table 7-26). Given the date of the observations (late June), all these species probably nest near the mine site, even if there was no confirmed nesting reported. Other species that were not observed in 2012 are also assumed to nest near the mine site because these species are present in the region during the breeding season. These are the mallard, northern pintail, green-winged teal, ring-necked duck and surf scoter.

Table 7-36 Presence and Status of Likely Waterfowl Species Frequented the Study Area

Species	Presence in the Region (Period) [1]	Breeding Status in the Study Area in 2012 [2]
Brant	Migration	-
Canada goose	Migration/Breeding [3]	Possible (H)
Wood duck	Summer [4]	-
Gadwall	Summer	-
American widgeon	Migration/Breeding	Possible (H)
Mallard duck	Migration/Breeding	-
American black duck	Migration/Breeding	Possible (H)
Northern pintail	Migration/Breeding	-
Northern shoveler	Summer	-
Ring-necked duck	Migration/Breeding	-
Redhead	Summer	-
Greater scaup	Migration/Breeding	Probable (P)
Common goldeneye	Migration/Breeding	Possible (H)
Common merganser	Migration/Breeding	Probable (P)
Long-tailed duck	Migration	-
Hooded merganser	Summer	-
Red-breasted merganser	Migration	-
Surf scoter	Migration/Breeding	-
White-winged scoter	Migration	-
American scoter	Migration	-
Snow goose	Migration [5]	-
Lesser scaup	Summer	-
Bufflehead	Migration/Breeding	Possible (H)
Red-throated loon	Migration	-
Common loon	Breeding	Possible (S)
Blue-winged teal	Summer	-
Green-winged teal	Migration/Breeding	-

[1] The presence in the region is an interpretation of the results of Hydro-Québec studies (Benoit and Ibarzabal, 2004; Benoit and Létourneau, 2004; Morneau, 2004; Mousseau, 2004; Mousseau and Benoit, 2004; Tecsult Environnement, 2004, AECOM Tecsult, 2010; Benoit and Bourguelat, 2012; Kaweshekami Environnement, 2012).

[2] The breeding status in the study area is based on observations made in 2012 according to their classification as breeding evidence (Atlas des oiseaux nicheurs du Québec (AONQ), 2011; see Appendix 7-16).

[3] Species considered as nesting in the Whabouchi project study area according to the species known distribution range during nesting period (Gauthier and Aubry, 1995) and to the results of the Hydro-Québec studies cited.

[4] The species is present in the region during the summer, but nesting has not been confirmed to this date.

[5] Known nesting area located further north in the case of species considered as migratory in the study area.

Other Aquatic Birds

In addition to geese, ducks and loons, other aquatic bird species could frequent the Whabouchi project study area during their migration and/or breeding period (Table 7-37). All the species assumed to nest in the area, except the spotted sandpiper, were observed during the 2012 fieldworks. During these works, two nesting species are confirmed: the killdeer and the greater yellowlegs.

Table 7-37 Presence and Status of Likely Aquatic Bird Species in the Study Area

Species [1]	Presence in the Region (Period) [1]	Breeding Status in the Study Area (2012) [2]
Least sandpiper	Breeding	Possible (S)
Semipalmated sandpiper	Migration	-
Dunlin	Migration	-
Short-billed dowitcher	Migration and Summer [3]	-
Wilson's snipe	Breeding	Possible (H, S)
Spotted sandpiper	Breeding	-
Solitary sandpiper	Breeding	Possible (H)
Herring gull	Breeding	Observed (X)
Greater yellowlegs	Breeding	Confirmed (DD)
Great blue heron [4]	Breeding [5]	Possible (S)
Sandhill crane	Breeding	Possible (H)
Belted kingfisher	Breeding	Possible (S)
Bonaparte's gull	Breeding	Observed (X)
Lesser yellowlegs	Migration	-
Killdeer	Breeding	Confirmed (DD)
Semipalmated plover	Migration [6]	-
Common tern	Summer [7]	Observed (X)

[1] The presence in the region is an interpretation of the results of Hydro-Québec studies (Benoit and Ibarzabal, 2004; Benoit and Létourneau, 2004; Morneau, 2004; Mousseau, 2004; Mousseau and Benoit, 2004; Tecsult Environnement, 2004, AECOM Tecsult, 2010; Benoit and Bourguelat, 2012; Kaweshekami Environnement, 2012).

[2] The breeding status in the study area is based on observations made in 2012 (present study) according to their classification as breeding evidence (AONQ 2011; see Appendix 7-16).

[3] Breeding in the region has not been yet confirmed. The study area would be located at the southern limit or outside the distribution range of the species during the nesting period.

[4] Species was observed in June 2012 outside the study area.

[5] Species considered as nesting in the study area according to the species known distribution ranges during the nesting period (Gauthier and Aubry, 1995) and to the results of the Hydro-Québec studies cited.

[6] Known nesting area located further north in the case of species considered as migratory in the study area.

[7] Although it is present in the region during the breeding period, the nesting of the species has not been yet confirmed.

The following species were sighted and/or heard during the 2012 fieldworks: great blue heron, sandhill crane, killdeer, solitary sandpiper, greater yellowlegs, least sandpiper, Wilson's snipe, herring gull and belted kingfisher.

Raptors

Five species of raptors were observed in the study area during the 2012 fieldworks (Table 7-38). No confirmed nesting was reported in 2012, however. Among the 19 raptor species susceptible of frequenting the study area, 13 are confirmed or probable breeders in the region (including resident species), 3 other species would frequent the study area only during migrations, and 3 species would be winter visitors.

Table 7-38 Presence and Status of Likely Raptor Species in the Study Area

Species	Presence in the Region (Period) [1]	Breeding Status in the Study Area (2012) [2]
Golden eagle	Migration	-
Northern goshawk	Resident	-
Osprey	Breeding [3]	Possible (H, S)
Northern harrier	Breeding	Possible (H)
Red-tailed hawk	Breeding	Probable (A)
Rough-legged hawk	Migration[4]	-
Northern hawk-owl	Resident	-
Great grey owl	Breeding	-
American kestrel	Breeding	Possible (S)
Sharp-shinned hawk	Summer [5]	-
Merlin	Breeding	-
Gyrfalcon	Winter [6]	
Peregrine falcon [7] (*Tundrius*)	Migration	-
Great horned owl	Resident	-
Snowy owl	Winter	-
Short-eared owl	Breeding	-
Long-eared owl	Breeding	-
Boreal owl	Resident	-
Bald eagle	Breeding	-

[1] The presence in the region is an interpretation of Hydro-Québec studies (Benoit and Ibarzabal, 2004; Benoit and Létourneau, 2004; Morneau, 2004; Mousseau, 2004; Mousseau and Benoit, 2004; Tecsult Environnement, 2004, Benoit and Bourguelat, 2012; Kaweshekami Environnement, 2012).

[2] The breeding status in the study area is based on observations made in 2012 (present study) according to their classification as breeding evidence (AONQ 2011; see Appendix 7-16).

[3] Species considered as nesting in the study area according to the known species distribution range during the nesting period (Gauthier and Aubry, 1995) and to the results of Hydro-Québec studies cited.

[4] Known nesting area located further north in the case of species considered as migrators in the study area.

[5] Although it is present in the region during the breeding period, the nesting of the species has not been yet confirmed.

[6] The species nests further north and would frequent the region only during winter.

[7] *Tundrius* subspecies.

During the 2012 fieldworks, the following species were sighted and/or heard: osprey, northern harrier, red-tailed hawk, American kestrel and great horned owl.

Terrestrial Birds

The description of terrestrial birds is presented in two distinct sections. The first section covers songbirds (forest birds), the populations of which were estimated through listening station. The second section includes all other terrestrial birds for which the estimated populations was not obtained by listening stations methods. This subgroup is designated here as "other terrestrial birds".

Forest Birds

The densities varied between 2.6 and 3.5 breeding pairs/hectare, depending on the natural environment (burned, shrubby bog, forest and alder stand). The number of forest bird breeding pairs that would be affected by the project activities is estimated at 545 pairs (Table 7-39 and Appendix 7-26), according to the estimation based on inventories taken in similar environments in the Rupert diversion bay section (Mousseau and Benoit, 2004). Burn represents the greatest area modified by the project facilities and infrastructures, and a large majority of breeding couples are from this environment (488 breeding couples). As for the other environments, 32, 19 and 6 breeding pairs would be estimated respectively in the forest stand, shrubby bug and alder stand.

The most numerous species are, in decreasing order of relative abundance, the white-throated sparrow (16.1%), dark-eyed junco (14.7%), Lincoln's sparrow (7.8%), grey jay (5.3%) and palm warbler (5.0%).

Table 7-39 Estimated Populations (Number of Breeding Couples) of Forest Birds Affected by the Whabouchi Project Facilities and Infrastructures

Facilities and Infrastructures	Environment				All Environments
	Recent Burn	Shrubby Bog	Forest Stand	Alder Forest	
Access Roads	14.4	0.7	2.5	0.2	17.8
Explosives Store	3.2	0.9	0.0	0.0	4.1
Pit	48.4	0.3	14.5	0.0	63.2
Waste Rock and Tailings Pile	285.6	5.8	10.1	5.5	307
Overburden Pile	35.7	7.9	1.4	0.0	45
Diversion of the Route du Nord	24.2	2.6	0.1	0.2	27.1
Sedimentation Basins	28.6	0.5	2.8	0.3	32.2
Industrial Complex	48.4	0.0	0.0	0.0	48.4
All Facilities and Infrastructures	**488.5**	**18.7**	**31.4**	**6.2**	**544.8**

Other Terrestrial Birds

Many of the other terrestrial birds most susceptible of frequenting the study area are residents in the region (Table 7-40), except for the willow ptarmigan, which is a winter visitor. Among these species, 11 of them were observed during the 2012 fieldworks. Only one nesting evidence was confirmed for the ruffed grouse. The other species are considered as possible or probable breeders.

Table 7-40 Presence and Status of Other Terrestrial Bird Species in the Whabouchi Study Area

Species	Presence in the Region (Period) [1]	Breeding Status in the Study Area (2012) [2]
American crow	Breeding	Possible (S)
Common nighthawk	Breeding	Probable (T)
Ruffed grouse	Resident	Confirmed (JE)
Common raven	Resident	Possible (H, S)[3]
Tree swallow	Breeding	-
Bank swallow	Breeding	-
Willow ptarmigan	Winter [4]	Wintering
Black-backed woodpecker	Resident	Possible (H, S)
American three-toed	Resident	Possible (S)
Hairy woodpecker	Resident	-
Northern flicker	Breeding	Possible (H, S)
Yellow-bellied sapsucker	Breeding	-
Downy woodpecker	Resident	-
Rusty blackbird	Breeding	-
Sharp-tailed grouse	Resident	-
Spruce grouse	Resident	Possible (H)
Mourning dove	Breeding [5]	Possible (H)[6]

1 The presence in the region is an interpretation of the results of Hydro-Québec studies (Benoit and Ibarzabal, 2004; Benoit and Létourneau, 2004; Morneau, 2004; Mousseau, 2004; Mousseau and Benoit, 2004; Tecsult Environnement, 2004, AECOM Tecsult, 2010; Benoit and Bourguelat, 2012; Kaweshekami Environnement, 2012).

2 The breeding status in the study area is based on observations made in 2012 (present study) according to their classification as breeding evidence (AONQ 2011; see Appendix 7-16).

3 Breeding in the region was confirmed by a nest on a cliff of the Mount Chinuchi (Benoit and Ibarzabal, 2004).

4 Known nesting area located further north in the case of species considered as migrators or winter visitors in the study area.

5 Species considered as nesting in the study area according to the species known distribution range during the nesting period (Gauthier and Aubry, 1995) and to the results of Hydro-Québec studies cited.

6 Species was observed in June 2012 outside the study area, at the Nemiscau camp.

The following species were sighted and/or heard during the 2012 fieldworks: ruffed grouse, spruce grouse, willow ptarmigan, mourning dove, common nighthawk and common raven.

Special-Status Avian Species

Table 7-41 lists the seven special-status species that could frequent the project study area.

Table 7-41 Provincial and Federal Status of Likely Special-Status Avifauna in the Whabouchi Project Study Area

Species	Threatened or Vulnerable Species Act (Québec) [1]	Species at Risk Act (Canada) [2]
Golden eagle	Vulnerable	None
Common nighthawk	LDTV[3]	Threatened
Peregrine falcon, *Tundrius ssp.*	LDTV	Of concern
Short-eared owl	LDTV	Of concern
Olive-sided flycatcher	LDTV	Threatened
Bald eagle	Vulnerable	None
Rusty blackbird	LDTV	Of concern

1 MRN, 2013c.
2 Gouvernement du Canada, 2013.
3 LDTV: likely to be designated as threatened or vulnerable species.

Only one special-status species was heard during the 2012 fieldworks, the common nighthawk.

The bald eagle was not observed during the 2012 fieldworks carried out for the present project. Although it can be observed near all large water bodies in the James Bay region, Lake Nemiscau seems to be the site most frequented by the species in the region (Benoit and Bourguelat, 2012). The nest of the species closest to the mine site would be located along the Broadback River (Benoit and Bourguelat, 2012). North of the 55th parallel, the density of breeding pairs is evaluated at 0.01 pair per 1,000 km^2 (Shaffer and coll., 2011). Since the bald eagle is uncommon in the region, except in particular locations such as Lake Nemiscau, and that the density of breeding pairs is very low, it is unlikely that the bald eagle frequents the mine site or the area of influence of the mining activities.

The golden eagle was not observed in the region during the works carried out for the Eastmain-1-A-Rupert impact assessment (Benoit and Ibarzabal, 2004). Mount Chinuchi, near the mine site, was visited as part of this study in 2002 to search for nests in the cliffs. No golden eagle nest was sighted during this flyover. The rarity of cliffs in the region seems to be a limiting factor for the nesting of the species. Therefore, it is unlikely that the golden eagle frequents the Whabouchi project site during the breeding period.

The peregrine falcon individuals observed in the region are generally considered as belonging to the *Tundrius* subspecies, which nests in Northern Quebec (Bird and coll., 1995).

The short-eared owl is a confirmed breeder for the Rupert River (Lake Nemiscau) and for the Rupert diversion bay section (Morneau, 2004). There were no observations of short-eared owls during the 2012 fieldworks. At the latitude of the study area, the short-eared owl could frequent the peatland located south of the pit during the breeding period.

The common nighthawk is present in the study area. As mentioned, the characteristic sound of diving males during the mating display confirmed the nesting of the species on the mine site, or at least in the vicinity. The common nighthawk nests on the ground, often in open and dry areas with a sandy or rocky substrate (Limoges, 1995). This environment is present on the mine site. This environment and areas of anthropogenic disturbance could potentially be used for nesting by the species on the mine site and in the project study area.

Over the last decades, the populations of olive-sided flycatcher have fallen significantly over its entire Canadian distribution range (Dunn and Downes, 1998; Downes and coll., 2011). This declining trend is significant in the boreal forest. The species was observed in 2003 in old burns in the Rupert diversion bay section (Mousseau and Benoit, 2004). Since this environment is also found on the mine site, the olive-sided flycatcher could be present.

The rusty blackbird is a typical species in the forest wetlands of the boreal forest, such as scrubland streams, peatlands, marshes and swamps along lakes and rivers (Nadeau, 1995). It is therefore likely that the blackbird frequents the peatland located south of the pit, or the other wetlands and riparian environments in the vicinity of the mine site.

7.6.2 Assessment of the Impacts

The following sections cover the identification of impact sources, the description of the impacts, the description of the mitigation measures for each project phase (construction, operation and closure) and the assessment of the residual impact significance on the avifauna.

To evaluate the significance of the residual impact, the avian fauna was subdivided in four subcomponents: waterfowl, aquatic birds, raptors and terrestrial birds.

7.6.2.1 Identification of the Impact Sources

Over the different project development phases, several activities represent potential impact sources on the avifauna. These impacts sources, according to the different project development phases, are describes below.

Construction Phase

- Sites clearing and preparation (excavation, stripping, backfilling, blasting and overburden management)
- Construction of the temporary and permanent infrastructures and facilities
- Use, maintenance and circulation of heavy machinery and vehicles
- Presence of workers and purchasing of goods and services

Operation Phase

- Sites clearing and preparation (excavation, stripping, backfilling, blasting and overburden management)
- Presence and operation of the infrastructures and buildings
- Water management (runoff, drinking water, wastewater, etc.)
- Use, maintenance and circulation of heavy machinery and vehicles
- Presence of workers and purchasing of goods and services
- Progressive rehabilitation of the waste rock and tailings pile

Closure Phase

- Use, maintenance and circulation of heavy machinery and vehicles
- Site rehabilitation
- Presence of workers and purchasing of goods and services

7.6.2.2 Description of the Impacts

The impact sources mentioned above represent activities and that will modify the existing environments frequented by birds and disturb their behaviors. These impact sources are described below, according of the project development phases.

Construction Phase

<u>Sites Clearing and Preparation (Excavation, Stripping, Backfilling, Blasting and Overburden Management)</u>

The clearing works and sites preparation could disturb the avifauna because such activities will unavoidably result in losses of environments frequented by the different bird species.

The management of overburden will also cause a loss of wetlands and terrestrial environments. To reach the deposit, the overburden will be excavated and stored near the pit, on the overburden stockpile. The development of this pile will result in avifauna environment losses.

These activities will have a greater impact on species that have a smaller home range. However, since the terrestrial environments in the study area are relatively homogenous, individuals will be able to move toward similar environments close to the mine site or in the study area.

The works could also cause mortality among the nestlings if carried out during the nesting and brood rearing period, approximately from mid-May to mid-July.

<u>Construction of the Temporary and Permanent Infrastructures and Facilities</u>

The construction of the infrastructures and facilities will increase the noise level. This activity will also require the lighting of the sites, thus modifying the natural light level. Among others, these changes could have incidences on the avifauna that frequents the mine site, notably on the songbirds that delimit their nesting territory by calls during the breeding period.

Use, Maintenance and Circulation of Heavy Machinery and Vehicles

Vehicles circulation over unpaved service roads can raise dust. This dust could be transported by wind and affect the surrounding terrestrial environment by modifying their bird carrying capacity. These activities will also result in increased noise on the mine site. Certain behaviors such as territorial delimitation, feeding, breeding and brood rearing could be disturbed.

Because the mine activities will proceed 24 hours a day, the noise caused by the use and circulation of heavy machinery and vehicles could disturb the bird species that are active at night, such as owls. The noise could also increase the stress level for the birds and could potentially result in behavior modifications.

Presence of Workers and Purchasing of Goods and Services

The presence of workers may increase the hunting pressure on waterfowl and other game species such as willow ptarmigan.

The waste generated by the workers will need to be managed on-site. The presence of wastes of the site could attract, among others, common raven and grey jay. The workers could also feed the birds, and thus modify their natural behavior.

Operation Phase

During the operation phase, the impact sources described for the construction phase will apply, as relevant. Certain impact sources are added during the operation phase and are described hereunder.

Presence and Operation of the Infrastructures and Buildings; Ore Extraction, Storage and Processing

During the operation phase, the progressive expansion of the pit (ore extraction), the development of the waste rock and tailings pile and the diversion of a section of the Route du Nord will result in a loss of terrestrial environments.

The extraction and stockpiling activities could generate dust emissions. This dust could be transported by wind and affect the surrounding terrestrial environment by modifying their bird carrying capacity. These activities will also result in increased noise on the mine site. Certain behaviors such as territorial delimitation, feeding, breeding and brood rearing could be disturbed.

Water Management (Runoff, Drinking Water, Wastewater, etc.)

The pit will become progressively deeper as the extraction progresses. The pumping activities required to dewater the pit will cause a drawdown of the water table.

This drawdown could have incidences on the nearby wetlands, notably on the extensive peatland situated south of the pit. In principle, bogs such as the shrubby bog are not hydrologically connected with the water table and would not be affected by the groundwater drawdown. However, the fen could be affected.

Peatlands offer favorable environments for the reproduction of several terrestrial or aquatic bird species.

Closure Phase

During the closure phase, the description of the impact sources presented for the construction and operation phases will also apply, as relevant. Certain impact sources are added during the closure phase and are describes hereafter.

Site Rehabilitation

The rehabilitation of the site will consist in restoring the disturbed areas, giving them characteristics similar to their original conditions as much as possible. Although this activity is a source of impact, the overall effect is considered positive because it aims to restore the disturbed environment to its natural conditions. The revegetation areas will again provide potential environments for the avifauna.

7.6.2.3 Description of the Mitigation Measures

The following mitigation measures will be applied to reduce the impacts on the avifauna. Most of these measures relate to the use of heavy machinery and vehicles, the management of overburden and the rehabilitation of disturbed areas. Also, the mitigation measures planned for the noise and ambient light and presented in Chapter 6 will also apply for the reduction of impacts on avifauna.

Construction Phase

- Identify the limits beyond which the circulation of heavy machinery and vehicles is forbidden
- Limit the circulation of heavy machinery to areas designated for clearing, where possible
- Favor the use of areas already disturbed by the exploration works for the circulation of heavy machinery and the temporary storage of construction materials
- Perform the maintenance of heavy machinery and vehicles in the facilities provided for this purpose (garage)
- Dispose residual materials according to appropriate procedures
- Replant the disturbed areas with indigenous species at the end of the works so as to re-create as quickly as possible the original natural conditions
- Undertake the clearing works outside the avifauna breeding period, if possible
- Forbid employees to hunt within the limits of the mining lease and use leases
- Implement an employee’s awareness program regarding the use of wildlife resources

Operation Phase

During the operation phase, all the mitigation measures described for the construction phase will apply, as relevant. The following additional mitigation measures will be added during the operation phase:

- Use overburden and indigenous species to revegetate the waste rock and tailings pile
- Progressively restore the waste rock and tailings pile, as the operating conditions allow
- Suspend ore extraction works for two weeks (goose break) during the spring migration of wildfowl

The progressive rehabilitation of the waste rock and tailings pile constitutes a mitigation measure, as it will ensure that new environments are provided as soon as possible for the avifauna.

Closure Phase

During the closure phase, all the mitigation measures presented for the construction and operation phases will apply, as relevant. The following additional mitigation measure will be added during the closure phase:

- Favor indigenous plant species (grasses, shrubs and trees) for the revegetation of the site

7.6.2.4 Significance of the Residual Impact on Wildfowl

The assessment of the residual impact on wildfowl of the three project phases combined was evaluated by compiling the populations that may be directly or indirectly disturbed, i.e. those of the mining activities area of influence (5 km radius) (Table 7-42). These estimations are based on the results of the avifauna surveys carried out near the study area as part of the hydroelectric projects (see Section 7.7.1).

Table 7-42 Estimated Numbers of Wildfowl in the Area of Influence of the Whabouchi Project Mining Activities (5 km Radius)

Species	Estimated Number
Spring Migration (Individuals)	
Canada goose	455
Dabbling ducks	113
Diving ducks	114
Common loon	0
Total	**682**
Nesting Period (Breeding Pairs)	
Canada goose	6
Dabbling ducks	16
Diving ducks	22
Common loon	3
Total	**47**
Brood Rearing Period (Broods)	
Canada goose	1
Dabbling ducks	6
Diving ducks	2
Common loon	0
Total	**9**
Fall Migration (Individuals)	
Canada goose	24
Dabbling ducks	43
Diving ducks	23
Common loon	1
Total	**91**

[1] As a precautionary measure, when two estimations were availables for a given period (migration, breeding, etc.), the highest estimation for the species group (Canada goose, dabbling ducks, etc.) was used, rounded off to the nearest whole number.

In the mining activities area of influence, a total population of 682 individuals will be affected annually, in theory, by the mine activities during the spring migration. During the breeding period, 47 nesting pairs (indicated pairs) and 9 broods could be affected annually by the mine activities. During the fall migration, an estimated population of 91 individuals will be affected by the mine activities. Therefore, it is during the spring migration that the largest populations would be affected.

After rehabilitation of the site, none of the effect of the mine activities on wildfowl will last. The only loss of environments for this group of birds will be Lake 29 of 0.16 ha that will be filled during the development of the waste rock and tailings pile.

The social value of the subcomponent is high, since several wildfowl species, notably the Canada goose, are highly valued by the local population. As the subcomponent is also protected under laws and regulations, because it is of major interest in terms of biodiversity and that there is a consensus about its protection among the scientific community, the ecosystemic value of wildfowl is high. Therefore, the combination of the social and ecosystemic values gives the subcomponent a high value. After application of the mitigation measures, the significance of the residual impact is moderate.

The nature of the impact on wildfowl is negative. The frequency of the impact is considered intermittent. The degree of disturbance is low because the populations directly affected by mine activities represent only a few individuals or tens of individuals, depending on the populations. During the spring migration, several hundred individuals could be affected, but the suspension of ore extraction activities during the goose break will significantly reduce the effect. The intensity of the impact is therefore moderate.

Since the effect of mining activities on wildfowl could extend beyond the mine site (noise, light, dust), the extent of the impact is considered local. After the closure of the site, there will remain no impact on wildfowl. The loss of the 0.16 ha Lake 29 is considered negligible for this subcomponent. The duration of the impact will therefore be medium. The impact is reversible because the rehabilitation of the site planned during the closure phase will restore the original conditions.

Table 7-43 presents the values assigned to each indicator and the resulting significance of the residual impact.

Table 7-43 Significance of the Residual Impact – Wildfowl

Intensity	Extent	Duration	Significance of the Residual Impact
High	Regional	Long	High
Moderate	**Local**	**Medium**	**Moderate**
Low	Punctual	Short	Low

7.6.2.5 Significance of the Residual Impact on Aquatic Birds

According to the collected information, several species of aquatic birds may frequent the wetlands, water courses and water bodies in the study area. The majority of this species group could also breed in the study area (11 species out of 17). The six other species may frequent the region during the migration or as a summer visitors, without breeding.

The consulted data reveal that the population of this group of birds would not be large in the area of influence of the mining activities. Passing migratory birds such as shorebirds used more the shores of the Rupert Bay during their migration, particularly in the fall. Species considered as nesting birds such as great blue heron and sandhill crane are presents, but in low density. Only some nesting shorebirds such as the spotted sandpiper, Wilson's snipe and greater yellowlegs would have more significant nesting populations.

On the mine site or in its vicinity, the environments with a potential for aquatic birds are the peatlands, notably the one located south of the pit, as well as the edges of water bodies and water courses.

Following the closure of the mine, the potential aquatic bird habitats lost as a result of the project development are peatlands (shrubby bog), scrublands (alder) and a small lake (Table 7-44). The total area lost would be of 9.55 ha.

Table 7-44 Area of Affected Aquatic Bird Environments Prior to the Rehabilitation of Disturbed Areas

Facilities and Infrastructures	Environment (ha)			All Environments
	Alder Forest	Shrubby Bog	Water Body	
Access Roads	0.07	0.24	0.00	0.31
Explosives Stores	0.01	0.31	0.00	0.32
Pit	0.00	0.12	0.00	0.12
Waste Rock and Tailings Pile	2.11	2.55	0.16	4.82
Overburden Pile	0.00	2.72	0.00	2.72
Diversion of the Route du Nord	0.06	0.91	0.00	0.97
Sedimentation Basins	0.13	0.16	0.00	0.29
Industrial Complex	0.00	0.00	0.00	0.00
All Facilities and Infrastructures	**2.38**	**7.01**	**0.16**	**9.55**

The social value of the aquatic birds (other than wildfowls) is low because this subcomponent is not highly valued or used by the local population. The ecosystemic value of this subcomponent is considered a moderate, as it presents an interest in terms of biodiversity. The combination of the social and ecosystemic values gives the subcomponent a low value. After application of the mitigation measures, the significance of the residual impact is low.

The development of the project will have little impact on the abundance, general distribution or use of the territory by the different aquatic bird populations. The nature of the impact on the aquatic birds is negative. The frequency of the impact is considered intermittent. The degree of disturbance of this subcomponent is therefore considered low. According the above considerations, the intensity of the impact is low. The extent of the impact is considered punctual, as the mine activities would affect only the individuals that frequent the site for breeding purposes. In contrast to the wildfowl, the small numbers of passing migratory birds will not be affected by the project development, or the effect on these populations is considered negligible.

The effect of mining activities on aquatic birds will begin at the construction phase and cease at the closure of the mine. The duration of the impact is therefore medium. The nature of the impact on the aquatic birds is negative. The impact is reversible because at the end of the project, the potential aquatic bird habitats will become available again since the noise and disturbance associated with mining activities will cease.

Table 7-45 presents the values assigned to each indicator and the resulting significance of the residual impact.

Table 7-45 Significance of the Residual Impact – Aquatic Birds

Intensity	Extent	Duration	Significance of the Residual Impact
High	Regional	Long	High
Moderate	Local	**Medium**	Moderate
Low	**Punctual**	Short	**Low**

7.6.2.6 Significance of the Residual Impact on Raptors

According to the collected information, several species of raptors may frequent the study area. More specifically, open environments such as the largest burns, wetlands and aquatic environments are those offering the greatest potential for this group of birds. Some of these species may breed near the mine site, notably the red-tailed hawk.

The environments on the mine site lost during the project development will be rehabilitated during the closure phase. Following the application of the mitigation measures, the environment losses for these species are considered negligibles.

Raptors are protected by laws and regulations. Thus, the social value of this subcomponent is high. Birds of prey play a major role in the ecosystem and there is a consensus about their protection in the scientific community. The ecosystemic value of this subcomponent is therefore high. The value resulting from the combination of these social and ecosystemic values is high. After application of the mitigation measures, the significance of the residual impact is moderate.

According to the knowledge on raptors, the quality, abundance and distribution of these birds will be relatively unaffected by the project development, because their home range is generally extensive. Only one red-tailed hawk nest would be affected by the project development. The degree of disturbance is therefore considered low. According to the above considerations, the intensity of the impact is moderate.

The nature of the impact on raptors is negative. The frequency of the impact is considered as intermittent. The extent of the impact is local, since the mine activities would affect only the individuals that frequent the mine site and the environments nearby to feed or breed.

Effectively, the hunting areas of the individuals nesting outside the mine site could overlap in part the locations of the proposed facilities and infrastructures.

The effect of mining activities on raptors will begin at the construction phase and cease after the closure of the mine. The duration of the impact is therefore medium. The impact is reversible because the environments disturbed by the mine activities will be rehabilitated during the closure phase.

Table 7-46 presents the values assigned to each indicator and the resulting significance of the residual impact.

Table 7-46 Significance of the Residual Impact – Raptors

Intensity	Extent	Duration	Significance of the Residual Impact
High	Regional	Long	High
Moderate	**Local**	**Medium**	**Moderate**
Low	Punctual	Short	Low

7.6.2.7 Significance of the Residual Impact on Terrestrial Birds

The areas of terrestrial bird environments affected during the construction, operation and closure phases are presented in Table 7-47, according to the main infrastructures and buildings of the project.

Before the site revegetation activities, the project will cause the loss of 161.6 ha of environments favorable to terrestrial birds. The loss of the recent burn environment is the most important, representing more than 141 ha. In general, the modification of these environments could have consequences on the abundance and distribution of terrestrial bird species on the mine site.

Table 7-47 Area of Affected Terrestrial Bird Environments Prior to the Rehabilitation of Disturbed Areas

Facilities and Infrastructures	Environment (ha)				All Environments
	Recent Burn	Alder Forest	Shrubby Bog	Forest Stand	
Access Roads	4.17	0.07	0.24	0.88	5.36
Explosives Stores	0.92	0.01	0.31	0.00	1.24
Pit	13.98	0.00	0.12	5.05	19.15
Waste Rock and Tailings Pile	82.59	2.11	2.55	3.52	90.77
Overburden Pile	10.32	0.00	2.72	0.49	13.53
Diversion of the Route du Nord	7.00	0.06	0.91	0.05	8.02
Sedimentation Basins	8.28	0.13	0.16	0.99	9.56
Industrial Complex	13.98	0.00	0.00	0.00	13.98
All Facilities and Infrastructures	**141.24**	**2.38**	**7.01**	**10.98**	**161.61**

During the operation and closure phases, the waste rock and tailings pile will be profiled and revegetated during its operation. The effect of this activity will be to recreate a favorable environment for terrestrial birds.

The number of forest bird breeding pairs affected by the pit footprint is estimated at 67 breeding pairs (Table 7-48). The three main species of this bird group affected by the loss of environments would be the white-throated sparrow (9 breeding pairs), dark-eyed junco (9 breeding pairs) and Lincoln's sparrow (5 breeding pairs). More than 51 breeding pairs may be present in the burn.

The other species of terrestrial birds present in the region (grouse, ruffed grouse, ravens and woodpeckers) are mostly resident populations. The lost area is probably negligible for the populations of the species in the region, at least after the closure of the mine. Also, since the terrestrial environments in the study area are relatively homogenous, the individuals of these populations may move toward similar environments at the periphery of the mine site or in the study area during the mine life.

Table 7-48 Estimated Number of Affected Forest Bird Breeding Pairs After Site Rehabilitation

Species	Environment			
	Burn	Shrubby Bog	Forest Stand	All Environments
American three-toed woodpecker	1	-	-	1
Black-backed woodpecker	2	-	-	2
Olive-sided flycatcher	1	-	-	1
Alder flycatcher	2	-	-	2
Grey jay	3	-	1	4
Tree swallows	1	-	-	1
Boreal chickadee	-	-	2	2
Winter wren	1	-	-	1
Ruby-crowned kinglet	1	-	2	3
Eastern bluebird	1	-	-	1
Veery	1	-	-	1
Hermit thrush	2	-	1	3
American robin	1	-	-	1
Orange-crowned warbler	2	-	-	2
Yellow warbler	1	-	-	1
Yellow-rumped warbler	1	-	3	4
Palm warbler	2	-	2	4
Northern waterthrush	2	-	-	2
Common yellowthroat	1	-	-	1
Wilson's warbler	1	-	-	1

Species	Environment			
	Burn	Shrubby Bog	Forest Stand	All Environments
Chipping sparrow	2	-	-	2
Fox sparrow	1	-	-	1
Song sparrow	1	-	-	1
Lincoln's sparrow	4	-	1	5
Swamp sparrow	-	-	1	1
White-throated sparrow	8	-	1	9
Dark-eyed junco	7	-	2	9
Pine siskin	1	-	-	1
Total	**51**	**-**	**16**	**67**

[1] The estimations are rounded off to the nearest whole number.

In general, terrestrial birds are not highly valued or used by the local population. A few species, notably Phasianidae (grouse, ruffed grouse, ptarmigan), however, are hunted by part of the local population. Therefore, the social value is considered moderate. The ecosystemic value is also considered moderate because terrestrial birds, notably forest birds, present an interest in terms of biodiversity. The value of the subcomponent is therefore moderate. After application of the mitigation measures, the significance of the residual impact is moderate.

After the closure of the mine, the modification of environments could have minor consequences on the abundance and distribution of the populations of the different species, as the affected populations are negligibles. The nature of the impact on terrestrial birds is negative. The frequency of the impact on habitat is considered as low, since the impact will occur mostly during the construction of the facilities and infrastructures. The degree of disturbance of this subcomponent is considered low because, although the impact alters its abundance and distribution, it does not compromise its integrity in the mine site sector. According to the above considerations, the intensity of the residual impact is considered low.

Since the impact on potential terrestrial bird habitats will be limited to the mine site, the extent of the impact is considered local. The duration is considered long, because after the site rehabilitation, part of the environments will be lost irremediably and the rehabilitated environments will not completely recover their original condition. The impact is irreversible because, as already mentioned, the lost environment areas for terrestrial birds could not be completely replaced.

Table 7-49 presents the values assigned to each indicator and the resulting significance of the residual impact.

Table 7-49 Significance of the Residual Impact – Terrestrial Birds

Intensity	Extent	Duration	Significance of the Residual Impact
High	Regional	**Long**	High
Moderate	**Local**	Medium	**Moderate**
Low	Punctual	Short	Low

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CHAPTER 8

HUMAN ENVIRONMENT

Environmental and Social Impact Assessment

March 28, 2013

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8. DESCRIPTION OF THE HUMAN ENVIRONMENT AND IMPACTS ANALYSIS

8.1 General Description of the Environment

The first part of this chapter presents an overview of the use of the land and its resources and of the socio-economic profile of the Cree community of Nemaska. The following sections present the impacts that the project could have over its entire life cycle as well as the mitigation and compensation measures being considered.

8.1.1 Historical Background

The James Bay territory is part of the Nord-du-Québec administrative region, which also includes Nunavik. It covers more than 350,000 km^2 and is circumscribed by the 49^{th} and the 55^{th} North parallels.

The James Bay Cree occupy the vast territory called *Eeyou Istchee*, the limits of which are defined in the James Bay and Northern Québec Agreement (JBNQA), the first major agreement concluded by the Government of Québec, the Crees and the Inuit of Northern Québec in 1975.

The JBNQA, the Paix des Braves and the new federal agreement constitute the legal, political and administrative framework through which we can assess and understand the accelerated growth and social development of the signatory communities, which in turn influenced the way of life of the Crees and the occupation of the land.

The territory of the Crees, *Eeyou Istchee*, comprises nine communities (Figure 8-1). A tenth community, Washaw Sibi, is being created and will be integrated. Each community has its history, its landscape, its unique character, as well as its local government. Thus, each community sees itself as a full-fledged nation and manages its own economic and social development. Nevertheless, all are united under the Grand Council of the Crees (GCC) of *Eeyou Istchee* and its administrative branch, the Cree Regional Authority (CRA)[1]. According to estimates, the Cree Nation of *Eeyou Istchee* currently numbers nearly 17,000 persons, mostly English-speaking.

In terms of infrastructure, it is only after the 1970s that the James Bay hydroelectric developments greatly contributed to the development of the road network. The James Bay Highway, a major road extending over 600 km, connects the town of Matagami to the heart of the La Grande complex. It is connected to the Transtaïga Highway, further north, and to the Route du Nord, which links the town of Chibougamau to the James Bay Highway. The James Bay

[1] The following pages discuss only the Cree Nation.

territory is also serviced by several airports located on the territory of the municipality of Baie-James, in Cree villages, and near hydroelectric installations.

8.1.2 Social and Territorial Change

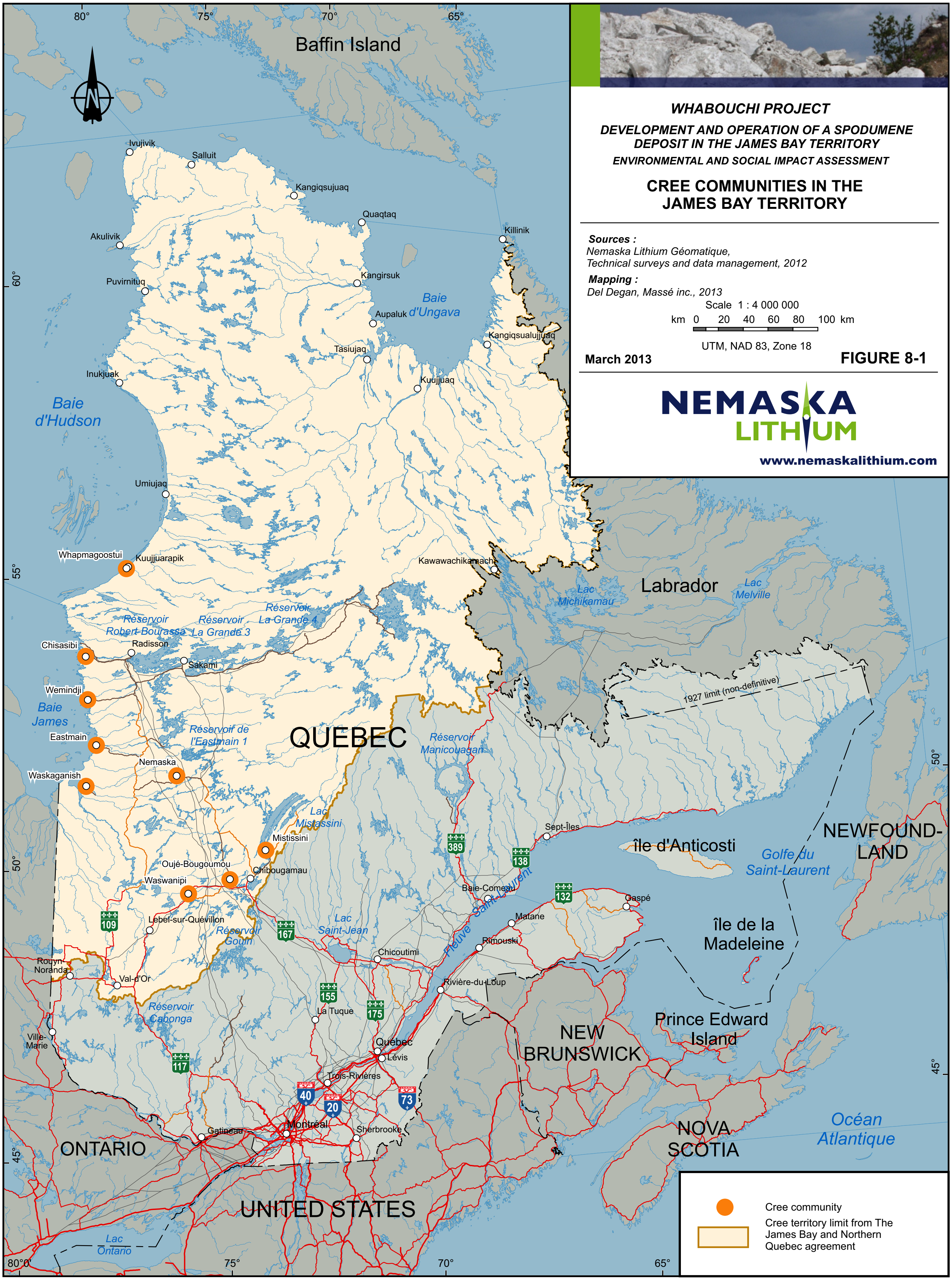
The land plays an important part in the life of the Crees. It is the repository of the collective memory, which can be found in the words of the elders, the ever-renewed tracks of the hunting routes, the births and departures, the meetings, the memorable anecdotes, etc. The land is also the foundation of the reasoning that underlies the modern Cree political structure: the Cree people have acquired a political weight and an increased social and politic complexity without renouncing the values founded in oral tradition. The Crees remain a society in which speech still has considerable weight.

8.1.3 Support Programs for Cree Harvesting Activities

As part of the JBNQA, under Chapter 28, the Cree Trappers' Association (CTA) was formed to help the trappers with the marketing of their furs, the promotion of species of interest, as well as the promotion and defense of their interests. The ATC is present in each community and also has a regional council. Several programs and special projects were developed to provide logistical and financial support for the trappers. Some services designed to encourage and support traditional activities on the land, such as transportation to base camps or equipment purchases, are financed by the ATC and other organisms – such as Aboriginal Affairs and Northern Development Canada and Hydro-Québec – in the form of remedial funds and enhancement or follow-up programs.

Also as part of the JBNQA, the Cree Hunter and Trapper Income Security Program (ISP) was set up to support the hunting, fishing and trapping activities so as to "encourage and preserve the traditional way of life of the Crees by providing Cree hunters and trappers with an income guarantee, benefits and other incentives." [2] The program guarantees a minimum annual income to the Crees, provided that they live on the land and that they take part in harvesting activities. The benefits allocated to the participants in the program are calculated on the basis of the number of days spent in the territory and the composition of the family unit, among other factors.

[2] Cree Hunters and Trappers Income Security Board. Annual Report, 2009-2010.



WHABOUCHI PROJECT

DEVELOPMENT AND OPERATION OF A SPODUMENE DEPOSIT IN THE JAMES BAY TERRITORY

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

CREE COMMUNITIES IN THE JAMES BAY TERRITORY

Sources :
Nemaska Lithium Géomatique,
Technical surveys and data management, 2012

Mapping :
Del Degan, Massé inc., 2013

Scale 1 : 4 000 000
km 0 20 40 60 80 100 km

UTM, NAD 83, Zone 18

March 2013

FIGURE 8-1

NEMASKA LITHIUM
www.nemaskalithium.com

8.1.4 Land Use

8.1.4.1 Family Hunting Grounds and Tallymen

Since the creation of beaver preserves that began in the 1930s, the territory of each *Eeyou Istchee* Cree community is subdivided into a number of family hunting grounds or trapping territories (traplines), each under the authority of a "Tallyman", a title partly derived from the traditional *Uchimaw*, or hunt leader. This title is inherited within the family, most often passing from father to son, and the role of the tallyman consists, among others, in ensuring the proper management of beaver populations. He also has the responsibility of allocating each year, or for a given period, the resources that can be harvested and closing the areas that must be preserved to ensure the replacement of the harvested species. Thus, here he represents a form of authority and exercises a degree of power over the group formed by the regular users of the trapline. However, this definition of the mandate of the tallyman is not unanimous within the Cree community and for some, it increasingly extends to other types of stewardship.

It should be noted that the role of the tallyman continues to evolve and becomes more complex with the developments of the last decades. In the past, the boundaries of family hunting grounds existed only in the memory of those who lived on the land. These boundaries were neither written down nor impenetrable (or exclusive). Once inscribed in the register, they became increasingly so, thus multiplying frictions and disputes about overlapping zones. Nevertheless, the family hunting grounds remain important symbolic and political points of reference; they are also powerful markers in the contemporary Cree identity.

Each trapline is associated with a tallyman and a group of users that includes his extended family and a number of other users linked by blood or friendship with the main titleholder. The families generally reside in cabins or tent frames on campsites that can comprise several units. Some regular users prefer to erect their base camp apart; this requires the prior approval of the tallyman.

8.1.4.2 Cree Harvesting Activities

The main harvesting activities on the family hunting grounds are hunting, fishing and fur animal trapping. The hunt for big game, practiced in the fall and winter, involves moose, woodland caribou, migratory caribou and black bear. Today, this hunt holds a prominent place in land use practices.

In spring, the northward migration of geese signals the beginning of a period of intense activity. The waterfowl hunt then involves the majority of the members of the Cree communities during at least two weeks. This hunt, which is highly valued by the Cree, is also practised in the fall, though less intensively.

The trapping of fur animals lasts from the end of fall until the spring thaw. The main species of interest are: beaver, American marten, mink, otter, lynx, weasel, several subspecies of fox, wolf and muskrat. Trapping is done less intensively than in the past due to its low profitability in regard of the effort involved.

Traditional net fishing and angling are practiced in the multitude of water bodies and streams on the territory, particularly in summer and fall, though many families still lay their nets under the ice in winter. The main harvested species are lake cisco, walleye, sucker, pike, sturgeon, lake whitefish, lake trout and brook trout. Fishing activities are particularly intense during the spawn of certain species and during the summer gatherings in community sites located near the villages, on the shores of major water bodies.

Harvesting activities decrease during the summer season, except for fishing and berry harvesting. Some communities continue to visit ancient traditional summer gathering sites, such as Old Factory (Wemindji), Fort George (Chisasibi), Waswanipi Post (Waswanipi) and Old Nemaska (Nemaska). Resources are transformed and shared within the community during traditional ceremonies and recreational activities. The sharing of the hunting catch remains an important foundation of Cree social organization and community ethic, in addition to its relationship to the land. Most of the resources that are abundantly harvested are redistributed within the extended families, or even the whole community. Moose and caribou meat, as well as fish and geese, are used in feasts and rituals associated with the cycle of life (births, marriages, walking out ceremony, etc.).

8.1.4.3 Access to the Land

In the past, well before the advent of the snowmobile and of the road network, navigation was the preferred mode of transportation between settlements and inland: originally with a paddle driven canoe, then with small motors. In the fall, the Crees traveled over very long distances to reach their main winter camp. The whole territory has been travelled by the generation of today's elders on foot, in canoes, with snowshoes and dogsleds. Some of them can still talk about episodes of that time, when life in the forest was the primary mode of subsistence.

Today, travel on the territory is by pickup truck, snowmobile, motorboat and canoe. Floatplanes or helicopters are used to reach the most remote traplines or during the thaw, when families move to their goose hunting camps.

The development of the road network contributed in modifying the occupation pattern on the territory, with the significant reduction in the time and effort required to reach the base camps and return from them. Since then, we see a gradual reduction of the length of stays and an increase in their frequency, notably for the Crees who have jobs in the community and have road access to their traplines. The presence of roads also influenced the selection of sites for the construction of new permanent camps, which are now preferably built on sites that are accessible by road.

The modernization of means of transportation and of the access to the territory, as well as the use of powered equipment (snowmobile, ATV, motorboat), brought about a significant improvement in living conditions, but it also means ever increasing costs related to land use.

8.1.4.4 Camp Sites

During their stays on the territory, the Crees reside in camps composed of rigid structures or cabins built of wood and plywood, equipped with a wood-burning stove and occasionally a porch. Cree base camps are strategically located on the trapline according to precise criteria such as the proximity to a permanent access road, the availability of drinking water and firewood (and other types of trees with domestic uses), as well as the presence of habitats that are favorable to snaring and trapping. Depending on the number of families associated with the trapline, up to 10 such camps can be found on the same location. The camp site can also include tent frames made of a plywood floor with a canvas-covered frame. Such tents are often erected by members of the user group who visit the territory during the goose hunt, or by families who don't have sufficient income to build a more elaborate structure. These structures can evolve and become permanent camps.

Each camp site includes at least one traditional teepee that is used for the transformation and preparation of the game, through tasks such as preparing moose hide, bear and beaver skins, crafting tools and cleaning and smoking fish. From these base camps, the hunters disperse toward harvesting areas during their hunting, trapping or fishing expeditions

The Crees also use seasonal or temporary camp sites. These are equipped with tent framesor traditional light structures such as the *miichiwaahp*[3] and the *maki*, which are used during waterfowl, bear or moose hunting expeditions. This type of camp is seen less frequently on the territory since the introduction of the snowmobile and the development of the road network, which allow hunters to return to their base camp at the end of the day. Nevertheless, known sites of old temporary camps are highly valued since they are still considered as potential stopovers or future residence sites. These temporary sites constitute logical waypoints in the hunting circuits that have been traveled for generations, and they ensure, especially in the winter, greater safety in case of problems. Each of these historically occupied sites is also associated with a collection of anecdotes, specific remembrances and legends, which form the collective memory or oral history of the trapline.

A third type of camp is the cultural camp: a gathering site for the members of the community that is used mainly for the transmission of Cree culture to the younger generations. The cultural camp generally comprises the main traditional structures such as the *miichiwaahp*, the *shaapuhtuwaan*, the *wigwam* and the *mihtukaan*. In recent years, a number of camps dedicated to religious purposes have been established on the territory and serve as gathering, evangelization, and summer retreats for families.

[3] http://ideeclic.com/cra2/?q=node/103

8.1.4.5 Valued Sites

The Crees are deeply attached to their hunting grounds, which harbor collective and individual memories; they are the site of important events, births and deaths, or are held as sacred places. Some locations that have been known and visited in the past are particularly valued.

8.1.5 Socioeconomic Profile of the Community of Nemaska

The territory of the Nemaska community covers a surface area of more than 55 km^2 on the western shore of Champion Lake, between Lake Mistassini and James Bay. It is over 390 km away from the town of Matagami, and 340 km from Chibougamau. The community of Nemaska is accessible all year long from Matagami via the James Bay Highway, and from Chibougamau by the Route du Nord.

Nemaska is an important administrative center in the *Eeyou Istchee* region since it harbors the offices of the grand Council of the Crees of *Eeyou Istchee* and of the CRA. This fact explains the particular importance of the service sector for the local economy.

8.1.5.1 Demographic Evolution

The community of Nemaska, with a population of 772 (Table 8-1), represents approximately 4.24% of the total population in the Cree communities. In terms of population size, it is the second from last in the *Eeyou Istchee* territory.

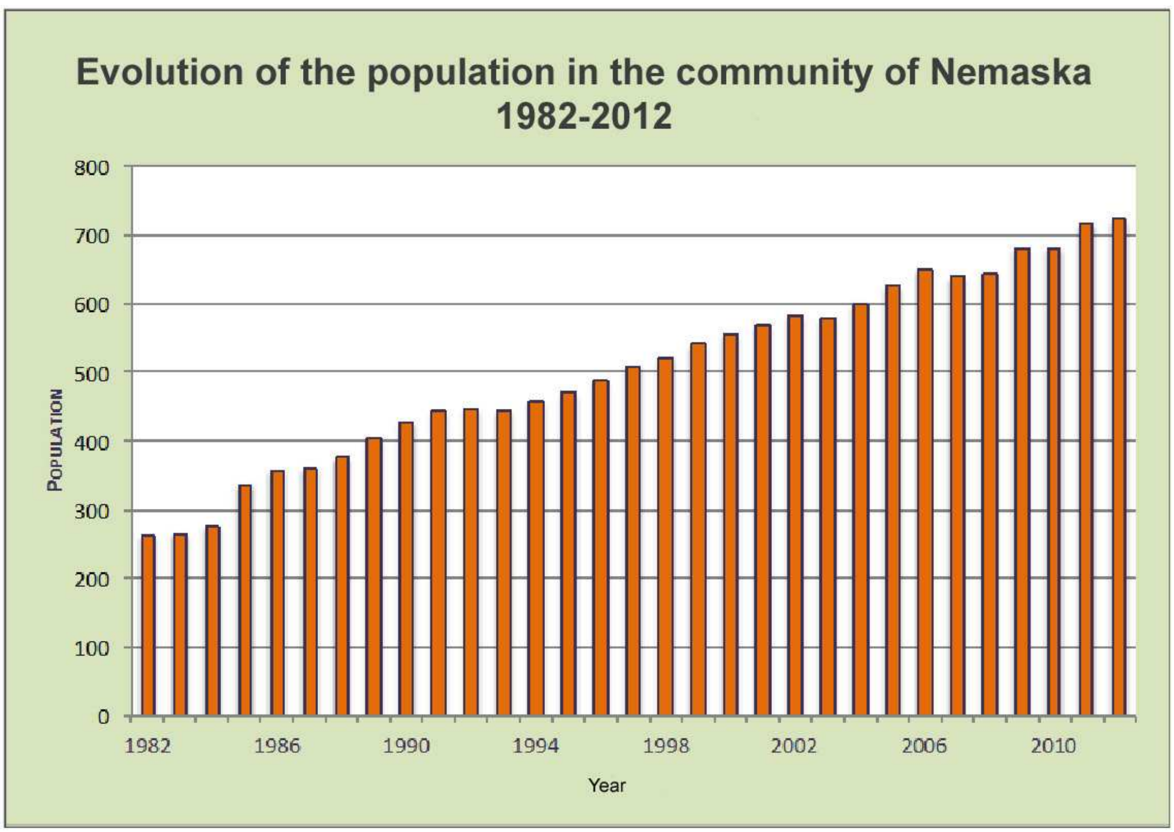
The demography of Nemaska follows the trend seen in the other *Eeyou Istchee* communities, with a rapid population growth over the last 30 years (ISQ, 2012). However, for the past 10 years, this growth rate has been decreasing gradually, as in the rest of the Cree population of *Eeyou Istchee* (ISQ, 2012).

Table 8-1 Evolution of the Cree and Northern Quebec Population

Community	1982	1992	2002	2012	2002-2012 Growth Rate (%)
Eastmain	319	438	594	680	14.48
Nemaska	261	447	582	722	24.05
Oujé-Bougoumou	0	479	594	793	33.50
Whapmagoostui	397	516	761	888	16.69
Wemindji	699	935	1,130	1,403	24.16
Waswanapi	784	922	1,250	1,710	36.80
Waskaganish	1,021	1,365	1,743	2,159	23.87
Mistissini	1,766	2,249	2,754	3,512	27.52
Chisasibi	1,855	2,644	3,338	4,134	23.85
Eeyou Istchee	7,102	9,995	12,746	16,001	25.54
Nord-du-Québec	39,050	39,352	39,817	42,579	6.94

Source: ISQ, 2012

Figure 8-2 Evolution of the Population in the Cree Community of Nemaska

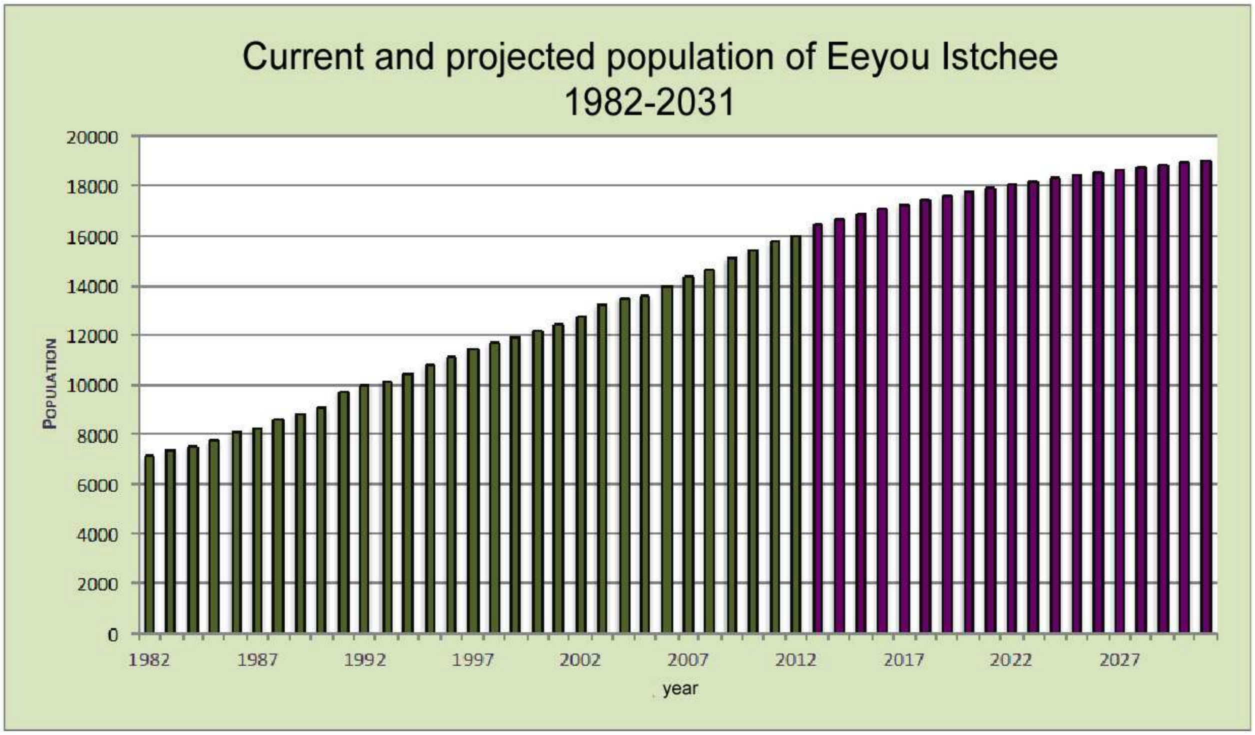


Source: CBHSSJB, 2012

According to the projections of the Institut de la statistique du Québec (ISQ, 2009), shown in Figure 8-3, the Cree population of *Eeyou Istchee* will increase by 18.88% between 2011 and 2031, when it will reach a population of nearly 19,000, which represents a much stronger growth than for the average population of Québec (ISQ, 2009).

This rapid demographic growth can largely be explained by a combination of two factors: a high rate of fecundity and an increased life expectancy at birth.

Figure 8-3 Current and Projected Population of *Eeyou Istchee*



Source: ISQ, 2009

Interviews conducted within the community indicate that the population of Nemaska is generally aware of this regional growth and feels its effects in the village. Some respondents expressed their concern about this demographic growth, particularly with regard to job opportunities and the availability of housing.

Population size is a factor that can greatly influence the type and intensity of the socio-economic impacts of projects on the community. Generally, smaller communities such as Nemaska are more sensitive to the socio-economic effects of large projects.

8.1.5.2 Birth and Death Rates

The birth rate in the *Eeyou Istchee* territory is twice that of the Québec average (ISQ, 2012).

Data from the Institut national de santé publique du Québec (Choinière, 2003) show no significant difference between the death rates of the *Eeyou Istchee* Cree and the rest of Québec.

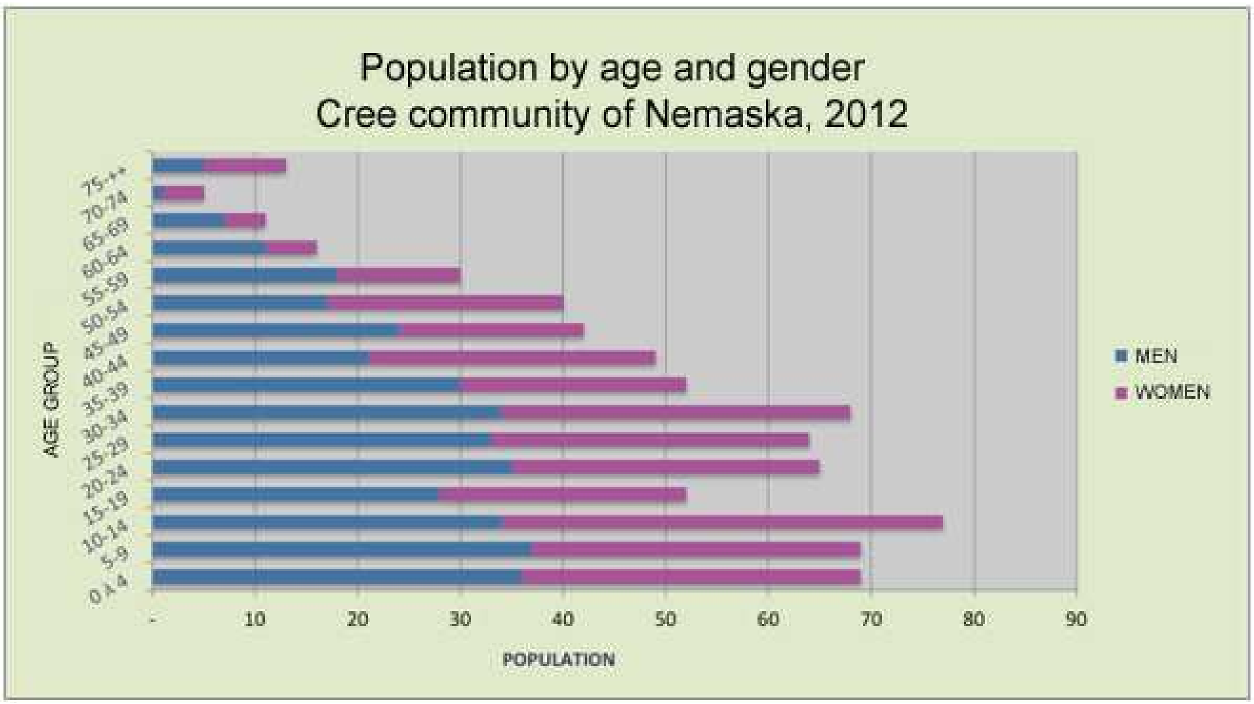
However, infant mortality in the 0 to 4 year old group is two times higher than the Québec average among the Cree. The infant mortality rate, though, has declined by more than 90% over the last 30 years among the *Eeyou Istchee* Cree (CBHSSJB, 2011).

8.1.5.3 Population Structure by Age and Gender

The main demographic feature of the Nemaska community is its youth. As can be seen in Figure 8-4, in 2012, the 396 inhabitants who are less than 30 years old represent more than 55% of the population of Nemaska. In this group, those who are less than 15 years old make up the largest demographic segment in the community with 31% of the population.

The gender distribution in the community is balanced (51% female vs. 49% male) throughout the age groups.

Figure 8-4 Population by Age and Gender



Source: CBHSSJB, 2012

Considering the youth of its population, a high rate of fecundity and a strong demographic growth, the population of Nemaska will continue to increase over the next 30 years. The needs of this population will follow the same trend, notably in terms of housing, jobs, social services and infrastructures.

8.1.5.4 Household and Family Characteristics

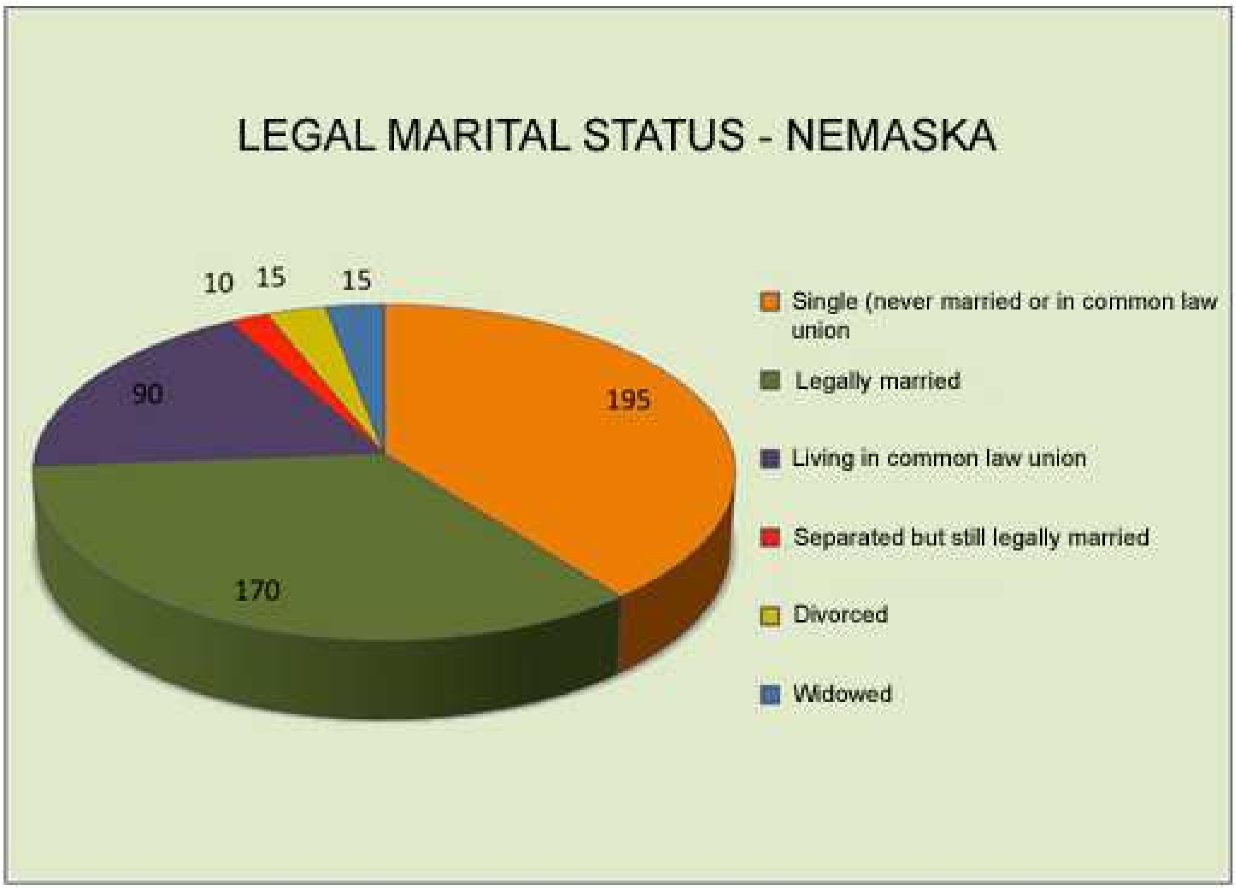
According to the 2011 data, Nemaska has 260 inhabitants aged 15 years or more who live in couples. Of these, 170 persons were legally married and 90 lived as common law couples (Statistics Canada, 2011).

Among the 180 families reported in the 2001 census, 50 are single-parent (27.8%).

Cree families are on average larger than in Quebec as a whole and households have more members (Statistics Canada, 2011). The large number of individuals in each household can be partly explained by two factors: a cultural tradition of keeping generations under the same roof, which ensures intergenerational support, and the scarcity of housing in the community.

A characteristic feature of *Eeyou Istchee* communities is that families, including single-parent families, live more often in multi-family households. Therefore, grandparents or other family members tend to be involved in the education of the children.

Figure 8-5 Legal Marital Status



Source: Statistics Canada, 2011

8.1.5.5 Linguistic Knowledge

In 2006, Cree language was the dominant mother tongue and was spoken by 98.8% of community members; it was also the most commonly used in the community of Nemaska, with 92.9% of the total population speaking Cree at home (Statistics Canada, 2006).

Schooling is done in Cree language from kindergarten to third grade. From the fourth grade on, classes are given in English and French. Interviews conducted with school personnel in the community revealed that a small number of Cree residents speak only English.

As can be seen in Table 8-2, the linguistic knowledge of the active population of Nemaska aged 15 years or more is generally quite similar to what can be found in the other communities of *Eeyou Istchee*. Cree therefore remains the dominant language among the population. Only 22% of this population, whether in Nemaska or *Eeyou Istchee*, masters the Cree writing.

Table 8-2 Linguistic Knowledge of the Active Population of Nemaska and *Eeyou Istchee* in 2008

	Nemaska (%)	*Eeyou Istchee* (%)
Spoken language		
Cree	98.8	98.7
English	98.8	98.7
French	34.1	37.2
Cree and English	97.6	97.5
Cree and French	34.1	36.6
English and French	34.1	37.0
Cree English and French	34.1	36.4
Written language		
Cree	22.4	22.1
English	96.5	95.4
French	25.9	26.5
Cree and English	22.4	21.2
Cree and French	9.4	8.1
English and French	24.7	25.4
Cree English and French	9.4	7.9

Source: CHRD, 2009

The great majority of the Nemaska population has a very good command of English, which is spoken by 97.6% and written by 96.5%. French ranks third in the languages used in the community, with 34.1% who can speak it and 25.9% who can also write in French.

More than 33% of the population of Nemaska masters the three spoken languages (Cree, English and French), and 9.4% of this population can both speak and write the three languages.

8.2 Approach for the Impacts Analysis on the Human Environment

8.2.1 Objectives

The following paragraphs discuss the approaches that were adopted to characterize the human environment in the project area, as well as the approach used to evaluate the impacts.

8.2.2 Approach for the Characterization of the Human Environment

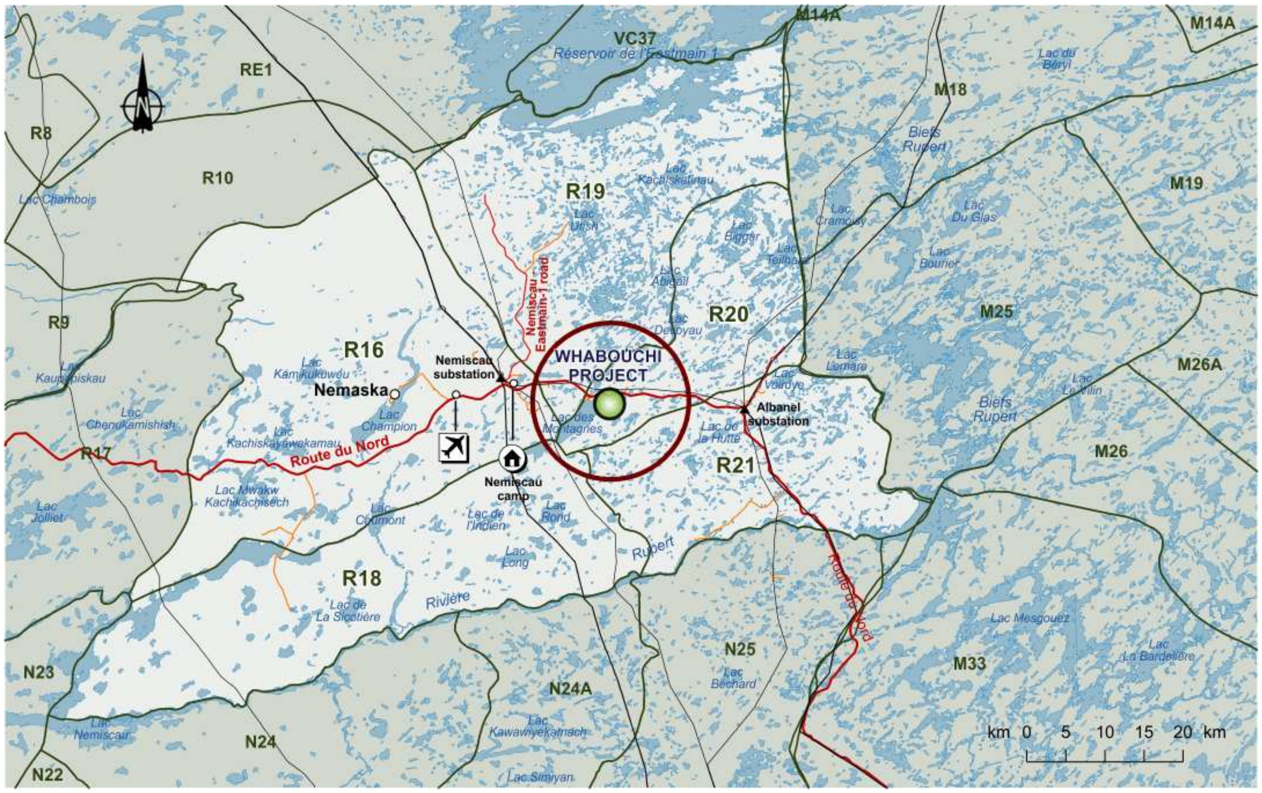
8.2.2.1 Land Use

The data on the use of the land and its resources come from different sources, depending on the subject, namely information regarding Crees vs. non-natives. The data on Cree land use come from semi-structured interviews with the tallymen and their families or with other users of the trapline. Prior to these interviews, a review the existing documentation containing relevant data was completed. The Cree users of the land considered in the present ESIA agreed about the use of data generated in past projects, in order to maximize the input of survey data and to avoid redundancies or duplication of effort.

The users of trapline R20 are directly concerned by the project, which is entirely located in the southwestern portion of the trapline. The tallyman and his family were met in three instances for extended interviews to collect relevant data about their practices as well as their concerns and expectations about the project. The majority of the data provided were mapped. Map 8-1 is the result of a generalization that is intended, on one hand, to facilitate the reading of the map and, on the other hand, to respect the confidential character of specific survey data. For example, some users of the land preferred not to indicate specifically their preferred big-game hunting or fishing grounds. It should also be noted that the snowmobile trails or the waterways shown on this map constitute the main travel corridors on the traplines. They do not represent all the travel options that are possible or actually used.

The tallymen of traplines R16, R18, R19 and R21 were met briefly to assess their presence in the areas adjacent to Lac des Montagnes or to trapline R20.

Figure 8-6 Traplines in the Vicinity of the Project



The tallymen of traplines M18 and M25, located near the project on the territory of the First Nation of Mistissini, will be met in the spring of 2013. The objectives of these meetings include informing the tallymen about the project's developments and the current environmental assessment process.

Data on the use of the territory by non-natives were obtained from the Société d'énergie de la Baie-James (SEBJ) and the Direction des opérations du Nord-du-Québec of the ministère des Ressources naturelles.

8.2.2.2 Socio-Economic Profile of the Community of Nemaska

The data for the socio-economic profile of the community of Nemaska come from two types of sources: literature reviews and "field" interviews with members of the community.

The quantitative data were obtained from an exhaustive literature review of the various available and accessible sources of information such as the Cree institutions (eg. Cree Board of Health and Social Services of James Bay (CBHSSJB), Cree School Board (CSB), James Bay Hunters and Trappers Association (JBHTA), etc.), provincial agencies (eg. Quebec Institute of Statistics, Institut national de la santé publique, Quebec Construction Commission, etc.), and federal agencies (eg. Statistics Canada). Sources of information provided by private organizations or crown corporations, such as Hydro-Québec's environmental impact assessment on the Eastmain-1-A-Rupert generating station (Hydro-Québec, 2004), were also consulted.

The data found in the consulted literature were enhanced and completed with several in-person interviews ("field interviews") with key socio-economic stakeholders within the community of Nemaska.

8.2.3 Human Environmental Impact Assessment Methodology

8.2.3.1 Identification of the Components

The identification of the key components of the human environment that should be considered in the assessment of the social impacts of the Whabouchi project was done taking into account experiences of developments of a similar scale in the northern environment; established good practice in environmental assessment; and the data collected through the community consultation activities described in Chapter 3. The various meetings and discussions with the Nemaska Cree brought to light the main sources of concerns and considerations, thus issues specific to this community as expressed by the participants.

The components that were selected for the analysis of social impacts are the following:

- Land and resources use
- Jobs and economy
- Community wellness
- Cultural and archaeological heritage
- Landscape
- Community infrastructures

8.2.3.2 Identification of Potential Impacts

The identification of the project's potential impacts on the human environment was a key objective of the consultation plan described in Chapter 3. Interviews with land users and consultation activities with various representatives and sectors of the community provided data on the experience of community members with large infrastructure projects in the region and on the impacts that were observed.

Additionally, a selection of ESIA reports, such as those on Hydro-Québec's Eastmain-1-A-Sarcelle-Rupert project (Hydro-Québec, 2004), Stornoway Diamonds' Renard project (Roche, 2011), as well as research projects examining the effects of resource development on Cree territory were consulted in order to take note of their respective issues and to analyze the impacts of these projects.

Based on these data and on its multidisciplinary experience, the team compiled an exhaustive list of potential impacts regarding the social aspects. The significance of impacts was then determined according to criteria of duration, extent and intensity, following the methodology described in Chapter 5.

8.2.3.3 Identification of Mitigation Measures

Defining mitigation measures is done according to three types of determinants:

- The specific requests expressed by land users during the consultation activities;
- Several mitigation measures are negotiated between the project proponent and community representatives, namely under the Resource Development Partnership Agreement (RDPA), which is still under discussion;
- A review of the best mitigation practices developed for other major projects on Cree territory, which largely contributed to the list of proposed mitigation measures.

8.2.3.4 Evaluating the Significance of Residual Impacts

The next step of the process consists in evaluating the significance of residual impacts after applying the proposed mitigation measures. The effects of the mitigation or enhancement measures allow to assess the significance of residual impacts for each social component. This residual impact, evaluated for each component, is stated at the end of the corresponding section.

8.2.4 Geographical Scope of the Social Impact Study

The Whabouchi project is located several hundred kilometers from any agglomeration (community or village), except for the Cree community of Nemaska, which is 30 km distant from the project. The geographical situation of the project, combined with multiple factors – such as its economic spinoffs, the small population of Nemaska and the demand for labor in the community – will certainly result in direct and significant impacts and benefits on the socio-economic environment of the Cree community of Nemaska.

The geographical scope of the social impact assessment is determined by the Cree community of Nemaska (Category I lands) and its surroundings (Category II lands and a portion of Category III lands), and a portion of the territory defined mainly by the use of the traplines surrounding the project footprint (R16, R17, R18, R19 and R21). The potential impacts or spinoffs that the project could have on other Cree communities or on the owners of camps located between the Whabouchi project and the town of Chibougamau, along the Route du Nord, are also considered.

8.3 Impacts Assessment

This section presents the analysis of the impacts of the Whabouchi project on the human environment. It is subdivided in six sections, each corresponding to the components of the human environment:

- Land and resources use
- Jobs and economy

- Community wellness
- Cultural and archaeological heritage
- Landscape
- Community infrastructures

8.3.1 Land and Resources Use

8.3.1.1 Description of the Environment

Trapline R20

Trapline R20 is located in Category II and III lands, some 25 km away from the community of Nemaska. It has an elbow shape with the western half delimited in part by Lac des Montagnes and by the Nemiscau River. The latter constitutes the western boundary of the trapline up to Lake Biggar, to the north. The southern point of the territory, where the project is located, is crossed from west to east by the Route du Nord and by a power line that links Nemiscau to the Albanel substation. Two other power lines cross the southeastern portion in a southeast-northwest direction. The portion of the territory extending south of the Route du Nord is in Category II lands. Trapline R20 encompasses Spodumène, Devoyau, Abigail, Biggar and Teilhard lakes (see Figure 8-6 and Map 8-1).

Two former mining exploration camps, possibly dating back to the 1960s, as well as three former Hydro-Québec camps can be seen a few kilometers north of the Albanel substation and on the eastern shore of Lac des Montagnes. The Route du Nord provides direct access to Lac des Montagnes, to the southwest of the trapline. The main permanent Cree camps are located in this area.

Mr. James Wapachee holds the title to trapline R20 since 2000. Mr. Wapachee uses this trapline regularly with his spouse and their extended family, which numbers nearly 40 persons, among them Mr. Wapachee's six brothers, three of whom have children. The users concentrate their harvesting activities near Des Montagnes, Devoyau and Teilhard lakes, as well as on the Nemiscau River.

Other Cree users of the trapline include those who have a camp near the Route du Nord, on trapline R20, and community members who attend Bible camp in the summer.

Non-natives also visit trapline R20 during the summer. They include workers from the work camps located near Lac des Montagnes. They go camping near Lac des Montagnes in Category III sections of the trapline. It is also reported that big-game and waterfowl hunters come in by vehicle or with ATVs during the hunting season.

<u>Camps</u>

The Wapachee family uses three base camps: the first on the northern shore of Lac des Montagnes, along the Nemiscau River; a second on the shore of Teilhard Lake; and the third outside of the trapline R20 boundaries, at kilometer 14 of the Auclair road. Map 8-1 shows the location of the permanent and seasonal camp sites in the vicinity of the mine site.

Three of the tallyman's brothers have camps along the Route du Nord. Two of them are located near the project. Another permanent cabin is also being built near the project.

Near James Wapachee's main base camp, we find the Bible Camp, a site that has been occupied for a long time for community activities and that has recently been refitted by Mr. Andrew Coonishish to receive Nemaska families during religious gatherings and summer youth camps. Traditional Cree ceremonies are also held near this camp.

Many seasonal or temporary camps are dispersed over trapline R20, mainly on the shores of lakes and of the Nemiscau River. A camp on the northwestern shore of Lac des Montagnes includes several cabins, many of which belong to the chief of the community, Mr. Matthew Wapachee, and to his family. This camp is continually being expanded.

Few non-native camps are found in the project area. Users report the presence of a fishing cabin on the shore of the Nemiscau River, 5 km north of Lac des Montagnes, and of an abandoned game warden camp on the northern shore of Lac du Spodumène.

Given the proximity of Lac des Montagnes and the Nemiscau River, and their accessibility by road, Nemaska residents visit them for fishing in the summer and fall.

For several years, trapline R20 has been visited by non-natives, mainly by workers hired in the community of Nemaska. Additionally, many workers visited this trapline during the construction of the large hydroelectric projects of EM1 and EM1A-Rupert, from Hydro-Québec's Nemiscau, EM1 and Rupert camps. These are no longer in use today. The workers are accustomed to enjoying the beaches of Lac des Montagnes and Lac du Spodumène since an access road has been built on the eastern shore of Lac des Montagnes.

Access to the Trapline and Activities

Users of trapline R20 reach their base camps by the Route du Nord. They regularly go to their camp on Lac des Montagnes for stays of varying length. From their camps, the hunters and the family spread out over the territory using vehicles, motorboats or snowmobiles, according to the season and the activity. The main navigation circuits follow the Nemiscau River, Lac des Montagnes and Teilhard Lake. The streams that link Lac des Montagnes to Lac du Spodumène and the Lacs Noirs are also navigable.

Several portage trails have been cleared on trapline R20 and are still in use, such as the one along the navigated section of Nemiscau River, which is regularly visited by the Wapachee family. One of these portages links Teilhard and Biggar Lakes, to the north of trapline R20. Many snowmobile trails are in use, and form a network starting from the main travel corridors, northward from the camp, following the hydrographical network of the Nemiscau River up to Biggar and Teilhard Lakes. The power line rights-of-way are also used for winter travel.

Furbearers are trapped in the winter by the tallyman and some of his brothers in the area of Lac du Spodumène and along a north-easterly hunting route, as well as south of Teilhard Lake and on the northeastern shore of Lac des Montagnes. The harvested species include beaver, otter, mink and marten. The totality of trapline R20 is a favorable habitat for beaver, particularly along the roads and along the Nemiscau River in the vicinity of Biggar Lake.

Big-game hunting, as well as waterfowl hunting, are practiced mainly in the fall. Users generally hunt for moose and geese in the area of Lac des Montagnes and along a navigation route that follows the Nemiscau River up to Devoyau Lake and continues eastward up to Lac des Plages. They also hunt in the northern portion of trapline R20, traveling through Devoyau, Abigail, Biggar and Teilhard Lakes, a route that is used in summer for the walleye and pike fishery. Moose are often observed along the Route du Nord and its branching access roads. Recent kills are reported in the area of the road near the Lac 1 access road and from the power line right-of-way that crosses trapline R20 from west to east.

In winter, moose can be hunted in the remote areas that are inaccessible before the frost. Bear and moose are both present over the entire territory of trapline R20.

The spring goose hunt occurs in several areas of trapline R20. The Wapachee family concentrates its activities in the area of Lac des Montagnes and Lac du Spodumène, where several blinds have been built. At the beginning of May, the ice in the area of the Bible Camp melts rapidly and provides a favorable habitat for the geese.

Ptarmigan is found easily over the entire R20 trapline, but it is mainly hunted in the power line rights-of-way and in the northern portion of the trapline. The tallyman uses a Scandik 8000 type snowmobile. His longest usual route takes approximately 2 hours 30 minutes, starting from the Bible Camp.

Users fish mainly in the large water bodies and rivers of trapline R20[4]. They use traditional fishing techniques and sometimes fishing lines. Ice fishing is also practiced, particularly for sturgeon. The main fall and summer fishing circuits are located along the Nemiscau River, as well as in Lac des Montagnes and Teilhard Lake.

Lac des Montagnes has long been fished by members of the community as well as non-natives. The lake was closed to fishing to prevent overharvesting during the years of intensive activity at the large hydroelectric projects, but the Wapachee family plans to return fishing there soon. Desirable species are: walleye, pike, sturgeon, longnose sucker, lake trout, speckled trout, lake whitefish, cisco and brook trout. Yellow perch can sometimes be found.

Sites of Interest

Among the valued sites or those of historical interest, we find several birthplaces, most of which correspond to the location of former camps on the northeastern shore of Lac des Montagnes or at Abigail and Devoyau Lakes. There are also reports of burial sites, of several valued old camp sites along the Nemiscau River, as well as two archaeological sites, one south of Teilhard Lake and the other near Lac des Montagnes, close to the Bible Camp. Human bones were found at the latter site. This area, which is currently occupied by several Cree families, was visited in the past by the canoe brigades that traveled up the Nemiscau River. Other valued locations include the site where the walking-out ceremonies are held, as well as the site of Mr. Wapachee's grandfather's camp, both on the shores of Lac des Montagnes; a former community gathering place near the Route du Nord, approximately 6 km west of the Albanel substation is also valued.

[4] The users preferred not to specify the location of their favorite fishing grounds in certain parts of the trapline.

Anticipated Land Use

Mr. Wapachee intends to continue his activities on trapline R20 for as long as he can. He is currently employed on an occasional basis in Hydro-Québec's remediation and monitoring work relating to the Rupert River diversion project. He plans to continue developing infrastructures to facilitate his activities on the territory with the help of the Niskamoon Corporation and, eventually, with other funds made available for the development of the territory.

Specific Development-Related Issues

Given the important developments that occurred on the territory since the construction of the Route du Nord and the hydroelectric projects, the tallyman has seen significant changes in certain areas, particularly with regard to several of the species that are usually harvested. Speaking of the hydroelectric projects, he observes changes in the quality and the levels of the water that enters the trapline, which is located downstream of the works. During the construction period, the waters of Lac des Montagnes and the Nemiscau River took on a darker colour, which is gradually returning to normal. Another effect of the development that was mentioned concerns the influx of workers in the area since the beginning of Hydro-Québec's projects, in particular at Camp Nemiscau, which increased the risk of overharvesting Lac des Montagnes.

Trapline R16

Trapline R16 encompasses the village of Nemaska as well as several infrastructures, such as the Nemiscau residences, the Route du Nord, the Nemiscau camp, the truck stop, the Nemiscau airport, a sewage treatment plant and the Nemiscau substation. The tallyman, Mr. Charles Cheezo, recently took the place of his brother, the late Samuel Cheezo, who deceased suddenly in the spring of 2012.

The Cheezo family has a permanent camp along the Route du Nord in the western part of the trapline, and a cabin in the multifamily camp site located near the Bible Camp. The family also has a permanent camp on an island in the Nemiscau River, which is used in fall and summer for fishing and in the spring for the goose hunt. Several temporary camps are dispersed over the territory of trapline R16, particularly along the Nemiscau and Pontax rivers. In fall, they concentrate their activities around the camp located on the Route du Nord and along the roads. In the summer and fall, the users navigate over a large portion of trapline R16. The Nemiscau River, among others, is navigated over its entire course up to Lac des Montagnes, where the family fish for walleye and lake trout.

Trapline R18

Trapline R18 extends to the south of trapline R16 and covers approximately 80 km from west to east. Its southeastern boundary is defined by the Rupert River and its northern limit by the Nemiscau River. Lac Valiquette, an extension of Lac des Montagnes, is included in its northeastern corner. To reach trapline R18, the users travel over three routes, one of which consists in following the power line from the Nemiscau substation to the south of Lac des Montagnes. The tallyman, Mr. Luke Tent, exploits trapline R18 all year long with is family. The main camps established by the users are located along the Rupert and Nemiscau rivers, as well as on Lac Caumont.

Fishing is practiced intensively on trapline R18 in the fall and summer, particularly in the Rupert and Nemiscau rivers and in Lac Nemiscau. The Nemiscau River is fished from Kamachistweyaskweyach Bay to Lac Valiquette. In the spring, the Tent family and several other community families hunt goose, mainly in the Rupert and Nemiscau rivers, west of Lac Caumont. The data about trapline R18 will be updated early in 2013.

Trapline R19

The chief of the community of Nemaska, Mr. Matthew Wapachee, holds the title to trapline R19 since 1990. In its extreme south corner, trapline R19 borders Lac des Montagnes. The southeastern boundary of the trapline is defined by the Nemiscau River and its northern limits by the Eastmain River. Several camps are distributed over trapline R19, notably along the EM1 Road and the Nemiscau River. In the southern portion of trapline R 19, the Wapachee family also occupies a permanent camp near the Bible Camp. This campsite gathers more than 10 families of the community and is occupied all year long, during the weekends and holidays, in particular during the spring goose hunt. More than 15 members of the Wapachee family gather at this camp on some occasions and many members of the extended family come to visit.

Goose ponds are particularly abundant in the Lac des Montagnes area and offer favorable sites for goose hunting. The central and northern portions of trapline R19 are accessible by snowmobile in winter and by boat in the fall. Apart from the goose hunt, the main hunting activities occur in parts of trapline R19 that are distant from the project site. A beaver trapping area is located north of Lac des Montagnes.

Trapline R21

Trapline R21 borders trapline R20 to the south. It is delimited by the northern shore of the Rupert River over a distance of some 45 km, and its Eastern part is crossed diagonally by the Lemare River. Mr. Kenny Jolly is the title holder to trapline R21, which he frequents regularly with his relatives. Their activities focus on the shores of the Rupert and Lemare rivers. The portion of the territory adjacent to trapline R20 is therefore not visited intensively and there are no camps in this area.

The totality of trapline R21 is favorable to hunting, fishing and trapping, but it should be noted that since 2002, the activities and several former harvesting areas along the Rupert and Lemare rivers have been modified by Hydro-Québec developments for the Rupert River diversion.

The members of the Jolly family have three permanent camps near the Route du Nord, south of Albanel substation. These camps are accessible and used all year long. One of them, near the Route du Nord to the south of Albanel substation, is particularly valued by the Jolly family.

Several lakes along the Route du Nord and in the northeastern section of trapline R21 offer good fishing. In winter, the hunting and trapping activities occur over the totality of the territory. The main routes follow the network of tributaries and the many lakes that dot the territory.

Many members of the community of Nemaska cross trapline R21 when traveling on the Route du Nord. Some of them hunt and trap near the road or fish in lakes on either side of the road.

Community Uses

The Bible Camp is a site dedicated to community activities. Its location is shown on map 8-1. Mr. Andrew Coonishish and his wife own the facility and are in charge of organizing summer activities for the children and families of the community. The site can receive up to 35 persons and, during the summer school vacation, day camps are organized for the children during four consecutive weeks. A staff of about 10 persons offers room and board to a total of 24 children per week. Retreats are also organized during the following weeks for adults of Nemaska and other neighboring Cree communities. When the camp is occupied, visitors take part in many activities in Lac des Montagnes, such as angling, swimming and games. Users also report that they drink the lake water.

In the summer of 2012, the Nemaska recreations department organized an inter-community fishing competition at the Bible Camp site. This activity may become a recurrent event.

An expansion of the facility is planned, which would increase the number of all-seasons cabins and include building traditional infrastructures that are usually found in Cree cultural camps, in order to diversify the services offered to the community.

Occupancy and Camps along the Route du Nord

Many members of the community of Nemaska use the Route du Nord in their travels to centers or for the fall hunt. Several families in the communities of Nemaska and Mistissini also have a permanent or seasonal camp along the road. A total of 13 such camps are reported; they are of varying sizes and some comprise several cabins and traditional structures.

Use of the Land and Resources by Non-Natives

Non-native land use in the area of influence of the Whabouchi project consists essentially in recreational activities practiced by permanent and temporary Hydro-Québec workers. Access to resources is managed by a jointly owned company formed by the Grand Council of the Cree (GCC) and Hydro-Québec. The mandate of the Weh-Sees Indohoun Corporation is to manage the recreational hunting and fishing activities of the workers on the Eastmain-1-A–Sarcelle–Rupert project and other users of the territory. It is responsible for issuing hunting and fishing permits to non-natives within its jurisdiction, which includes the study area of the present project.

Specific fishing quotas for each lake, and hunting quotas are established by the ministère des Ressources naturelles in conjunction with the tallymen affected by Hydro-Québec's projects. When the quota for the fish harvest is reached, the Weh-Sees Indohoun Corporation closes the access to the lake. Non-natives must obtain additional permits from the GCC to hunt or fish on Category I and II lands around the community of Nemaska. They cannot practice trapping within the jurisdiction of the Weh-Sees Indohoun Corporation, but they can install cabins and shelters outside of Category I lands.

The great majority of non-native users of the territory are Hydro-Québec employees, either permanent employees of the regional facilities or construction employees who are housed in a series of work camps distributed throughout the area. Some 80 employees currently reside within the Nemaska territory, compared to 324 in 2001; this includes the temporary work camps.

As Hydro-Québec's large projects come to an end within the next few years, only permanent employees of the hydroelectric power stations will remain on the territory except for the personnel dedicated to the maintenance and renovation of the Albanel substation. This personnel should remain in the area for a few years, beginning in 2013. Also, it is expected that activities of the Weh-Sees Indohoun Corporation will conclude in 2014, though many members of the Cree community, including some Nemaska tallymen, expressed their appreciation for its management and requested that it be maintained, particularly in the context of accelerated exploration activities contemplated by the Plan Nord[5].

The other non-native users of the Nemaska territory are mainly Nemaska residents who are not employed by Hydro-Québec, workers housed at the CCDC, as well as tourists and guests, who numbered 484 persons in 2001 (SEBJ, 2012).

Several tallymen in the community of Nemaska consider that the creation of the Weh Sees Inhodoun was effective in ensuring the preservation of the territory’s resources during the major construction phases of the Eastmain-1 project. They expressed the wish that the Weh-Sees Indohoun Corporation remain in place and be financed by the mining projects that could be developed on the territory (SEBJ, 2012).

Sport Fishing

Workers from all the work camps within the Weh Sees Indohoun Corporation jurisdiction have practiced recreational hunting and fishing activities in Nemaska since the creation of the Corporation in 2007. Work camp employees and non-native permanent workers in Nemaska have proven to be particularly avid fishermen. In 2011, residents practiced fishing in a proportion of 41%, compared to 23% of the workers from the Eastmain and La Sarcelle camps (SEBJ, 2012).

During the 1,156 fishing expeditions to favourite destinations in the Nemiscau River, Nemiscau Lake and the Rupert River, non-native residents of Nemaska captured 3,231 fish and released 1,745 (SEBJ, 2012). The 664 fishermen (23% of the employees) from the Eastmain and La Sarcelle camps, who favor more northern fishing destinations, captured 9,047 fish in 2001, and released 3,103 (SEBJ, 2012). The other users, who preferred Mesgouez Lake, the Nemiscau River, Nemiscau Lake and the Rupert River, caught 10,824 fish and releasing 6,116 (SEBJ, 2012). At the request of the Crees, five lakes included in the Corporation jurisdiction were closed in 2011 (SEBJ, 2012).

The following tables show the overall non-native fishing activities on the Nemaska territory between 2007 and 2011.

[5] With the election of a Parti Québecois government, the Plan Nord becomes « Le Nord pour tous ».

Table 8-3 Total Fishing Activity by Non-Native Nemaska Residents in the Weh Sees Inhodoun Corporation Territory, 2007-2011

Place of Residence	Fishers	Expeditions	Catches	Releases
Camp Nemiscau	1,332	5,372	12,908	48%
Residences TransÉnergie	639	3,720	12,142	57%
Others	2,085	5,048	40,986	61%
Total Weh Sees Inhodoun	8,270	38,231	123,342	57%

Source: SEBJ, 2012

Table 8-4 Non-Native Fishing Expeditions on Nemaska Traplines, 2011

Trapline	Number of Lakes	Number of Expeditions
R16	12	239
R17	8	145
R18	9	555
R19	8	72
R20	13	333
R21	10	490

Source: SEBJ, 2012

Table 8-5 Number of Fishing Permits Issued by the Nemaska Cree Council, 2007-2011

Year	Number of Permits
2007	500
2008	732
2009	726
2010	511
2011	313

Source: SEBJ, 2012

Table 8-6 Fishing Activity in Lakes and Streams by Non-Native Fishers in Nemaska, 2007-2011

Lake/Stream	Number of Expeditions					
	2007	2008	2009	2010	2011	Total
Nemiscau Lake	0	104	661	716	310	1,791
Lac des Montagnes	344	337	174	235	166	1,256
Champion Lake	269	499	476	110	140	1,494
Rupert River	293	409	359	637	414	2,112
Nemiscau River[1]	499	574	521	261	196	2,051
Mwakw Kachi Lake	0	190	88	130	71	479
Joliette Lake	0	52	34	109	34	229

[1] The species quotas were reached in 2011.

Source: SEBJ, 2012

Recreational Hunting

There is little recreational hunting by non-native users of the Nemaska territory. Local tallymen say that they are generally satisfied with the behavior of non-native hunters, except for one, who mentioned an attempted break-in at one of his family members camp in 2011 (SEBJ, 2012). In 2011, a single moose was caught by non-natives on trapline R19, the same territory in which another moose was killed in 2009.

All tallymen noticed a decrease in the presence of non-native hunters since the closure of Hydro-Québec's Camp Nemiscau. However, several mentioned the possibility that the gradual influx of greater numbers of caribou on the territory might attract more non-native hunters (SEBJ, 2012).

Hunting Camps and Outfitters

A Nemaska tallyman indicated that he intends to develop an outfitting facility on his land in the coming years (SEBJ, 2012). The active outfitter closest to the project site, Pourvoirie GRB Région 10, is located at Lac Evans, south of the community of Nemaska. Non-natives have also been granted a series of land rights in the project area by the ministère des Ressources naturelles. A total of 67 Land rights have been granted in a 10 km wide strip on either side of the Route du Nord, 23 of which are for vacationing purposes, 16 for private purposes, 8 for municipal purposes and 3 for industrial purposes (MRN, 2012).

8.3.1.2 Impacts Assessment

Identification of Sources of Impact

The sources of impact on the Land Use component identified for each project phase are the following:

Construction Phase

- Sites clearing and preparation (excavation, stripping, backfilling, blasting and overburden management);
- Construction of the infrastructures and temporary and permanent facilities;
- Water management (runoff, drinking water, wastewater, etc.);
- Management of residual materials, hazardous materials and fuel;
- Use, maintenance and circulation of heavy machinery and vehicles;
- Presence of workers and purchasing of goods and services.

Operation Phase

- Sites clearing and preparation (excavation, stripping, backfilling, blasting and overburden management);
- Presence and operation of the infrastructures and buildings;
- Extraction, storage and processing of the ore;
- Water management (runoff, drinking water, wastewater, etc.);
- Management of residual materials, hazardous materials and fuel;
- Use, maintenance and circulation of heavy machinery and vehicles;
- Presence of workers and purchasing of goods and services.

Closure Phase

- Water management (runoff, pit flooding);
- Presence of workers and purchasing of goods and services;
- Use, maintenance and circulation of heavy machinery and vehicles;
- Site rehabilitation.

Description of potential impacts

The following impacts were identified for the Land and Resource Use component:

1. Cree users of the land included in the study area will see their hunting activities disturbed near the mine site, along the Route du Nord and in the power line corridor. Moose and waterfowl hunting, in particular, may be affected as these species will avoid or leave the area. The impact will be felt over the entire life of the project and will force users to transfer their activities elsewhere on the territory.

2. The trapping of furbearing animals in the project area could be affected by a reduction in the populations of harvested species in favorable areas during the construction phase of the project. The project footprint will also result in a loss of potential habitat for furbearing animals.
3. Berry and firewood harvesting activities in the burned areas near the site will be affected.
4. The accessibility of the territory visited by the Cree will be disturbed or modified by the presence and activities of the mine, and this until its closure. In particular, snowmobile travel will have to adjust to the presence of installations, the safety perimeter and the circulation of trucks and heavy machinery in the operating area of the mine.
5. Over the life of the project, the presence of the mine and its activities will impact the tranquility and the use of Cree camps located near the site. In particular, users of the Bible camp could be affected by the construction, extraction and waste rock and tailings storage activities.
6. Resource harvesting activities by non-natives in the study area are generally limited to fishing in Lac des Montagnes and in the Nemiscau River. This activity could be disturbed by the mine activities over the entire duration of the project, including the closure phase.

Table 8-7 Impact Summary – Land and Resources Use

Description of the Impact	Positive/ Negative	Project Phases		
		Construction	Operation	Closure
1. Reduction in hunting activities along the Route du Nord and in the power line corridor near the mine site	Negative	✓	✓	✓
2. Reduction in trapping activities near the mine site	Negative	✓	✓	✓
3. Modification in harvesting activities (berries, plants and firewood) near the mine site	Negative	✓	✓	✓
4. Avoidance of harvesting resources (wildlife, aquatic and vegetal) due to a perception of contamination near the mine site	Negative	✓	✓	✓
5. Modification in the accessibility of the territory due to the presence of the mine	Negative	✓	✓	✓
6. Modification in the use of the Bible Camp and other camps near the mine site	Negative	✓	✓	✓
7. Disturbance of non-native fishing activities in Lac des Montagnes and Nemiscau River	Negative	✓	✓	✓

Description of Mitigation Measures

Mitigation measures being considered to reduce the impact of the project on the use of the territory by the Cree are the following:

1. In order to avoid disturbing the spring goose hunt, the mine will suspend all extraction activities (blasting, deposition of material on the tailings pile, etc.) during the spring goose hunt, also called the Goose Break.

2. The Cree users of the land will be informed regularly of the mine's calendar of activities to facilitate the management and, if necessary, the reorganization of their harvesting.
3. The Cree users of the territory and the members of the community will be informed of the results of the environmental monitoring, and will be consulted regularly about their observations and recommendations concerning the occupancy of the affected territory by wildlife species of interest.
4. If necessary a beaver and black bear trapping program will be implemented before the construction phase, jointly with the tallyman of trapline R20, Mr. James Wapachee.
5. The by-products of the site clearing, at any phase of the project, will be made available to Cree users of the land or to the community of Nemaska.
6. Protective measures will be taken to ensure the safety of Cree users along snowmobile routes that could be affected by the mine activities. Adequate signaling will be installed at appropriate crossings near the mine site.
7. Discussions will continue regarding the Bible camp, and with the Cree users of the camps that will be affected by the mine activities.
8. If possible, the waste rock and tailings pile will be designed so as to limit the propagation of noise towards the Bible camp.
9. Employees on the mine property will be prohibited from harvesting wildlife (hunting, fishing and trapping).

Significance of the Residual Impact

The social value of this component is high because of its importance for the community and because of the relationship of interdependence that link individual and collective cultural identities. Therefore, the value of this component is high. After applying the mitigation measures, the significance of the residual impact on the Cree Land Use component will be moderate.

Table 8-8 Significance of the Residual Impact – Land and Resources Use

Intensity	Extent	Duration	Significance of the Residual Impact
High	Regional	Long	High
Moderate	**Local**	**Medium**	**Moderate**
Low	Punctual	Short	Low

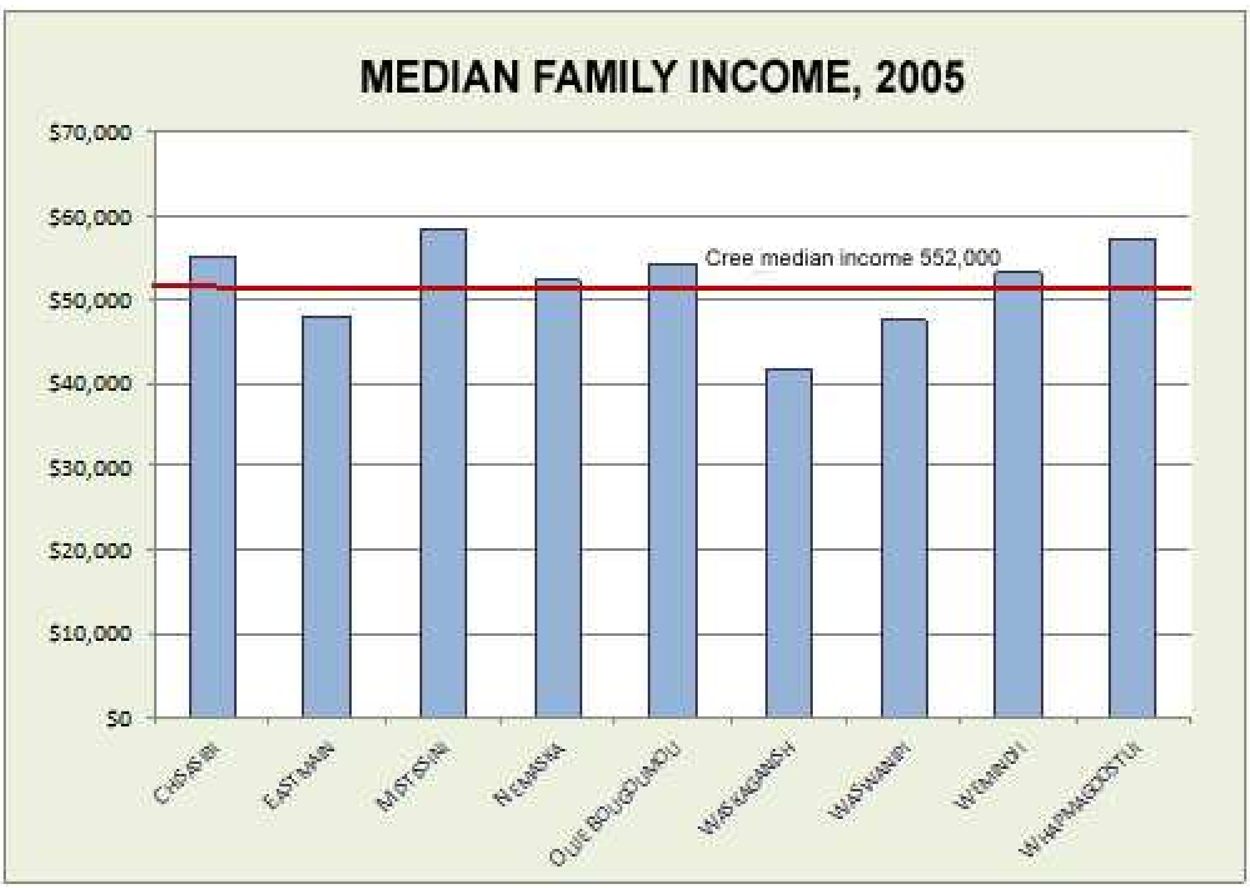
8.3.2 Employment and Economy

8.3.2.1 Description of the Environment

Employment Income and Transfer Payments

As shown in Figure 8-7, the median income of Cree families in 2005 varied little between the different communities of *Eeyou Istchee*. In 2005, the median family income in the community of Nemaska was $52,352 before taxes (Statistics Canada, 2006). In comparison, the median family income for the whole of *Eeyou Istchee* was $52,000 (Statistics Canada, 2006).

Figure 8-7 Median Family Income by Community



Source: Statistics Canada, 2006

In 2005, the median family income ($49,920-$50,719) and median individual income ($20,128-$22,471) after taxes in the community of Nemaska were slightly less than the Quebec average (Statistics Canada, 2006). Unlike the median family and individual income, the median household income in the community of Nemaska was higher than that of Quebec in 2005. However, this difference can be explained, among other factors, by the fact that the average size of households in the community of Nemaska is larger than that of Quebec (3.5 versus 2.3) (Statistics Canada, 2006).

It should be noted that specific characteristics of life in Cree communities influence income and consumption therein. The cost of living is generally higher in Cree communities, notably due to the high cost of consumer goods, transportation and energy.

Employment by Sector

The term "resource region" refers to a region where the main work providers are primary sector companies (exploitation of natural resources such as hydroelectricity, forests and mineral resources). The Nord-du-Québec region and *Eeyou Istchee* are considered such resource regions (MDEIE, 2011). Indeed, in the whole Cree nation, close to one fourth of the jobs (23.8%) are directly related to the primary sector (CHRD, 2009; MESS, 2010). However, as shown in Table 8-9, this situation does not apply to the community of Nemaska. On this point, Nemaska is distinct from other Cree communities in that it is an important administrative center for the *Eeyou Istchee* territory. In fact, the primary sector represented only 8.3% of the jobs in the community in 2008 (CHRD, 2009; MESS, 2010).

Table 8-9 Job Distribution by Economic Sector in Nemaska, *Eeyou Istchee* and Quebec

Economic Sector	Nemaska (%)*	*Eeyou Istchee* (%)*	Quebec (%)*
Primary	8.3	23.8	2.3
Secondary	6.3	10.3	20.2
Tertiary	85.4	65.9	77.5

Source: CHRD, 2009 and MESS, 2010

* Due to limited data availability, numbers for Nemaska and *Eeyou Istchee* are for 2008, while those of Quebec represent the year 2009.

Thus, in 2008, the tertiary sector (health, social and education services, municipal services or other governmental services) was the predominant economic sector, representing 85.4% of the employment in the community (CHRD, 2009; MESS, 2010).

As shown in Table 8-10, nearly a third (31%) of the jobs are in public administration, while this type of employment provides only 20% of the jobs in *Eeyou Istchee* (CHRD, 2009).

Table 8-10 Job Distribution by Economic Sector

Economic Activity Sector	Nemaska (%)	*Eeyou Istchee* (%)
Public administration	31.0	21.2
Other industrial	21.3	6.3
Education	13.1	15.8
Health care and social services	8.2	11.7
Agriculture, forestry, hunting and fishing	6.6	22.0
Arts, entertainment and leisure	4.9	1.3
Construction	4.9	8.7
Other services	3.6	3,6
Food	1.6	3.3
Wholesale and retail commerce	1.6	4.7
Finance, insurance, real estate	1.6	1.0
Information and culture	1.6	0.4

Source: CHRD, 2009

As in the case of the primary sector, construction is a marginal economic activity in Nemaska, representing only 4.9% of the jobs in the community. In *Eeyou Istchee*, the construction sector is much more important and represents almost twice the proportion of jobs (8.7%) than in Nemaska (CHRD, 2009). Also, only 6.6% of the jobs in Nemaska involve the primary sector (hydroelectricity, forestry, hunting and fishing), while in *Eeyou Istchee*, this sector provides 22% of the employment (CHRD, 2009). Because of this economic outline which is specific to the community of Nemaska, there could be some difficulty recruiting in the community the qualified labor required for certain operations.

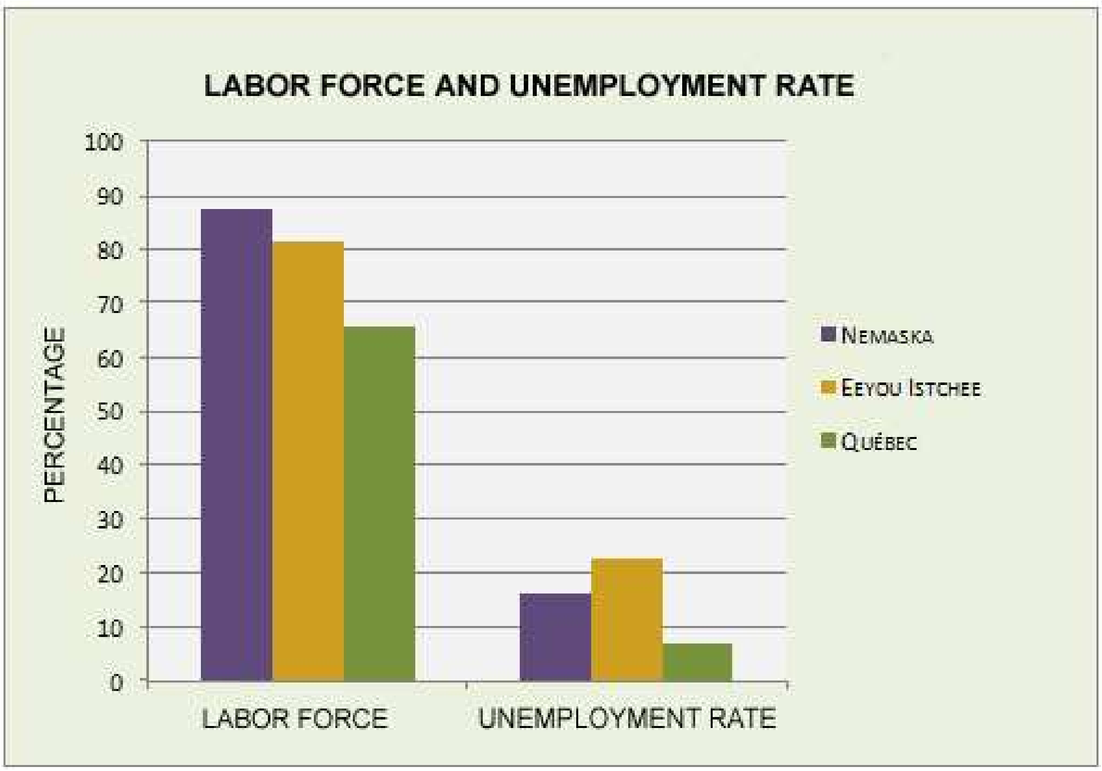
An interview with the director of the local development center indicates that several attractive projects with interesting economic spinoffs for the community are underway or being considered. For example, there are several contracts between Hydro-Québec and local businesses for construction work and environmental follow-up. A commercial center, a church and the municipal garage were built recently. Furthermore, several infrastructure projects have been undertaken, such as the construction of a new Band Council office, a new clinic and a justice center. The mining sector could also undergo a strong expansion; several mine projects in the region likely to increase further the demand for local workers, including the Rose project (Critical Elements), are being considered. Although a significant number of projects related to the construction sector have been carried out in the community (e.g. Hydro-Québec), the information collected to date shows that they do not have significant effects on the local labor.

Labor and Unemployment Rate

In general, the Cree communities experience a higher unemployment rate than the Quebec average. As shown in Figure 8-8 and Figure 8-9, the 2008 unemployment rate in the 15 to 64 year old population of *Eeyou Istchee* (22.8%) and Nemaska (16.4%) was much higher than for the population of 15 years old and more in Quebec as a whole (6.9%) (CHRD, 2009). Furthermore, the unemployment rate among the youth (15 to 20 years old; 23%) is much higher than among adults (24 to 64 years old; 15%) (CHRD, 2009). Data from the same study indicate that the unemployment rate in the community of Nemaska is lower than in the *Eeyou Istchee* territory (16.4%) (CHRD, 2009).

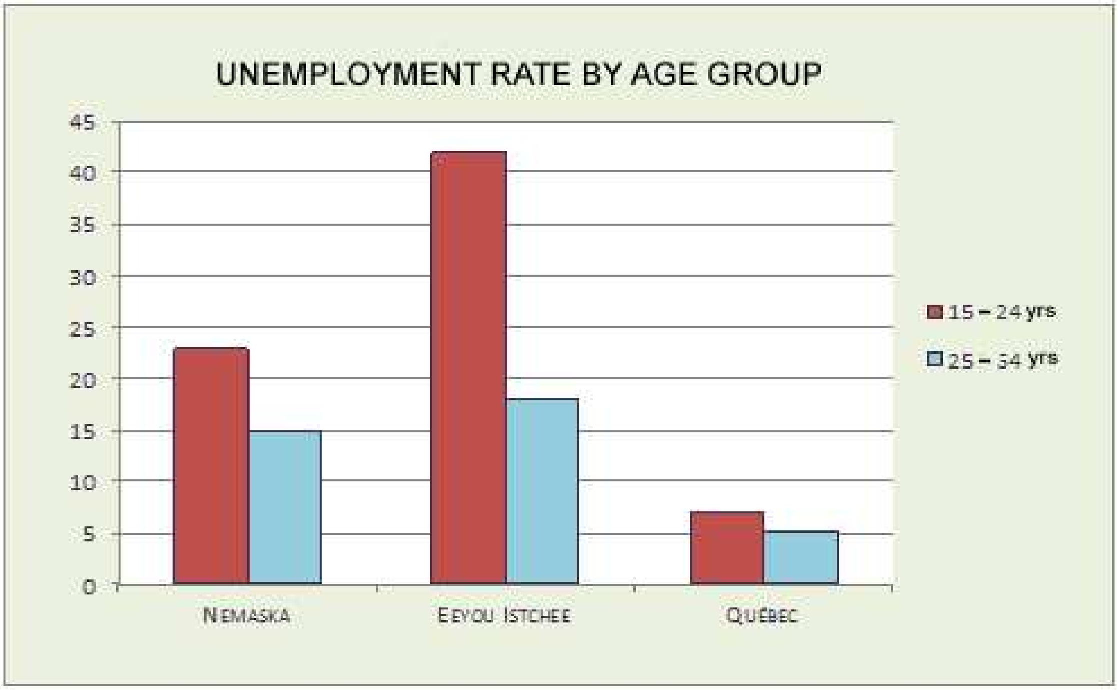
It is important to note that the absolute number of workers can be an important factor to consider when developing large projects. In 2012, the total population of the community of Nemaska was estimated at 722 persons, of which 215 were aged less than 15 years old, 52 were between 15 and 19, and 298 were between 20 and 49 years old. The employment on the Cree territory and the jobs offered by Cree organizations are another important element that must be taken into account, since these organizations enjoy fiscal advantages with which the private sector can hardly compete.

Figure 8-8 Labor Force and Unemployment Rate



Source: CHRD, 2009

Figure 8-9 Unemployment Rate by Age Group, 2008



Source: CHRD, 2009

Local Businesses and Industries

Several regional organizations and businesses are active in the *Eeyou Istchee* territory, and more specifically in Nemaska. These organizations and businesses belong to the Crees, the Band Councils or to a Cree-held entity. Although Nemaska constitutes an administrative center, none of the businesses mentioned below has its headquarters within this community. The main Cree businesses in the *Eeyou Istchee* territory include:

Newco

Newco is a joint venture of EBC-Nelson, Waska Ressources and the communities of Nemaska and Waskaganish. The company is active in the environment, civil engineering and forestry sectors.

Cree Construction and Development Company (CCDC)

The CCDC is active in road construction and maintenance in Quebec; its subsidiary in Nemaska is called Nemaska Eenou Company (NEC) (CCQ, 2012; REQ, 2012). In 2006, this business was the largest employer of Cree construction workers (CCQ, 2012).

Air Creebec

Air Creebec is an airline that is wholly owned by the Crees through CREECO (REQ, 2012). It serves the Cree communities throughout *Eeyou Istchee*, James Bay and Hudson Bay (Air Creebec, 2012). It also flies between the Cree communities and several destinations in Quebec (Montréal, Val-d'Or and Chibougamau) and Ontario (Timmins) (Air Creebec, 2012).

<u>PetroNor Petroleum Products</u>

PetroNor specializes in the distribution of petroleum products and lubricants throughout d'*Eeyou Istchee* (PetroNor, 2012). It also operates service stations in the region. It is held by two entities: Pétroles Beesum and Cree Energy Distribution (REQ, 2012). PetroNor can deliver fuel in bulk or in barrels to the mining projects in the James Bay territory (PetroNor, 2012).

<u>Groupe Kepa</u>

The Kepa Group is owned by the Cree communities of Chisasibi and Wemindji (Groupe Kepa, 2012a). It provides diversified services in ground cargo transportation over the whole James Bay and *Eeyou Istchee* territories (Groupe Kepa, 2012b).

<u>Cree Regional Economic Enterprises Company (CREECO)</u>

CREECO is wholly held by the Cree Regional Administration (GCC, 2012; CCQ, 2012; CREECO, 2012). It comprises all the Cree businesses that were created through the compensations provided under Article 25 of the James Bay and Northern Quebec Agreement (JBNQA) (GCC, 2012; CCQ, 2012; CREECO, 2012). In addition to the above-mentioned Air Creebec and CCDC, CREECO owns a multitude of other companies in the *Eeyou Istchee* region. Among them: Valpiro (aircraft servicing and maintenance) Servinor inc. and Jessel Foods (wholesale food), Eeyou Power LP (electricity production), Eeyou Baril, Gestion ADC (catering and housekeeping services) and Quality Inn (Val-d'Or).

Education and Training

The rate of graduation and participation in post-secondary education programs is generally lower in the Cree communities than in the rest of Quebec. As shown in Table 8-11, 444 individuals were registered in post-secondary curricula and in 2011-2012, this number increased to 494 registrations (Cree School Board, 2011). Among the 494 post-secondary students, 26 were from Nemaska (Cree School Board, 2011). According to the Cree School Board (CSB) annual report, this represents an approximate 11% increase in the number of students from *Eeyou Istchee* registered in a post-secondary program during the 2011-2012 school year (Cree School Board, 2011).

Table 8-11 Involvement in Higher Education, *Eeyou Istchee*

Institution	2009-2010		2010-2011	
	Registrations	Graduates	Registrations	Potential Graduates[1]
College	301	57	269	104
University	126	24	130	30
Vocational / Other	17	4	43	13
Total	**444**	**85**	**442**	**147**

[1] Potential graduates only. As of June 16, 2011, 26 students had graduated.

Source: Cree School Board, 2011

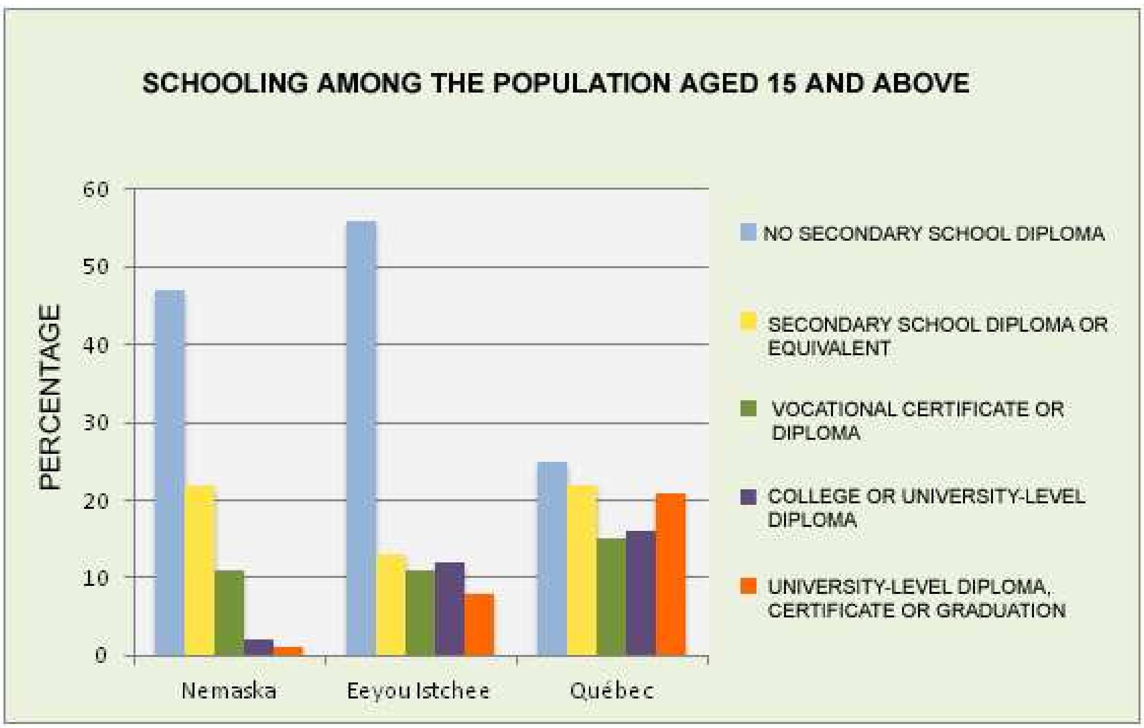
The most popular post-secondary programs in *Eeyou Istchee* are: arts/sciences (general) (32), nursing (26) and police science (24) (Cree School Board, 2011). Vocational training programs are relatively popular within the Cree population. In 2006, 11% of the population had a diploma or certificate from a vocational school, close to the Quebec average of 15% (Cree School Board, 2011).

Education in Nemaska

As illustrated in Figure 8-10, with regard to professional diplomas (apprenticeship or vocational school certificates) and college diplomas, the graduation rate in the community of Nemaska is similar to the Cree average with 11.2% of vocational diplomas and 11.2% for college diplomas, which is slightly lower than the Quebec average (Statistics Canada, 2006).

As in the case for the vocational and college-level sectors, the university graduation rate (9%) is similar to the Cree average and slightly less than the Quebec average (Statistics Canada, 2006). In 2006, the population of Nemaska had 240 members with only a secondary school diploma (or equivalent), not including other vocational and post-secondary diplomas, 50 with a college diploma and 40 who had a university diploma (Statistics Canada, 2006).

Figure 8-10 Comparison of the Schooling among the Population Aged 15 and above in Nemaska, *Eeyou Istchee* and Quebec



Source: Statistics Canada, 2006

With a total of 318 persons holding at least a secondary school diploma, Nemaska offers a labor pool that could be described as limited (Statistics Canada, 2006). Although these data could have evolved during the last five years and despite the recent intensive involvement of the

Crees in several development projects, the limited number of individuals who have a vocational diploma indicates that the pool of labor with technical expertise remains small. This labor is usually highly desirable for mining projects. This situation must therefore be taken into consideration when developing training and hiring objectives and goals for Cree labor.

It should be noted that the traditional summer hunting and trapping activities are very popular among the 17 to 26 years old. In fact, this age group is the second largest beneficiary of the Hunters and Trappers Income Security Program.

8.3.2.2 Impacts Assessment

Identification of the Impact Sources

The Whabouchi project will create many jobs and business opportunities for the community of Nemaska. It should be noted that the jobs created by the various project phases could correspond in part to the profile of professional abilities developed by the Nemaska workers, considering the major projects that have been undertaken recently in the region. Indeed, projects such as the Troilus mine or the Eastmain 1 and Eastmain 1-A-Sarcelle-Rupert hydroelectric projects have given to several Cree workers an opportunity to develop their skills in the areas of construction, heavy machinery operation and other specialized work relevant to the Whabouchi project.

However, the Nemaska Crees are generally involved in the tertiary sector or in the service industries. Therefore, they will need specially-adapted technical training programs to fully benefit from employment opportunities offered by the project. Moreover, the operation of the mine will create job opportunities that require a high degree of specialization (e.g. for the operation of the concentrator), and few Crees in Nemaska are trained in this area except those who could have had the opportunity of working at the Troilus mine's concentrator. The present section presents a summary of the project's sources of impact on employment and economy in the community of Nemaska.

Construction phase

- Sites clearing and preparation (excavation, stripping, backfilling, blasting and overburden management);
- Construction of the infrastructures and temporary or permanent facilities;
- Presence of workers and purchasing of goods and services;
- Water management (runoff, drinking water, wastewater, etc.).

Operation phase

- Sites clearing and preparation (excavation, stripping, backfilling, blasting and overburden management);
- Presence of workers and purchasing of goods and services.

Closure phase

- Dismantling of the infrastructures and installations;

- Presence of workers and purchasing of goods and services.

Description of impacts

The following impacts were identified for the Employment and Economy component:

1. The various phases of the Whabouchi project will create new jobs and vocational training opportunities for the members of the community of Nemaska. The intensity of this positive impact is high, considering regional underemployment issues that are demonstrated by statistics on the unemployment rate in Nemaska and in *Eeyou Istchee*. The importance of this aspect was mentioned repeatedly by the participants in consultation activities described in Chapter 3 (comments about job opportunities, local hiring, educational criteria, and one comment about jobs for the youth).

   The mine construction phase will need approximately 250 employees, while the operating phase will require the hiring of about 100 persons for mining activities, 78 for the operation of the concentrator, and 14 in administrative functions, representing 192 positions distributed over three shifts (Nemaska Lithium, 2012). An estimated 125 persons should be present at the mine site at any given moment. As for the closure of the mine site, it will call for 15 employees.

   The development, operation and closure of the mine site will have important economic spinoffs for the local and regional businesses. Indeed, many services that are essential for each of the phases will have to be provided by regional companies, Cree-controlled or not. The project also provides opportunities for the development of new enterprises or for the expansion of small and medium businesses in the region. However, the experience of the Troilus mine shows that the performance of joint ventures between Cree and non-Cree companies can be greatly improved by providing training to the Cree partners (Penn and Roquet, 2008). The requirements could include services relating to blasting, work camp construction and maintenance, site preparation, construction of certain infrastructures, materials transportation, waste rock and tailings pile reclamation at closure, as well as for the dismantling of the infrastructures.

   The topic of business opportunities for local and regional companies was in fact raised repeatedly by participants in the consultation activities described in Chapter 3 (comments about biases in the attribution of contracts, economic benefits of the project for the community, direct local business opportunities for Nemaska Enterprises, indirect business opportunities for local companies and economic diversification).

2. The Whabouchi project will result in an increased demand for goods and services in Nemaska. This increased demand will translate into important economic spinoffs within the community, notably for the local businesses.

3. The development of the Whabouchi project represents an opportunity for the Nemaska Crees to acquire relevant training, especially in the field of mining. Considering the potential deployment of numerous mining operations in the region, the training of Cree workers could open long-term employment perspectives, well beyond the life of the mine.

4. The closure of the mine will have an impact on the employment and economy, mainly in Nemaska. The positions created for the operation of the mine will be progressively

abolished at closure. Also, the businesses that benefited from the spinoffs of the mine or those that were created in response to its needs will have to develop new markets.

5. The development of the Whabouchi project represents a source of income for the provincial and federal governments. Additionally, the taxation of worker income will be another source of revenue for the governments.
6. Since the labour pool in Nemaska and the region is limited, the Whabouchi project could increase the pressure on local and regional human resources. This situation could in turn become a problem for personnel recruitment and retention for other employers in the community.
7. The salaries of community members hired by the mine could potentially result in increased debts for Cree families in Nemaska. This new income will facilitate access to credit, encouraging employees and their families to spend above their means, to purchase vehicles or for construction and renovation projects, for example. An employee of the CBHSSJB social services has estimated that this phenomenon was observed among the employees of the Troilus mine (Interview with a CBHSSJB employee, 2012), an assertion that has been corroborated by case studies (El Kreshi, 2009). This will add to the average indebtedness of Native families, which is higher than the Quebec average (the financial dependency index is 0.62 for Natives and 0.45 for the rest of Quebec) (MTQ, 2005).

   The integration of Cree and non-Cree workers at the mine will be a challenge in the operation of the Whabouchi project. The mine will employ Cree and non-Cree workers, which will involve a meeting of different cultures and languages.

A summary of the project impacts on the Employment and Economy component is presented in Table 8-12.

Table 8-12 Impact Summary – Employment and Economy

Description of the Impact	Positive/ Negative	Project Phases		
		Construction	Operation	Closure
1. Job creation for the Crees	Positive	✓	✓	✓
2. Business opportunities for local and regional enterprises	Positive	✓	✓	✓
3. Increased demand for goods and services in the community of Nemaska	Positive	✓	✓	✓
4. Socio-economic consequences of mine closure	Negative			✓
5. Increased government income (royalties and taxes paid by the mine and the employees)	Positive	✓	✓	✓
6. Difficulty in retaining local labour due to competition with the mine, and consequences for the existing employers in the community (labour availability, pressure on salaries, etc.)	Negative	✓	✓	
7. Risk of indebtedness in families of mine workers	Negative	✓	✓	✓
8. Integration of Cree and non-Cree workers at the mine (language, culture, discrimination)	Negative	✓	✓	

Mitigation Measures

A set of mitigation and enhancement measures will help reduce the significance of negative impacts and maximize the significance of positive impacts of the Whabouchi project:

1. Ensure that the partnership agreement clauses relating to employment and economy are followed during the entire project. The non-confidential elements of this agreement may be provided upon demand when it has been signed;
2. Implement an employee assistance program that will cover, among other issues, financial planning program, job transition at the closure of the mine, and other challenges relating to the intercultural context.
3. Promote the awareness of Cree culture among mine employees.

Significance of the Residual Impact

The social value of this component is high, as it involves major development issues for the community of Nemaska. It is therefore highly valued by the local community. Consequently, the value of the component is high. After applying the mitigation measures, the significance of the residual impact on the Employment and Economy component will be moderate. The intensity of the impact is considered high, since many jobs offering interesting training opportunities will be created, and because significant economic spinoffs are anticipated. As described above, the nature of the impact is both negative and positive. The frequency of the impact is considered continuous because the employment and economic spinoffs opportunities will remain. The extent of the impact is a regional, as the jobs created by the project and its economic spinoffs will be felt well beyond the study area. The duration of the impact is considered medium because it covers the three phases of the project, from construction to closure, and concludes at the end of the project.

Table 8-13 presents the values assigned to each indicator and the intensity of the resulting residual impact.

Table 8-13 Significance of the Residual Impact – Employment and Economy

Intensity	Extent	Duration	Significance of the Residual Impact
High	**Regional**	Long	**High**
Moderate	Local	**Medium**	Moderate
Low	Punctual	Short	Low

8.3.3 Community Wellness

8.3.3.1 Description of the Environment

The Crees generally exhibit a profound feeling of belonging towards their community. According to a 2003 survey by the Institut national de la santé publique du Québec (INSPQ), 82% of the *Eeyou Istchee* residents, all age groups combined, consider that their sense of belonging is "rather strong", compared to 56% for the general population of Quebec (INSPQ, 2008a).

Despite this strong sense of belonging, Cree communities such as Nemaska are confronted with serious social problems. The population agrees that three such issues are "serious" social problems in all *Eeyou Istchee* communities: alcohol and drug abuse, delinquency, and child neglect (INSPQ, 2008a). Other social problems, such as obesity, anxiety and suicide are also among the main social concerns reported (INSPQ, 2008b; INSPQ, 2008a). This section discusses the topics of alcohol, drug abuse, anxiety, suicide, parental neglect, poverty and criminality.

Alcohol

The public health impact of alcohol in the Cree communities has been known for a long time, and its negative consequences affect many other aspects of the community life. Like all the Cree communities in *Eeyou Istchee*, Nemaska is a "dry community", which means that the sale of alcohol is prohibited by regulation of the Band Council (INSPQ, 2008b). Therefore, there is no alcohol outlet on the community territory. Despite these dissuasive measures, the importation of alcohol from southern towns such as Val-d'Or, Chibougamau and Matagami is relatively common so that alcohol abuse continues to affect members of the community of Nemaska.

In general, the proportion of residents in Cree communities who consume alcohol is smaller than in the rest of Quebec (53% vs. 82%), and they consume less frequently than other Quebecers (INSPQ, 2008b; INSPQ, 2009).

The consumption of alcohol in Cree communities generally takes the form of binge drinking, i.e. an excessive consumption of alcohol at one time (INSPQ, 2009). This form of drinking tends to cause health problems, trauma, behavior problems and social problems (INSPQ, 2008b; Torrie, 2005). For example, one study reported in 2003 that 80% of the suicides in *Eeyou Istchee* were related to alcohol abuse (CBHSSJB, 2003).

Drugs

The intensity of the drug problem in Cree territory depends on a multitude of factors: the type of substance used, the quantity consumed, the mode of absorption, frequency of consumption, etc. As elsewhere in Quebec and Canada, cannabis (marijuana and hashish) is the preferred drug in *Eeyou Istchee*, and it is used more often by the young than by other age groups (INSPQ, 2008b).

Cocaine is the second drug most often consumed by the *Eeyou Istchee* population, with 8.6% of the individuals aged 12 or more who have used it (INSPQ, 2008b). As in the case of cannabis, cocaine is mostly used by the youth. It is also reported that the proportion of persons aged 15 and more who have consumed cannabis or cocaine increased between 1991 and 2003, going from 15% to 21% in the case of cannabis, and from 4% to 10% for cocaine (INSPQ, 2008b). The use of other types of drugs remains marginal in all the *Eeyou Istchee* communities (INSPQ, 2008b).

Suicide

The suicide rate in Native communities is generally much higher than among non-natives (Health Canada, 2006). For the Crees, however, the situation is different: in 2003, the suicide rate was lower than the Canadian average and well below the average in Native populations, and this since 1975 (INSPQ, 2008c; CBHSSJB, 2003).

Anxiety

According to interviews with members of the community, anxiety and its repercussions are a growing problem in Nemaska. Based on the comments collected during the consultation activities, the factors responsible for this evolution are the accelerated development of the regional economy, the lack of jobs and interpersonal tensions. Alcohol and drugs can also accentuate this phenomenon.

Parental Neglect

Parental neglect is another important social issue in the Cree communities. According to a report of the Direction de la protection de la jeunesse (DPJ) on the troubled youth in *Eeyou Istchee*, 1,137 cases were reported and 912 cases were accepted in 2010-2011. Among the latter, 80% are parental neglect cases, often related to alcohol and drug abuse (CBHSSJB, 2011). Table 8-14 reproduces data from this study.

Table 8-14 Troubled Youth Cases Reported and Treated

	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011
Reported	1 141	1 169	1 121	965	951	1 035	1 137
Accepted	933	1 026	918	842	711	858	912

Source: CBHSSJB, 2011

Poverty

The proportion of persons earning a low income has slightly decreased between 2006 and 2009 in *Eeyou Istchee*. Nevertheless, 20% of the *Eeyou Istchee* families with one child or more lived on a low income in 2009, compared to 4% of the families in the rest of the James Bay region.

A survey taken by the INSPQ in 2003 on food insecurity in *Eeyou Istchee* shows that slightly more than a quarter (26.6%) of the Cree adult population had lived through a situation of food insecurity (INSPQ, 2008d) compared to almost 15% of the population of Quebec (ISNPQ, 2008b). No significant variation by gender or age can be observed in the case of food insecurity, though older individuals are generally less at risk.

Police and Criminality

The Cree communities now operate their own regional police force, known as the Eeyou-Eenou Police Force (EEPF). Its headquarters are located in Chisasibi. The office of the local police force serving Nemaska is located in the community and has five employees (one chief, three police officers and one auxiliary officer).

Violent crime is rare in Nemaska. The local police department reports that the majority of crimes are associated with alcohol and drug abuse. Drunk driving is indeed one of the most frequent offences in the community.

Interviews conducted with members of the Nemaska police force highlighted the most frequent offences in the community:

- Problems related to youth delinquency (e.g. vandalism);
- Assault with a weapon and weapons possession;
- Problems related to drug and alcohol abuse;
- Driving offences (impaired driving);
- Domestic violence.

Justice Center

A Justice Center was recently built in Nemaska and will be inaugurated soon. This new Center should facilitate the administration of justice in the community. Until now, legal affairs in the community were dealt with by the traveling court of Quebec (Galarneau, 2008).

8.3.3.2 Impacts Assessment

Sources of Impact

The sources of impact for the Community Wellness component are:

Construction Phase

- Presence of workers and purchasing of goods and services.

Operation Phase

- Presence of workers and purchasing of goods and services.

Closure Phase

- Presence of workers and purchasing of goods and services;
- Presence of remnants on the site.

Description of Impacts

The following impacts were identified for the Community Wellness component:

1. The arrival of workers from other regions may increase the availability of illicit substances (drugs and alcohol) to the members of the community of Nemaska, a phenomenon that is

well known to the health care workers in the region. This potential impact was mentioned during the consultation described in Chapter 3.

2. The development of the Whabouchi project could have a positive impact on the community members' quality of life as a result of the economic opportunities it will create. Several participants in the consultation mentioned the mine's potential contribution to the improvement of living conditions in Nemaska.
3. The project could have negative impacts on the social cohesion of the community. The members of the community will not all be in a position to benefit uniformly from economic opportunities offered by the mine, and the perceived disparities between those who have jobs or contracts and the other members of the community could intensify existing tensions. In this regard, during consultation activities, several concerns were expressed about the distribution of the project's economic spinoffs in the community (comments about competition for local jobs, conflicts between members of the community, disputed trapline boundaries, intra-family conflicts, and about the concentration of the mine's economic spinoffs in the hands of the tallymen). The concentration of economic opportunities among the tallymen and their families was a recurring concern in these discussions.
4. For some Crees, the development of the project could contribute to a feeling of gradual loss of their traditional way of life and their cultural identity. It is recognized that rapid structural changes in Native communities can destabilize the community, which translates as anxiety regarding development and the changes brought to the environment.

Table 8-15 presents a summary of the impacts of the project on the Community Wellness component.

Table 8-15 Impact Summary – Community Wellness

Description of the Impact	Positive/ Negative	Project Phases		
		Construction	Operation	Closure
1. Potential increase in the accessibility of illicit substances in the community	Negative	✓	✓	✓
2. Improved quality of life due to economic opportunities created by the mine	Positive	✓	✓	✓
3. Reduced cohesiveness of the community	Negative	✓	✓	✓
4. Feeling of loss and breach of cultural identity associated with changes in the land	Negative	✓	✓	✓

Description of the Mitigation Measures

The following measures to mitigate negative impacts and to enhance positive impacts on the Community Wellness component are being considered:

1. Develop a drug and alcohol abuse prevention program in collaboration with the CBHSSJB and the Nemaska community wellness center.

2. Adopt strict zero-tolerance disciplinary measures concerning drugs and alcohol for the mine workers.
3. Distribute the mine's newsletter in the community of Nemaska.

Significance of the Residual Impact

The social value of the component is high because it somehow constitutes the foundation of wellness in the context of the other human environment components. Furthermore, there is a close relationship between health and wellness. Therefore, the value of the component is high. After applying the mitigation and enhancement measures, the significance of the residual impact on the Community Wellness component will be moderate. The intensity of the impact is moderate since the project will modify the existing equilibrium of the community wellness.

The nature of the impact on the community wellness is both negative and positive. The frequency of the impact is considered as continuous because the impact will last over the entire project. The extent of the impact is local because it will be felt mainly by the members of the Cree community of Nemaska.

Table 8-16 presents the values assigned to each indicator and the resulting significance of the residual impact.

Table 8-16 Significance of the Residual Impact – Community Wellness

Intensity	Extent	Duration	Significance of the Residual Impact
High	Regional	Long	High
Moderate	**Local**	**Medium**	**Moderate**
Low	Punctual	Short	Low

8.3.4 Cultural and Archaeological Heritage

8.3.4.1 Description of the Environment

A review of the inventory of Quebec archaeological sites (ISAQ) was carried out to identify known archaeological sites in the vicinity of the Whabouchi project. Three such archaeological sites are located within 1 km of the mine site. Table 8-17 presents details about these three archaeological sites.

Table 8-17 Archaeological Sites near the Whabouchi Project

Site	Distance from Project	Cultural Identification	Informal Location
EkFx-1	Less than 1 km	Indeterminate prehistoric Amerindian (12,000 to 350 BP)	Eastern shore of the Nemiscau River
EkFx-2	Less than 1 km	Indeterminate prehistoric Amerindian (12,000 to 350 BP)	Eastern shore of the Nemiscau River, east of site EkFx-1
EkFx-3	1 km	Indeterminate prehistoric Amerindian (12,000 to 350 BP)	Northern shore of Lac des Montagnes, near the mouth of the Nemiscau River

Source: Archéo-08, 2012

In 2011, the firm of Archéo-08 completed an archaeological potential study that covered an area of 20 km². Its main objective was to evaluate the probability of prehistoric and historic human occupations (Archéo-08, 2011).

Following this archaeological potential study, during the summer of 2012, an archaeological inventory was carried out on the site of the mining project, in order to verify the presence or absence of archaeological remains within the project footprint. Manual surveys and visual inspections focused on areas considered to have archaeological potential (Archéo-08, 2011). The surveyed territory covers a surface area of approximately 20 km^2 on either side of the Route du Nord at the level of kilometer 275. The surveyed area was subdivided into seven zones, as illustrated in Figure 8-11:

Zone 1: Located at Lac des Montagnes

Zone 2: A section of the eastern shore of the Nemiscau River

Zone 3: Located east of the mine site and the South of the Route du Nord

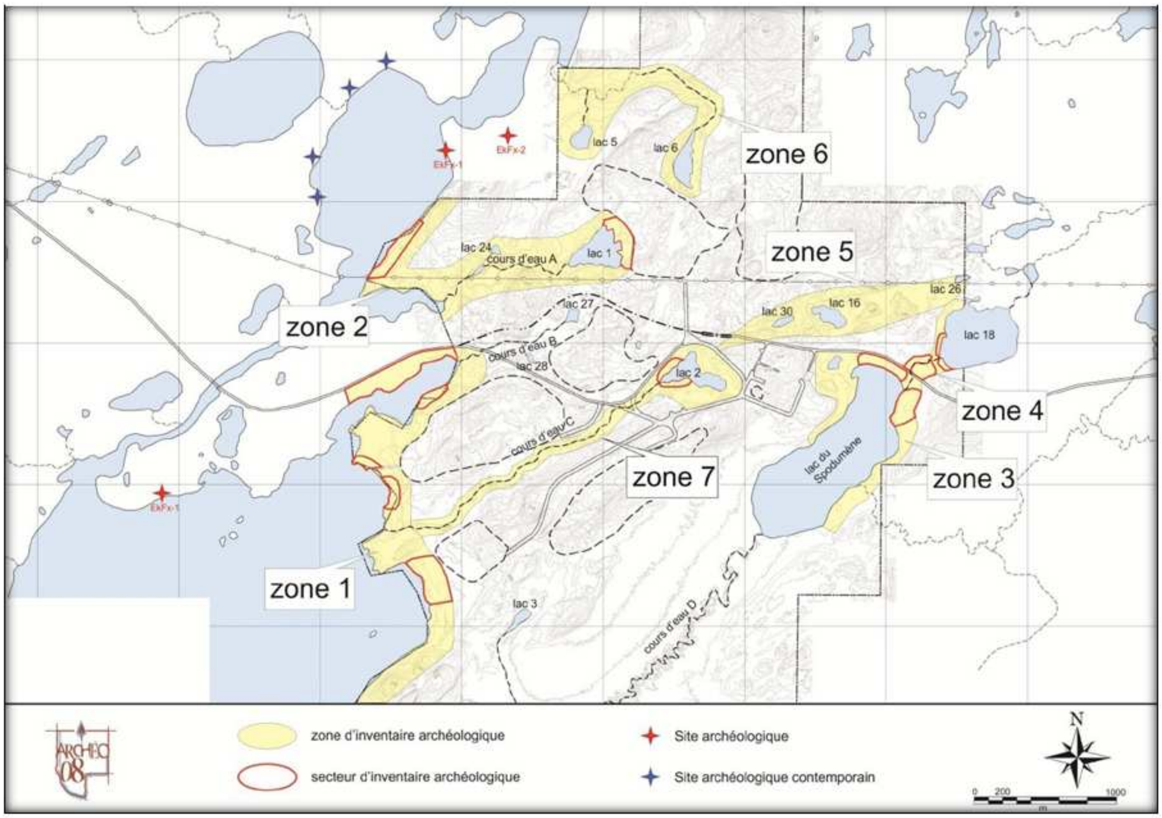
Zone 4: North of the stream that links Lac du Spodumène to Lac 18, as well as the western third of Lac 18

Zone 5: North of Lac 2 and ending southwest of Lac 2

Zone 6: Combines lakes 5 and 6 as well as the streams that link them to the Nemiscau River

Zone 7: Perimeter of Lac 2 and stream C, which connects Lac 2 to Lac des Montagnes

Figure 8-11 Location of the Archaeological Survey Areas



During the archaeological inventory the tallyman of trapline R20, on which the mine property is located, was interviewed, as was Mr. Erick Cheezo, a user of trapline R16. These interviews provided relevant information about the location of past Native encampments and installations. This survey did not lead to the discovery of historical or archaeological sites, though some recent Cree encampments were discovered during the fieldwork. These camps were described, photographed and located using GPS. They provide insight about the construction methods, the use of the land and the resources available to the Crees on the shores of the Nemiscau River.

No remains of human establishments prior to the 1950s were identified by the archaeological survey. In light of the results, the work contemplated within the boundaries of the mine property will have no impact on the Cultural Heritage and Archaeology component. Therefore no impact assessment was undertaken. However, in the event that archaeological remains would be discovered fortuitously during the work, the site(s) of the finds will be managed in accordance with the Quebec Cultural Property Act (L.R.Q., ch. B-4).

Also, if archaeological remains are found on the mine site, the supervisors shall have the obligation of promptly reporting them to the contractor and, if necessary, suspend work in the location of the discovery until archaeologists can complete their assessment. Nemaska Lithium will also notify the tallyman and Cree authorities.

8.3.5 Landscape

8.3.5.1 Description of the environment

Landscape issues involve the activities associated with land use and the sociocultural specifics of the environment. In Native contexts, the characterization of landscape transformations due to a development project such as Whabouchi pose analytical challenges because of the major differences between Cree and non-Native concepts of the affected land.

The landscape is both a physical reality and a perceptual reality that can be apprehended by human consciousness. Its attractiveness also resides in its capacity to incarnate an identity and provoke identification through its symbolic dimension. The landscape is also the repository of memories that speak as much of natural events as of cultural events, each causing the others in the cycles of harmonious or unbalanced interaction (Samson, 1996).

Loosely defining the word "landscape", one can say that it is simultaneously a geographic, topographic and biophysical reality that is in interaction with humans, who perceive it through a cultural filter.

The analysis of the landscape that will receive the Whabouchi project requires identifying landscape units defined and classified according to a set of standard criteria – such as accessibility, exposure and visual interest, or the sensitivity of the observer, whether he/she is mobile, stationary or passing through. As the project's receiving environment is a territory that is visited mainly by the Cree, it is important to mention what distinguishes and characterizes their concept of landscape.

Cree Conception of the Landscape

Literature about the landscape appreciation among the James Bay Crees is practically inexistent. At this time, we can only propose inferences based on the knowledge of the current sociocultural context. The James Bay Cree communities exhibit a significant diversity with regard to cultural learning, the experience of the land, and the relationship with this land, among others. This diversity is especially pronounced between generations and manifests itself both in the aesthetic or spiritual values associated with the landscape and at the more abstract level of the concept of territory. The Cree notion of landscape therefore includes appreciation criteria that can vary between generations and among individuals themselves. This diversity is partly due to the historical circumstances and must be considered in the assessment of the value given to the landscape and in the definition of the landscape issues that are significant for the Cree.

Generally speaking, elders and trappers speak of the landscape and its components in a descriptive and pragmatic fashion, even when expressing feelings such as their attachment to a given location. Certain landscape elements can take a cultural, sacred or legendary character and can include major rapids or waterfalls, mountains and topographic features such as rocks, cliffs, islands and beaches. They can also be community or family gathering places, such as the Bible Camp, or locations that are associated with the loss of kin or ancestors. The land is dotted with burial sites, the exact location of which might not be systematically known to all, but that can be invested with affective attachment or a particular spiritual dimension.

The trappers often refer to the system of ecological relationships that characterize the landscape. They seldom mention aesthetic criteria when speaking of valued landscapes and locations. On the other hand, they will evoke the richness of the animal or vegetal resources of a location and its heritage or familial value. This explains that breaches of the integrity of the land are a prime and general concern in relation with the foreseen changes, before the concerns about visual aspects.

The way trappers speak about the landscape differs from that of young Cree or adults that went through the non Native education system. For them, the aesthetic value of a landscape can be evoked and highly appreciated. In their discourse, they will nevertheless refer to the idea of a rupture in the ecological integrity of the landscape. The relationship between habitats and species that compose them, as well as the collective memory deposited in every parcel of the environment, seem to be inseparable from the visual dimension of a landscape.

Notwithstanding the differences in expression between generations, the Cree notion of landscape is therefore based on the territory and its integrity, on the feeling of belonging and on the collective identity. We can also suppose that the appreciation of the landscape includes a sacred or spiritual dimension for many Cree of all generations, and that any modification in the landscape caused by the operation will represent an infringement on this dimension. The relationship with the sacred is a particularly delicate topic that is difficult to discuss with the Cree, with the risk that it might be ignored by the analysis. Let us just mention that the spiritual value given to the land seems to be carried with varying degrees from one generation to the other and that, for many, it does not seem to preclude open-mindedness toward the development of the territory.

As a part of the present project, the collected information on the perception of the landscape and the value given to it by the Cree were documented during interviews with users of the traplines located near to project and with other members of the community of Nemaska. The landscape-related perceptions and values expressed by the Cree respondents were noted during the identification of valued sites and areas, sites of interest for the community, as well as during discussions about the specificities of each trapline, among others.

For the purpose of the landscape analysis, we can identify certain locations which are valued at the individual or family levels and others that are valued collectively or, at least, by a large proportion of the community. Landscape units retained for the visual analyzes were defined on the basis of the two perspectives described above.

On the biophysical level, the landscape that will receive the Whabouchi project is typical of the James Bay highlands and of the Rupert River watershed. It is defined by an undulating relief and by a discontinuous loose cover composed of glacial material. Mount Chinuchi, northwest of the mine property, is the highest point in the area with an altitude of 442 m. Most of the water bodies are small, Lac des Montagnes being the largest, followed by Lac du Spodumène. Spruce-moss stands dominate the vegetal landscape, and the forest displays a varying density dominated by black spruce. Slightly more than half of the study area is covered with regenerating burns and wood debris, mainly to the North of the Route du Nord and east of Lac des Montagnes.

In this context, the six following landscape units were selected for analysis:

- The sector of the future mine pit;
- The sector of the waste rock and tailings pile;
- The point of view on these two landscape units from the Route du Nord;
- The point of view in front of Mr. Reggie Wapachee's camp, toward the northeast;
- The point of view from the Bible camp, toward the northeast;
- All the points of view from Lac des Montagnes that offer visual access to the future waste rock and tailings pile or to landscape areas that are transformed by the project activities.

8.3.5.2 Impacts Assessment

The sources of impact on the Landscape component were identified as follows for each project phase:

Construction Phase

- Sites clearing and preparation (excavation, stripping, backfilling, blasting and overburden management);
- Construction of the infrastructures and temporary or permanent facilities.

Operation Phase

- Sites clearing and preparation (excavation, stripping, backfilling, blasting and overburden management);
- Presence and operation of the infrastructures and buildings;
- Extraction, storage and processing of the ore;
- Progressive rehabilitation of the waste rock and tailings pile.

Closure Phase

- Site rehabilitation;
- Dismantling of the infrastructures and installations;
- Presence of remnants on the site.

Description of Impacts

The following impacts were identified for the Landscape component:

1. During the construction and operation phases, the clearing of the land and the construction of the infrastructures and buildings, as well as their permanence on the land, will alter the existing landscape. The impact, however, will be less severe in the construction phase than during the operation phase. Indeed, the excavation of the pit and

the expansion of the waste rock and tailings pile will have a growing impact on the landscape. Cree users, in particular, will see significant modifications in the landscape from the many points of view in the surroundings. The waste rock and tailings pile, in particular, will create a significant visual obstacle for travelers or for the users of camps located near the site. The users of the Route du Nord will also see changes in the visual quality of the landscape near the site as its major infrastructures expand.

The waste rock and tailings pile, in particular, will occupy a growing surface area as the exploitation of the deposit progresses. The proposed modification of the routing of a section of the Route du Nord could potentially have a visual impact inasmuch as the new layout will open a different point of view on an impacted landscape, namely the north face of the waste rock and tailings pile. The continuous lighting of the facilities will also have a negative impact on the visual quality of the landscape. During the closure phase, the impact on the landscape will gradually decrease. At the completion of this work, the landscape will be permanently modified, but the visual impact will diminish with time due to the revegetation of the waste rock and tailings pile and the gradual flooding of the pit. Photo 8-1 reproduces a 3D simulation of the waste rock and tailings pile and pit after rehabilitation. Photo 8-2 shows a view of the site while nearly half of the waste rock and tailings pile has not yet been restored.

Photo 8-1 Simulated Perspective of the Waste Rock and Tailings Pile Beach

Photo 8-2 Simulated Aerial Perspective of the Site

Table 8-18 presents a summary of the project's impacts on the landscape.

Table 8-18 Impact Summary – Landscape

Description of the Impact	Positive/ Negative	Project Phases		
		Construction	Operation	Closure
1. Modification of the landscape associated with the site clearing and preparation work (opening on the land)	Negative	✓	✓	✓
2. Visual impact of the mine facilities (man-made additions to the natural landscape)	Negative	✓	✓	
3. The ore extraction and storage, particularly the development of the pit and waste rock and tailings pile will modify the landscape by altering its topography	Negative		✓	
4. The dismantling of infrastructures and facilities will reduce the presence of man-made constructions in the landscape	Positive			✓
5. The rehabilitation of the site will partly restore the natural character of the landscape	Positive			✓

Description of Mitigation Measures

The mitigation measures contemplated for the Landscape component are the following:

1. A progressive revegetation of the waste rock and tailings pile and the restoration of surfaces that have been altered over the life of the project will be implemented and their effectiveness will be monitored. In order to maximize the growth of the plant cover and the visual aspect of the waste rock and tailings pile, native plant species will be favored and measures will be taken to give the most natural appearance possible to the waste rock and tailings pile, by giving rounded shapes to the piles of materials.

2. In the planning phase, the use of materials that optimize the visual integration of the installations with the landscape will be priviledged.
3. If necessary, visual screens to hide aesthetically disturbing infrastructures will be built.

It should be noted that the mitigation measures contemplated in Chapter 6 for the ambient light levels will also apply to the landscape component, notably with regard to the visual aspect of light pollution.

Significance of the Residual Impact

The social value of this component is high because of its significance for the local community. As previously mentionned, the landscape is not limited to visual aesthetic features, but incorporates a much wider set of elements, which includes temporal and spiritual dimensions. Consequently, the value of the component is high. After applying the mitigation measures, the significance of the residual impact on the Landscape component is high. The intensity of the impact is considered high, as the project will significantly modify the structure of the existing landscape, notably by adding anthropogenic elements. The nature of the impact on landscape is mostly negative. The frequency of the impact is considered continuous because the impact will be felt for the entire duration of the project. The extent of the impact is local, since the landscape alterations will be perceptible beyond the project footprint. The duration of the impact is considered long because it will persist after the end of the project.

Table 8-19 presents the values assigned to each indicator and the resulting significance of the residual impact.

Table 8-19 Significance of the Residual Impact – Landscape

Intensity	Extent	Duration	Significance of the Residual Impact
High	Regional	**Long**	**High**
Moderate	**Local**	Medium	Moderate
Low	Punctual	Short	Low

8.3.6 Community Infrastructures

8.3.6.1 Description of the Environment

Health Services and Social Resource Use

<u>Day-Care Centers</u>

According to interviews and consultations with stakeholders in Nemaska, the community's day-care center has always operated at full capacity. In 2012, 58 children were registered at the day-care center, which is its maximum capacity. Looking at the high birth and fertility rates in the population, it is foreseeable that the demand for this type of service will increase in the coming years. Table 8-20 shows the ratio of children per educator at the SheSheGuin Day-care Center for the years 2003 and 2012.

Table 8-20 Ratio of Children per Educator at the SheSheGuin Day-Care Center, 2003 and 2012

	2003	2012
Infants (0-18 months)	4	12
Tots (19-23 months)	6	6
Toddlers (24-35 months)	8	11
Preschooler (36-47 months)	8	16
Nursery school (48-59 months)	10	13

Source: SheSheGuin Day-care Center, 2012

Health and Social Services

Health and social services in all *Eeyou Istchee* communities are provided by the Cree Board of Health and Social Services of James Bay (CBHSSJB). Each of the nine Cree communities is served by a clinic, the Community Miyupimaatisiiun Center (CMC), which offers mainly primary care and a dental clinic. The CBHSSJB also employs six psychologists, a social worker, a therapist and a traditional healer, who visit the nine communities on a regular basis. The clinics are generally managed by nurses (CBHSSJB, 2011).

According to interviews with stakeholders in the health sector, the community of Nemaska lacks funding and competent personnel (e.g. psychologists, social workers, on-site ophthalmologist etc.). For example, during the consultations in the community, 79 persons were on the waiting list for the services of an optometrist and/or ophthalmologist in Nemaska.

There is also a sub-regional hospital on the *Eeyou Istchee* territory, in the community of Chisasibi, which offers a limited range of services (INSPQ, 2008e). People who need hospital care involving more resources are treated in hospitals in the South, mainly in Abitibi-Témiscamingue, Nord-du-Québec and Montréal, according to the level of care required (INSPQ, 2008e).

Community Support Services

The population of Nemaska has access to several social services and community organizations. These include the Wellness Center, the social services department, a multiservice day care center (MSDC) and the Youth department. The programs of these organizations focus mainly on vulnerable populations. The lack of resources (financial, qualified employees and time) to meet the continually increasing needs of the community was mentioned during interviews and consultations with stakeholders in the sector.

Housing

For many years, the lack of housing has been a major concern in all the Cree communities. As all other *Eeyou Istchee* communities, Nemaska is governed by the Indian Act, meaning that the administration of the collectivity rests in the hands of the Band Council. Thus, the Band Council manages the funds of the Canada Mortgage and Housing Corporation (CMHC) that are allocated for the construction and renovation of housing. It also administrates, among others, the housing subsidies for the territory. Private property is therefore almost inexistent in *Eeyou Istchee*, which makes it very difficult for the members of the community to obtain personal financing (e.g. mortgages). For example, according to the Nemaska housing administration, only two individuals owned their residence in 2012.

In 2011, Nemaska had a total of 226 dwellings, a 13% increase from 2006. Among these, 200 were considered as occupied by ordinary residents (Statistics Canada, 2006 and 2011). The Nemaska housing administrator and other members of the community estimated that, at the beginning of 2012, there was a shortage of 84 dwellings, while the sums allocated to the communities by the Nemaska general administration are only sufficent to build between two and four new houses per year.

The number of persons per dwelling in the Cree communities has greatly diminished during the last decades, but it remains higher than the Quebec average. In 2011, the average number of persons per household in Nemaska was 3.5, while in Quebec, this average was 2.3 (Statistics Canada, 2011). In 2006, an estimation of the number of occupied houses where there was more than one person per room showed an average of 5.7% in Nemaska, while in Quebec, this average was 1% (Statistics Canada, 2006).

In addition to the shortage of housing, the buildings' poor and unsanitary condition is an important issue within the community. In 2006, it was estimated that 22.9% of the occupied dwellings were in need of major repairs (Statistics Canada, 2006). Mould is the main problem related to the salubrity of the houses.

This situation is due to a multitude of factors, such as weather conditions, insufficient material and financial resources, and the lack of routine maintenance.

To make up for the shortage of housing in the community and facilitate access to ownership, Canada Mortgage and Housing Corporation (CMHC) is implementing its Home Ownership Program in Nemaska. This program offers mortgages that facilitate access to ownership for the Natives. Many members of the community of Nemaska have expressed an interest for this program.

8.3.6.2 Impacts Assessment

The sources of impacts on the Infrastructures component were identified as follows for each project phase:

Construction Phase

- Presence of workers and purchasing of goods and services.

Operation Phase

- Presence of workers and purchasing of goods and services.

Closure Phase

- Presence of workers and purchasing of goods and services.

Description of Impacts

The following impacts were identified for the Community infrastructures component:

1. Concerning the project exerting a pressure on social services, a community worker from the Cree Health Council social services said that major projects, such as Eastmain-1 in particular, increased the workload of the social services (CBHSSJB, 2012). It was also shown that with the intensification of economic activity and the integration of many Crees in the regional job market, practices or services that are more frequent among the Cree than in the general population of Quebec, such as elder care, are declining, which could intensify the pressure on social services (Vincent, 1998). In the case of the Whabouchi project, due to the nature of its activities and despite the fact that the project is smaller than Eastmain-1 (at least during the construction phase), it is anticipated that there will be repercussions on Nemaska social services. Among others, there would be an increased demand for various healthcare services (illness, injuries, etc.) not only from members of the community but also from outsiders.

   Also, considering the anticipated schedules and work shifts, it should be expected that the social services, which offer family support services, may be increasingly solicited even though community members will return home after their work day. The impact on social services will be felt mainly during the construction and operation phases of the project. As for the health services, the intensity of the impact will be variable, but it will be felt over the three phases of the project. As mentioned earlier, many of Nemaska's social organizations have a very limited capacity to absorb increased loads due to various reasons such as the lack of resources (population support services), and space (day-care center). The social service organizations also feel increasing pressure due, among other factors, to the population growth in Nemaska. With regard to housing, job creation and the project's economic spinoffs in the community will create favorable conditions for access to ownership, which will revitalize social projects such as the Home Ownership Program.

Table 8-21 presents a summary of the project impacts on the Infrastructures component.

Table 8-21 Impact Summary – Infrastructures

Description of the Impact	Positive/ Negative	Project Phases		
		Construction	Operation	Closure
1. Increased pressure on social services (elder care, day-care services, health and social services, youth protection).	Negative	✓	✓	
2. Easier access to housing	Positive	✓	✓	✓

Description of the Mitigation Measures

The mitigation measures contemplated for the Community infrastructures component are the following:

1. A nurse and personnel trained in first aid will be on the mine site all times and will treat benign cases at the mine, thus minimizing the demand on the Nemaska medical services;
2. Identify and create intervention partnerships with the key social and community organizations in Nemaska.

Significance of the Residual Impact

The social value of this component is moderate, because community infrastructures play an essential role in addressing important social issues in the community and help maintain its balance. However, this role will not be fundamentally impacted or compromised by the project. After applying mitigation measures, the significance of the residual impact on the community infrastructures will be moderate. The intensity of the impact is considered low, as the mitigation measures will limit the increase in demand for health services, among others. The nature of the impact on community infrastructures is both negative and positive. The frequency of the impact is considered as continuous, as the impact will occur over the entire project. The geographical extent is local because eventual effects on the community infrastructures will be felt beyond the project site. The duration of the impact is considered medium, because at the conclusion of the project, the potential pressures do to an increase in the population (presence of mine workers) on the existing infrastructure will cease.

A summary of the impact of the project on the community infrastructures component is presented in Table 8-22.

Table 8-22 Significance of the Residual Impact – Infrastructures

Intensity	Extent	Duration	Significance of the Residual Impact
High	Regional	Long	High
Moderate	**Local**	**Medium**	**Moderate**
Low	Punctual	Short	Low

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NEMASKA LITHIUM

CHAPTER 9

CUMULATIVE EFFECT ASSESSMENT

Environmental and Social Impact Assessment

March 28, 2013

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9. CUMULATIVE EFFECT ASSESSMENT

This chapter discusses the assessment of the project's cumulative effects.[1] The assessment of cumulative effects is based on the Cumulative Effects Assessment Practitioners' Guide published by Canadian Environmental Assessment Agency (CEAA) (Hegmann et al., 1999) and the method described in the CEAA's Operational Policy Statement: Addressing Cumulative Environmental Effects under the Canadian Environmental Assessment Act (ACÉE, 2007).

Cumulative effects refers notably to the effects of the present project development, in this case the Whabouchi project, on the valued environmental and social components, considering as well the impacts caused by past, current or future actions, projects or events on these same components, within a define spatiotemporal perspective.

The cumulative effects assessment process includes the following major steps:

1. Establishing the scope of the assessment (notably, identifying regional concerns, selecting valued components (VC) and defining the spatial and temporal limits).
2. Identifying the past, present and future projects, actions and events that could potentially interact with the selected VCs.
3. Analyzing the cumulative effects on the selected VCs.
4. Identifying mitigation and follow-up measures for the cumulative effects, where necessary.

9.1 Scope of the Assessment

The concerns voiced by the members of the community of Nemaska during the consultation activities allowed the identification of certain VCs that should be retained for the cumulative effect assessment. Additionally, specialist opinions and the legal protection status attributed to certain environmental components were also considered in the selection of the VCs.

It should be pointed out, however, that not all the population's concerns were retained as VCs, but only those involving an anticipated interaction with other past, present or future actions, projects or events. Also, only the past, present or future activities, projects and events about which sufficient information was available and accessible were retained for the assessment of cumulative effects.

9.2 Valued Components

The cumulative effects assessment does not cover all the environmental and social components presented in the environment and social impact assessment (ESIA) of the Whabouchi project. As

[1] In this chapter, the words "effect" and "impact" have the same meaning.

mentioned above, this assessment focuses specifically on the environmental and social components on which the development of the Whabouchi project, combined to other past, present or future projects, actions and events could have concurrent impacts, i.e. added impacts.

The selection of VCs for which the assessment of cumulative effects is conducted is based on the consultation activities held in the community (including focus groups), the opinions and experience of the project team members in similar projects and their observations during the fieldworks. The VC selection also corresponds to the issues relating to the Whabouchi project.

Eight VCs were thus identified:

- Air quality
- Noise
- Water quality
- Fish and fish habitat
- Woodland caribou
- Little brown bat
- Land use, specifically hunting, fishing and trapping
- Socio-economic aspects

The following paragraphs summarize the reasons justifying the selection of VCs for the cumulative effects assessment.

9.2.1 Air Quality

Air quality is a valued component because the community of Nemaska is interested in this aspect and expressed concerns during the consultation activities. Effectively, several interventions during these activities concerned the generation of dust by the open-pit mine operation. The circulation of vehicles and machinery was also questioned in terms of their possible impact on the environment and human health. These concerns arise notably from the presence of Cree camps near the project site.

9.2.2 Noise

Given the proximity of the camps and the Bible Camp, the project gives rise to concerns about the noise that would be generated once the mine is operating. Some interviewees expressed concerns about the increase in noise in the vicinity of the Bible Camp, a site that is socially valued and visited by the community members, notably in the context of the community activities.

9.2.3 Water Quality

Water quality is a significant concern that was mentioned in several instances during the consultation activities held in the community of Nemaska. The risk of water contamination due to the project gave rise to questions from members of the community of Nemaska. As mentioned in Chapter 3 of the ESIA, there is a special relationship between the Eeyou Istchee Cree and water, since this resource is considered as a vital element that ensures the health of the ecosystems and the well-being of the collectivity.

9.2.4 Fish and their Habitat

Due to the importance of fish in the Nemaska Crees' eating habits, this resource is considered as a VC. As mentioned in Chapter 8 of the ESIA, the main harvested species are: lake cisco, walleye, sucker, pike, sturgeon, lake whitefish, lake trout and brook trout. During the consultation activities, the potential degradation of fish habitats was also mentioned by certain members of the community.

9.2.5 Woodland Caribou

The woodland caribou (*Rangifer tarandus caribou*) was retained as a VC because of its provincial status as vulnerable species under the Act Respecting Threatened or Vulnerable Species, since 2005. Also, the woodland caribou was given in 2002 the status of threatened species by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and is thus protected under the Species at Risk Act. In the last years, woodland caribou has been the subject of a recovery plan managed by the ministère des Ressources naturelles (MRN), which promotes appropriate solutions to ensure the caribou's recovery in the Québec territory and thus remove it from the list of special-status species (Équipe de rétablissement du caribou forestier du Québec, 2008).

The numerous discussions that were held and still continue between the Crees and the government of Québec, notably about the measures that should be taken to protect the woodland caribou and particularly its habitats, underline the interest given to this species.

In September 2012, the work group on the recovery of woodland caribou issued a report on the situation of the woodland caribou in the James Bay territory (Rudolph and coll., 2012).

9.2.6 Little Brown Bat

Due to its status of endangered species, as designated by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC, 2002), the little brown bat (*Myotis lucifugus*) is retained as a VC.

As mentioned in chapter 7 of the ESIA, a maternity of some 300 individuals of little brown bat is found at approximately 625 m east of the mine site, in a building owned by the ministère des Ressources naturelles (MRN). This maternity has been monitored by the MRN for several years.

9.2.7 Hunting, Fishing and Trapping

The hunting, fishing and trapping activities, and particularly their continuation on the territory, were at the core of many interventions during the consultations held in the community of Nemaska. Effectively, certain members of the community voiced their concerns about a possible cohabitation of the mining project and the hunting, fishing and trapping activities on the land. Community members whose traplines are affected by the project are concerned by the changes that the latter could cause in their hunting, fishing and trapping activities and on the availability of wildlife resources.

9.2.8 Socio-Economic Aspects

The socio-economic aspects were retained as VC since, as mentioned in Chapter 3 of the ESIA, there is a high unemployment rate among the youth of the Nemaska community. Furthermore, the interviewed members of the community often insisted on the importance of developing skills and jobs. The employment opportunities and the hiring of local workers were subjects of discussion during the consultation activities.

9.3 Spatial and Temporal Limits

The assessment of cumulative effects requires the establishment of spatial and temporal limits within which the assessment is completed. The spatial and temporal limits that were adopted are presented in the following paragraphs.

9.3.1 Spatial Limits

Two distinct study areas were defined for the cumulative effects assessment, i.e. the local study area and the regional study area (Map 9-1). The local study area refers mainly to the territory within which the biophysical impacts will be felt. The boundaries of this local study area were defined according to the selected VCs and the project activities. The local study area covers a surface of 314 km^2, centered on the mine site.

The regional study area, on the other hand, refers to the territory within which the socio-economic impacts will be felt, for example job creation and economic spinoffs. This area is much more extensive so as to include, notably, mining projects that are at the development phase, such as Goldcorp's Éléonore Project (Mines Opinaca) and the Renard Diamond Project (Stornoway Diamonds Inc.) This regional study area also includes the Cree communities of Nemaska, Mistissini and Oujé-Bougoumou as well as the towns of Chibougamau and Chapais. The regional study area of the cumulative effects assessment encompasses a surface of 110,928 km^2.

Map 9-1 shows the local and regional study areas of the cumulative effects.

9.3.2 Temporal Limits

Since the signature of the James Bay and Northern Québec Agreement (JBNQA) in 1975, the development and the management of the territory and its resources have greatly changed. Among others, the hydroelectric development of the territory with Hydro Québec's major projects has modified the regional dynamics. For example, the development of roads opened the territory and gave access to locations that were difficult to reach until then. The development of the major projects also required the importation of a labor pool mainly from outside the region.

Also, necessary forest clearing for the construction of roads and powerlines, and the priming of reservoirs, has altered the landscape significantly. These changes are still well visible on the land and remain in the memories of its users.

More recently, the signature in 2002 of the Paix des Braves between the government of Québec and the Crees of Québec established the foundations of a new relationship between both parties. This agreement provides for a sharing of revenues from mines, hydroelectric developments and forestry on category I, II and III lands (Grand Council of the Crees, undated).

Therefore, the baseline for the assessment of cumulative effects is set at 1975, while the ultimate temporal boundary corresponds to the end of the mine closure phase in 2036. Beyond this limit, it becomes difficult to forecast projects and especially to access sufficiently detailed information. The assessment of the cumulative effects on the VCs therefore covers a period of approximately 60 years (1975 to 2036).

9.4 Past, Present and Future Projects, Actions and Events

The list of past, present and future actions, projects and events within the regional study area was developed on the basis of various sources of information. Among them, the Internet sites of the ministère des Ressources naturelles du Québec, the ministère du Développement durable, de l'Environnement, de la Faune et des Parcs du Québec, Hydro-Québec, the James Bay Advisory Committee on the Environment and Nemaska Lithium were consulted to find details about relevant projects. Also, discussions with Nemaska Lithium representatives and the members of the Cree community of Nemaska identified and confirmed the existence of certain projects on the territory, as well as some future projects.

These past, present and future actions, projects and events had, have or will have impacts on components of the physical, biological and social environments. These impacts associated with the development of different projects in various time and space frames are neither simple to evaluate nor readily measurable. In fact, since the details of these projects are not always available and/or accessible, particularly in the case of future projects, it is often impossible to quantify the cumulative effects.

9.4.1 Past Projects, Activities and Events

The past projects, activities and events identified in the cumulative effects study areas relate mainly to the James Bay development, i.e. major hydroelectric projects (including the development of roads, power stations, substations and powerlines) carried out by Hydro-Québec or its subcontractors. Resource exploitation activities, for example forestry and mining activities also represent sources of territory changes.

Hydroelectric Development

Primarily, the regional study area includes Hydro Québec's Eastmain-1-A-Sarcelle-Rupert project[2] (Eastmain-1-A power station and Rupert diversion). This major hydroelectric project began in 2002 and was completed in 2012 (SEBJ, 2011).

This project comprises, among others, the following works:

- The Nemiscau-1 dam and the Nemiscau-2 dam;
- The 59 km 315 kV powerline between the switchyard and the Nemiscau substation (Nemiscau-Eastmain-1 line);
- The Nemiscau workcamp (used as secondary workcamp)[3];
- The Nemiscau-Eastmain-1 road, a permanent road, running north to south over a distance of 78 km;
- The Muskeg-Eastmain-1 road, a permanent road running east to west over a distance of approximately 40 km;
- The rehabilitation of the section of the route du Nord between the Nemiscau airport and the James Bay Road, a distance of approximately 109 km.

Sources: Hydro-Québec, 2004, 2010 and 2012a

The Eastmain-1 hydroelectric project, contemplated in the JBNQA, is also found in the area (Hydro-Québec, 2004). The construction of this project was completed between May 2002 and December 2006 (Hydro-Québec, 2012a). The Eastmain-1 generating station was commissioned in 2006. Between 2003 and 2007, the Eastmain-1 project required investments of more than $2G (Hydro-Québec, 2004).

Also, the Opinaca reservoir was created in 1980. The purpose of this project was to divert water from the Eastmain watershed toward the Grande Rivière watershed, which feeds the Robert-

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[2] Includes the Eastmain-1-A generating station, built near the Eastmain-1 station, the Sarcelle powerhouse, near the outlet of the Opinaca reservoir, and the Rupert diversion toward the Eastmain-1 reservoir and the downstream generating stations (Hydro-Québec, 2010).

[3] The Nemiscau workcamp was built during Phase I of the La Grande complex, between 1970 and 1980 (Hydro-Québec, 2004).

Bourassa, La Grande-2-A and La Grande-1 generating stations. This reservoir project was completed as part of the La Grande complex.

Transportation Infrastructures

The works associated with Hydro Québec's La Grande complex extended between 1971 and 1996 (Hydro-Québec, undated). The Nemiscau airport was built by Hydro-Québec during the La Grande works to facilitate notably the transportation of its employees. This transportation infrastructure also facilitates travel of other persons in the territory. As part of the Eastmain-1 project, the Nemiscau airport was expanded by the Société d'Énergie de la Baie-James (SEBJ) for its own needs (Hydro-Québec, 2004). This airport is located less than 10 km east of the Cree community of Nemaska.

The route du Nord is a 406 km unpaved road running between Chibougamau and Kilometer 275 of the James Bay Road. The first section of this road, 86 km long, between Chibougamau and the Broadback River, was built in the early 1990s (Forchemex, undated). The road construction was completed in 1993 (Hydro-Québec, 2004). Between Kilometer 0 and Kilometer 258, the route du Nord is under the responsibility of the ministère des Transports du Québec (MTQ), while the Société de développement de la Baie-James is in charge of the section between Kilometer 258 and Kilometer 407 (SDBJ, undated). The Cree community of Nemaska is 10 km away from Kilometer 296 of the route du Nord.

Mining Activities

Many mining exploration activities were carried out in the territory since 1975, particularly in the regional study area. However, due to the scarcity of available and accessible data about these mining activities, only those where the exploration or development works are sufficiently advanced are considered in the assessment of cumulative effects. These activities are presented in the following section.

The Troilus mine, owned by Inmet Mining Corporation, ceased its operations in 2010. Located some 120 km north of Chibougamau, this former open-pit copper and gold mine operated during approximately 15 years. The restoration and infrastructure decommissioning activities began in 2007 (progressive restoration) and continued until 2012 (Les Affaires, 2011).

Forestry Activities

Many forestry activities have been carried out on the territory since 1975, particularly in the southern part of the regional study area. Within the territory of application of the Paix des Braves, 15 forest management units (FMUs) were reported (MRN, 2002). Within these FMUs, the beneficiary can exploit forest resources.

Other Activities

Among the other activities involving a part or the totality of the regional study area for cumulative effects, we find the MRN's 2005-2012 woodland caribou re-establishment plan. It proposes an action plan with 30 measures aiming to preserve the caribous. Several measures concern the maintenance or improvement of caribou survival and the preservation of adequate habitats (Équipe de rétablissement du caribou forestier du Québec, 2008). Other activities include research works by the woodland caribou recovery work group, notably the publication of a report on the status of woodland caribou (*Rangifer tarandus caribou*) in the James Bay territory of northern Québec (Rudolph and coll., 2012). This kind of research provides, among other benefits, a better picture of the situation of the species and proposes concrete actions to ensure its protection.

In another area, the Weh-Sees Indohoun Corporation was created by the Government of Québec, Hydro-Québec and the Grand Council of the Crees (Eeyou Istchee) pursuant to the Boumhounan Agreement, in order to ensure notably the management of wildlife on a 16,656 km^2 territory. This corporation was created to control the recreational fishing and hunting activities of the workers employed at the Eastmain-1-A-Sarcelle-Rupert project and of other users of the land (Weh-Sees Indohoun, undated). The territory managed by the Weh-Sees Indohoun Corporation includes Nemaska's category I and II lands.

Forest Fires

The Whabouchi project is located within a limited protection area managed by the Société de protection des forêts contre le feu (SOPFEU, undated). Table 9-1 shows the surfaces burned by forest fires off the various causes between 1975 and 2012 in the James Bay, Jamésie and Nemaska regions. At any time, lightning proves to be the principal cause of forest fires. Only in the Nemaska area, a total of 187,627 hectares of forest burned between 2004 and 2012.

Table 9-1 Surface Area Destroyed by Forest Fires in Limited Protection Areas, by Cause

Period	Region	Destroyed Surface Area (ha)					
		Lightning	Industry	Recreo-tourism	Residents	Others	Total
1975-1983[1]	James Bay	965,704	38,471	6	1,930	0	**1,006,111**
1984-1993[1]	James Bay	2,557,297	11,574	5,512	475	0	**2,574,858**
1994-2003[1]	James Bay	2,334,216	1,233	8,620	7,663	572	**2,352,303**
1975-2003[1]	James Bay	5,857,217	51,278	14,138	10,068	572	**5,933,272**
2004-2012[2]	Jamésie	555,679	25,381	14,682	35,711	3,350	**634,804**
2004-2012[2]	Nemaska	146,217	24,800	6,563	6,698	3,350	**187,627**

Sources:

1 : Hydro-Québec, 2004

2: Personal communication, Éloïse Richard-C., Information officer, Société de protection des forêts contre le feu, January 30, 2013

Wildlife Reserves

Wildlife reserves are territories designated under the Act respecting the conservation and development of wildlife. The ministère des Ressources naturelles (MRN) is it the authority responsible for these territories, with the mission of conserving and developing their wildlife resources. There are two wildlife reserves within the regional study area, i.e. the Assinica wildlife reserve and the Lacs-Albanel-Mistissini-et-Waconichi wildlife reserve. Wildlife reserves are managed by the Société des établissements de plein air du Québec (Sépaq). Various activities are carried out within these territories, notably hunting, fishing and camping.

The Assinica wildlife reserve covers a surface of 8,885 km^2. Due to its location, wildlife harvesting activities in the Assinica wildlife reserve are limited to fishing, as hunting is reserved to the Natives. Furthermore, some fish species are reserved exclusively to the Crees, notably whitefish and sturgeon. This territory was designated as a wildlife reserve in 1985 (Sépaq, undated-a).

The Lacs-Albanel-Mistissini-et-Waconichi wildlife reserve occupies a surface of 16,400 km^2. The management and development of this territory are jointly controlled by the Cree Nation of Mistissini and the Sépaq (Sépaq, undated-b). The current Lacs-Albanel-Mistissini-et-Waconichi wildlife reserve was created in 1985. Previously, this territory was a hunting and fishing reserve.

9.4.2 Current Projects, Activities and Events

In 2011, the Government of Québec launched the Plan Nord. Its purpose is to promote the development of Northern Québec and its resources in the perspective of sustainable development and social responsibility (Government of Québec, 2012a). The Plan Nord will result in investments of more than $80G and the creation and/or consolidation of approximately 20,000 jobs per year.

Several of the current or future projects presented below are directly or indirectly related to the Plan Nord, particularly with regard to the development of transportation infrastructures.

9.4.2.1 Mining Activities

Table 9-2 presents the mining exploration projects that were in activity in 2012 within the cumulative effects regional study area. In this list, five projects[4] shown in bold characters have reached the development phase: BlackRock project (BlackRock Metals), Renard project (Stornoway Diamond Corporation/SOQUEM), Lac Macleod project (Western Troy Capital Resources), Rose project (Critical Elements Corporation) and Éléonore project (Goldcorp (Les Mines Opinaca)). These five projects are described in the section on future projects.

[4] The development of the James Bay Lithium project (Lithium One / Galaxy Resources) is currently suspended (Les Affaires, 2012).

Table 9-2 Mining Exploration Projects – Regional Study Area

No	NTS	Companies / Prospectors	Projects	Substances	Works (see legend)
13	32F15	Canada Rare Earths	Goéland	REE	TA, D (14:4,050)
14	32F15, 16	Ressources GéoMégA / Niogold Mining Corporation	Montviel	REE-Nb	Rs, MS, TA, Pg, D (22:9,100), T, MT
15	32F16	Atocha Resources	Trésor Nord	REE	Gc(h), GpEm(G), GpMa(G)
76	**32G09, 16, 32H13**	**BlackRock Metals**	**Blackrock**	**Fe-V-Ti**	**FS, Env, D (977:20,803), MT**
77	32G16, 32H13	Apella Resources	Lac Doré	Fe-V-Ti	TA
94	32G15	Pro Minerals	Lac Laura	Cu-Au-Ag	S, D (4:477), T
95	32G15	M. Bouchard / G.L. Géoservice	Phoenix	Cu-Zn-Au-Ag-Co	S, T
97	32G15, 16	Northern Superior Resources / M. Bouchard / G.L. Géoservice	Croteau Est	Au	S, TA, G, GpEI(G), GpMa(A,G), Pr, D (12:3,000), T
98	32G15	Cogitore Resources	Lac Scott	Zn-Cu-Au-Ag	Rs, G, Gc(ro), GpEm(B,G), D (20:8,036)
99	32G15	2736-1179 Québec	Barrette Nord	Au-Ag-Cu-Zn	D (2:550), T
100	32G16	Xmet / Prodigy Gold	Roy	Cu-Au-Ag	D (2:800)
103	32G16	2736-1179 Québec	Mont Porcupine	Au-Cu-Fe-V-Ti	TA, D (3:900)
104	32G16	2736-1179 Québec	Lac Taché O'Leary	Cu-Zn-Au-Ag	D (7:2,000)
105	32G16	2736-1179 Québec	Lempira AG	Ag	TA, D (4:900)
106	32G16	2736-1179 Québec	Lac Taché VMS	Cu-Zn-Au-Ag	TA, Pr, D (19:6,300), T
107	32G15, 16	2736-1179 Québec	Lac Caché-Obalski	Au-Cu-Fe-Ti-V	D (2:740)
108	32G15, 16	2736-1179 Québec	Lac David	Au-Fe-V-Ti-P	TA, Pr, D (6:900)
109	32G16	2736-1179 Québec	Lac Chibougamau	Fe-V-Ti	TA, D (2:500)
111	32G15, 16, 32J01, 02	Murgor Resources	Waconichi	Au	G, Gc(t), GpEI(G), Pr, D (5:1,000)
112	32G16	Globex Mining	Berrigan	Zn-Au-Ag-Co-Pb	TA
114	32G16	SOQUEM / MDN	McGold (MOP II)	Au-Cu	GpEI(G), D (14:3,118)
115	32G16	SOQUEM	Bruneau	Cu-Au	GpEI(G), D (1:423)

No	NTS	Companies / Prospectors	Projects	Substances	Works (see legend)
116	32G16, 32H13, 32I04, 32J01	Exploration Typhon	Monexco	Au-Ag	D (6:x)
117	32I04	Fuhua Mining	Bignell	Cu-Au-Ag	S, Pg
120	32G15	Golden Valley Mines	Bearmac	Au	Pg
121	32G15	Golden Valley Mines	Bejopipa	Au-Ag-Cu-Zn	Pg, D
122	32G15	Golden Valley Mines	Kharlamov	Au-Ag-Cu-Zn	Pg
124	**33A16**	**Stornoway Diamond Corporation / SOQUEM**	**Renard**	**Diamond**	**FS, Env**
128	33A07, 08	Eastmain Resources	Mine Eastmain	Au-Ag-Cu	G, Pr, D (28:13,062)
129	33A08	Dios Exploration	33 Carats Sud	Au	Pg
130	32P16, 22M13	Cameco Corporation / AREVA Resources Canada	Camie River	U	Qs, G, Gc(s), GpEm(A), GpMa(A), D (4:1,084)
131	32P16, 22M13	Cameco Corporation	Otish South	U	Qs, G, Gc(s), GpEm(A), GpMa(A), D (8:4,213)
132	33A01	Explorations Ditem	Lac Henri	REE	S, G, GpRa(G), Pr
133	32P16, 33A01	Strateco Resources	Matoush	U	Rs, GpRa(G), Pg, D (42:24,103)
134	32P16, 33A01	Strateco Resources	Matoush Extension	U	GpRa(G), Pg
135	32P16	Strateco Resources	Éclat	U	GpRa(G), Pg
136	32P16	Strateco Resources / Pacific Bay Minerals	Pacific Bay	U	Pg, D (10:5,510)
137	32P07, 10, 14, 15, 16	Strateco Resources / Majescor Resources	Mistassini	U	GpRa(G), Pg, D (5:467)
138	32P10, 15, 16, 22M13, 33A01	Dios Exploration	Hotish	U-REE	S, G, Pr, T
139	**33A02**	**Western Troy Capital Resources**	**Lac Macleod**	**Cu-Mo-Ag-Au**	**FS, Env, D (3:402)**
141	32J11	Monarques Resources	Sirmac	Li	G
142	32J09, 10, 11, 15, 16, 32O01	Beaufield Resources / Melkior Resources	Troilus JV	Cu-Zn-Au-Ag-Li	GpEI(G), Pr, D (25:4,261), MT
143	32J14, 15, 32O02	Habanero Resources	Lezai	Cu-Zn-Au-Ag	S, G, Pr
144	32J10	Landore Resources Canada	Lessard	Cu-Zn-Au-Ag	G, Gc(ro)

No	NTS	Companies / Prospectors	Projects	Substances	Works (see legend)
145	32J11	Atocha Resources	Descouverte	Cu-Zn-Au-Ag	GpEm(A), GpMa(A)
146	32K09	Canadian Royalties	Huskies-Wildcats-Tiger-Rampard	Cu-Ni-PGE	GpEm(A), GpMa(A)
149	32O11, 12, 14	Monarques Resources	Nisk (Lac Levac)	Cu-Ni-Co-PGE	G, GpEI(G), GpEm(B), GpMa(G), D (9:2,972), T
150	32O11, 12, 14	Monarques Resources	Lemare	Cu-Ni-PGE-Au	GpEm(A), GpMa(A), D (2:498)
151	32O14	Monarques Resources	Arques	REE-Nb-Ta	GpRa(G), D (6:1,577)
152	32O14, 15	Monarques Resources	Bourier	Cu-Zn-Pb-Ag-Au	S, G, Gc(s), GpEm(A), GpMa(A), Pr, D (15:2,214), T
153	32O12	Monarques Resources	Duval	Cu-Ni-Co-PGE-Au	GpMa(G), D (6:1,338)
154	32O12, 32N09	Monarques Resources	Valiquette	Cu-Ni-PGE	GpEm(A,B), GpMa(A,B), Pr, D (14:2,672)
155	32O11, 33B03	Monarques Resources	Amiral	Cu-Ni-Zn-Au	GpEm(A), GpMa(A)
156	33B02	Monarques Resources	Rosebay	Cu-Zn-Au	GpEm(A), GpMa(A)
157	33B02, 03, 04	Goldcorp / Azimut Exploration	Wabamisk	Au-Ag-Cu-Zn-Pb-Mo	S, Pg, T
158	33B04, 05	Eatmain Resources	Clearwater	Au-Bi-Te	S, Rs, G, Gc(s), Pr, D (68:26,323), T
159	32N07, 08, 09	Monarques Resources	Caumont	Cu-Ni-PGE	S, G, GpEm(A), GpMa(A), Pr, T
160	32N09	Monarques Resources	Dumulon	Cu-Zn-Ag	GpEm(A), GpMa(A),
161	33C01, 33B04	Dios Exploration / Osisko Mining Corporation	AU33 West	Au	G, Gc(t), Pr
163	33C01	Jourdan Resources	Pivert East / Stairs	Li-REE	D (20:3,053)
164	**33C01**	**Critical Elements Corporation**	**Rose**	**Li-Ta**	**S, Rs, TA, G, Pr, S (75:12,000), MT**
165	32N14, 15, 16, 33C01, 02	Sirios Resources / Dios Exploration	Pontax	Au-Ag-Cu-Zn-Pb-diamond	D (12:1,683)
166	33C01, 02	Arianne Resources / Virginia Mines	Opinaca	Au-Cu-Zn	Gc, Pg

No	NTS	Companies / Prospectors	Projects	Substances	Works (see legend)
167	33C01, 02, 07	Virginia Mines	Anatacau / Wabamisk	Au	S, G, Gc(t), GpEI(G), GpMa(G), Pr, D (6:1,272), T
168	33C03	Lithium One / Galaxy Resources	James Bay Lithium[5]	Li	FS
169	33C03	J.P. Frigon	Lithium	Li-Au	Pg
170	33C02, 03, 06, 07	Rock Tech Lithium	Kapiwak	Li-REE	GpEm(A), GpMa(A), GpRa(A)
171	33C03	Y. Lemelin	Val Joe Lin	Au-Cu	S, T
172	**33B12, 33C09**	**Goldcorp (Les Mines Opinaca)**	**Éléonore**	**Au**	**S, Rs, G, D (50:24,000), T**
173	33C16, 33B12, 13	Golden Valley Mines / Sirios Resources	Cheechoo B	Au	S, G, Pg
176	33C08, 33B05	Dios Exploration	Shadow	Au-Diamond	G, Gc(t), Pr
177	33B03, 06	NQ Exploration / CHS Resources	Eastmain Nord	Au-Ag-Cu-Zn	GpEm(G)
178	33B05	Dios Exploration	LeCaron	Au	G, Gc(t), Pr
179	33C08, 09, 10, 33B02, 03, 06	Midland Exploration	Baie James Éléonore	Au	S, Gc(ro), Gc(s), Pr

Legend:

Prospection and Geological Works	Geochemical Surveys	Geophysical Surveys	Other Types of Works
S : sampling	Gc : unspecified geochemical survey	GpEl : electric geophysical survey	FS : feasibility or market study
MS : mineralogic study	Gc(h) : geochemical survey in humus	GpEm : electromagnetic survey	Env : environmental study
G : geological survey	Gc(ro) : geochemical survey in rock	GpMa : magnetometric survey (magnetic)	Qs : Quaternary study
Pg : unspecified prospection and geological works	Gc(s) : geochemical survey in soil	GpRa : radiometric survey	Rs : resource and reserve study
Pr : prospection	Gc(t) : geochemical survey in till	(A) aerial, (B) borehole and (G) ground	TA : technical assessment study
D (nb:m) : diamond drilling (number : total metres)			MT : metallurgical test
T : trenching and stripping			

Source: MRN, 2012

[5] Same as preceding footnote.

9.4.2.2 Forestry Activities

At this time, and within the boundaries of the regional study area defined for the cumulative effects assessment, different actors are carrying out several forestry activities, either as commercial wood harvesting or activities related to the development of other projects. For example, the development of roads and power infrastructures requires the clearing of portions of the land.

The forest management units (FMU) found within the regional study area are concentrated in the southern portion thereof. Specifically, there are 10 FMUs, identified as follows: 026-61, 026-62, 026-63, 026-64, 026-65, 086-63, 086-64, 086-65, 086-66 and 087-64. The managing agents of these FMUs and their respective surfaces are presented in Table 9-3.

Table 9-3 Forest Management Units in the Regional Study Area

FMU #	Managing Agent	FMU Surface
026-61	Les chantiers Chibougamau ltée	7,815 km^2
026-62	Les chantiers Chibougamau ltée	5,505 km^2
026-63	Barrette-Chapais ltée	4,970 km^2
026-64	Barrette-Chapais ltée	6,024 km^2
026-65	Waswanipi Corporation	4,875 km^2
086-63	Domtar	3,792 km^2
086-64	Domtar	2,903 km^2
086-65	Matériaux Blancher inc.	3,533 km^2
086-66	Abitibi-Bowater	4,989 km^2
087-64	Abitibi-Bowater	4,758 km^2

Source: Cree-Québec Forestry Board, 2008

9.4.2.3 Other Current Projects, Activities and Events

Outfitters

Within the regional study area of the cumulative effects, there are 12 outfitters (28 permanent camps) offering hunting and fishing activities. Table 9-4 gives the names, the type of activities and the geographic coordinates of these outfitters and their permanent camps.

Table 9-4 Outfitters in the Regional Study Area

Outfitter Number	Name	Type of Activity	Location
10525-01	Dream Catcher Adventures S.E.N.C.	Fishing	Latitude: 50.22778 Longitude: -76.018333
10526-02	Pourvoirie Mirage inc.	Hunting, fishing	Latitude: 52.766667 Longitude: -73.716667
10526-03	Pourvoirie Mirage inc.	Hunting, fishing	Latitude: 52.710833 Longitude: -73.716944

Outfitter Number	Name	Type of Activity	Location
10549-01	Oujé-Bougoumou Entreprises inc.	Fishing	Latitude: 50.547222 Longitude: -75.292778
10552-01	Robert D. White (Pavillon Square-Tail Lodge)	Fishing	Latitude: 50.767778 Longitude: -74.645833
10552-02	Robert D. White (Pavillon Square-Tail Lodge)	Fishing	Latitude: 50.909722 Longitude: -74.618611
10554-03	Association de Pourvoirie du Lac Mistassini	Fishing	Latitude: 51.369722 Longitude: -73.735833
10554-01	Association de Pourvoirie du Lac Mistassini	Fishing	Latitude: 51.048611 Longitude: -73.768056
10554-04	Association de Pourvoirie du Lac Mistassini	Fishing	Latitude: 51.383333 Longitude: -73.000278
10554-11	Association de Pourvoirie du Lac Mistassini	Fishing	Latitude: 51.233333 Longitude: -74.700000
10554-05	Association de Pourvoirie du Lac Mistassini	Fishing	Latitude: 51.433333 Longitude: -72.883333
10554-06	Association de Pourvoirie du Lac Mistassini	Fishing	Latitude: 51.450000 Longitude: -72.733333
10554-07	Association de Pourvoirie du Lac Mistassini	Fishing	Latitude: 51.366667 Longitude: -72.566667
10554-08	Association de Pourvoirie du Lac Mistassini	Fishing	Latitude: 51.533333 Longitude: -72.800000
10554-10	Association de Pourvoirie du Lac Mistassini	Fishing	Latitude: 51.333333 Longitude: -74.566667
10554-02	Association de Pourvoirie du Lac Mistassini	Fishing	Latitude: 51.150000 Longitude: -73.150000
10555-01	Waswanipi Development Corporation	Fishing	Latitude: 49.880278 Longitude: -76.824722
10565-01	Camp de pêche Pomerleau inc.	Hunting, fishing	Latitude: 49.916667 Longitude: -74.166667
10580-01	Americree Ltee	Fishing	Latitude: 50.823889 Longitude: -76.707500
10580-02	Americree Ltee	Fishing	Latitude: 50.751111 Longitude: -77.029167
10580-04	Americree Ltee	Fishing	Latitude: 51.039167 Longitude: -76.856667
10613-01	Wabannutao Eeyou Development Corporation	Fishing	Latitude: 52.514444 Longitude: -75.959444
10613-04	Wabannutao Eeyou Development Corporation	Fishing	Latitude: 52.517222 Longitude: -75.550556
10613-03	Wabannutao Eeyou Development Corporation	Fishing	Latitude: 52.263611 Longitude: -75.463056
10613-02	Wabannutao Eeyou Development Corporation	Fishing	Latitude: 52.538056 Longitude: -75.708611

Outfitter Number	Name	Type of Activity	Location
10619-01	Awashish Outdoor Adventures inc.	Fishing	Latitude: 51.463333 Longitude: -74.288889
10621-01	Pourvoirie Aigle Pêcheur	Fishing	Latitude: 50.927222 Longitude: -73.618889
10633-01	Outpost Lake Rocher	Fishing	Latitude: 50.582222 Longitude: -76.432500

Source: Personal communication, Nathalie Desjardins. Ministère des Ressources naturelles. Emails dated February 5 and 7, 2013

Road Infrastructures

The extension of Route 167 North in the direction of the Otish Mountains, over a total distance of 239.5 km, is a project of the ministère des Transports du Québec (MTQ, 2010). This road project will connect the communities of Mistissini and Chibougamau to Stornoway's Renard mining project and to other mine sites. The speed on this road will be limited to 70 km/h (MTQ, 2010). The project calls for the construction of 24 bridges, all of the wood-on-steel type. The cost of the project is estimated at $238M (MTQ, 2010). Construction is expected to take 5 years and began in February 2012 (Radio-Canada, 2012a).

9.4.3 Future Projects, Activities and Events

As mentioned in the CEAA's Operational Policy Statement (2007), the projects, activities or events that can be considered certain, reasonably foreseeable or hypothetical were considered in the assessment of cumulative effects.

9.4.3.1 Mining Projects

Due to their advanced stage of development and their implementation potential, the five following mining projects, which are at the development stage, are briefly described below. It should be noted, however, that the mining exploration activities presented in the projects that are already underway will probably continue but that, due to the scarcity of available information, they are not discussed here.

Renard Project (Stornoway Diamond Corporation / SOQUEM)

Located near the Otish Mountains, approximately 250 km north of the Cree community of Mistissini, the Renard project consists in the operation of a diamond mine. The project proponent is Stornoway, a wholly owned property of Stornoway Diamond Corporation (Roche, 2011). The project consists in operating open pits and underground mining to exploit diamond-bearing kimberlite pipes. The expected extraction rate is 6,000 tonnes of ore per day, reaching a maximum rate of 7,000 tonnes per day during the first years (Roche, 2011). Mining operation activities are planned for 2014. The life span of the mine is estimated at approximately 20 years (Roche, 2011). The project cost is estimated at $802M and some 300 jobs would be created during the operation (MRN, 2012).

An important component of the Renard project is the extension of the existing Route 167 over a distance of 240 km, by the ministère des Transports du Québec (MTQ). Construction of this road, which will provide year-long access to the mine site, began in 2012.

Lac Macleod Project (Western Troy Capital Resources)

Western Troy Capital Resources' Lac Macleod project is located approximately 275 km north of the town of Chibougamau. The project consists in operating an open-pit copper-molybdenum-silver mine. As access is currently limited, this mine site will benefit from the MTQ's extension of Route 167, which will make it more accessible. The mine construction works began early in 2012 (Western Troy Capital Resources, undated). The opening of the mine is planned for 2015 and its operation should come to an end in 2024. The number of employees is estimated at 250 (Place aux jeunes en région, 2012). The cost of the project is estimated at $210M (MRN, 2012).

Rose Project (Critical Elements Corporation)

Critical Elements Corporation's Rose mining project is located 38 km north of the Cree community of Nemaska. The mine site is therefore accessible all year long, notably via the Route du Nord. The project consists in operating an open-pit mine to exploit what is considered a world-class tantalum and lithium deposit (Corporation Éléments Critiques, 2012). An eventual underground operation is however not excluded. The extraction rate, as currently planned, would be 4,500 tonnes per day. The ore will be processed in an on-site plant. Production should begin in 2014 and conclude in 2030 (Place aux jeunes en région, 2012). The cost of this project is estimated at $270M (MRN, 2012).

Éléonore Project (Goldcorp (Les Mines Opinaca))

The Éléonore Project of Mines Opinaca, a wholly-owned subsidiary of Goldcorp Inc., consists in an underground mine operation of a gold deposit near the Opinaca reservoir. The underground operation will radiate from a shaft reaching a depth of approximately 1,500 m. Located some 190 km east of the Cree village of Wemindji, the project also involves the construction of some 60 km of an access road between the mine site and the northern end of the La Sarcelle control structure access road (Hydro-Québec) to provide all-season access to the mine site. The production is estimated at 7,000 tonnes of ore per day, for an average annual production of approximately 600,000 ounces of gold (MRN, 2012). The life span of the mine is estimated at approximately 15 years. The mine should begin production in 2014 (Goldcorp, undated). The number of employees is estimated at 1,000 during the construction phase, and 600 in the operation phase (La Presse, 2011a). The investment in this mining project is estimated at $1.4G (MRN, 2012).

BlackRock Project (BlackRock Metals Inc.)

The BlackRock mining project is located 30 km southeast of Chibougamau, in the Lac Doré area. It consists in the on-site production of an iron ore concentrate that will be shipped to China (ACÉE, 2011). A partnership was concluded in 2012 between the mining company and Port Saguenay to transport the ore by rail to the Grande-Anse port facilities (Radio-Canada, 2012b). This open-pit mine project will target iron, titanium and vanadium. The project also includes the construction of a 25 km access road and of a powerline. The concentrate production in 2014 is estimated at 2,000,000 tonnes (BlackRockMetals, 2011). The mine would employ 250 persons (La Presse, 2011b). BlackRock Metals plans to invest $650M in this open-pit mine project (Argent, 2012).

9.4.3.2 Other Activities

Outfitters

The Awashish Cree family of the community of Mistissini is considering an outfitting project. The activity offered by this future outfitter would be goose hunting (La Presse, 2011c). This outfitter would be located at the former site of the Troilus mine, where the late Sam Awashish had ancestral hunting and fishing rights (Les Affaires, 2011).

Protected Areas

The Cree communities of Nemaska and Waswanipi, with the Grand Council of the Crees, wish to create two adjacent protected areas, namely Chisesaakahiikan (proposed by Nemaska) and Mishigamish (proposed by Waswanipi) (SNAP, 2013). In 2011, the James Bay Advisory Committee on the Environment (JBACE) supported the two proposed protected areas, which would preserve mature forests (CCEBJ, 2012). The surface of the protected areas in Nemaska's proposal would be 3,466.4 km^2, and 4,535.5 km^2 in the Waswanipi proposal (Rudolph and coll., 2012). The establishment of these protected areas would exclude these lands from forestry developments to the benefit of wildlife species such as woodland caribou, among others.

National Park

The government of Québec, in partnership with the Cree Nation of Mistissini, has proposed the creation of a national park, tentatively named Albanel-Témiscamie-Otish. Encompassing more than 11,000 km^2, this project, located 90 km north of Chibougamau, would promote among others the natural, cultural and historical heritages (MDDEFP, 2005). This project, in which the conservation principle is a fundamental element, notably includes lakes Mistissini and Albanel. Various activities would be offered, such as hiking and dogsled excursions, recreational fishing, as well as hunting and trapping for the beneficiaries of the James Bay and Northern Québec Agreement (JBNQA). Different zones would be delineated within the proposed park boundaries, such as extreme preservation zones, preservation zones, ambience zones, service zones and sacred areas (MDDEFP, 2005).

A second park project is found within the regional study area, i.e. the Assinica national park reserve. Located approximately 20 km north of Oujé-Bougoumou, this territory occupies a surface of 3,193 km^2. The creation of this park reserve improves the protection of certain wildlife species, notably the woodland caribou and the bald eagle, two species that are designated as vulnerable in Québec (MDDEFP, 2002). The Oujé-Bougoumou Crees will be responsible for the management of operations, activities and services in this future national park (MDDEFP, 2011).

Proposed Biodiversity Reserves

Five proposed biodiversity reserves are located in the regional study area. They are the Paakumshumwaau-Maatuskaau proposed biodiversity reserve, the Waskaganish proposed biodiversity reserve, the Tourbières-Boisées-du-Chiwakamu proposed biodiversity reserve, the Lac-Dana proposed biodiversity reserve and the Albanel-Témiscamie-Otish proposed biodiversity reserve. The main purpose of these five proposed reserve projects is to preserve the biodiversity of the terrestrial environment. A conservation plan is developed for each proposed biodiversity reserve. Mining and forest development activities are prohibited within these biodiversity reserves.

The proposed Paakumshumwaau-Maatuskaau biodiversity reserve is located some 20 km southeast of the Cree community of Wemindji and presents a surface of 4,539 km^2. The projected Waskaganish biodiversity reserve is located approximately 40 km east of the Waskaganish Cree community and occupies a surface of 1,062.7 km^2. With a surface of 158.2 km^2, the proposed Tourbières-Boisées-du-Chiwakamu biodiversity reserve is located approximately 80 km southwest of the Cree community of Nemaska. Finally, the proposed Lac-Dana biodiversity reserve, occupying a surface of 347.4 km^2, is located approximately 97 km southeast of the Waskaganish Cree community while the proposed Albanel-Témiscamie-Otish biodiversity reserve covers 11,871.3 km^2 in the James Bay territory, northeast of the town of Chibougamau and of the Mistissini Cree community.

9.5 Assessment of the Cumulative Effects

The past, present and future projects and activities, combined with the Whabouchi project, have caused and will necessarily result in modifications on the environment and social context. Different indicators were used to evaluate the cumulative effects on the selected VCs. Table 9-5 identifies the VCs associated with the issues and presents the indicators retained to evaluate the cumulative effects.

Table 9-5 Issues, Valued Components and Indicators

Issues	Valued Component (VC)	Indicators
Degradation of air quality	Air quality	• Increased dust emissions • Increased emissions of atmospheric pollutants
Loss of tranquillity	Noise	• Increased noise level
Degradation of water quality	Water quality	• Increased pollutants/metals (effluents)
Contamination of fish species or Increased mortality	Fish and fish habitat	• Modification/disturbance of the habitat of certain species • Loss of water bodies
Disturbance of individuals Increased mortality	Woodland caribou	• Modification/disturbance of the habitat • Reduced quality of the habitat • Surface area of the affected land

Issues	Valued Component (VC)	Indicators
Disturbance of individuals in the maternity	Little brown bat	• Reduction in the frequentation or occupation of the maternity
Disturbance of activities related to land and resource use (hunting, fishing and trapping)	Hunting, fishing and trapping	• Accessibility of the territory • Increased pressure from wildlife harvesting • Increased theft and vandalism • Portion of the territory rendered inaccessible • Number of affected traplines
Disturbance of the social cohesion Improvement of the financial situation	Socio-economic aspects	• Reduced support for the project • Job creation • Investments

Table 9-6 presents the list of projects, activities or events that could have possible incidences on the VCs of the environment. Although water quality, fish and their habitat, and bats are considered as VCs, the assessment of cumulative effects on these three VCs was not completed since the past, present and future activities and events that were identified do not have concurrent interactions with the present Whabouchi project.

Table 9-6 List of Projects, Activities or Events with Incidences on the Valued Components

Project, Activity or Event[6]	Past	Present	Future	Valued Components				
				Air Quality	Noise	Woodland Caribou	Hunting, Fishing and Trapping	Socio-Economic Aspects
Hydroelectric Projects								
Eastmain-1	X			Increased dust and atmospheric emissions due to circulation	Increased noise during works	Reduced quality of the habitat	Increased pressure from wildlife harvesting Modification in the use of the land and resources	Between 2003 and 2007: investments of more than $2G Job creation
Eastmain-1-A-Sarcelle-Rupert	X	X		Increased dust and atmospheric emissions due to circulation	Increased noise during works	Reduced quality of the habitat	Increased pressure from wildlife harvesting Modification in the use of the land and resources (36 traplines concerned)	Employment: 27,000 person-years Economic spinoffs: approximately $2,350M
Nemaska-Waskaganish Substation and Powerlines	X			Increased dust and atmospheric emissions due to circulation	Increased noise during works	Habitat disturbance during deforestation	Modification in the use of the land and resources	Job creation

[6] Regarding hydroelectric projects and transportation infrastructures, the past and present boxes are associated with the construction of these projects, but their operation continues in the present and/or future boxes, with some incidences that are potentially less significant.

Project, Activity or Event[6]	Past	Present	Future	Valued Components				
				Air Quality	Noise	Woodland Caribou	Hunting, Fishing and Trapping	Socio-Economic Aspects
Opinaca Reservoir	X			Increased dust and atmospheric emissions due to circulation	Increased noise during works		Increased pressure from wildlife harvesting Modification in the use of the land and resources	Job creation
Transportation Infrastructures								
Nemiscau Airport	X			Increased emissions of atmospheric pollutants	Increased noise during landings and takeoffs	Disturbance of individuals	Improved access to the territory, thus increasing the pressure from wildlife harvesting Modification in the use of the land and resources (1 trapline concerned)	Job creation
Route du Nord	X			Increased dust and atmospheric emissions due to circulation	Increased noise level	Reduced quality of the habitat Disturbance of individuals	Opening of the territory, thus increasing the pressure from wildlife harvesting Modification in the use of the land and resources	Job creation
Extension of the Route 167 North in the direction of the Otish Mountains		X		Increased dust and atmospheric emissions due to circulation	Increased noise level	Reduced quality of the habitat Disturbance of individuals	Increased pressure from wildlife harvesting Modification in the use of the land and resources (7 traplines concerned)	Jobs: Construction: 3,115 person-years (during 5 years) Operation: 37 direct jobs and 8 indirect jobs Economic spinoffs: Construction: $180.9M Operation: $2.1M

Project, Activity or Event[6]	Past	Present	Future	Valued Components				
				Air Quality	**Noise**	**Woodland Caribou**	**Hunting, Fishing and Trapping**	**Socio-Economic Aspects**
Resource Exploitation								
Forestry Activities	X	X	X	Increased dust and atmospheric emissions due to circulation	Increased noise level	Habitat losses Reduced quality of the habitat Disturbance and possible displacement of individuals	Opening of the territory Increased pressure from wildlife harvesting Modification in the use of the land and resources	Job creation
Mining Exploration Activities	X	X	X	Increased dust and atmospheric emissions due to circulation	Increased noise level	Disturbance and possible displacement of individuals	Opening of the territory Increased pressure from wildlife harvesting Modification in the use of the land and resources	Job creation: In Québec, 3,800 direct and indirect jobs In 2010: $261M in expenditures in Northern Québec
Mining Projects								
Troilus Mine	X			Increased dust and atmospheric emissions due to circulation	Increased noise level	Reduced quality of the habitat Disturbance and possible displacement of individuals	Increased pressure from wildlife harvesting (1 trapline concerned) Modification in the use of the land and resources	Employment: 260 jobs Economic spinoffs : Construction (3 years): $225M Capital investment (2000-2006): $35M

Project, Activity or Event[6]	Past	Present	Future	Valued Components				
				Air Quality	Noise	Woodland Caribou	Hunting, Fishing and Trapping	Socio-Economic Aspects
Renard Project			X	Increased dust and atmospheric emissions due circulation	Increased noise level	Reduced quality of the habitat Disturbance and possible displacement of individuals	Increased pressure from wildlife harvesting (1 trapline concerned) Modification in the use of the land and resources	Employment: Construction: approximately 500 workers Operation: approximately 450 workers Economic spinoffs : Construction: $733M Operation: $110.8M
Lac Macleod Project			X	Increased dust and atmospheric emissions due to circulation	Increased noise level	Reduced quality of the habitat Disturbance and possible displacement of individuals	Increased pressure from wildlife harvesting Modification in the use of the land and resources	Job creation Project cost: $210M
Rose Project			X	Increased dust and atmospheric emissions due to circulation	Increased noise level Fish disturbance and habitat loss	Reduced quality of the habitat Disturbance and possible displacement of individuals	Increased pressure from wildlife harvesting Disturbance of hunting, fishing and trapping activities (1 trapline concerned) Modification in the use of the land and resources	Employment: Construction: 200 employees Operation: 200 employees Investments: $250M
Éléonore Project			X	Increased dust and atmospheric emissions due to circulation	Increased noise level	Reduced quality of the habitat Disturbance and possible displacement of individuals	Increased pressure from wildlife harvesting Disturbance of hunting, fishing and trapping activities (involving 3 traplines) Modification in the use of the land and resources	Job creation Construction: 1,000 persons Operation: 600 persons Project cost: $1.4G

Project, Activity or Event[6]	Past	Present	Future	Valued Components				
				Air Quality	Noise	Woodland Caribou	Hunting, Fishing and Trapping	Socio-Economic Aspects
BlackRock Project			X	Increased dust and atmospheric emissions due to circulation	Increased noise level	Reduced quality of the habitat Disturbance and possible displacement of individuals	Increased pressure from wildlife harvesting Modification in the use of the land and resources	Job creation: 250 persons Investments: $650M
Wildlife Territories or Protected Territories								
Outfitters		X	X	Increased dust and atmospheric emissions due to circulation			Increased pressure from wildlife harvesting	Job creation
Wildlife Reserves	X						Increased pressure from wildlife harvesting Management of hunting and fishing activities	
Protected Areas			X			Habitat protection		
Biodiversity Reserves			X			Habitat protection		
Albanel-Témiscamie-Otish National Park and Assinica National Park Reserve		X	X			Habitat protection		
Others								
Forest Fires	X		X	Temporary modification of air quality (smoke)		Temporary loss of habitat	Disturbance of wildlife harvesting activities Modification in the use of the land and resources	

Project, Activity or Event[6]	Past	Present	Future	Valued Components				
				Air Quality	Noise	Woodland Caribou	Hunting, Fishing and Trapping	Socio-Economic Aspects
Woodland Caribou Recovery Plan 2005-2012	X					Objective of ensuring the protection of the species and its habitat		
Groupe de travail sur le rétablissement du caribou forestier	X	X				Objective of ensuring the protection the species and its habitat		
Weh-Sees Indohoun Corporation	X						Management of hunting and fishing activities	Objective of ensuring the protection of the rights and interests of the land and resource users

9.5.1 Air Quality

Although there is no currently available data on the quality of outside air in the James Bay territory (CRSSS Baie-James, undated), there does not seem to be any specific issues concerning the air quality near the Whabouchi project site. Effectively, the site is not located near a major agglomeration where various activities such as industries, would concentrate. The nearest community is the Cree community of Nemaska, 30 km west of the Whabouchi project site.

Therefore, the main project or activity in the local cumulative effects study area that, combined with Nemaska Lithium's Whabouchi project, could have effects on the air quality is the Route du Nord. However, due to its remoteness, traffic on this road is limited. Most of traffic on this road is heavy vehicles. The Route du Nord is mainly used for the travel of land users, forestry companies, mining companies, tourists and for the hydroelectric developments (MTQ, 2005). The annual average daily traffic in 2002-2003 was estimated at approximately 210 vehicles in the section south of Kilometer 108, and approximately 110 north of Kilometer 108. Furthermore, except for the Cree community of Nemaska, which is 10 km from Kilometer 300, there is no town or agglomeration along the Route du Nord. However, some Cree camps are installed along this road.

Considering the current and future mining exploration projects on the territory, an increase in the traffic on the Route du Nord could be expected. This increase in the traffic could result, among other effects, in additional emissions of dust and certain atmospheric pollutants that could have possible incidences on air quality. However, it is difficult to forecast quantitatively the potential impact of increased traffic on the Route du Nord on air quality, since there is little information currently available about future projects.

In the regional study area, the other identified projects, activities or events contribute very little to no modification of air quality. Effectively, due to their remoteness from the Whabouchi project site, their effects cannot be considered concurrents with those of the present project.

Where the Whabouchi project is concerned, dust emissions are the main source that could affect the air quality. However, their dispersal by the wind naturally reduces the concentration of dust and fine particles as the distance from the source increases.

Also, the current regulation, i.e. the Clean Air Regulation of 2011, defines maximum concentrations for various atmospheric pollutants. The purpose of the regulation is to protect the air quality by controlling, among others, the atmospheric contaminant emissions, and all projects and activities must comply with it.

Nemaska Lithium will monitor air quality to ensure, among others, that the applicable criteria are respected. Additionally, this follow-up will provide insight on the dynamic of the cumulative effects if certain projects are undertaken since then, particularly the contribution from the Route du Nord. If necessary, the follow-up will help propose specific measures if any issue arise.

Considering the past, current and future projects, activities and events, it is unlikely that the cumulative effects on air quality will be significant in the local study area of the Whabouchi project, as well as in the regional study area. Therefore, the cumulative impact on air quality is considered negative and low.

9.5.2 Noise

In the local cumulative effects study area, the elements that have incidences on noise are the Route du Nord, and particularly the circulation of vehicles on this road. As mentioned above, the Route du Nord is a remote road where vehicles circulation is limited. It is mostly used by heavy vehicles. Although it is difficult to quantify, traffic on the Route du Nord constitutes a source of noise that is concurrent with the Whabouchi project.

The presence of the Nemaska airport, 19 km west of the Whabouchi project, is also a source of noise. However, traffic at this airport is not heavy. In 2003, less than 2,000 movements were reported (MTQ, undated).

The mining exploration activities that are underway near the Whabouchi project site result in a certain increase in the circulation on the Route du Nord. However, this increase is difficult to quantify, notably because of the limited information available on the use of the Route du Nord and the lack of specific data about the other mining exploration projects.

In the regional study area, many other past, present and future projects, activities and events have incidences on the noise component (see Table 9-6). However, their possible cumulation with the Whabouchi project is limited due to the distance that separates them. For example, the extension of the Route 167 North project toward the Otish Mountains is approximately 205 km away from the Whabouchi project.

Finally, in the case of certain past projects, the noise emissions have ceased and are therefore not concurrent with those of the Whabouchi project.

Instruction notice 98-01 from the ministère du Développement durable, de l'Environnement, de la Faune et des Parcs (MDDEFP, 2006) manages the noise emissions on the territory of Québec. It sets maximum daytime and nighttime sound levels for different zoning categories. Therefore, the Whabouchi project must necessarily respect the noise emissions that are authorized for its zoning category, i.e. Category IV.

Considering the past, current and future projects, activities and events, it is unlikely that the cumulative effects on noise will be significant in the local study area of the Whabouchi project, as well as in the regional study area. For these reasons, the cumulative impact on noise is considered negative and low.

9.5.3 Woodland Caribou

Table 9-6 identifies the past, present and future projects, actions and events that have an impact on the woodland caribou. Most of these are related with the disturbance and loss of habitat, a result of the deforestation activities required for the development of various projects.

As mentioned earlier, the woodland caribou was attributed the status of threatened species in 2000 by the COSEWIC, while at the provincial level, it is considered since 2005 a vulnerable species under the Act Respecting Threatened or Vulnerable Species. At present in Northern Québec, the populations of woodland caribou sustain the disturbances that are considered important because they exceed the limits that guarantee their stability (Rudolph and coll., 2012).

The main reasons for the decline of the woodland caribou are the modification of its habitat and recreational hunting (Équipe de rétablissement du caribou forestier du Québec, 2008). Predation by gray wolves and black bears is also responsible for this situation. Woodcutting and the hydroelectric developments have significantly disturbed the caribou habitat over the years.

In the regional cumulative effects study area, several projects have contributed to disturbing the woodland caribou habitat to varying degrees. Effectively, the past road projects (notably the Route du Nord) and future ones (notably the extension of Route 167 North towards the Otish Mountains) required or will require that large surfaces of the land be deforested. For example, the extension of Route 167 North towards the Otish Mountains requires the clearing of 3,551.6 ha, including the totality of the borrow pits. In order to evaluate the impacts of the route project on the caribou populations in the project area, the MTQ will implement a woodland caribou monitoring program. Also, the MTQ will collaborate in the MRN's caribou monitoring program. More specifically, in this monitoring program, the MTQ will consider the protection of sensitive zones (e.g. birthing areas) and will set protection objectives (MDDEFP, 2012). As for the development of the Eastmain-1-A powerhouse and Rupert diversion project, it caused the loss of 95 km^2 (9,500 ha) of winter habitat that had a high potential for caribou (Hydro-Québec, 2004). During the construction phase of the project, Hydro-Québec monitored the caribou (forest ecotype and/or barren-ground ecotype) over two consecutive years, i.e. 2008 and 2009 (Hydro-Québec, 2012b). The 2008 monitoring found 323 trails and 6,632 caribou (Hydro-Québec, 2010). This monitoring of the caribou populations will continue in 2014 (Hydro-Québec, 2012b).

In the Whabouchi project, the surface area that will have to be cleared for the construction of the infrastructures and facilities remains relatively small, i.e. 165 ha. Also, as mentioned in chapter 7 of the ESIA, the territory in which the Whabouchi project is located does not appear to be intensively visited by woodland caribou. No caribou tracks were observed in the aerial survey conducted for the project during the winter of 2012.

The site of the Whabouchi project is located within the Weh-Sees Indohoun sector, where recreational hunting of caribou is prohibited. However, subsistence hunting is allowed. The situation of the species is alarming and in order to protect it, the Grand Council of the Crees

(Eeyou Istchee) and the Cree Trappers' Association have agreed to implement an awareness campaign among the population to stop woodland caribou hunting (Conseil Cris-Québec sur la foresterie, 2012).

The forestry activities carried out in the southern part of the regional study area also disturb the caribou habitat. Effectively, the construction of forest roads for the wood harvesting activities increases the fragmentation of the caribou habitat. Furthermore, forestry activities could make the environment more favorable for moose. An increased moose population would contribute to the augmentation of wolf populations, thus resulting in increased predation of caribou (Commission régionale sur les ressources naturelles et le territoire de la Baie-James, 2010). It is also recognized that the opening of the territory, and more specifically the creation of corridors, facilitate the movements of predators, notably the gray wolf (Rudolph and coll., 2012). Thus, all the other mining projects requiring the construction of an access road will increase the fragmentation of the habitat of caribou and provide new travel paths for potential predators.

Natural disturbances such as forest fires also modify the caribou habitat. In fact, the rejuvenation of forests as a result of forest fires could be favorable for moose, while the woodland caribou prefers mature, undisturbed conifer forests.

The presence of the Albanel-Témiscamie-Otish National Park and of the Assinica National Park Reserve ensures, in a certain manner, the protection for the habitat of vulnerable species, in this case the woodland caribou. Furthermore, the protected area projects would be beneficial as they would preserve, in a circumscribed territory, the diversity of its species and ecosystems.

The community effects on the woodland caribou are considered negatives and notably because of the preoccupying situation of the species in the James Bay territory and of the disturbance of its habitat, particularly in past years.

Considering the precarious situation of the species, Nemaska Lithium wishes to collaborate actively with governmental authorities. To this end, Nemaska Lithium will inform the ministère des Ressources naturelles about observations of caribou near the mine site and will forward any other information deemed relevants, for example the location of a calving area or a forest fire.

9.5.4 Hunting, Fishing and Trapping

Since 1975, the use of the territory and its resources, particularly the hunting, fishing and trapping activities in the regional study area, has undergone changes. With the development of the James Bay region and the development of, among others, the major hydroelectric projects, the users of the land had to adapt their activities to this new environment. Portions of the territory that were previously accessible and visited have become inaccessible and are therefore abandoned by the users. For example, the lowering of water levels in the Rupert River has modified the use of permanent camps on five Nemaska traplines (Hydro-Québec, 2004).

Because they greatly modify the landscape, the deforestation activities required for the development of many projects, for example the construction of linear infrastructures such as power lines and roads also modify the use of the land and its resources. Effectively, the presence of a road, and more particularly the circulation of vehicles, constitutes a source of noise in the environment. The users of the land must therefore deal with this new perturbation of the noise levels in their hunting, fishing and trapping activities. This disturbance of the auditory environment can lead to the avoidance of certain areas by some wildlife species.

In the development of hydroelectric projects such as the Eastmain-1-A powerhouse and Rupert diversion project, portions of the territory were flooded and some water courses have seen their flow reduced or completely diverted. Mr. James Wapachee's trapline R20, on which the Whabouchi project is located, was impacted by the Eastmain-1-A powerhouse and Rupert diversion project. This hydroelectric project resulted in changes in the fishing activities on the Nemiscau River and Lake Teilhard (Hydro-Québec, 2004).

Between 2007 and 2010, Hydro-Québec monitored the use of the land by the Crees, particularly the use of 33 traplines in the 6 concerned Cree communities, including Nemaska. Additionally, in 2011 and 2012, semi-directed interviews and focus groups were organized, notably to identify the impacts of the construction and operation of the structures and to evaluate the effectiveness of the mitigation and valorization measures (Hydro-Québec, 2012b). Follow-up studies in 2007 and 2008-2009 showed that the Nemaska tallymen are concerned, among others, by the increased nuisances (e.g. noise and dust), the reduced accessibility to certain areas and the resulting obligation to relocate certain activities on the territory, as well as by changes in the use of their camps (Hydro-Québec, 2012c). The follow-up on the use of traplines will continue for the following 3 years: 2013, 2016 and 2021.

The Whabouchi project, with a footprint that is considerably smaller than that of the major projects that characterized the development of the James Bay, is located on a single trapline, i.e. trapline R20. Comparatively, the extension of Route 167 North towards the Otish Mountains will involve a total of 7 traplines, while the Eastmain-1-A powerhouse and Rupert diversion project affected 36 traplines.

Additionally, because of its location along the Route du Nord, the Whabouchi project will evolve in areas where the hunting, fishing and trapping activities on trapline R20 are already disturbed by the presence of the road infrastructure. Due to its location, the Whabouchi project does not require the construction of several kilometers of access road to reach the mine site. Such an infrastructure would have disturbed more significantly the land and resource uses by creating notably a new opening.

On the other hand, the construction of roads opens new territory. Thanks to this opening, access to the territory and its resources, which was until then rather limited, is now facilitated for native as well as non-native users. For example, the Eastmain-1-A powerhouse and Rupert diversion project required the construction of 177 km of access roads, representing 2.7% of the total length of roads built in the James Bay territory since 1974 (Hydro-Québec, 2004). The projected Route 167 North extension over a distance of some 112 km falls within the regional study area and represents 47% of the total length of the planned road. The presence of roads facilitates access to the territory, thus potentially increasing the pressure from wildlife harvesting. The presence of such road infrastructures necessarily modifies the land and resource uses.

Recreational hunting and fishing can also increase the harvesting pressure on certain species within the regional study area. Effectively, the development of outfitting services on the territory encourages and facilitates the harvest of wildlife species. However, since 1996, there is a moratorium on the deliverance of outfitting permits on the JBNQA territory (Commission régionale sur les ressources naturelles et le territoire de la Baie-James, undated). Recreational hunters and fishers must hold a permit and respect quotas regarding authorized catches.

Also, the Weh-Sees Indohoun Corporation maintains control on the hunting and fishing activities by the workers from the Eastmain-1-A-Sarcelle-Rupert project and other users of the land. This Corporation makes sure that the harvesting pressure on wildlife species within its jurisdiction is not excessive. The organization is responsible for issuing access permits to those who wish to go recreational fishing within its jurisdiction.

The projects identified within the regional study area do not specifically prevent hunting, fishing and trapping activities, but rather change the way they are carried out in the territory. The wildlife harvesting activities within the regional study area will never be compromised. Therefore, the cumulative effects on hunting, fishing and trapping are considered negatives and low.

The monitoring and follow-up program that will be implemented by Nemaska Lithium will follow the use of the land and its resources and identify, among others, eventual modifications resulting from the development of the Whabouchi project as well as other projects. Thus, the pursuit of the hunting, fishing and trapping activities by the Crees and other users in the project's host region will be documented.

9.5.5 Socio-Economic Aspects

Table 9-6 presents the list of past, current or future projects, activities and events that are susceptible of impacting socio-economic aspects. Thus, the hydroelectric projects, mining projects and transportation infrastructure projects are mostly those that have an impact on the employment and economy within the regional study area.

Since 1975, the large-scale projects created many jobs. By itself, the Eastmain-1-A powerhouseand Rupert diversion resulted in the creation or maintenance of direct, indirect and induced jobs that could, during the construction phase, reach up to 1,189 person-years (Hydro-Québec, 2004). Spinoffs in the order of $104.9M are expected in the Cree economy, including $93.2M in direct spinoffs. During the operation phase, Hydro-Québec plants to award some $45M of contracts to Cree companies. As for the Jamésie economy, Hydro-Québec foresees that during the construction, spinoffs will reach $106.7M, including $87.3M in direct spinoffs (Hydro-Québec, 2004). The results of Hydro Québec's follow-up on the economic spinoffs of the Eastmain-1-A and Sarcelle power stations and Rupert diversion shows that there was an monthly average of 183 Cree workers during the 2007-2011 period, which represents 10% of

Cree among the workers. The communities of Mistissini, Waskaganish and Nemaska are those mostly represented, with respective percentages of 38%, 22% and 10% of the workers (Hydro-Québec, 2012b). This follow-up also concluded that an amount of $831M was paid to 37 Cree companies and to the tallymen for the execution of 316 contracts.

For their part, the mining projects have for many years invested significant sums in the territory of Québec. For example, in 2011, a total of $3,156M (current) were invested for exploration and development activities (MRN, undated-a). This investment represents a 318% increase from the sums invested in 1999. In Québec, the mining sector created 16,855 jobs for the year 2011, a number that was comparable to that of 1999, which was 16,869 (MRN, undated-b).

In the Whabouchi project, a total of 81 persons will work during the operation phase of the mine, i.e. 14 persons in the administration sector, 43 in mining operations, 14 in maintenance activities and 10 in the metallurgy sector (Met-Chem, 2012). An optimization of economic spinoffs at the local scale is contemplated in the collaboration agreement currently being discussed by Nemaska Lithium, the Resource Development Partnership of the Cree community of Nemaska and the Cree Regional Authority (CRA). Combined with other projects, the Whabouchi project would therefore have positive cumulative effects in terms of employment and economic spinoffs.

The implementation of the Plan Nord will stimulate and encourage the realization of numerous mining projects in the territory. Effectively, during the upcoming years, eleven new projects could be undertaken. The realization of all these projects would entail investments of the order of $8.24G, in addition to the creation of 11,000 jobs during construction and 4,000 jobs during operation (MRN, 2010).

For the 2012-2021 period, the Comité sectoriel de main-d'œuvre de l'industrie des mines estimates that the mining sector's labor requirements in the Nord-du-Québec region will be of the order of 10,677 job openings (Comité sectoriel de main-d'œuvre de l'industrie des mines, 2012). In the same region, the jobs that will be the most in demand during the 2012-2021 periods will be those of specialized heavy equipment operators (excavators and trucks) and labourers (mines).

Due to the number of projects that are underway and planned, the pool of qualified and available labour force could be limited and might not fulfill the industry's needs and requirements. This shortage of qualified labour force will mean that outside workers will be necessary. Combined with the other projects, the Whabouchi project will therefore also have negative cumulative effects because a form of competition will arise between the different work providers who will need to fulfill their respective labor requirements. Also, outside workers will leave their family environment for a period of time, thus modifying established family dynamic.

The cumulative effects on employment and the economic spinoffs are both positives and negatives. These cumulative effects are considered positives in the sense that they create wealth in the territory. Job creation and increased local and regional economic spinoffs are two of the elements that help an individual, community and/or region to improve, among other things, their socio-economic situation. These cumulative effects are also considered negatives, since the realization of all the projects in the territory will mean that there won't be enough qualified and available labour force to fulfill all the job openings. This could give rise to competition between mining companies to hire qualified workers, as well as competition between regions to provide the necessary professional expertise.

From the social point of view, the introduction of the Whabouchi project, combined with the other past, present and future projects, could create some strain between community members and even between communities. Effectively, the arrival of such projects on the territory can be seen by some as an opportunity for development and improvement of living conditions, while for others, these projects could rather be considered as destructuring elements that alter the way of living on the land and that clash with traditional values.

With regard to the follow-up, the collaboration agreement actually under discussion provides for the creation of a committee when the mine will be in operation. Composed of representatives of Nemaska Lithium and of the community of Nemaska, this committee will be responsible, notably, for monitoring employability in the Cree community of Nemaska and the economic spinoffs generated by the Whabouchi project. This committee may also make recommendations to improve certain aspects of the projects, for example the training possibilities and business opportunities.

To summarize, the cumulative effects on employment and economic spinoffs are considered positives and moderates due to the training opportunities, jobs created and significant economic spinoffs generated by past, present and future projects. On the other hand, these cumulative effects are considered negatives and low, notably because of the lack of specialized labour force and the hiring competition for workers.

By implementing its monitoring and follow-up program, Nemaska Lithium will be able to validate, among other things, the anticipated impacts of the Whabouchi project in terms of employment and economic spinoffs, and to observe the effectiveness of the mitigation and improvement measures. This monitoring and follow-up mechanism will also document in a certain measure the influence of other projects on this component and thus to seize the dynamic.

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NEMASKA LITHIUM

CHAPTER 10

ASSESSMENT OF TECHNOLOGICAL RISKS AND EMERGENCY MEASURES PLAN

Environmental and Social Impact Assessment

March 28, 2013

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10. ASSESSMENT OF TECHNOLOGICAL RISKS AND EMERGENCY MEASURES PLAN

This chapter discusses the technological risks, workplace health and safety management, and emergency measures plan. The engineering, equipment purchase and construction phase described in the project development plan, as well as the operation phase detailed in the operation plan, are covered in this chapter.

The project management team pursues its goal of continuous improvement in order to achieve the highest health, safety and environmental (HSE) standards during the construction phase. All work practices are regulated by current laws and by the project development plan, which cover HSE. Every contractor working on the site will be responsible for ensuring the protection of the environment as well as the health and safety of his employees. The HSE management plan will comply with all laws, regulations and relevant standards so as to ensure a continuous improvement of the health, safety and environment.

The implementation of the HSE management plan will be the responsibility of the health, safety and environment manager, who will report to the project director. However, all agree that in order to reach the highest environmental standards, the site construction director and the entire construction management team shall work closely with the HSE director and his staff.

10.1 Hygiene Management

10.1.1 Workplace Hygiene

The industrial hygiene program ensures that workers are not exposed to contaminants or chemical agents that could affect their health or their physical integrity. Thus, it is intended to identify and monitor such contaminants and physical agents in order to issue recommendations, when required, to control them at the source or to provide appropriate individual protection equipment to the workers. The program will be developed in conformity with the requirements of the Regulation respecting the quality of the work environment (RRQ, c. S-2.1, r. 15).

The workplace airborne contaminants that will be monitored are:

- Breathable concentrations of crystalline silica type dust;
- Carbon monoxide inside the concentrator.

The physical agents that will be monitored are:

- Noise;
- High or low temperatures.

The workplace hygiene program will be managed by the staff of the health and safety department.

10.2 Health, Safety and Environment Management

This section is divided in two topics: the construction phase and the operation phase.

10.2.1 Specific Risk Management during the Construction Phase

Nemaska Lithium and the representative of the contractor (team of companies performing the engineering, administration and construction management associated with the project) agree that workplace health and safety shall be an issue and a constant concern. No goal or performance imperative shall justify compromises about the physical or mental integrity of individuals, and even less to tolerate the taking of risks that could result in injuries.

Concretely, the Whabouchi project management team is committed to ensure and maintain a healthy and safe work environment for all employees and other persons working on the project (e.g. contractors, subcontractors), in conformity with the law.

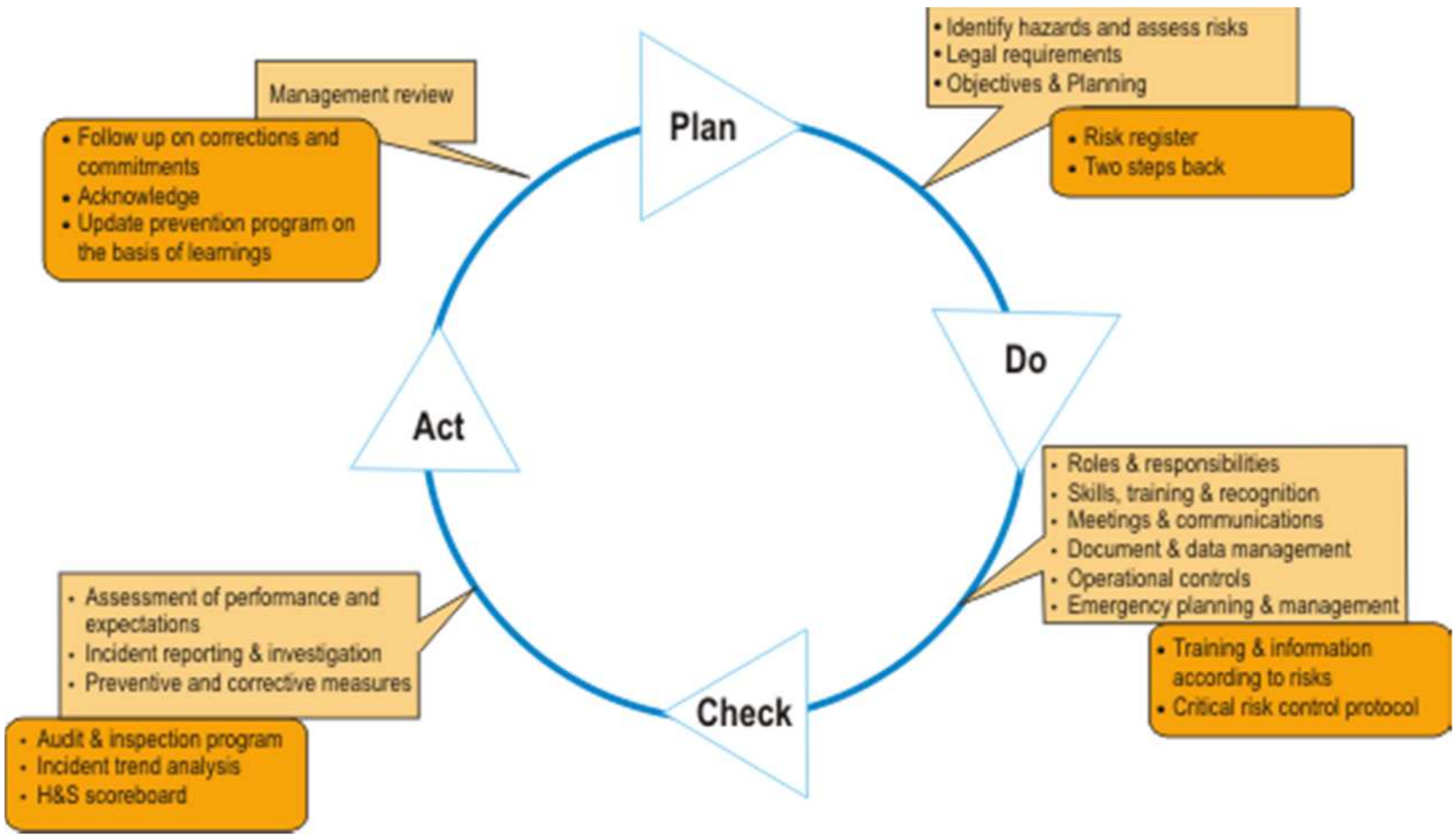
To achieve this goal, a prevention program will be developed for the worksite. This program will be based on the strict and a rigorous application of health and safety regulations and of the procedures developed by Nemaska Lithium and the contractor's representative.

The responsibility for the application of this prevention program will encompass all decision levels, down to the individual worker. Each worker on the worksite will have the obligation of performing his tasks in such a manner that he or any other person is not exposed to hazards. All activities shall be performed in conformity with the rules established by the worksite direction and health and safety standards.

The purpose of the prevention program is to eliminate at the source all hazards for the workers' health, safety and physical integrity.

Figure 10-1 summarizes the components of the construction health and safety program.

Figure 10-1 Summary of the Worker's Risk Prevention Program



10.2.1.1 Employer Requirements

The contractors shall adopt and apply the principles of the risk management process that are relevant to their work. If needed, risk prevention dispositions could be incorporated in the contracts with contractors and subcontractors.

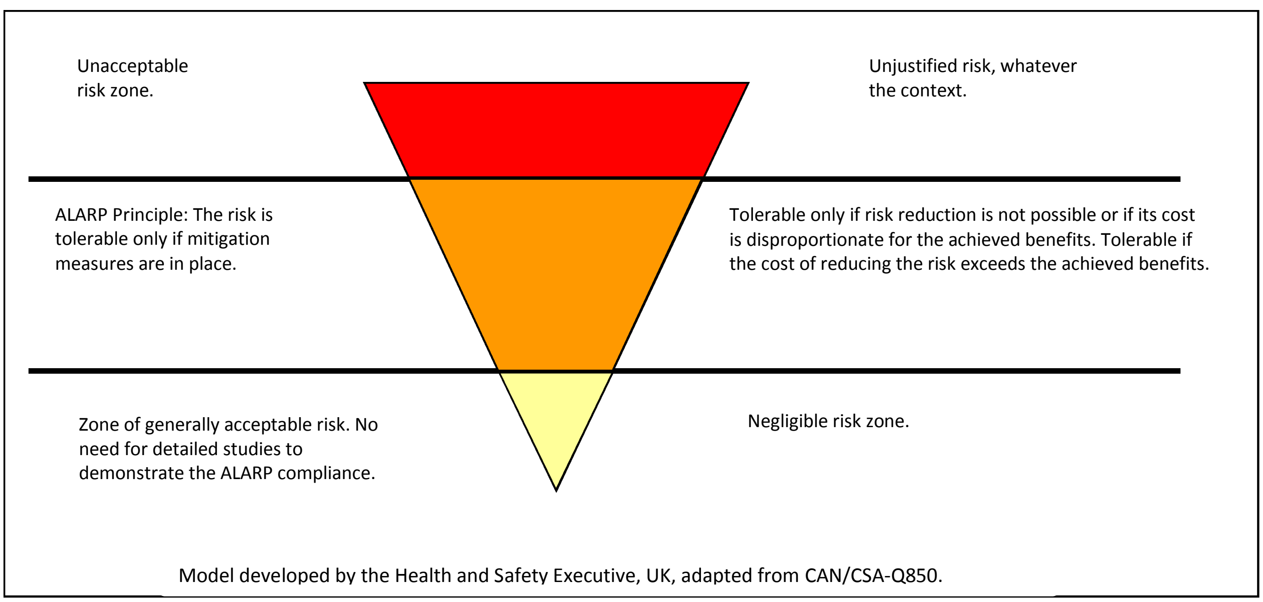
The contractors must demonstrate that they prioritize safety in their own organization. The principal contractor's risk manager will evaluate proactively the capacity of each contractor to provide his services in conformity with the project risk management goals, and he shall ensure that corrective measures are implemented if needed.

The project director will be in charge of demanding risk management audits if he estimates they are necessary.

10.2.1.2 ALARP Principle

It should be noted that the risk tolerance criteria include requirements related to risk mitigation measures. Nemaska Lithium's prime objective in risk management consists in reducing the risk to the lowest achievable level, whether during the construction, operation or closure phases. The lowest achievable levels are defined by the ALARP (*As Low as Reasonably Practicable*) principle. The ALARP principle, illustrated in Figure 10-2, is widely used and accepted by appropriated authorities in the field of risk management. Its aim is a continuous improvement process over every phase of the project. Nemaska Lithium will apply this principle to achieve the objectives set through a risk management process.

Figure 10-2 ALARP Principle



10.2.1.3 Risk Register

The risk register is the main tool to monitor identified risks and related actions. It includes the following data:

- Identification and description of the hazards that contribute to the risk;
- Assessment of the risk level and of the main risk factors, including consequences and probability of occurrence;
- Summary of the control, safety and recovery measures required maintain the risks at the ALARP (*As Low as Reasonably Practicable*) level;
- Reduction and control actions, and persons in charge of their application;
- Assessment of the anticipated risk level after application of the control and mitigation actions.

The risk register is an essential document for identify every risk and assigns resources for its elimination or control until it reaches a tolerable level according to the ALARP principle described above.

The risk register is an essential control tool for the construction phase of the Whabouchi project. It will also be used during the operation phase. It will be updated when an action is completed or revised.

Appendix 10-1 gives examples taken from the risk register.

10.2.1.4 Organization and Responsibility

A dedicated risk manager will be nominated within the project services team to lead the risk management process through the different phases. The project and operations directors will be responsible for the risk management process, and will receive directly the reports of the prime contractor's risk manager. The project director will have the responsibility of establishing and maintaining an organizational culture that allows efficient work processes, supporting the risk management objectives and implementing the recommendations to improve this management.

The risk manager's specific responsibilities, under the supervision of the project director, will be the following:

- Ensure the application of the strategy in the form of a risk management process;
- Ensure that the organization has adequate funds and resources to undertake the risk management process;
- Implement and maintain a risk management program;
- Implement and maintain a risk register;
- Apply the learning of the risk analyses (HAZID and HAZOP) so that the frequency and consequences of accidents are minimized as low as reasonably possible, i.e. to the ALARP level;

- Ensure that the risk reduction actions are defined, approved, assigned and followed;
- Manage the processes that guarantee that risk reduction measures are decided;
- Define, organize and lead safety studies relating to major and minor accidents;
- Update the technological risk analyzes when changes are made to the design or after events that could affect the conclusions of existing analyzes;
- Ensure that proper consideration is given to the risks in the development of emergency measures plans, operating procedures and training programs;
- Ensure that all options are considered in order to achieve the highest level of technological safety and to apply intrinsic safety design principles;
- Ensure that the results and the effects of the risk management process are communicated to the group responsible for the safety, prevention, environment and risk management during the operation phase;
- Ensure that the organization and application of the risk management process are conducted so as to allow periodic audits by a third party;
- Continually improve the procedures and work methods in order to optimize the effectiveness of the risk management process.

10.2.1.5 Health, Safety and Environment Performance Indicators

Retrospective and prospective performance indicators will be put in place during the construction phase in order to detect deviances of the HSE programs and apply corrective measures. The following is a partial list of performance indicators that could be used.

Prospective Indicators

- Completed verifications (audits, inspections);
- Awareness campaigns;
- HSE training of subcontractors and assessment;
- HSE meetings;
- Emergency measures plan practices;
- First aid and RCR training;
- Work permits;
- Risk assessment training;
- Observance of safe work practices;
- Training for specific tasks.

Retrospective Indicators

- Recordable accident rate;
- Lost time accident rate;
- Number of environmental incidents;
- Number of lost work days;
- Number of first aid cases;
- Number of modified duty cases;
- Number of modified duty days;
- Number of near-misses;
- Number of occupational diseases.

10.2.2 Specific Risk Management during the Operation Phase

The health and safety policy for the operation phase will be a continuation of the policy applied during the construction phase. It will be in conformity with the requirements of the Regulation respecting occupational health and safety in mines (RRQ, c. S-2.2 r.19.1). As mentioned hereinbefore, the ALARP principle and the risk register that have been describes are elements that will be maintained over the entire life span of the mining installations.

The purpose of the prevention program is to eliminate at the source hazards for the health, safety and physical integrity of the workers.

The following elements will be included in the workplace health and safety program that will apply to the mine activities and will be required for its operation.

Personal Protective Equipment

- Safety harness;
- Safety belt;
- Safety hat;
- Protective eyewear;
- Safety boots;
- Fitting clothes;
- Respirator air supply compliant with quality standards on breathable air;
- Self-contained breathing apparatus.

10.2.2.1 Specific Elements of the Prevention Program

Accountability

As mentioned hereinbefore, the responsibility for the application of this master prevention program will included all decision levels, down to the individual worker. Every worker working at the mine installations will have the obligation of performing his tasks in such a manner that he or any other person is not exposed to hazards. All activities shall be performed in conformity with the rules established by the operations direction and health and safety standards.

The upper management of the company shall provide evident leadership in developing policies, encouraging employee participation, communicating the necessary information and allocating resources to continually improve the prevention performance.

A health and safety committee will be created and a prevention representative will be nominated, as required under the Québec Act respecting occupational health and safety (RSQ. c. S-2.1) and the related Regulation respecting occupational health and safety in mines (RRQ. c. S-2.2 r.19.1). The meeting minutes will be public.

The following paragraphs describe the elements of the operational safety management program.

<u>Knowledge of the Process</u>

The following documents or plans will be developed, updated and communicated to the concerned persons:

- Hazards associated with the process;
- Normal and abnormal operating conditions;
- Protective systems, including the consequences of their failure;
- Electrical plans, control schematics;
- Ventilation systems.

The following activities will be maintained:

- Keeping the information about the design and modifications of the equipment up to date;
- Identifying safe operating conditions;
- Implementing and updating the operating procedures.

<u>Facilities Hazards</u>

A complete and current documentation about the hazards present in the facilities will be kept up to date and accessible to the employees. This documentation will include the data sheets on the chemicals, the HAZOP reports and the specific instructions provided by the equipment suppliers.

- A hazard review will be carried out at regular intervals; it will be documented and included in the risk register;

- Corrective measures will be applied when deemed necessary.

Task Safety Analysis

The purpose of the task safety analysis is to identify the hazards and the mitigation measures for each task during the operation activities, including maintenance. The task safety analysis is a safe work planning tool.

- The sector supervisor completes the task safety analysis with from the participation of the workers in the sector and the assistance of the health and safety coordinator;
- A task safety analysis must be completed before undertaking a new activity or when a change occur (new tools, equipments, materials, procedures, work organization, etc.).

Change Management

Change management is a process intended to maintain a strict control and to communicate any change in the equipments, work methods, procedures, work organizational structures, etc.

Before making a change, the hazards must be identified and their risks analyzed to ensure that the proposed change will not result in personal injuries or equipment or property damages. This process must take into account the planned changes and the unforeseen modifications.

The changes must be communicated to the concerned workers.

Subcontractor Management

The subcontractors will have the responsibility of complying, at a minimum, with the health and safety program that Nemaska Lithium will provide to ensure the safety of all their own workers and those of Nemaska Lithium, as well as to prevent damages to the facilities. The following elements will be included in the subcontractor management:

- Develop a subcontractor safety program;
- Provide the Nemaska Lithium safety information to the subcontractors;
- Develop and circulate an orientation program for the subcontractors;
- Evaluate the subcontractor's safety performance and apply any necessary corrective measures.

Pre-Startup Reviews

All facilities will be subject to safety reviews during their design and before their commissioning. The inspections and controls will ensure that the equipments are installed according to the drawings and specifications. A formal list of the observed deficiencies will be compiled. These deficiencies will be managed according to the degree of risk that they represent. The critical verifications and tests will be completed before the use of the equipments.

Mechanical Integrity of the Equipments

The equipment mechanical integrity control program aims to prevent failures that could imperil the health and safety of the workers or cause financial losses. This program will include the following elements:

- Designing, building and maintaining the facilities according to good engineering practices, in conformity with accepted codes and standards;
- Applying relevant regulations;
- Taking into account voluntary or consensual standards as well as the manufacturer's instructions in the design, construction and maintenance of the equipments;
- Selecting subcontractors who are familiar with applicable codes;
- Inspecting and verifying the equipments according to code requirements;
- Developing a documented maintenance and inspection program to ensure the integrity of the facilities;
- Developing a preventive maintenance program, including inspections, tests and maintenance procedures, and defined appropriate intervals.

Critical Procedures

Certain safe work procedures and practices will be put in place to ensure safety in the operation and maintenance of the facilities. Clearly written procedures reflecting safe work practices will be developed. The following critical procedures will be implemented:

- Working at height;
- Confined space entry;
- Isolation and lock-out tag-out;
- Trenches and excavations;
- Hot work;
- Electrical works;
- Handling of heavy loads or risk lifting.

Training

The Regulation respecting occupational health and safety in mines (RSQ. c. S-2.2 r.19.1) specifies the workplace safety trainings that workers must receive, based on the modules of the course published by the Commission scolaire de l’Or-et-des-Bois.

First, the skills and knowledge required to perform a task will be identified, particularly in the case of tasks that are critical for health and safety. The task safety analyses, among others, will be used in these trainings. The knowledge and the experience required to perform a task safely will be identified. The critical safety procedures and the emergency measures plan are elements that will be necessarily covered. The use of respiratory protection devices and of instruments to measure the presence of contaminants in the air will also be part of the training. The program will include classroom sessions (theory) and on-the-job training (practice). The workers' degree of knowledge will be evaluated. They shall demonstrate their knowledge before being assigned a job. Employee training records will be maintained.

Information

All persons arriving at the site will be informed of the applicable safety rules and of the emergency measures plan, including the alarm systems, the evacuation procedures and other actions to take, the hazards of working in the cold (outside work) or in hot conditions, and of the hazards associated with wild animals, including bears. Additionally, several types of meetings and billboards will be used to provide current and relevant information. This strategy will be documented in a communication plan that will describe the activities, responsibilities, frequencies and target public. The following is a partial list of the planned information sessions:

- Health and safety meetings at a predetermined frequency;
- Work process reviews;
- Hazard review on controlled products;
- Review of learning from accident and near miss investigations.

Incident Investigation

An incident investigation policy will be put in place. This policy will cover incidents resulting in injury, failure of controlled substance confinement, equipment damage and production losses. It also covers near-misses that could provide insight. Incidents will be investigated to define their causes, particularly their fundamental causes, and to identify the necessary corrective measures to apply. The incident investigations will be initiated immediately after the events. The learning from these investigations will be shared with the concerned persons, including workers who are potentially exposed to the same risks.

Inspections and Compliance Audits

Several types of inspections and audits are planned to ensure that the elements of the health and safety program are in place and operational, and to develop corrective measures if necessary. The following list identifies some type of inspections and audits:

- Inspection of emergency equipments, protective devices of the evacuation systems, and response tools in case of fire;
- Verification of work practices;
- Equipment inspection;
- Preventive maintenance inspection;
- Heavy equipment inspection and maintenance;
- Tool inspection;
- Inspection by government authorities;
- Health and safety audit to verify program application;
- Fire protection audit;
- Audit by the insurers.

Performance Indicators

Retroactive and prospective performance indicators will be put in place to detect deviance from the programs and to apply corrective measures.

Retrospective indicators

- Reportable accident rate;
- Lost-time accident rate;
- Number of controlled product confinement breaches affecting the environment.

Prospective indicators

- Percentage of scheduled inspections completed after the planned date;
- Percentage of scheduled training not completed;
- Percentage of corrective measures identified by incident investigations, inspections or audits that have not been applied within the timeframe set in the action plan;
- Number of treatment process malfunctions that could potentially harm the environment.

Fire Protection

The fire protection system is designed to protect the facilities. The equipments respect the following National Fire Protection Association (NFPA) codes: NPPA 13 Sprinkler Network, NFPA 14 Fire System Network, NFPA 20 Fire Water Pump, NFPA 10 Portable Fire Extinguishers, NFPA 30 Flammable and Combustible Liquids Code. The equipments will also be designed in conformity with the 2005 National Building Code of Canada and the relevant FM Property Loss Prevention Data Sheets pertaining to automatic sprinklers, conveyors, automatic fire detection, ore processing installations, flammable liquid tanks, hydraulic systems, etc.

The buildings covered by the fire protection tools include the offices, the miners' changing room, the maintenance facilities, the garage, the warehouse, the fuel storage area and fueling station, and the concentrator.

A fire system network with hydrants will be built outside the buildings. The distance between fire hydrants will depend on the location of the buildings.

The petroleum products storage tanks will have double walls and will be installed within a confinement dam.

First Aid

A first aid station with qualified medical personnel and the necessary material will be provided to serve the mining operations. If necessary, its staff will be assisted by personnel of the Nemaska health clinic.

Any person affected by an injury or feeling ill shall present herself to the first aid local, where she will be taken in charge.

First Aiders and First Aid Kits

The number of first aiders and first aid kits specified by the Regulation respecting occupational health and safety in mines (RSQ c. S-2.2 r.19.1) will be in place, as will a team of first responders.

Transportation to an Hospital Centre

An injured worker requiring emergency evacuation to the Nemaska clinic or other hospital centre can be transported from the airstrip at Nemaska.

The Whabouchi project's emergency plan will describe the measures and means that apply in such circumstances.

Human Errors

Particular attention will be given during the detailed engineering of the facilities to reduce the potential for human errors or behavior that could result in accidents.

A program will be developed and implemented for the operation phase.

10.3 Management of Technological Risks

This section identifies the technological risks associated with the construction, operation and closure phases of the Whabouchi project, and more specifically the mine (open pit), the concentrator, the access roads and the waste rock and tailings management. The elements included in the technological risk assessment include:

- The extraction, handling and storage of the ore (pit);
- The concentrator and its different equipments;
- The management of the waste rock and tailings;
- The storage of petroleum products;
- The storage of chemicals;
- The explosives storage areas;
- The equipment maintenance facilities;
- The secondary mine roads, the use and maintenance of machinery, and road traffic.

This assessment aimed to identify the major risks, their consequences, their probability of occurrence, the prevention or mitigation measures in place, and the management of safety. The Whabouchi project is located at a considerable distance from any permanent habitation and does not represent a risk for the populations in case of accident. However, it is conceivable that an accident could affect workers on the site and the environment. The site is also far away from resources that could be deployed in the event of a major accident, and will need to rely on its own intervention capacities. It is therefore important to identify the risks that could affect the site, so that resources can be put in place to react promptly and confidently in case of a major accident.

Nemaska Lithium considers that the technological risk assessment is an essential element. The risk management process, adopted and applied in the project will ensure that the plausible consequences of identified accident scenarios will be reduced sufficiently to keep the level of risk as low as reasonably possible (ALARP).

Appropriate intervention measures will be developed with the emergency measures plan. During the construction phase, all the events that could threaten the environment or its components will also be covered by a specific emergency plan for the construction phase. An appropriate emergency plan will also be developed for the permanent closure of the facilities. The operation phase deserves a more elaborate analysis, considering the hazards that will be present on the site.

10.3.1 Why a Technological Risk Assessment?

Considering the distance separating the Whabouchi mining operations from government resources, the mine operator will have to take the first emergency measures in case of technological accident, spill, etc. The risk assessment provides information about the intervention means and the procedures to follow for the following cases:

- Transport of dangerous substances (petroleum products, chemicals, explosives, etc.) or of potentially dangerous products;
- Hazardous product spills on the access road, the secondary mine roads or the site itself, with special attention to the reaction speed and the means available at the site;
- Storage of petroleum or other products;
- Fire hazards during transport or on the site;
- Risk of forest fire around the site or along the access road.

Nemaska Lithium has taken into account the probability of such events.

10.3.2 Risk Management System

Nemaska Lithium already applies a management system that covers health and safety, accident prevention, environment and risks.

The objectives of the management system specify that Nemaska Lithium's management and employees are committed to reduce risks to the lowest reasonably possible level and to manage the residual risks to ensure a safe workplace and protect the environment at all times.

Nemaska Lithium endeavors to provide a healthy and safe workplace by designing, maintaining and promoting safe and productive work practices in all its activities.

Nemaska Lithium will comply with any specific health and safety regulation or prescription that applies to its activities in the jurisdiction.

To this end, Nemaska Lithium will:

- Incorporate all occupational health and safety considerations in its activities, from design to conclusion;
- Take all reasonable measures and possible practices to eliminate from the workplace all situations that could constitute a hazard;
- Provide information, training, methods and protective equipment to allow the employees to work productively in a safe environment;
- Ensure that all employees understand and respect the established safe work practices and techniques;
- Make sure that all the contractors employed by Nemaska Lithium comply with this policy;
- Maintain a presence of persons or teams who can intervene in case of medical or environmental emergency;
- Improve occupational health and safety through a continuous process of assessment and improvement of its work instructions;
- Make sure that a complete investigation is made of all incidents, in order to eliminate or reduce the possibility of recurrence of such events.

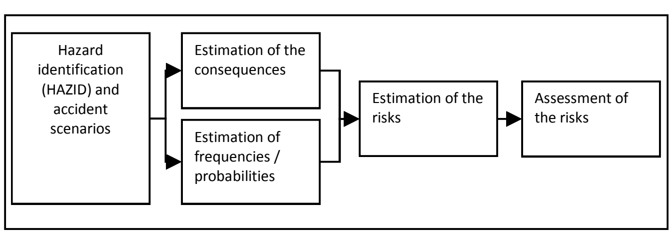
10.3.3 Risk Assessment Methodology and Tolerance Criteria

The following sections describe the methodology used for the risk analysis.

10.3.3.1 Assessment Process

The methodology of the risk assessment is illustrated in Figure 10-3. This procedure follows the directive issued by the MDDEFP. In the first step, the hazards associated with the infrastructures or equipments under study are identified, which supports the development of accident scenarios. In the subsequent steps, the potential consequences of the scenarios are identified by mathematical simulation or other methods. The frequencies or probabilities of an accident are estimated from accidents databases or expert opinions. Finally, the risks are evaluated.

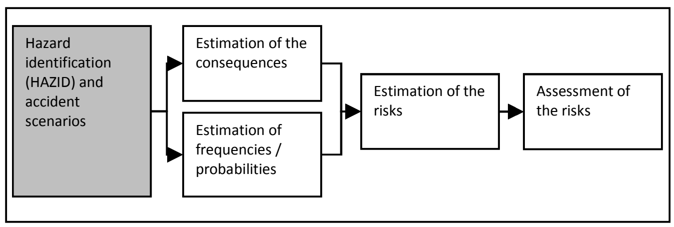
Figure 10-3 Risk Assessment Methodology



10.3.3.2 Hazard Identification and Scenario Development Methodology

The hazard identification process is illustrated in Figure 10-4. The purpose of this step is to identify the sources of hazards associated with the infrastructures and equipments being studied. A HAZID (*hazard identification study*) analysis was therefore completed in order to identify the sources of hazard, their causes and the existing mitigation measures. This identification considers the existing chronic hazards introduced by the normal or quasi-normal operation of the installations, as well as the sources of hazard associated with degraded operations and during the incidents. It should be noted that the preventive measures associated with normal or quasi-normal operation of the facilities are generally well recognized by accepted standards and by the regulations. The number of theoretical scenarios is virtually unlimited, though in practice the assessment should be limited to the dominant scenarios.

Figure 10-4 Hazard Identification

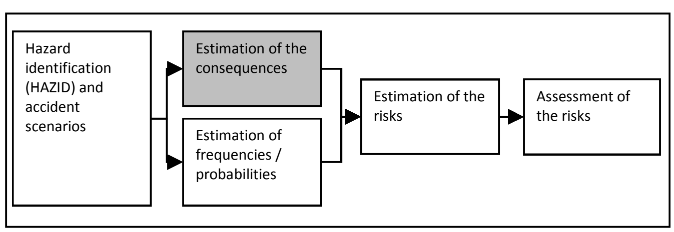


The information provided by the HAZID sessions and the analysis of the learning from incidents in similar facilities supported have allowed the development of incident scenarios. The results of the HAZID analysis are presented in Appendix 10.2.

10.3.3.3 Incident Consequences Estimation Methodology

The process followed to estimate the consequences is illustrated in Figure 10-5. Since the consequences of accidents cannot be simulated, they were estimated on the basis of expert opinions.

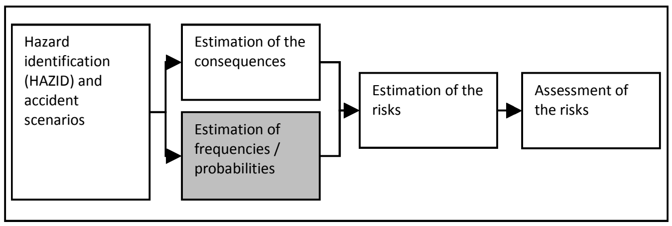
Figure 10-5 Estimation of the Consequences



10.3.3.4 Frequency Estimation Methodology

The process to estimate the frequencies is illustrated in Figure 10-6. The accident scenarios that were retained for a quantitative analysis of their consequences were also analysed for their probability. The probabilities and frequencies were established on the basis of failure frequencies observed in similar facilities.

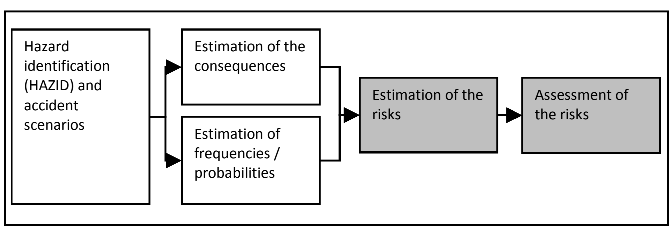
Figure 10-6 Estimation of the Frequencies



10.3.3.5 Risk Estimation and Assessment Methodology

The risk estimation and assessment process is illustrated in Figure 10-7. These estimations and assessments were based on criteria that take into account the severity of the consequences of undesired events, the probability of occurrence of these events and the degree of uncertainty relating to the consequences and probabilities.

Figure 10-7 Risk Estimation and Evaluation



These criteria are described in the following subsections, tables and figures:

- Figure 10-8 Risk matrix
- Table 10-1 Severity levels of the consequences
- Table 10-2 Probability of occurrence class
- Table 10-3 Uncertainty level
- Table 10-4 Acceptability criteria

The level of risk identified takes into account the prevention and mitigation measures that are in place, provided that these measures are robust and reliable.

Figure 10-8 Risk Matrix

Severity of consequences

Very high	Moderate	High	Very high	Very high	Very high
High	Moderate	Moderate	High	Very high	Very high
Moderate	Low	Moderate	Moderate	High	Very high
Low	Low	Low	Moderate	Moderate	High
Very low	Very low	Low	Low	Moderate	Moderate
	Very low	Low	Moderate	High	Very high

Probability of occurrence

The levels of severity are described in Table 10-1 and cover the following elements:

1) Workers/Public: Health and safety of the persons in the area at the time of the accident;
2) Environment: Impact on the environment;
3) Goods: Damages to property, interruption of production.

Table 10-1 Severity Levels of the Consequences

Severity of Consequences	Workers/Public	Environment	Goods
Very high	• Several losses of life caused by direct exposure.	• Very important uncontained spill of hazardous materials. • Elimination of regional species. • Contamination of the aquifer and drinking water.	• Major damages to property, leaving buildings unusable/Interruption of production during one month.
High	• Loss of life caused by direct exposure.	• Important uncontained spill of hazardous materials. • Elimination of regional species. • Contamination of the aquifer and drinking water.	• Major damages to property, leaving buildings unusable/Interruption of production during one week.
Moderate	• Injuries. • Severe illnesses.	• Minor uncontained spill of hazardous materials. • Elimination of local species. • Contamination of individual drinking water wells.	• Important damages/Interruption of production during one week.
Low	• Injuries and illnesses that do not result in disability. • Significant loss of quality of life. • Benign illness.	• Major contained spill of hazardous materials. • Part of the local organisms subject to a negative impact.	• Minor damages/Interruption of production during one day.
Very low	• Benign impact on the quality of life.	• Minor contained spill of hazardous materials. • No measurable impact in the area.	• No damages/Interruption of production during 12 hours.

The probability is the potential that an identified hazard results in an accident. The indications expressing the probability or the frequency of a hazard were developed by taking into account, where possible, the history of events in the industry or an estimate based on the engineering studies when historical data is not available. The accident scenarios were evaluated according to different probability classes. Table 10-2 classifies the probability of occurrence.

Table 10-2 Probability of Occurrence Classes

Probability of Occurrence	Definition
Very high	Will occur in most circumstances
High	Can occur in most circumstances
Moderate	Can occur within a given interval of time
Low	Might occur within a given interval of time
Very low	Can occur in exceptional circumstances

The estimation of the risks is subject to a degree of uncertainty. Table 10-3 lists the uncertainty levels that affect the risk estimate in each case.

Table 10-3 Uncertainty Levels

Probability of Occurrence	Definition
Very high	Missing information: new technology, new configuration
High	Some information available: adaptation of a technology in a new application
Moderate	Many information available: application of a technology in use elsewhere, with modifications
Low	Many information available: application of a technology in use elsewhere, with few modifications
Very low	Many information available: application of a technology in use elsewhere, without modification

Table 10-4 describes the risk acceptability criteria.

Table 10-4 Acceptability Criteria

Risk Level	Definition
Very high	Unacceptable risk – The company's highest responsible person is notified and ensures that risk mitigation and reduction plans are implemented
High	Unacceptable risk – The responsible vice-president ensures the continuous implementation of preventive control measures and risk reduction plans, in addition to reassessing the risks at regular intervals
Moderate	The risk must be reduced as low as reasonably possible (ALARP) – The direction ensures that the risks are monitored, that the control measures and mitigation plans are operational, and verifies that the procedures are followed
Low	Acceptable risks – The first-line supervisors must ensure that the employees and subcontractors are aware of the risk and that the established procedures and control measures are respected
Very low	Negligible risks

10.3.4 Summary of Technological Risks

The technological risks identified by the HAZID study are summarized in Table 10-5. The consequences, the probability of occurrence, the uncertainty and risk levels were evaluated on the basis of the risk matrix presented in Figure 10-8, of the consequence severity levels in Table 10-1, the occurrence probability classes in Table 10-2, the uncertainty levels relating to the consequences or the probability of occurrence given in Table 10-3, and the risk acceptability criteria in Table 10-4.

A more detailed analysis of each risk is presented in sections 10.3.4.1 to 10.3.4.8.

Table 10-5 Summary of Technological Risks

#	Identification of the Risk	Description of the Risk	Consequences	Probabilities	Uncertainty Level	Risks	Recommendations
10.3.4.1	Open mine pit	Flooding of the pit	H	L	M	M	
		Rock falls	VH	L	M	M	
		Uncontrolled explosion in the pit	VH	VL	L	M	
10.3.4.2	Concentrator	Fire	H	L	L	M	
		Binding	H	L	L	M	
10.3.4.3	Petroleum products, bunker and fuels	Petroleum products spill	M	L	L	M	
	Petroleum products, bunker and fuels	Fire	H	L	L	M	
	Petroleum products, oils and greases	Spill	L	L	L	L	
10.3.4.4	Miscellaneous chemicals	Spill	M	L	L	M	
10.3.4.5	Explosives storage and handling	Surface explosion	M	L	L	M	
		Theft of explosives	H	VL	L	M	
10.3.4.6	Waste rock and tailings confinement	Instability of the waste rock and tailings pile slope	L	L	L	L	
		Bad quality of the water leachate from the waste rock and tailings pile	L	L	L	L	
10.3.4.7	Roads	Accident involving hazardous materials on the route du Nord	H	L	M	M	It is recommended that formal agreements for the sharing of intervention resources in case of accidents be concluded with the ministère des Transports, the other mining operations in the area and the Cree community of Nemaska.
		Accident involving a truck hauling spodumene on the route du Nord	L	L	L	L	
10.3.4.8	Other hazards	Forest fires	M	M	M	M	

10.3.4.1 Open Pit Mine

This section covers the risks associated with the open pit mine. Three hazards that could result in major accidents were identified:

- Flooding of the pit;
- Rock falls along the pit slopes;
- Detonation of an explosives storage or poorly controlled blasting.

Flooding of the Pit

Water seepage is an inherent hazard in mining operations. In the case of pits, surface or groundwater could penetrate into the pits as a result of rock damages due to blasting or structural faults, which cause excessive cracking and facilitate the infiltration of water into the pits.

The following prevention and mitigation measures are in place:

- Geological and geotechnical investigations were completed as part of the site characterization;
- Monitoring of the effects of blasting in the pit on the formation of excessive cracking;
- Pumps to drain water to the surface;
- Emergency measures plan with warning systems and training.

The level of risk associated with the flooding of the pit is presented in Table 10-6. This risk must be monitored.

Table 10-6 Risk Level for Open Pits – Flooding

Potential Consequences	Probability	Uncertainty Level	Risk Level
High	Low	Moderate	Moderate

Rock Falls along the Pit Slopes

Rocks falling along the pit walls could cause injuries, lost of life and economic damages.

The following prevention and mitigation measures are in place:

- Slopes of the pit will be set in conformity with the Regulation respecting occupational health and safety in mines (RSQ c. S-2.2 r.19.1);
- Monitoring of the potential for landslides or rock falls in the pit;
- Emergency measures plan with warning systems and training.

The risk level associated with rock falls is presented in Table 10-7. This risk must be monitored.

Table 10-7 Open Pits Risk Level – Rock Falls

Potential Consequences	Probability	Uncertainty Level	Risk Level
Very high	Low	Moderate	Moderate

Uncontrolled Detonation in the Pit

An inadequately controlled blasting could result in an unplanned detonation.

The following prevention and mitigation measures are in place:

- Blasting to be controlled in conformity with the requirements of the Regulation respecting occupational health and safety in mines (RSQ c. S-2.2 r.19.1);
- Blasting works to be executed by a subcontractor specializing in the use of explosives in mines;
- Emergency measures plan with alert systems and personnel training (RSQ c. S-2.2 r.19.1).

The risk level associated with uncontrolled detonation is presented in Table 10-8. This risk must be monitored.

Table 10-8 Open Pits Risk Levels – Detonation

Potential Consequences	Probability	Uncertainty Level	Risk Level
Very high	Very low	Low	Moderate

10.3.4.2 Concentrator

This section covers the risks associated with the concentrator. Two hazards that could result in major accidents were identified:

- Fire;
- Stuck points.

Fire

A fire in the concentrator could cause injuries, death and economic losses. Hydraulic or lubricating oil leaks, welding work on rubber-lined equipments, and conveyor belt frictions are potential causes for a fire.

The following prevention and mitigation measures are in place:

- Use of low flash point hydraulic and lubricating oil;
- Implementation of measures to confine lubricant or hydraulic oil spills;

- Maintenance of the conveyors to prevent belt misalignment and frictions;
- Control of welding operations on rubber-lined equipments;
- Design based on NFPA standards;
- Fire system network and hydrants;
- Firefighting water reserve with a capacity of 200,000 US gallons (757.1 m^3);
- Emergency brigade;
- Emergency measures plan with alert systems and personnel training (RSQ c. S-2.2 r.19.1).

The risk level associated with a fire in the concentrator is presented in Table 10-9. This risk must be monitored.

Table 10-9 Concentrator Risk Level – Fire

Potential Consequences	Probability	Uncertainty Level	Risk Level
High	Low	Low	Moderate

Binding

The conveyors constitute nip points that could result in injuries or loss of life. The following prevention and mitigation measures will be in place:

- Nip points guarded in conformity with standard CSA Z-432 Safeguarding of Machinery, or an equivalent standard; and
- Worker training and information about the hazards of stuck points.

The risk level associated with stuck points is presented in Table 10-10. This risk must be monitored.

Table 10-10 Concentrator Risk Level – Binding

Potential Consequences	Probability	Uncertainty Level	Risk Level
High	Low	Low	Moderate

10.3.4.3 Petroleum Products

This section covers the risks associated with the management of petroleum products. Three hazards that could result in major accidents were identified:

- Fuel spills;
- Fuel fires;

- Oil and grease spills.

Petroleum Products or Fuel Oil Spills

A petroleum products spill, due to equipment corrosion, ruptures or human errors could result in a contamination of the soil, the surface water and the groundwater.

The following prevention and mitigation measures are in place:

- Double-walled petroleum products tanks;
- Level detection in the tanks and spill prevention;
- Confinement slabs at the hydrocarbons receiving and distribution areas;
- Water-hydrocarbon separators at the fuel storage area;
- Procedure for the receiving and distribution of hydrocarbons, including training;
- Double-walled daily supply tank;
- Spill cleanup kit, including absorbents;
- Emergency measures plan.

The risk level associated with hydrocarbon spill is presented in Table 10-11. This risk must be monitored.

Table 10-11 Risk Level for Hydrocarbon Spill

Potential Consequences	Probability	Uncertainty Level	Risk Level
Moderate	Low	Low	Moderate

Petroleum Products, Fuel Oil, Fire

Petroleum product fires could occur in the fuel storage area, at the daily supply tanks, during their transportation and distribution with a potential of injuries, death, economic losses and contamination of surface and ground water as well as of the soil.

The following prevention and mitigation measures are in place:

- Maintenance of the equipments to prevent hydrocarbon leaks and spills;
- Spill cleanup kit, including absorbents;
- Fire and smoke detection systems;
- Portable fire extinguishers;
- Reserve of firefighting foam to combat hydrocarbon fires;
- Fire system networks and hydrants near the petroleum product storage area;
- Emergency measures plan with specific intervention procedure.

The risk level associated with a fire involving hydrocarbons is presented in Table 10-12. This risk must be monitored.

Table 10-12 Risks Level for Hydrocarbon Fire

Potential Consequences	Probability	Uncertainty Level	Risk Level
High	Low	Low	Moderate

Petroleum Products, Oil and Grease Spills

A spill of petroleum products such as lubricating oils and greases, resulting from equipment failure, manipulation errors and machinery leaking on the roads could contaminate the surface and groundwater as well as the soil.

The following prevention and mitigation measures are in place:

- Devices to confine spills within the storage, distribution and use areas;
- Spill cleanup kit, including absorbents;
- Employee training and awareness about environmental protection;
- Emergency measures plan with specific intervention procedure.

The risk level associated with oil and grease spill is presented in Table 10-13. This risk must be monitored.

Table 10-13 Risk Level for Oil and Grease Spill

Potential Consequences	Probability	Uncertainty Level	Risk Level
Low	Low	Low	Low

10.3.4.4 Miscellaneous Chemicals

Various chemicals, some of which are classified as hazardous materials under the Transportation of Dangerous Goods Regulations (DORS/2008-34) or the Controlled Products Regulation (DORS/88-66), are used as vehicle fuel, lubricants, explosives, or as reagents and additives in the ore processing at the concentrator. Table 10-14 presents a wrap-up of hazardous materials and controlled products used on site. Appendix 10-4 presents the material safety data sheets on these dangerous goods. The class and identification number (PIN) of the hazardous materials are particularly useful as they specify the methods of intervention described in the Emergency Response Guidebook 2008 (ERG2008) prepared jointly by Transport Canada, the US Department of Transportation and the Secretariat of Transport and Communications of Mexico. It lists the category of the controlled product, the storage methods and the protective measures relating to their storage and use on the site.

Table 10-14 Dangerous Goods and Controlled Products

Phase	Dangerous Goods	Dangerous Goods Note: N/A = unregulated		Transportation Mode	Storage Mode	Controlled Product Class Note: N/A = unregulated
		Class	PIN			
Operation	AERO 855 Promoter	9 Environmentally Hazardous Substance	3082	210 L drums	Warehouse	**D2B**: Toxic
Operation	ARMAC C Organic amine salt, coco amine acetate	8 Corrosive Substance	3259	Bags	Warehouse	**E** Solid Corrosive Substance
Operation	Sodium carbonate	8 Corrosive Substance	N/A	Bags	Warehouse	**D2B** Toxic (eye irritant) **E** Corrosive substance
Operation	D618 MSD Powder	N/A	N/A	Bags	Warehouse	N/A
Operation	Emulsified explosives	1.5D Explosive	0332	Portable 1 m^3 tank	Explosives Magazine	N/A
Operation	Kerosene	3 Flammable Liquid	1223	210 L drums	Warehouse	**B-3** Combustible liquid **D-2A Class** Substance causing other toxic effects (HIGHLY TOXIC) **D-2B Class** Substance causing other toxic effects (TOXIC)
Operation	MA1277 Methyl Isobutyl Carbinol	3 Flammable liquid	2053	210 L drums	Warehouse	**B-3** Combustible liquid **D-2B** Toxic substance
Operation	MAFLOC 10	N/A	N/A	Bags	Warehouse	N/A
Operation	Fuel Oil	3 Flammable liquid	1202	Tanker truck	Petroleum products storage area: 50,000 L tanks (2), double-walled on concrete slab	**B-3** Combustible liquid **D-2A Class** Substance causing other toxic effects (HIGHLY TOXIC) **D-2B Class** Substance causing other toxic effects (TOXIC)
Operation	Caustic Soda	8 Corrosive substance	1824	25 kg drums	Warehouse	**E** Corrosive substance
Operation	SYLFAT FA2	N/A	N/A	25 kg drums	Warehouse	N/A
Operation	Various Unspecified Greases	–	–	210 L drums	Stored in 210 L drums	
Operation	Various Unspecified Oils	–	–	210 L drums	Stored in 210 L drums	

A spill of hazardous substances due to equipment failures or human errors could contaminate the process water, the surface water and the soil.

The following prevention and mitigation measures are in place:

- Maintenance program to prevent leaks due to corrosion or equipment failures;
- Dedicated chemical storage areas with measures to prevent and contain spills, including level indicators with alarms on the storage tanks and confinement basins around each tank;
- Spill cleanup kits, including absorbents;
- Personal protective equipment to prevent contact with hazardous substances;
- Procedures for the handling and use of chemicals, including training;
- Emergency showers and eyewash stations in areas where chemicals are in use;
- First aid responders;
- Emergency measures plan with specific intervention procedure.

The risk level associated with various chemicals is presented in Table 10-15. This risk must be monitored.

Table 10-15 Risk Level Associated with Chemicals

Potential Consequences	Probability	Uncertainty Level	Risk Level
Moderate	Low	Low	Moderate

10.3.4.5 Explosives Storage and Handling

This section covers the risks associated with explosives. Two hazards that could result in major accidents were identified:

- Aboveground explosion;
- Theft of explosives.

Aboveground Explosion

A fire in a storage area, an improper handling of explosives or the impact of debris on the explosive stores could lead to an explosion with projection of debris, potentially causing injuries, death and material damages.

The following prevention and mitigation measures are in placed:

- Explosives stores built in conformity with the Explosives Regulations (C.R.C., ch. 599) pursuant to the Explosives Act (C.R.C., ch. 599) and its directives.
- Sûreté du Québec permits;
- Distances separating the explosives stores in accordance with the regulation;
- Heating and lighting devices certified for explosives stores;

- Specialist subcontractors, trained on the handling of explosives;
- Storage in fenced areas;
- Emergency measures plan for the mine with alert systems and personnel training (RSQ. c. S-2.2 r.19.1).

The risk level associated with a surface detonation of explosives is presented in Table 10-16. This risk must be monitored.

Table 10-16 Risk Level Associated with Aboveground Explosions

Potential Consequences	Probability	Uncertainty Level	Risk Level
Moderate	Low	Low	Moderate

Theft of Explosives

The theft of explosives could place explosives in the possession of persons who could use them for criminal purposes.

The following prevention and mitigation measures are in placed:

- Explosives stores built in conformity with the Explosives Regulations (C.R.C., ch. 599) pursuant to the Explosives Act (C.R.C., ch. 599) and its directives;
- Sûreté du Québec permits;
- Controlled circulation of persons on the site;
- Surveillance cameras.

The risk level associated with the theft of explosives is presented in Table 10-17. This risk must be monitored.

Table 10-17 Risk Level Associated to Explosives Theft

Potential Consequences	Probability	Uncertainty Level	Risk Level
High	Very low	Low	Moderate

10.3.4.6 Waste Rock and Tailings Confinement

This section covers the risks associated with the waste rock and tailings confinement area. Two hazards that could result in major accidents were identified:

- Instability of the waste rock and tailings pile slopes;
- Inadequate quality of the leachate from the waste rock and tailings.

Instability of the Waste Rock and Tailings Pile Slopes

The slopes could become unstables and cause the collapse or slumping of waste rock beyond the confinement zone.

The following prevention and mitigation measures are in placed:

- Geological/hydrogeological studies;
- Stability study.

Inadequate Quality of the Leachate from the Waste Rock and Tailings

Poor water quality could be a result of soil permeability, which would modify the surface water quality, affect the fish habitats quality and the use of the water as water supply.

The following prevention and mitigation measures are in placed:

- Geological/hydrogeological studies;
- Static and kinetic testings on the waste rock and tailings, which demonstrated that the leachate meets the MDDEFP criteria for water seepage;
- Tests demonstrating that the waste rock and tailings do not generate acid mine drainage;
- Water management plans providing for the catchment of all runoff from the site;
- Contact water management plan, including control works comprising ditches and sedimentation pond;
- Monitoring instrument system.

The risk level associated with an inadequate quality of the leachate from the waste rock and tailings confinement area is presented in Table 10-18. This risk must be monitored.

Table 10-18 Risk Level Associated with a Poor Quality Mine Tailings Leachate

Potential Consequences	Probability	Uncertainty Level	Risk Level
Low	Low	Low	Low

10.3.4.7 Roads

This chapter covers the risks associated with road traffic. Two hazards that could result in major accidents were identified:

- Accident involving hazardous substances on the route du Nord;
- Accidents involving a truck hauling spodumene concentrate.

Accident Involving Hazardous Materials on the Route du Nord

An accident on the route du Nord involving hazardous materials could cause spills or fire from tanker trucks carrying hydrocarbons or other chemicals, resulting in the contamination of the surface water, groundwater and soil by hydrocarbons or other chemicals, as well as forest fires.

The following prevention and mitigation measures are in placed:

- Road design based on ministère des Transports du Québec standards for heavy truck traffic.
- Service areas along the road;
- Regular use of the road provides a degree of surveillance;
- Transporters emergency plan.

The risk level associated to hazardous material spill and fire on route 167 is presented in Table 10-19. This risk must be monitored.

Table 10-19 Risk Level Associated with a Hazardous Material Spill and Fire on the Route du Nord

Potential Consequences	Probability	Uncertainty Level	Risk Level
High	Low	Moderate	Moderate

Accident Involving a Truck Hauling Spodumene Concentrate

The circulations of trucks transporting the spodumene concentrate on the route du Nord could result in highway accidents and spodumene spills.

The following prevention and mitigation measures are in placed:

- The route du Nord is maintained by the ministère des Transports du Québec;
- Permanent dust control is used in strategic locations.

The risk level associated with an accident involving a truck hauling spodumene on the route du Nord is presented in Table 10-20.

Table 10-20 Risk Level Associated with an Accident Involving a Truck Transporting Spodumene Concentrate

Potential Consequences	Probability	Uncertainty Level	Risk Level
Low	Low	Low	Low

10.3.4.8 Other Hazards

Forest Fires

A forest fire could cause damages or destroy the Nemaska Lithium facilities.

- The area as already suffered a forest fire and there is little combustible material.

The risk level associated with forest fires is presented in Table 10-21.

Table 10-21 Risk Level Associated with Forest Fires

Potential Consequences	Probability	Uncertainty Level	Risk Level
Low	Low	Low	Low

10.4 Fire Protection

A water distribution network, supplied by a new well, will be put in place to serve the buildings. A pumping station with two electrical pumps will send the well water toward a 760,000 L storage tank located within the concentrator, which will be used as a firefighting reserve. The pumping station will comprise an electrical pump with a backup pump and a diesel-powered pump.

Approximately 200,000 US gallons (757.1 m^3) of water will be available for fire protection.

The installations are designed to provide fire protection for the entire facility, including the electrical rooms and other high-risk areas. The final selection of fire protection systems will be made at the detailed engineering step, in conformity with the various applicable regulations and with the insurer's requirements.

The water will be distributed through buried pipes with electrical heat-tracing. The fire hydrants will be located along the access roads to provide easy access in case of emergency.

A signpost indicating the location of the fire valve and a supply manifold will be available at the entrance of each building. Firefighting cabinets with 1½" hoses will be provided on every floor, at 30 m intervals throughout the building. Firefighting cabinets with 2½" hoses will be installed in every stairwell and on every floor including the roof. For exceptionnal risks, wet or dry fire sprinklers will be installed, depending if the area is heated or not. Air-pressurized preaction systems or double-interlock preset devices will be used to protect the electrical rooms.

The alarm system will include a panel located in the guardhouse, as well as detectors and manual stations covering all areas of the facility. The alarm signals will be transmitted automatically to the facility's security desk.

Muster points will be identified, as well as evacuation routes and procedures in case of alarm. Dry powder extinguishers will be installed in the fire cabinets as well as in certain areas such as the offices, laboratories, warehouses, lunch areas and fueling stations.

10.5 Emergency Measures Plan

This chapter presents a summary of the emergency measures plan. A complete version of this plan is available in Appendix 10-3. This plan covers the emergency measures applicable to the open mine pit, the concentrator, the waste rock and tailings pile, the fuel depot, the supply store and the on-site roads under the jurisdiction of the Whabouchi project.

This plan was developed in accordance with the applicable national regulations, standards and practices, as well as those of the National Fire Protection Association (NFPA), including the Regulation respecting occupational health and safety in mines, the Canadian National Fire Prevention Code, the relevant NFPA codes, the FM Global Property Loss Prevention Data Sheets, Standard CAN/CSA Z731-03 Emergency Preparedness and Response, the Transportation of Dangerous Goods Regulations, the Environment Quality Act (RSQ, c. Q-2), the Environmental Emergency Regulations (DORS/2003-307) under the Canadian Environmental Protection Act (CEPA 1999), and the Guide de gestion des risques d'accidents industriels majeurs à l'intention de l'industrie et des municipalités (CRAIM 2007).

Although the emphasis must first be placed on prevention, the very nature of human and industrial activities ensures that disasters will happen and severely impact the operations of the company, its personnel, the population and the environment. Such events unfortunately occur, and the emergency measures plan is intended to deal with such situations.

Considering its relative isolation, the Whabouchi project facilities must dispose of sufficient resources to respond in case of emergency situations.

It is also advisable to conclude mutual cooperation agreements with other companies in the area and with the Cree community of Nemaska.

10.5.1 Management of the Plan

The emergency measures plan will be the concern of the site manager. In his absence, this responsibility will be assumed by the deputy site manager.

An emergency measures advisor, designated for this function, will be responsible for the development and maintenance of the emergency measures plan. This person shall, among other responsibilities, ensure that the personnel are trained on the emergency measures plan and that drills are organized. He will also provide advice to the managers. He will have authority for the application of the plan and will be *ex officio* member of the emergency coordination team in case of emergency.

An emergency measures planning committee will assist the emergency measures advisor in the development, maintenance and implementation of disaster response activities.

The emergency measures plan will follow the management methods specified in the Regulation respecting occupational health and safety in mines.

10.5.1.1 Organization

The emergency measures plan shall be applied in conformity with the following principles:

- The chain of command is the same in emergencies as in normal situations, i.e. the general manager on duty becomes the emergency measures coordinator, according to the scope of the emergency.
- The emergency measures planning committee develops, prepares and circulates the emergency measures plan; initiates and prepares large-scale simulations, reviews the results and follows up on them; develops response relations with civil authorities, other industrial organizations in the area and the Cree community of Nemaska; ensures that the emergency measures plan is updated annually.
- The emergency brigade is in charge of emergency responses (fire and spills) in the ore processing facilities, as well as other interventions.

The following paragraphs provide a brief description of the main roles and responsibilities of the emergency responders.

Vice-President Operations

- Take or approve major decisions.

General Manager of Operations

- Designate the members of the emergency measures planning committee;
- Designate an emergency measures coordinator and delegate the necessary authority;
- Approve the emergency measures plan;
- Ensure that the response teams are provided with resources;
- Lead the emergency responses;
- Ensure that communication process is established and maintained with the employees, their families, the government agencies and the Cree community of Nemaska.

Emergency Measures Coordinator

- Know the fire and environmental risks present on the site;
- Implement the response measures with the equipment and personnel required for emergency responses;
- Develop response procedures and train the personnel in their application;

- Communicate on a regular basis with the employees and the Cree community of Nemaska to keep them informed about the emergency measures. Receive their comments and follow up on them.

Emergency Brigade Members

- Allow response plans for emergencies;
- Take part in the training and drills;
- Report immediately at the site of an emergency when the alarm is sounded;
- Locate and rescue imperiled personnel;
- Perform the rescue activities in accordance with instructions;
- Execute firefighting interventions in accordance with instructions;
- Execute spill control interventions.

Event Witness

- If possible to do so without risk, respond to the emergency situation;
- Initiate the emergency process by communicating with a supervisor or the security department, giving:
  - His name.
  - The location and description of the emergency situation.
  - Any other requested information.
  - Remain available for further need.

Employees

- Know the alarm codes in case of fire or evacuation;
- Know to whom they should report in case of evacuation;
- Know the location of the muster point;
- Apply the emergency procedure according to the nature of the incident;
- Collaborate with the response teams;
- Remain available on the site and wait for instructions from his supervisor.

Supervisors

- Ensure the application of the emergency measures plan according to the situation;
- Go to the muster point and make sure to be visible to the employees of his department.
- Take a headcount of their employees;
- Make sure that the employees under his responsibility remain together;
- Participate in the application of emergency measures as needed;

- Inform his personnel when the situation returns to normal and provide information on the progress of the operation.

Purchasing Coordinator

- Organize external resources to ensure an adequate response in case of incident;
- Maintain relations and negotiate service agreements with external resources (suppliers);
- Make sure that external resources operate properly (emergency case);
- Inform the site coordinators of the progress of the operations.

Human Resources Coordinator

- Ensure that the employees are informed about the content of the emergency measures plan;
- Communicate with families as needed;
- Ensure the proper operation of the internal communication system;
- Stay informed of the evolution of the incident in order to answer the request for information from the employees and the media;
- Advise the management in matters of communication;
- Inform the employees and the media about the conclusion of the response operations.

Nurse

- Collaborate in the planning of emergency response;
- Evaluate and distribute tasks, organize simulation drills;
- Prepare the human resources for appropriate responses;
- Perform the triage of injured persons;
- Participate in the evacuation and transportation of the injured;
- Lead and coordinate first aiders, rescuers and responders;
- Assess the health condition of the responders during extended intervention;
- Evaluate the interventions, making necessary modifications when required;
- Ensure communication with external medical services.

Health, Safety and Environment Coordinator

- Generally act as coordinator for the emergency;
- Organize the persons according to their area of intervention;
- Assess the situation and implement the emergency measures plan in whole or in part;
- Facilitate the consultation between contact persons from the various areas of intervention;

- Inform the management about the evolution of the situation and the application of the emergency measures plan;
- Give certain instructions concerning the operations;
- Approve the evacuation of a given area;
- Ensure that the actions taken ensure the safety of persons and the safeguarding of goods;
- Analyse the operation of the emergency measures plan and suggest necessary corrections to the management;
- Submit a report on the emergency situation to the management.

Management

- Inform to whom it may concern at the head office;
- Obtain information about the incident and the application of the emergency measures plan;
- Authorize a general evacuation of the site;
- Authorize communications with employees and their family, as well as the information that can be released to the media;
- Communicate information about the progression of the response to the employees;
- Lift the emergency situation and authorize the return to normal operations;
- Supervise the analysis of the cause and effects of the incident and ensure that an appropriate follow-up is made.

10.5.1.2 Training

A training program is applied according to the various functions of Nemaska Lithium's personnel.

Managers/Supervisors

- Must be trained on the emergency measures and master its contents.

All Employees and Persons on the Site

- Be informed about hazardous situations, the alarm modes including emergency phone numbers and the radio frequencies, the fire alarm and evacuation tones, the evacuation instructions and the muster points.

Emergency Brigade

- Be trained on response procedures in case of fire, explosion or spill of controlled products/hazardous materials.

Drills

- A program of regular drills will be implemented to train on the procedures applicable to evacuations, firefighting, explosions and spills, vehicle accidents and rescue of injured persons.

10.5.1.3 Audit and Compliance

An annual audit of the emergency measures plan will be conducted by a third party. The audit will refer to the Manuel de sauvetage minier and Standard CAN/CSA Z-781, Emergency Preparedness and Response.

10.5.1.4 Management Review

An annual management review will be performed to ensure that the emergency measures plan is operational and supported by trained personnels and appropriate equipments, and that the relations with external partners, including the Cree community of Nemaska, are maintained and supported.

10.5.1.5 Accidents and Malfunctions

The emergency measures plan includes specific procedures to respond to accidents and malfunctions. The response procedures take into account events resulting from climate changes, including forest fires, floods, strong winds and snow storms.

10.5.2 Specific Response Procedures

The following specific response procedures are defined in the complete emergency plan, which also identifies the roles, the equipments and the response methods.

10.5.2.1 Fire

Fires can happen in the following areas:

- Fuel depot;
- Concentrator;
- Mine pit equipments;
- Explosives stores;
- Forest;
- Roads.

The emergency plan provides specific response procedures for each case.

10.5.2.2 Explosion

The potential sources of explosion are:

- Explosives stores;
- Fuel depot;
- Power transformers.

The emergency plan provides specific response procedures for each case.

10.5.2.3 Medical Emergencies

The potential medical emergencies are:

- Cardiac discomforts;
- Severe trauma;
- Severe burns;
- Food poisonings;
- Etc.

Specific procedures for the evacuation of sick or injured persons are available in the emergency plan.

10.5.2.4 Chemical Spills

Specific procedures for chemical spill responses are available in the emergency plan.

10.5.2.5 Response Equipments

The following response equipments are required for the Nemaska Lithium operation (open pit extraction, concentrator, fuel depot and explosives stores). This partial list will be updated as necessary:

- Firefighting water reserve;
- Fire pump;
- Fire system network with hydrants and hoses;
- Automatic sprinklers to protect specific risks including the housing and services complex, the power generating equipments, the conveyors, etc.;
- Firefighting foam for petroleum product fire;
- Portable fire extinguishers of various classes to fight wood and paper, petroleum products and electrical fires;
- Gas detectors, selected according to the inherent hazards;
- Self-contained respirators;

- First aid kits;
- Stretcher;
- Emergency vehicle;
- Radios and phones;
- Alarms;
- Surveillance cameras;
- Smoke and fire detectors;
- Other equipments according to specific needs.

10.5.2.6 Alarms and Evacuation

The emergency plan identifies the various evacuation alarms and procedures.

10.5.3 Summary of the Risk Assessment and Emergency Plan

The risk assessment found that Nemaska Lithium is in the process of implementing a policy of continuous improvement based on the ALARP (as low as reasonably possible) principle.

A prevention program, outlined herein, will also be implemented. The responsibility for this program is distributed at all decision levels, down to the worker. Every worker of the Whabouchi project has the obligation of performing his tasks in a manner that does not endanger him or other persons. Tools will be put in place to identify the hazards, including task safety analyzes (HAZOP). Procedures with training will be developed to define safe methods to use the equipments and perform the tasks. The specific elements of the prevention program are: the definition of lines of accountability; the knowledge and information about the process; the hazards present in the facilities; the task safety analyzes; change management; subcontractor management; pre-commissioning reviews; mechanical equipment integrity; critical procedures; training and information; incident investigations; inspections and audits; performance indicators; fire protection; first aid; rescuers and first aid kits; transportation of the injured to hospital centers and human errors.

An emergency measures plan will be implemented in order to have access to the personnel, equipments and procedures to respond efficiently and safely to events that could be harmful to the site and its personnel.

A health and safety committee will be formed and a prevention officer will be designated.

Concerning the mine facilities, geological and hydrogeological studies were completed to characterize the soil and sub-surface. The selected option was an open-pit mine. This mining plan was developed on the basis of previously mentioned studies. No particularly dangerous situation was identified in these mining operations.

Additionally, a concentrator and maintenance facilities will be built. A fuel depot will also be built.

No facility presenting hazards that could endanger the on-site personnel was identified.

Finally, mutual cooperation agreements shall be concluded with other companies in the area and with the Cree community of Nemaska to pool their response resources.

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CHAPTER 11

ENVIRONMENTAL MONITORING AND FOLLOW-UP PROGRAMS

Environmental and Social Impact Assessment

March 28, 2013

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11. ENVIRONMENTAL MONITORING AND FOLLOW-UP PROGRAMS

The activities planned for Nemaska Lithium's Whabouchi project call for an environmental monitoring program and an environmental follow-up program. The purpose of environmental monitoring is to ensure the conformity of the project with applicable environmental laws and regulations. The environmental follow-up aims to validate the predictions made in the environmental and social impacts assessment (ESIA) of the Whabouchi project and to recommend, if necessary, appropriate corrective measures.

The details of these two programs, however, will be finalized when the detailed engineering of the project is complete and the conditions of authorizations known. The purpose of this section is to present the framework within which the two environmental programs will be developed.

The monitoring and environmental follow-up programs will rely on an active participation of the Cree partners in the community of Nemaska, such as the Community Advisory Panel (CAP). For example, the biophysical components of the monitoring and follow-up programs will benefit from interviews conducted with users of the land and its resources, who are in a position to notice or perceive certain potential changes in the environment due to their frequentation and knowledge of the territory. With regard to the components of the human environment, CAP participants may comment on the effectiveness of mitigation or improvement measures.

11.1 Environmental Monitoring

The objective of the environmental monitoring program is to ensure that the requirements of applicable environmental laws and regulations, as well as the conditions established by the certificate of authorization issued under article 154 of the Environment Quality Act (EQA) are fulfilled; and that the commitments and mitigation measures proposed in the Whabouchi project ESIA are properly carried out. The Environmental Monitoring Program also entails verifying that the work is carried out properly, that the equipment and facilities operate adequately, and reporting any potential disturbance to the environment due to construction or operation activities. The compliance assurance program will remain in place for the entire life of the project, from construction to closure. The application of this program will allow the implementation of corrective measures and/or a reorientation of the work if necessary, thus improving the development of the project.

The first step in the environmental compliance assurance program is to ensure that all the certificates of authorization, leases and permits required for the development of the project have been secured. Subsequently, the person in charge of the environment at Nemaska Lithium will make sure that employees and subcontractors know and closely adhere to the Environmental Monitoring Program. Furthermore, all parties at the worksite (contractors, site manager, site supervisors, foremen, etc.) will be made aware of environmental issues and protective measures. The roles and responsibilities of each party will be clearly defined, and the specific measures needed to protect the environment in their respective tasks will be identified in their job specifications.

At the beginning of any activity on the site, the workers will be convened for a kick-off meeting where they will be informed about the measures concerning environmental protection and emergency measures. The noncompliance report procedure and all the monitoring documents will also be introduced during this meeting.

In general, a designated environmental monitor will make daily visits to the work areas during the construction work to verify the compliance with applicable regulations and obligations, to evaluate the quality and effectiveness of the mitigation measures included in the ESIA, and to record any observation of environmental noncompliance. The environmental monitor will communicate his observations to the site supervisor so that timely and appropriate corrective action is taken. The objective is to identify preventive measures that will prevent the reoccurrence of noncompliant situations. The environmental monitor will submit a weekly written report on the status of the monitoring program to Nemaska Lithium's environmental officer. This environmental monitoring report shall notably include any noncompliance noticed and the corrective measures that were applied. Nemaska Lithium's environmental officer will ensure that the environmental monitoring program is being observed, and that the reports reflect actual activities carried out on the site. Any situation that may result in harmful effects for the environment will be reported to appropriate authorities and a follow-up will be done to ensure corresponding measures are applied. The environmental monitor may also identify desirable improvements in the mitigation measures as it may help simplify contractors' work all the while meeting environmental protection goals.

The preliminary environmental monitoring program presented hereafter will be finalized once authorizations for the development of the project have been issued. The final environmental monitoring program will include the following elements:

- An exhaustive list and the location of all elements that require environmental monitoring; such list will specify, among others, the regulatory requirements and applicable standards and criteria;
- The measures and means considered to protect the environment and the social components;
- The detailed characteristics of the monitoring program, where these are predictable (e.g. location of monitoring activities, definition of roles and responsibilities, protocols, measured parameters, analytical methods, communication of information and results to the public, schedules, etc.);
- A mechanism to intervene in case of noncompliance with legal and environmental requirements, or with Nemaska Lithium's commitments;
- Nemaska Lithium's obligations regarding environmental monitoring reports (number, frequency and content);

- Nemaska Lithium's commitments regarding the communication of environmental monitoring results to the populations concerned.

11.2 Environmental Follow-Up

The objectives of the environmental follow-up program are to assess the effectiveness of the mitigation or compensation measures considered in the ESIA; to monitor the evolution of sensitive environmental components; and to compare this evolution with conditions prior to the project, in order to identify trends or impacts that may result from the project activities or from natural occurrences. An environmental management system (EMS) will be established to conduct environmental follow at every phase of the project (from construction to closure, including rehabilitation), in accordance to applicable provincial and federal requirements. In order to comply with environmental standards, thus protecting environmental components, corrective measures may also be recommended and implemented as part of the environmental follow-up program. The final program will describe how follow-up results will be used to adjust or modify the design and/or the implementation of mitigation measures, this in order to improve environmental aspects of the project. With this follow-up, Nemaska Lithium will be proactive in the event of a specific environmental issue and will be able to react promptly and effectively.

The environmental monitoring program will focus on specific aspects of the physical, biological and social components. Its implementation will start at the beginning of the construction phase and remain for the entire life of the project. Nemaska Lithium's environmental officer will be responsible for the implementation of the environmental follow-up program. He will also keep the CAP informed on the program, and he will take into account, as much as possible, recommendations and/or observations made by this committee.

Nemaska Lithium wishes that the members of the Cree community of Nemaska, and particularly the tallyman of trapline R20, Mr. James Wapachee, take an active part in environmental follow-up activities. For example, the tallyman could be an observer in the follow-up work on his trapline, or he could designate a representative in the event he cannot attend. The involvement of the Crees in environmental follow-up work will be discussed within the CAP.

The following components will be subject to environmental monitoring in the context of the Whabouchi project:

- The integrity and physical stability of the structures
- Physical environment
    - Air quality
    - Groundwater quality and level
    - Quality of final effluents and surface water
    - Vibrations
- Biological environment

    - Vegetation and effectiveness of reclamation work
    - Fish and benthic invertebrate communities
- Social environment
    - Land and resources use
    - Employment and economic spinoffs

The following sections briefly outline the various aspects of the preliminary environmental follow-up programs. A final follow-up program will be developed once governmental authorizations for the project are secured. The final follow-up program will include, among others, a mechanism to intervene in case of unforeseen degradation of the environment, and Nemaska Lithium's commitment regarding the communication of the environmental follow-up results to the local population. The environmental follow-up reports will be prepared according to MDDEFP's *Guide à l'intention de l'initiateur de projet*[1] (MDDEFP, 2002).

11.2.1 Integrity and Physical Stability of the Structures

According to good practice and to the requirements of Directive 019 (MDDEFP, 2012), inspections will be carried out to verify the integrity and stability of the structures, and to ensure that there are no anomalies. These inspections include daily walk-through inspections, monthly detailed technical inspections, annual detailed inspections and specific *ad hoc* inspections.

The monthly, annual and specific inspections will be carried out by specialists and/or engineers assigned to the monitoring of the structures. The components targeted by these inspections will include the ditches, spillways, and conduits; the mine pit, the waste rock and tailings pile, sedimentation pond dikes, as well as all elements contributing to site security and thus to the protection of the environment. Also, the instruments used for measuring the performance of infrastructures will be subject to strict verifications (quantitative data). The detailed annual inspection will be carried out in the spring, towards the end of the thaw and before the advent or blooming of vegetation.

Annual inspection reports will be prepared during the operation phase in compliance with the requirements of section 2.12.1.2 of Directive 019 (MDDEFP, 2012). These reports will cover the following elements, among others:

- A summary of regular activities carried out during the year, indicating any major problem likely to affect the environment, as well as the measures taken for its resolution;

[1] Ministère du Développement durable, de l'Environnement, de la Faune et des Parcs du Québec, formerly known as ministère du Développement durable, de l'Environnement et des Parcs du Québec (MDDEP), ministère de l'Environnement du Québec (MENV) or ministère de l'Environnement et de la Faune du Québec (MEF).

- Any changes made in the program of periodic inspections on the stability of structures, as mentioned in Directive 019 (Aire d'accumulation de résidus miniers);
- The corrective actions taken to address inadequacies observed through periodic inspections as specified in Directive 019 (Ouvrages de rétention);
- The modifications made to the intervention plan in case of accidental spills described in Directive 019 (Plan d'intervention lors d'un déversement).

Measures to be implemented during the operation and rehabilitation phases, such as the gradual replanting of the waste rock and tailings pile, will improve and maintain the long-term stability of the structures. As specified in the Guideline for preparing a mining site rehabilitation plan and general mining site rehabilitation requirements (MRN[2], 1997), Nemaska Lithium will implement a program to monitor structures for a minimum of two years after rehabilitation work is completed.

11.2.2 Physical Environment

11.2.2.1 Air Quality Monitoring

A follow-up program on air quality around the Nemaska Lithium facilities will be implemented, which will allow validating results of the modeling completed as part of the Whabouchi project ESIA. The purpose of the follow-up study will be to measure the impact of mining activities on air quality near the mine site and, if necessary, to recommend appropriate corrective measures.

Air quality indicators measured in 2012 will serve as baseline for comparison. Fixed and diffuse emission sources will be sampled during the first two years of operation of the mine. The sampling frequency will be the one prescribed by the Clean Air Regulation (chapter Q-2, r. 4.1) and will meet the requirements of the Centre d'expertise en analyse environnementale du Québec (CEAEQ) as specified in the *Guide d'échantillonnage de l'air ambiant* (CEAEQ, in preparation). Additionally, the following elements will be reported for each fixed or diffuse emission source as outlined in Directive 019 (MDDEFP, 2012):

- The nature of contaminants, the quantity released (m.t./year), the discharge rate (m^3/h), the temperature of gases (°C) and the concentration of the contaminant ($\mu g/Nm^3$);
- The scrubbing systems or measures taken to prevent, eliminate or reduce the emission of contaminants, and their percentage of effectiveness;
- The locations and means used to store or dispose of the dust (if dry scrubbers are used).

[2] Ministère des Ressources naturelles du Québec, formerly known as ministère des Ressources naturelles et de la Faune du Québec (MRNF), ministère des Ressources naturelles, de la Faune et des Parcs du Québec (MRNFP) or ministère de l'Énergie et des Ressources du Québec (MER).

The follow-up program may be modified or terminated if the measures implemented indicate that air quality standards are respected at all times. The main objective of this environmental follow-up is to ensure the project's compliance with applicable regulations. In the event of problems, corrective measures will be promptly implemented to address the situation.

Air quality monitoring stations will be set up in the same locations as in the 2012 study, near Route du Nord and near the waste rock and tailings pile. Additionally, an air quality monitoring station will be installed near the concentrator. Also, a reference station will be set up outside of the mine site to ensure that air quality standards are respected. The exact location of this control station will be determined after finalizing the detailed engineering of the project.

More specifically, air quality monitoring will focus on dust emissions caused by the circulation of heavy machinery and vehicles, and by ore transportation and crushing activities. Monitoring will also include suspended particulates, i.e. total particulates (less than 100 µm) and particles smaller than 2.5 µm ($PM_{2.5}$).

Nemaska Lithium's environmental officer will prepare a summary report at the end of each campaign of air quality measurement. Also, a full report summarizing all measurements taken during the year and describing the eventual corrective measures will be issued at the beginning of the following year.

11.2.2.2 Groundwater Quality and Level Monitoring

Mining activities on the project site can have impacts on the groundwater quality and flow regime. An environmental follow-up will be implemented during the construction and operation phases and after the closure of the site. Nemaska Lithium will comply with all requirements applicable to such programs, as described in sections 2.3.2 and 2.3.3 of Directive 019 (MDDEFP, 2012), regarding the location of the observation wells, the analytical parameters, the sampling frequency, the selection and application of alert thresholds, etc. As part of the groundwater quality and level monitoring, Nemaska Lithium will install observation wells, and will monitor the piezometric level upstream and downstream of the facilities that are considered potential impacts sources (MDDEFP, 2012). If criteria are exceeded or abnormal values are detected, appropriate measures will be taken promptly to rectify the situation.

Groundwater Monitoring

As required by Directive 019 (MDDEFP, 2012), a groundwater monitoring system will be installed around facilities considered at risk (e.g. ore processing plant, tailings pile, petroleum and chemical products storage areas, etc.), except locations where all underlying hydrogeological settings are identified as Class III with no hydraulic linkage.

Monitoring is required around facilities considered at risk, namely the waste rock and tailings pile, sedimentation ponds, maintenance garage and fuel depot, and due to the presence of Class II or III groundwater at the project site. Furthermore, a monitoring of the groundwater is necessary to document the effects of the drawdown that may result from the mine pit dewatering.

In conformity with the requirements of Directive 019 (MDDEFP, 2012), a minimum of three observation wells, one upstream and two downstream, will be installed near the facilities that pose a risk of contamination. Thus, approximately 21 wells will be set up around the following facilities: mine pit, waste rock and tailings pile, sedimentation ponds (4) and fuel depot. The exact location of these observation wells will be identified once in accordance with the final set up of the mine infrastructures and hydrogeological data. The existing network of observation wells will be used during the operation phase as well as during the site closure and rehabilitation phase.

The local background groundwater concentrations of the parameters listed in Table 11-1 have already been calculated for the project. These background concentrations are presented in Chapter 6 of the Whabouchi project ESIA.

As specified by Directive 019 (MDDEFP, 2012), groundwater monitoring measurements during the operation phase will be taken twice a year, in the spring after snowmelt while the water table is at its highest, and in the summer low-flow period. Table 11-1 presents the indicators used in the monitoring, as well as the sampling frequency that will be used during the operation phase.

Groundwater sampling will be done in accordance with standard procedures as described in *Guide d'échantillonnage à des fins d'analyses environnementales : Cahier 3 – Échantillonnage des eaux souterraines* (MDDEFP, 2011). The samples will be collected at each observation well using dedicated systems and appropriate containers, and preserved as specified for each indicator until their transfer to a MDDEFP-certified analytical laboratory.

Groundwater monitoring will be continued during all the project phases and will help Nemaska Lithium ensure that mitigation measures applied at the site are in compliance with Directive 019 (MDDEFP, 2012) and with the Metal Mining Effluent Regulations (MMER) (2012). If criteria are exceeded or abnormal values are detected, Nemaska lithium will promptly and appropriately respond to rectify the situation.

During the closure phase, i.e. the post-operation period (expected to last 2 years) and the post-rehabilitation period (5 years minimum), the monitored indicators will be the same as measured during the mine operations and specified in Table 11-1. The sampling frequency will be twice a year.

The post-rehabilitation monitoring program will continue as long as the requirements of Directive 019, the effluent discharge objectives for the site, and the groundwater quality criteria, demonstrate compliance for a continuous period of five years; and/or when the MDDEFP approves its suspension.

Table 11-1 Indicators Analyzed for Groundwater Monitoring during the Operation Phase

Monitoring Indicators[1]	Sampling Frequency
Physico-chemical indicators	
pH	Twice a year, in the spring and summer
Electrical conductivity	
Nutrients and ions	
Calcium	Twice a year, in the spring and summer
Magnesium	
Potassium	Twice a year, in the spring and summer
Sodium	
Bicarbonates	
Sulphates	
Metals (dissolved)	
Arsenic	Twice a year, in the spring and summer
Copper	
Total cyanide	
Iron	
Nickel	
Lead	
Zinc	
Organic compounds	
C_{10}-C_{50} petroleum hydrocarbons	Twice a year, in the spring and summer

[1] Depending on the nature of the ore, the process or the tailings, other parameters may be added to the groundwater quality monitoring program under article 20 of the Act. Depending on the nature of the contamination observed at the site after rehabilitation, other parameters could also be added to the groundwater quality monitoring program.

Piezometric Monitoring

The level of the water table will be monitored at the site of all wells installed to monitor groundwater quality and the effects of the mine pit dewatering. Measurements will be taken twice a year at each observation well in spring and summer in order to cover high and low water periods.

Monitoring Report

As part of the groundwater and piezometry monitoring, Nemaska Lithium will submit an annual report to the MDDEFP, in electronic form and using the template provided by the department. This annual report will include the following elements:

- Sampling dates;

- Map of the sampling stations;
- Results of the sample analysis;
- Laboratory certificates;
- Interpretation and evolution of results with regard to the requirements of Directive 019;
- Mitigation measures or modifications to the groundwater monitoring program, if any.

11.2.2.3 Surface Water Quality and Final Effluent Monitoring

Surface Water Management

The Whabouchi project considers having two outlets in the environment, one in Creek C and one in Lac des Montagnes. A sedimentation pond will be located near the southwestern limit of the waste rock and tailings pile. This pond will collect the runoff and the seepage from the pile. It will be fed via the ditches surrounding the pile, and which will drain the water by gravity. The outlet of the sedimentation pond is Creek C, which empties in Lac des Montagnes. The other sedimentation pond will be located southwest of the mine site and will collect mine water, i.e. the groundwater seeping in the mine pit and the precipitations falling on the mine pit footprint. This sedimentation pond will drain towards Lac des Montagnes.

As mentioned in Chapter 4 of the ESIA, the process water will be entirely recycled and there will be no release of such water in the environment. A source of makeup water will be required for the operation of the concentrator.

The runoff from outside the mine site will not be collected through the drainage network used for the mine and its infrastructures. Rather, this water will be diverted in order to avoid any contact with the mine installations. The water exposed to mine installations, e.g. the concentrator, the maintenance garage, etc., will be collected and treated if necessary before being released in the environment.

Nemaska lithium will endeavor to comply with the effluent discharge objectives (EDO) for mine effluents that will be determined specifically for this project by the MDDEFP.

Federal and Provincial Requirements Concerning the Quality of Final Effluent and Surface Water

Monitoring of the final effluent is required at the provincial level by *Directive 019 sur l'industrie minière* (MDDEFP, 2012) and at the federal level by the Metal Mining Effluent Regulations (DORS/2002-222; hereinafter referred to as MMER, 2012). The federal government also requires a monitoring of the effects on the environment (notably water quality monitoring) under the MMER (2012). All these studies must follow the federal guidelines of the Metal Mining Environmental Effects Monitoring (EEM) Technical Guidance Document (Environment Canada, 2012). The EDOs that will be set by the MDDEFP for the Whabouchi project also constitute a provincial requirement. Moreover, the final mine effluent could be subject to other requirements under Article 20 of the EQA as a condition of the certificate of authorization (MDDEFP, 2012).

In this regard, Nemaska Lithium will begin monitoring the effluent as soon it is released in the environment, and maintain the surveillance until the complete cessation of mining activities. Data collected during the characterization of the effluent and the monitoring of water quality will be used to:

- Monitor changes that might induce modifications in water quality and take appropriate action if necessary;
- Provide information on the variations in the quality of effluents as well as their temporal and seasonal trends;
- Obtain measurements of environmental variables that may facilitate the interpretation of data in other monitoring programs (monitoring of fish, benthic invertebrate communities, etc.).

Requirements of Directive 019 on the Mining Industry

The characterization of the final effluents, required by Directive 019 (MDDEFP, 2012), includes the regular monitoring of a limited set of physico-chemical indicators sampled at variable frequencies based on these given indicators, as well as an annual follow-up of a more exhaustive list of indicators (Table 11-2). Nemaska Lithium will proceed with the characterization of the final effluents during both the operation and closure phases.

The following paragraphs outline the types of monitoring that will be carried out through the operation and closure phases.

Operation Phase

Regular Monitoring

The regular monitoring includes the collection of grab samples and the measurement of a series of indicators at the frequencies indicated in Table 11-2 (MDDEFP, 2012). The flow rate and pH will be measured on a continuous basis, as is required by Directive 019 in the case of ore processing plants or mines that generate effluents at a rate of more than 1,000 m^3/day. Suspended matter will be measured three times a week, together with the flow and pH measurements at intervals of at least 24 hours. Concentrations of arsenic, copper, iron, nickel, lead, zinc and cyanide will be measured once a week, while the flow and pH measurements will be measured at intervals of at least four days. The monthly (kg/month) and annual (kg/yr) loads will be calculated for each indicator in accordance with Directive 019 (MDDEFP, 2012). Acute toxicity tests on rainbow trout (*Oncorhynchus mykiss*) and daphnia (*Daphnia magna*) will be performed once per month, at minimum intervals of 15 days, while the effluent is discharged. Nemaska Lithium will follow MDDEFP (2009), CEAEQ (2005) and Environment Canada's (2000) guidelines regarding the testing method and collection of mine effluent samples for monitoring acute toxicity .

Sampling for the weekly and monthly analyzes will be done at the same time as the samples collected three times a week for pH, flow rate and suspended matter. These frequencies will be maintained until the final cessation of mining activities. The frequency of the regular effluent monitoring may be reduced to a minimum of once per quarter if the results meet the requirements of Directive 019 for a continuous period of at least six months (MDDEFP, 2012).

Annual Monitoring

The annual monitoring includes the measurement and analysis of indicators presented under the "Annual monitoring – Directive 019" heading of Table 11-2, as well as acute toxicity tests on rainbow trout and daphnia. This sampling will be done once every year, during the month of July or August. Sampling for the annual monitoring will be done on the same day, thus replacing the regular weekly monitoring for that week. Two sampling and flow measurement stations will be installed upstream of the two outlets in Creek C and Lac des Montagnes. In conformity with Directive 019 (MDDEFP, 2012), the precision of instruments used for the measurement of the pH and flow rate will be checked against the released flow. The pH and flow measurements as well as the sampling will be carried out according to the requirements of the MMER and the guidelines of the MDDEFP's *Guide d'échantillonnage à des fins d'analyse environnementale* (2008a and 2009). Standard precautions will be taken to avoid any contamination during the sampling and shipping of the samples.

The monitoring indicators will be analyzed in a MDDEFP certified laboratory and the analysis will comply with the analytical requirements (e.g. detection limit of the method) prescribed by Directive 019 (MDDEFP, 2012). Strict quality control and assurance measures will be implemented to ensure that the sampling follows current good practice.

Monitoring Reports

Nemaska Lithium will submit to the MDDEFP a monthly report in electronic form, following the template provided by the MDDEFP. The content of this report will be as specified by Directive 019 (MDDEFP, 2012), including:

- The results of the analyzes of all final effluents;
- The measurements taken during the month and the calculation of the monthly loading;
- The cases of noncompliance with MDDEFP requirements and actions taken to prevent and eliminate their causes;
- The dates and results of inspections on flow and pH measurement and data logging systems.

If there is no release of effluent at the outlet during the month, the report shall mention the fact and will nonetheless be forwarded to the Direction régionale de l'Abitibi-Témiscamingue et du Nord-du-Québec of the MDDEFP.

Additionally, as part of its mining operations, Nemaska Lithium will submit an annual report in electronic form, using the model provided by the MDDEFP and presenting the elements specified by Directive 019 (MDDEP, 2012) including:

- A summary of current activities for the year, indicating any major problem likely to have effects on the environment, as well as the measures taken for its resolution;
- The annual quantities of all mining residues and their distribution for each disposal method;

- The surface areas used for the waste rock and tailings pile and the sedimentation ponds;
- The date of the sampling for the annual characterization and the results for the measured monitoring indicators;
- An interpretation of the results for all final effluents and an assessment of their compliance;
- The calculation of annual loads;
- The water balance, or an update thereof if it has previously been submitted to the MDDEFP;
- The results of the water balance calculation for the waste rock and tailings pile;
- The modifications made to the periodic inspection program on the structures' physical stability;
- The corrective actions taken on elements that were considered inadequate during the inspections;
- The modifications made to the response plan in case of accidental spills.

The annual report produced by Nemaska Lithium will include a section summarizing the rehabilitation work completed during the year, if any, including the location and the area of the restored surfaces, as well as the monitoring measures that were implemented.

Closure Phase

During the closure phase, Nemaska Lithium will maintain two types of monitoring. The first monitoring concerns the post-operation period, which is expected to last 2 years, and during which the rehabilitation work will be completed. The second type of monitoring concerns the post-rehabilitation period, and should last a minimum of five years. Post-operation monitoring will be done twice a month for the first six months, and once a month thereafter (6 to 24 months). Post-rehabilitation monitoring will be carried out six times a year. Monitoring indicators will be the same as in the regular monitoring (Table 11-2).

The post-rehabilitation monitoring program may be suspended when the water quality meets the following requirements:

- The average displayed for four consecutive final effluent samplings comply with the requirements of Directive 019, the certificate of authorization and/or the depollution attestation;
- The pH is between 6.0 and 9.5;
- The toxicity level measured through tests on rainbow trout and daphnia are below the acute lethality level;
- The long-term trend for each final effluent is decreasing, and this trend is confirmed through predicting models for the contaminants considered in the environmental follow-up.

Monitoring Report

Throughout the closure phase, Nemaska Lithium will submit annual reports in digital format, using the model provided by the MDDEFP and presenting all elements specified by Directive 019 (MDDEP, 2012) including:

- The sampling date for the annual characterization and the results for measured indicators;
- An interpretation of the results for all final effluents and a validation of their compliance;
- The calculation of annual loads;
- The water balance, or an update thereof if it has already been submitted to the MDDEFP;
- The results of the water balance calculation for the waste rock and tailings pile.

Requirements of the Metal Mining Effluent Regulations (MMER)

The MMER (2012) requires an environmental effects monitoring, or EEM (Article 7 of the MMER, 2012). Although these studies concern more specifically the biological environment, they do include requirements regarding effluent characterization, sublethal toxicity testing and water quality monitoring (Article 3 of Schedule 5 of the MMER, 2012).

Effluent Monitoring

The MMER is effective during the operation and closure phases, until the effluent no longer contains harmful substances (Appendix 4 of the MMER (2012)) and that its flow rate is below 50 m^3/day. At all times, concentrations at the two effluent outlets must remain under the limits prescribed in Schedule 4 of the MMER, they must not cause acute lethality, and their pH must remain between 6.0 and 9.5.

Nemaska Lithium will collect weekly samples of each effluent to measure the pH, flow rate and suspended matter; and to analyze the monitoring indicators including arsenic, copper, nickel, lead, zinc, total cyanide and radium 226, as shown in Table 11-2. The characterization of each effluent in terms of alkalinity, electrical conductivity, temperature, hardness and total concentrations in aluminum, cadmium, iron, mercury, molybdenum, selenium, ammonia nitrogen and nitrates, will be conducted four times a year (ideally every quarter, and at least one month apart).

Table 11-2 Monitoring Indicators and Measurement or Sampling Frequency – Final Effluents Monitoring

Follow-up Indicators[1]	Measurement/Sampling Frequency							
	Regular Monitoring							Annual Monitoring
	Directive 019 (2012)				MMER (2012)			Directive 019 (2012)
	Continuous	3X/wk	1X/wk	1X/mo	1X/wk	4X/yr	2X/yr	
Basic Physico-Chemical Indicators								
Alkalinity						X		X
Electrical conductivity						X		
Flow rate	X	X						X
Turbidity								X
pH	X	X			X			X
Temperature						X		
Hardness						X		X
BOD_5								X
DCO								X
SM (suspended matter) or TSS (total suspended solids)		X			X			X
Dissolved solids								X
Total solids								X
Nutrients and Ions								
Ammonia nitrogen or ammonia						X		X
Kjeldahl total nitrogen								X
Fluorides								X
Nitrates						X		
Nitrates + nitrites								X
Total phosphorus								X
Chlorides								X
Sulphates								X
Metals and Metalloids								
Aluminum						X		X
Arsenic			X		X*			X
Cadmium						X		X
Calcium								X
Chromium								X
Cobalt								X
Copper			X		X*			X
Total cyanides[2]			X					
Iron			X			X		X
Magnesium								X
Manganese								X

Follow-up Indicators[1]	Measurement/Sampling Frequency							
	Regular Monitoring							Annual Monitoring
	Directive 019 (2012)				**MMER** (2012)			Directive 019 (2012)
	Continuous	3X/wk	1X/wk	1X/mo	1X/wk	4X/yr	2X/yr	
Mercury						X[3]		X
Molybdenum						X		X
Nickel			X		X*			X
Lead			X		X*			X
Potassium								X
Selenium						X		X
Sodium								X
Zinc			X		X*			X
Organic Compounds								
Phenolic substances								X
C_{10}-C_{50} petroleum hydrocarbons								X
Others								
Radium 226[2]					X[4]			
Acute toxicity				X				X
Sublethal toxicity							X[5]	

* The testing frequency may be reduced to a minimum of once every quarter if the mean monthly concentration of the substance in the effluent collected at this final release point is below 10% of the value set in Column 2 of Schedule 4 (MMER, 2012).

1 In cases where there is a difference in nomenclature and/or analytical method between the indicators specified in Directive 019 and the MMER, indicators applicable to each jurisdiction will be used.

2 Directive 019 does not specify a monitoring of total cyanides and radium 226 in the final effluent in the case of an operation such as the Whabouchi project.

3 The monitoring of mercury may be interrupted if concentrations are below 0.0001 mg/l in 12 consecutive samples.

4 The monthly concentrated load must be calculated for this parameter; the testing frequency may be reduced to a minimum of once per quarter if the results of 10 consecutive tests show that concentrations of radium 226 are below 0.037 Bq/L. According to Directive 019 (MDDEFP, 2012), the annual monitoring of this element is required only in operations where the mineral deposit is composed of radioactive substances, which is not the case for the Whabouchi project.

5 Toxicity tests on a fish, invertebrate, plant and algae species will be conducted twice per calendar year during the first three years, starting six months after the date at which the mine becomes subject to Article 7 of the MMER (Schedule 5, par. 6(1)). After the first three years, the frequency of the tests may be reduced to once per calendar year.

Acute and Sublethal Toxicity Testing

Determination of the Acute Lethality Level

Tests to determine the acute lethality of the effluent will be performed according to the method outlined by Environment Canada (2000; reference EPS1/RM/13). Monthly testing will be done on a grab sample collected at each final effluent release point.

The environmental monitor will be responsible for determining the date for the collection of the grab samples and for informing Environment Canada at least 30 days beforehand. The samples will be collected at the specified location and time (or as soon as possible after this date), at intervals of at least 15 days, making sure that the volume of effluent collected is sufficient to complete all the required tests.

If a grab sample from either effluent presents an acute level of lethality, the characterization of the effluent(s) will be done promptly, in accordance with paragraph 4(1) of Schedule 5 (MMER, 2012). The concentrations of harmful substances listed in Column 1 of Appendix 4 (MMER, 2012) will be recorded. Subsequently, twice a month at minimum intervals of seven days, a grab sample will be collected at the release point where the effluent presenting an acute lethality was taken; for the purpose of acute lethality testing. This sampling frequency will be maintained until the effluent shows no acute lethality in three consecutive tests, at which time the frequency will be reduced to once a month (MMER, 2012).

If the effluent does not present an acute lethality level during 12 consecutive months, the frequency of the acute lethality testing may be reduced to once per quarter. In all cases, the date of the sampling will be determined by the environmental monitor and communicated to Environment Canada at least 30 days beforehand. The grab samples will be collected at minimum intervals of 45 days, and if it is found that an effluent grab sample shows an acute lethality level, the steps described in the previous paragraph shall apply (MMLER, 2012).

Sublethal Toxicity Testing

Sublethal toxicity tests will be carried out according to applicable methods specified in Article 5, paragraph (3) of Schedule 5 of the MMLER (2012). Since these effluents are released in freshwater, the sampling will consist in collecting specimens of one species of fish, invertebrate, plant and algae. The sublethal toxicity tests will be performed on an aliquot portion of a sample of each effluent collected at the final release point that presents the highest risk of harmful effects on the environment. The first sublethal toxicity test will be completed on an effluent sample collected no later than six months following the date at which the mine becomes subject to Article 7 of the MMER (2012). The sublethal toxicity tests will be carried out twice per calendar year during three years and, subsequently, once a year.

Water Quality Monitoring

As required for an EEM (Article 7 of the MMER, 2012; Environment Canada, 2012) and in order to meet the EDOs set by the MDDEFP, Nemaska Lithium will monitor the quality of the surface water. This monitoring will provide, among others, information about the concentrations of contaminants in the project's area of influence, in the area affected by mining operations and in other locations selected according to the biological monitoring requirements. The water quality monitoring will also help validate predictions made by the ESIA modeling and, if necessary, adjust of mitigation measures.

Water quality monitoring reference stations will be located in water bodies or streams comparable to those in the exposed area in terms of hydrology, bathymetry and type of sediments. The sampling stations will be located to monitor the quality of water in locations likely to be affected by the project.

Generally speaking, the location of water quality sampling stations will be determined according to the following criteria:

- Monitoring will focus particularly on streams and water bodies potentially affected by the various project components, namely:
    - Creek C;
    - Lac des Montagnes;
- Specific small streams in the sub-watersheds that may potentially be affected by the various stockpiling areas.

Water samples will be collected at the locations selected for the biological monitoring (benthic invertebrates and fish communities) (see Section 3.3.2). The exact number of water quality monitoring stations and their precise location will be specified in the final environmental monitoring program.

As recommended in the EEM guide, Nemaska Lithium shall monitor the water quality four times a year, at minimum intervals of one month (Table 11-3). Sampling campaigns will be carried out during the summer and fall, at the same time as the monitoring of antic invertebrate and fish communities (see Section 3.3.2). The samples will be taken on the same day as those for the characterization of mine effluents. Water quality monitoring will start at the beginning of the construction work and will continue until the end of the rehabilitation.

Water sampling will be done according to accepted standard methods and the recommendations of Chapter 6 of the technical guide for EEMs (Environment Canada, 2012).

Nemaska Lithium will also monitor the septic installations that will receive domestic sewage generated at the mine site. This monitoring will ensure that the treatment installations are in conformity with the Regulation Respecting Waste Water Disposal Systems for Isolated Dwellings. It will ensure, among others, that discharge standards are respected and that timely correctives are applied as necessary. Nemaska Lithium will comply with the environmental monitoring requirements presented in Schedule 4 of the *Guide de présentation des demandes d’autorisation pour les systèmes de traitement des eaux usées d’origine domestique* (MDDEFP, 2008b).

<u>Monitoring report</u>

In conformity with articles 21 and 22 of the MMER (2012), and no later than the 31^{st} of March of each year, Nemaska Lithium with submit, a report on the effluent and water quality monitoring performed during the preceding calendar year. This monitoring report will include the following information:

- The collection dates for all samples;
- The location of the final release points where samples were taken for sublethal toxicity tests and effluent characterization;
- The latitude and longitude of the sampling areas used for water quality monitoring and a written description of the location of such areas;

- The results of effluents characterization, water quality monitoring and sublethal toxicity tests;
- The methods used in the characterization of effluents and water quality monitoring, as well as the detection limits thereof;
- The quality assurance and control procedures that were implemented.

The water quality data from the exposed area will be compared to those from the reference area for the various indicators analyzed in the context of the monitoring.

Table 11-3 Monitoring Indicators and Measurement/Sampling Frequency – Water Quality Monitoring for the EEM Required under the MMER (2012)

Monitoring Indicators	Measurement/Sampling Frequency
Basic Physico-Chemical Indicators	
Alkalinity	Four times a year
Electrical conductivity	
Hardness	
TSS (total suspended solids)	
Dissolved oxygen	
pH	
Temperature	
Metals / Metalloids	
Arsenic	Four times a year
Copper	
Cyanides[1]	
Iron	
Nickel	
Lead	
Zinc	
Others	
Radium 226	Four times a year[2]

[1] The MMER does not specify a monitoring of cyanide because this substance is not used as a reagent in the process.

[2] In the case of radium 226, the testing frequency may be reduced to a minimum of once per quarter if the concentration of the substance in the effluent is below 0.037 Bq/L in 10 consecutive tests performed according to Article 12 of the MMER (2012).

11.2.2.4 Vibration Monitoring

As shown on Map 8-1 of the ESIA, a number of permanent camps are located within 1 km of the mine site. As specified by Directive 019, an automatic system to monitor ground vibrations and air pressures near dwellings (i.e. the permanent camps) will be put in place during the construction and operation phases. Between one and three stations will be installed at permanent camps located closest to the mine site. A log of mining operations monitoring data (vibration velocity, frequency of ground vibrations, air pressure, blasting patterns) will be kept for a period of at least two years. Nemaska lithium will comply with the Directive 019 requirements applicable to an open pit mine, notably the prohibition of blasting between 19:00 and 7:00.

11.2.3 Biological Environment

As part of the biological environment follow-up, Nemaska Lithium will monitor the vegetation, the sediment quality, the benthic invertebrates and the fish communities. The following paragraphs describe this monitoring in further detail.

11.2.3.1 Vegetation and Effectiveness of Reclamation Work

The purpose of the vegetation follow-up program is to assess the effectiveness of rehabilitation in areas disturbed by the construction phase, and of the replanting of affected surfaces during the progressive rehabilitation and closure of the mine site.

With regard to the vegetation follow-up program, particular attention will be given to the monitoring of species survival and to the growth rate of the vegetation implanted on the site. Inventories will be taken annually in the spring for a period of three years following the implementation of the plant cover, or until it has been demonstrated that the vegetation is adequately restored and implanted.

The areas disturbed during the construction phase will be replanted so as to re-create the original natural conditions as quickly as possible, as mentioned in Chapter 7 of the Whabouchi project ESIA. Nemaska Lithium will monitor the revegetated areas to ensure that the plants have taken hold and that the mitigation measures are effective. This monitoring will also indicate if corrective action is required. The sites that will be replanted during the construction phase include the access roads and the work areas used during the exploration and that will not be of further use during the operation phase. Nemaska Lithium will produce a report on the vegetation follow-up upon completion of the replanting of disturbed areas, at the end of the construction phase.

The waste rock and tailings pile will undergo gradual replanting, as the operating conditions allow. As in all restoration programs, indigenous species (seedlings and seeds) will be preferred and carefully selected to maximize the growth of the plant cover and improve the visual aspect of the waste rock and tailings pile. These plants will have a better chance of adapting to the climate, the characteristics of the soil and the water regime in the region. Appropriate measures will also be taken to give the pile the most natural shape possible, by rounding off the piles of materials. If necessary, the areas needing a better plant recovery will be reseeded.

Revegetation work will also be carried out at the closure of the mine. Areas altered by the project will be rehabilitated so as to restore natural conditions comparable to their original state. Except for the mine pit, which will be flooded, the entire site will be replanted with indigenous species. Nemaska lithium will monitor these replanting activities following the closure of the mine, during the site rehabilitation. The report on the vegetation follow-up will be produced as early as the first summer following the closure of the mine. The results of the follow-up on the progressive rehabilitation of the waste rock and tailings pile will be included in this report. When necessary, corrective plantations and/or reseeding will be done where the mortality rate is high. Follow-up reports will be issued until monitoring shows conclusive results for three consecutive years. Should the results be considered inconclusive, a final report will be issued after the fifth year of the post-rehabilitation phase. Vegetation follow-up reports will be submitted to the CAP.

11.2.3.2 Sediments, Benthos and Fish

The MMER (2012) requires an environmental effects monitoring (EEM; Environment Canada, 2012) to measure the effects on benthic organisms and fishes (articles 10, 11, 12 and 13 of Schedule 5, MMER, 2012). Before undertaking the biological follow-up studies, Nemaska Lithium will submit the monitoring plans to Environment Canada for approval (articles 19 and 23 of Schedule 5, MMER, 2012). The biological monitoring studies include the following elements:

- Site characterization;
- Data collection dates and time;
- The quality assurance and control measures as well as a summary of the information from previous biological studies;
- The results of the sediment quality monitoring;
- The study on the benthic invertebrates community;
- The study on fishes.

The objective of the biological monitoring is to evaluate the effects of the release of treated mine effluent on the fishes and their habitat, as well as the effectiveness of mitigation measures. The sediment, benthos and fish follow-up plan described in this section is based on the recommendations of the EEM technical guide (Environment Canada, 2012) and will be of the control/impact type, for which reference and exposed areas will be identified. For the purposes of the sediment quality, benthic invertebrates and fish monitoring, the exposed areas correspond to Creek C and to Lac des Montagnes, while the reference zones correspond to Lac du Spodumène and Lake 1.

Sediment Quality

To support the studies on fishes and benthic invertebrates, the sediment samples will be collected in the same exposed and reference zones as those used in the fish and benthic invertebrate populations follow-up. Sediment samples will be taken to determine the granulometric distribution and the total organic carbon content. The follow-up plan on benthic invertebrates will detail the methods used for the sampling and laboratory analysis (Moisan et Pelletier, 2008 et 2011; Environment Canada, 2012).

The results of the granulometric analyzes and of the total organic carbon dosage will indicate if the habitat in the exposed area diverges from that in the reference zone, and facilitate the interpretation of the benthic invertebrate studies.

Benthic Invertebrates

The invertebrate benthic study is a monitoring tool that is widely used as an indicator of the condition of the fish habitat. As part of the Whabouchi project, the effects on fish habitat will be evaluated on the basis of different indicators, including a comparison of the benthic invertebrate communities exposed to treated mine effluent (exposed zone) with other communities that have not been exposed (references zone). To this end, Nemaska Lithium will collect benthic invertebrates in both exposed and reference zones, or according to an exposure gradient (same zones as for the monitoring of fish populations). The data on the different benthic invertebrate communities will be compared using different descriptors. The following community descriptors will be used to identify potential impacts of the effluents on the benthic invertebrate communities:

- Total invertebrate density;
- Species richness;
- Simpson diversity index;
- Equitability;
- Density of each taxon;
- Relative abundance of each taxon;
- Absence/presence of each taxon;
- Bray-Curtis coefficient.

The results of the sampling performed for the description of the biological environment presented in Chapter 7 of the ESIA will be taken as baseline to represent the status of the environment before the project's development.

However, in the event that additional benthic invertebrate samples become necessary, these will be collected at the time of year when the diversity of benthic invertebrates is maximum, as prescribed in the EEM technical guide (Environment Canada, 2012).

In the case of freshwater monitoring, the recommended level of identification for benthic organisms is the family. The environmental monitoring on benthos will cover the entire life of the project, including the closure phase (post-operation and post-rehabilitation), and the monitoring will be carried out once every year.

<u>Fishes</u>

Nemaska Lithium will monitor the fish populations to identify, as applicable, any difference in the growth, reproduction, survival or health of these populations. The study will also monitor decontamination of individuals, notably with regard to the concentration of mercury in fish tissues, in order to determine if the mine effluent released in the receiving environment has effects on the fishes.

It should be noted that metal mines are not required to monitor fish if the mercury concentration of the effluent in the exposed zone is below 1% within 250 m of a final release point (MMER, 2012, Schedule 5, par. 9b). Moreover, fish tissue analyzes are only required if the effluent characterization measures a mercury concentration of 0.10 µg/L or more (MMER, 2012). At this time, the data about mercury concentrations is not available. A geochemical modeling of the effluent has been undertaken and its results will indicate if monitoring is warranted.

Study Areas

Fish populations and their habitats will be monitored in Creek C and Lac des Montagnes, as these two habitats will be influenced by the release of treated mine effluent (exposed zones). In each exposed zone, a fishing station will be located near the effluent release point, but outside of the initial mixing zone. Another fishing station will be located in a less exposed area, but near the effluent release point. These fishing stations will also be located near those selected for the previous fieldwork in order to allow comparisons with the conditions of the environment before the project.

Two references zones were selected for the monitoring of fish populations: Lake 1 and Lac du Spodumène. These reference zones will allow comparisons with the condition of fish populations in the exposed zones. In the reference zones, the fishing stations will be located near those selected for the previous fieldwork. Other water bodies and streams could be subject to a monitoring of fish populations, for example those located near the waste rock and tailings pile and the mine pit.

The exact number of water bodies and streams that will be sampled; as well as the number of fishing station and their precise locations will be determined later, at the time of the first follow-up campaign.

For the purpose of this comparison, the following indicators will be used to determine if the effluents have an effect on fish populations:

- Age (survival);
- Size according to age (body mass vs. age) (energy use – growth);
- Relative gonad mass (weight of the gonads vs. body mass) (energy use – reproduction);
- Condition (body mass vs. length) (energy storage – condition);

- Relative liver mass (weight of the liver vs. body mass) (energy storage – condition).

In order to determine if changes have occurred between the fish populations in exposed zone and those of the reference zones, the results from the exposed zones will be statistically compared to those obtained in the reference zones.

Selected species

The most important factors in the selection of species for the EEM program are exposure, abundance, representativeness of the survey area, and sensitivity to the effluent. The recommended fish monitoring method for the EEM program consists in examining adult specimens of two relatively sedentary fish species, including one benthivore species (Environment Canada, 2012). The following elements will be considered in the selection of these two species:

- The species of resident fish (non-migratory) identified during the site characterization;
- The abundance of sexually mature males and females in the exposed and reference zones;
- The species for which fishing or sampling permits can be obtained;
- The species most exposed to the effluent (Environment Canada, 2012).

For the purpose of the fish population monitoring, the minimum recommended sample size for the two selected species is 20 males and 20 females, all sexually mature.

Sampling Method

The fishing methods used in the fish monitoring will be based on those used in the field, based on recommendations of the *Guide de normalisation des méthodes d'inventaire ichtyologique en eaux intérieures* (SFA, 2011) and on the Metal Mining Environmental Effects Monitoring (EEM) Technical Guidance Document (Environment Canada, 2012).

Monitoring Indicators

Different measurements must be taken to calculate the variation in the selected fish monitoring indicators, notably the length (at fork, total or standard), total body mass, age, gonad mass, egg mass, fecundity, liver or hepatopancreas mass, anomalies (parasite, lesion, tumor, etc.), sex and concentrations of mercury and heavy metals in the flesh and the liver.

Monitoring Period, Frequency and Duration

Summer is the preferred time for the monitoring of fish populations and their habitats. During this period, the water temperature is higher and fish are more mobile. Thus, their movement increases the probability of capture with fixed fishing gear. Furthermore, since this type of study is generally carried out in summer, comparisons with studies made in other environments will be facilitated (comparison of abundance, size, condition, etc.). The duration of the environmental monitoring of fish populations will cover all phases of the project.

MMER Biological Follow-Up Report

Nemaska Lithium will prepare interpretation reports on the biological monitoring and will submit them to the authorizing agency according to the presentation modalities specified in Schedule 5 of the MMER. Interpretation reports for the initial biological follow-up study and each subsequent study completed as part of the EEM program will provide the following information:

- A description of the variances from the monitoring plan;
- Information about collected samples and sampling stations;
- A summary of results for each benthic invertebrate community sampling station;
- A summary of results for each fish sampling zone;
- The results of statistical analyzes;
- The identification of the presence or absence of effects on the fish populations and benthic invertebrate community;
- A comparison of the results of the statistical analyzes and of the sublethal toxicity tests;
- The findings of the EEM;
- Any recommended improvement or change in the monitoring plan for the subsequent EEM.

Nemaska Lithium will make these reports on the biological environment follow-up available to the CAP.

11.2.4 Human Environment

Nemaska Lithium will implement a follow-up program on the human environment, particularly concerning the use of the land and its resources, the welfare of the community, as well as employment and economic spinoffs. This monitoring program will begin with the construction phase and continue up until the cessation of mining activities, including the closure phase as well as the site rehabilitation activities. As part of this follow-up program, Nemaska Lithium will produce annual reports which will be made available to the CAP. The objectives of this follow-up include:

- Ensure that the persons affected by the project, particularly in the Cree community of Nemaska, the tallyman of trapline R20 and the other users of the land have the opportunity to express their concerns and their expectations about the project and its impacts;
- Ensure that their expressed concerns and expectations are communicated to Nemaska Lithium in a timely manner;
- Validate the predictions and assumptions presented in the ESIA, and assess the effectiveness of the proposed mitigation and improvement measures.

In 2011, Nemaska Lithium implemented a plan to consult the Cree community of Nemaska. This plan was developed in accordance with rigorous and accepted consultation practices. As part of this plan, the CAP was created to provide a platform for exchanges and collaboration between Nemaska Lithium and the Cree community of Nemaska. The CAP will therefore play an important role in the follow-up on the human environment, as the privileged interlocutor.

Furthermore, the Cree liaison officer hired by Nemaska Lithium will remain in this position for the entire duration of the project. As described in chapter 9 of the Whabouchi project ESIA, the role of this liaison officer is to ensure a permanent presence so that community members can obtain information at their convenience and can express their concerns in their own language to a member of their community.

11.2.4.1 Land and Resources Use

The follow-up on the use of the territory and its resources will help Nemaska Lithium validate the effectiveness and applicability of the mitigation measures presented in the Whabouchi project ESIA. This follow-up will also validate the anticipated impacts of the project on this component, particularly with regard to the use of trapline R20 on which the project is located. Through this follow-up, the users of the territory may express their assessment of the mitigation measures and, if necessary, suggest adjustments.

To make this follow-up program possible and, above all, effective, Nemaska Lithium will have frequent meetings with the users of trapline R20, notably with tallyman James Wapachee and his family, as well as with the other regular users of the trapline. The users of the Bible Camp will also be met to evaluate the effectiveness of the mitigation measures. The CAP will also take part in the follow-up in order to document impacts of the project on the use of the land and its resources, as well as any other aspect related to this component.

The collaboration agreement currently under discussion between Nemaska Lithium, the Resource Development Partnership of the Cree community of Nemaska and the Cree Regional Authority will provide for consultation mechanisms to maximize and facilitate exchanges between the users of the land and the mining company.

11.2.4.2 Employment and Economic Spinoffs

As mentioned in Chapter 1 of the Whabouchi project ESIA, the collaboration agreement being discussed by Nemaska Lithium, the Resource Development Partnership of the Cree community of Nemaska and the Cree Regional Authority, will ensure that the rights and interests of the Nemaska Crees will be considered in the Whabouchi project. Thus, jobs and contracting issues will be addressed in this collaboration agreement, notably to maximize the benefits for Nemaska.

Additionally, as mentioned in Chapter 3 of the Whabouchi project ESIA, the Resource Development Partnership Agreement (RDPA) currently negotiated between Nemaska Lithium, the Grand Council of the Crees and the Cree community of Nemaska will specify modalities for the sharing of the mine operating profits. Indeed, a major element of this RDPA will be the maximization of economic spinoffs for the Cree community of Nemaska.

The employment and economic spinoffs follow-up program will help Nemaska Lithium validate the predictions made in the Whabouchi project ESIA and, if necessary, take appropriate corrective measures. This follow-up will also validate the effectiveness and applicability of the proposed mitigation and improvement measures. Through this follow-up, the Cree community of Nemaska and other communities in the James Bay region may voice their concerns and expectations, and suggest improvements or adjustments if necessary.

The employment and the local and regional economic spinoffs of the project will be monitored during the construction, operation and closure phases. More specifically, at all phases of the project, the training given, jobs created, contracts awarded to local and regional companies, as well as the purchase of goods and services from local and regional suppliers will be closely documented. In this regard, Nemaska Lithium will implement various initiatives to improve its employment and economic spinoffs follow-up program. For instance, it will meet representatives of community and commercial organizations in Nemaska and in the James Bay region, as well as stakeholders in the employment and education sectors, to follow-up on the devolution of employability in Nemaska.

11.3 Environmental and Social Management Plan

As part of its commitment to preserve the environment, Nemaska Lithium will implement an environmental and social management plan (ESMP) for the Whabouchi project. This management tool will ensure that the measures and controls proposed in the ESIA are effectively applied in order to limit environmental and social impacts. More specifically, the ESMP will govern the compliance assurance and environmental follow-up programs described in this document. This ESMP will also include the action plans and the emergency procedures outlined in Chapter 10 of the ESIA.

The ESMP will be applied at all phases of the project, from construction to closure. It will be inspired by ISO 14 001, an international standard on environmental management that aims to improve environmental performance.

The elements in the Whabouchi project ESMP will include, among others:

- The main environmental and social issues, mitigation measures and residual effects identified in the Whabouchi project ESIA;
- The regulatory and legal requirements that apply to the project;
- The follow-up indicators, schedules, measurable environmental objectives and performance goals;
- The environmental programs developed to reach the goals and objectives (e.g. compliance assurance and environmental follow-up programs);
- The assignment of responsibilities.

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CHAPTER 12

GLOSSARY, ABBREVIATIONS AND UNITS OF MEASUREMENT

Environmental and Social Impact Assessment

March 28, 2013

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12. GLOSSARY, ACRONYMS AND UNITS OF MEASUREMENT

Table 12-1 Glossary

Term	Definition	Source
Acute toxicity or acute lethality (test)	Test to determine the concentration of a substance that causes 50% mortality in a given species after a 48 hours exposure.	Adapted from Environment Canada, 2012
Aliquot	Accurately measured sample of a fluid used in an analysis.	Adapted from OQLF, 2013
Alkalinity	The total alkalinity (measured as the concentration of $CaCO_3$) illustrates the sensitivity of the environment to acidification.	Adapted from PWGSC, 2013
Alluvial deposit	Clay, silt, sand, gravel, pebbles or other detrital material deposited by water. Alluvial deposits are made up of particles from local rocks that have undergone more or less significant alteration during their transport by running water.	Adapted from PWGSC, 2013
Anouran	Order comprised of frogs, toads and tree frogs.	Adapted from AARQ, 2013
Anoxic	Condition in which the concentration of dissolved oxygen is so low that certain groups of micro-organisms prefer oxidized forms of nitrogen, sulfur, or carbon as an electron acceptor.	Adapted from PWGSC, 2013
Anthropogenic	Having its origin in the human activity.	Adapted from PWGSC, 2013
Aquifer	An underground layer of water-bearing permeable, rock or unconsolidated material (gravel or sand) from which important quantities of water can be extracted.	Adapted from PWGSC, 2013
Audit	Diagnostic operation on a given activity or organizational status, based on the independent evaluation of the results of studies, systematic assessments and verifications, with the objective of issuing an opinion or recommending sustainable corrective actions.	Adapted from OQLF, 2013
Avifauna	Avian fauna; the bird species that nest or wintering in a given area after migration.	Adapted from PWGSC, 2013

Term	Definition	Source
Bathymetry	The measuring of water depth and the processing of corresponding data to determine the configuration of the bottom.	Adapted from PWGSC, 2013
Benthos (benthic organisms)	The living organisms present at the bottom or in the sediments of aquatic habitats (lakes, rivers, ponds, etc.).	Adapted from MDDEFP, 2013a
Biocide	Active substance intended to destroy any harmful organism by chemical or biological means.	Adapted from OQLF, 2013
Biological oxygen demand	Unit measuring water pollution, defined as the amount of oxygen in milligrams per litre consumed in the biological decomposition of organic matter (vegetal or animal) and inorganic matter (sulphates, iron salts, etc.) during a period of time and at a given temperature.	Adapted from MDDEFP, 2013a
Bog	A type of peatland that receives water only from atmospheric precipitation, which also provide the only source of nutrients except for what is provided by the decomposition of the plants forming the peat substrate.	Adapted from Payette et Rochefort, 2001
Borrow pit	An excavation, outside the limits of the building works or road being constructed, from which the material necessary for the construction is produced.	Adapted from PWGSC, 2013
Bray-Curtis coefficient.	Distance coefficient that reaches a maximum value of 1 for two sites that are entirely different and a minimum value of 0 for two sites that possess identical descriptors. The value of the coefficient measures the amount of association between sites. The B-C Index is a member of the class of distance coefficients known as a semimetric that some prefer to call dissimilarity coefficients.	Adapted from Environment Canada, 2012.
Buffer strip	Permanent plant cover combining herbaceous plants, shrubs and trees, adjacent to a stream or lake.	Adapted from Gagnon et Gangbaz, 2007
Burn	Unit of land over which a fire of any kind has spread and is still regenerating.	Adapted from PWGSC, 2013
Camp	Refers to a physical shelter (anthropogenic construction) built on the land.	-

Term	Definition	Source
Camp site	Refers to the site of several camps.	-
Catch per unit effort	Corresponds to the number of fishes captured by fishing gear (e.g. bait trap, gill net, electrofishing) per unit of effort.	-
Caudata	Order of invertebrates that includes, in Quebec, salamanders, newts and mud puppies.	Adapted from AARQ, 2013
Concentrate	Mineral substance obtained after physical or chemical processing of the ore.	Adapted from MRN, 2013
Concentrator	A plant where ore is separated into values (concentrates) and rejects (tails).	PWGSC, 2013
Contaminant	Any physical, chemical, biological or radiological substance in the air, soil or water that has an adverse effect. Any chemical substance with a concentration that exceeds background levels or which is not naturally occurring in the environment.	INAC, 2007a
Crusher (grinders)	A machine for crushing rock or other materials.	INAC, 2007b
Deposit	Mineral deposit or ore deposit is used to designate a natural occurrence of a useful mineral, or an ore, in sufficient extent and concentration to be economically and technically extracted.	OQLF, 2013
Dominant species	The species that predominates in an ecological community particularly when they are most numerous or form the bulk of the biomass.	PWGSC, 2013
Drilling	Mining activity consisting in penetrating the soil to extract samples for exploration purposes. Also refers to the action of piercing rock to place an explosive load to excavate a shaft, gallery or stope.	Adapted from MRN, 2013
Drumlin	A low, smoothly rounded, elongate hill of decametric to hectometric scale, built under the margin of a glacier and shaped by its flow, parallel to the direction of movement of the ice.	Adapted from OQLF, 2013
Dust reducer	Liquid (e.g. calcium water) used to prevent the release of dust on unpaved roads.	Adapted from PWGSC, 2013

Term	Definition	Source
Dyke	A vertical or near vertical thin body of igneous rock that while in its molten state intruded into a crack in older rocks (ie., a kimberlite dyke). Also a long wall or embankment built to prevent flooding.	INAC, 2007a
Ecoregion	Part of an ecoprovince characterized by climate-specific ecological processes with respect to soil, water, vegetation, animals, etc.	Adapted from PWGSC, 2013
Ecosystem	As defined in the *Canadian Environmental Protection Act* (1999), "ecosystem" means a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit.	CEAA, 2013
Effluent	Treated or untreated liquid waste material that is discharged into the environment from a structure such as a settling pond or treatment plant.	Adapted from INAC, 2007a
Equitability	Distribution of the number of individuals of each species at a given station.	-
Esker	A long winding ridge of gravel, sand, etc. originally deposited by a meltwater stream running under a glacier.	INAC, 2007a
Exfiltration	The removal of water from the soil at the ground surface, together with the associated unsaturated upward flow.	PWGSC, 2013
Experimental gillnet	Type of fishing net suspended vertically in the water so that a fish attempting to pass through it is caught by its gills and snared in the net.	Adapted from Aquaportal, 2013
Exposed area	Fish habitat and waters frequented by fish that are exposed to effluent.	Adapted from Environment Canada, 2012.
Fen	A type of peatland that receives a variable quantity of water, both from precipitations and from watershed drainage loaded with mineral elements that enrich the wet soil. The fen presents a diversified vegetation, generally dominated by a herbaceous cover, notably Cyperaceae, with bryophytes, shrubs and trees.	Adapted from Payette et Rochefort, 2001
Fish habitat	Spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes.	Fisheries Act - R.S.C., 1985, c. F-14 (Section 34)

Term	Definition	Source
Flow rate	Volume of water flowing in the stream or conduit at a given place and within a given period of time.	OQLF, 2013
Forest management unit	The forests in the domain of the State are divided into management units that, among other things, define areas for the production of forest resources or an increase in that production. Management units are land units in which allowable cuts are calculated and forest operations are planned and carried out in keeping with sustainable forest development objectives.	Sustainable Forest Development Act, RSQ, c A-18.1
Forest stand	A community of trees possessing sufficient uniformity in composition, age, arrangement or condition, to be distinguishable from the forest or other growth on adjoining areas. Thus forms a silvicultural or management entity.	PWGSC, 2013
Greenhouse gas	Greenhouse gases are those gaseous constituents of the atmosphere, both natural and anthropogenic, those absorb and emit radiation at specific wavelengths within the spectrum of thermal infrared radiation emitted by the Earth's surface.	OQLF, 2013
Hardness	Concentration of all metallic cations, except alkaline metal cations, present in the water. Generally, hardness is a measure of the concentration of calcium and magnesium ions in the water; it is often expressed as milligrams of calcium carbonate per litre of water.	Adapted from MDDEFP, 2013a
Herd	A congregation of gregarious wild animals.	PWGSC, 2013
Herpetofauna	Term that refers to all reptile and amphibian species.	Adapted from AARQ, 2013
Home range	Refers to the territory in which an animal travels in the course of its normal activity.	Adapted from Melquiot, 2003
Hoop net	A box-shaped or funnel-shaped apparatus that is constructed of netting or wire mesh fastened to a hoop or frame and that is used to catch fish without enmeshing them.	PWGSC, 2013

Term	Definition	Source
Hydraulic conductivity	The hydraulic conductivity of a material represents the capacity of water to circulate through it. The proportionality coefficient, K, of Darcy's law, is commonly referred to as the hydraulic conductivity. It is expressed as a unit of speed.	Adapted from Banton et Bangoy, 1997
Hydrographic basin or network	Region or area bounded by topographic highs that drains water toward a stream or lake.	INAC, 2007a
Hydrologic regime	Variations in the state and characteristics of a water body which are regularly repeated in time and space and which pass through seasonal or other phases.	OQLF, 2013
Hypoxic	Water with a low concentration of oxygen(less than 2 mg/l).	PWGSC, 2013
Ichthyofauna	All the fishes forming a community.	Adapted from PWGSC, 2013
Igneous	Rocks formed by the crystallization of molten magma, also called magmatic rock.	Adapted from INAC, 2007a
Intensive recreation zone	Part of the territory of a park allocated to outdoor intensive recreation.	Parks Act (c, P-9, a. 9 and 9.1); Parks Regulation (c. P-9, r. 25)
Kjeldahl total nitrogen	Organic nitrogen and ammonia nitrogen content of a sample, measured under specified conditions by the Kjeldahl method.	Adapted from OQLF, 2013
Leachable	Qualifies a material from which one or more soluble constituents can be extracted by a solvent.	Adapted from OQLF, 2013
Leachate	Solution containing elements that have been solubilized or entrained by leaching.	Adapted from MDDEFP, 2013a
Lithology	Study of the physical properties and aspect of rock.	Adapted from OQLF, 2013
Low flow	Lowest level of a stream.	Adapted from MDDEFP, 2013a
Low-flow period	Period during which the water level is at its lowest.	Adapted from PWGSC, 2013
Low-water flow	Lowest value of discharge in a stream during a hydrological year.	OQLF, 2013
Lux meter	An instrument for measuring photometric quantities such as illuminance.	Adapted from PWGSC, 2013

Term	Definition	Source
Maximum preservation zone	Part of the territory of a park allocated to the preservation of the integrity of the environment.	Parks Act (c, P-9, a. 9 and 9.1); Parks Regulation (c. P-9, r. 25)
Mining	Act of extracting and concentrating substances from a mineral deposit.	Adapted from MRN, 2013
Mining claim	Title conferred by ministerial decree to an individual or group, which grants him the right to exploit the specified mineral substance and to dispose of the products of this exploitation. The ownership of mineral resources in Canada is established by staking the subsurface rights to the area of interest. This area, which is recorded with the Mining Recorders Office, is called a mining claim.	PWGSC, 2013 and INAC, 2007a
Mining exploration	Mining activity relating to the discovery of mineral deposits, which includes geological mapping, geophysical and geochemical surveys; drilling, remote sensing, etc. (see also prospection).	Adapted from MRN, 2013
Mining lease	Contract giving the leaseholder the exclusive right to prospect and exploit the mineral resources on a property.	Adapted from PWGSC, 2013
Moraine	Material of mostly glacial origin deposited directly by a glacier or indirectly in glacial rivers and lakes and in the sea.	Adapted from OQLF, 2013
Native species	A species that originates from the area where it is living naturally and that has not been introduced from elsewhere.	OQLF, 2013
Natural high water line	Boundary between a predominance of aquatic plants to a predominance of terrestrial plants or, if there are no aquatic plants, the line at which terrestrial plants stop growing in the direction of a water body.	Adapted from MDDEFP (2008)
Near-miss	Any situation in which an accident almost occurred.	Act respecting industrial accidents and occupational diseases (L.R.Q., c. A-3.001)
Oligotrophic	The state of a body of water when it has a low nutrient content (mainly nitrogen and phosphorus) and where the productivity is low.	-

Term	Definition	Source
Open pit mine	Any open surface excavation for the extraction of minerals/ore by drilling, blasting or cutting.	INAC, 2007a
Ore	A mineral or solid material containing a precious or useful substance in a quantity and form that makes it economically viable to extract.	Adapted from MRN, 2013
Outfitter	An undertaking which, in return for payment, provides lodging and services or equipment for the practice of hunting, fishing or trapping activities for recreational purposes.	PWGSC, 2013
Outlet	Opening or passage through which flows the discharge from a reservoir or stream.	Adapted from MDDEFP, 2013a
Overburden	Material of any nature, including loose soil, sand, gravel, that lies above bedrock or a deposit.	INAC, 2007a
Pegmatite	A coarse-grained (one or more centimetres, sometimes more than one metre) magmatic silicate rock.	Adapted from OQLF, 2013
Permeability	The intrinsic permeability of a material is a characteristic representing its aptitude to allow the circulation of fluid. It is expressed as a unit of surface area.	Adapted from Banton et Bangoy, 1997
pH	Value representing the acidity or alkalinity of water. The pH scale ranges from 0 to 14; a pH of 7 is regarded as neutral, a pH less than 7 corresponds to an acid solution and a pH greater than 7 corresponds to an alkaline solution.	Adapted from MDDEFP, 2013b
Phenology	Study of life cycle phases or activities of plants and animals related to time and climate.	PWGSC, 2013
Photointerpretation	Analysis of aerial photographs or satellite imagery to establish the basic elements of a map.	-
Piezometric level	Level of the water in a borehole or well drilled at a given point in an aquifer.	Adapted from OQLF, 2013
Piezometry (level)	Level of the water in a borehole or well drilled at a given point in an aquifer.	Adapted from OQLF, 2013

Term	Definition	Source
Pile	Accumulation area where materials are stored either temporarily or permanently (e.g. overburden pile, waste rock and tailings pile).	-
Pit dewatering	Drainage of seepage water from a mine by pumping out the water from a low point.	Adapted from OQLF, 2013
Preservation zone	Part of the territory of a park allocated to the preservation of the environment in general.	Parks Act (c, P-9, a. 9 and 9.1); Parks Regulation (c. P-9, r. 25)
Prospection	Mining activity consisting in the search for economically valuable deposits, or the evaluation thereof.	Adapted from MRN, 2013b
Protected area	An area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means.	CEAA, 2013
Quarry	An open pit, mine or excavation, where building materials such as stone and gravel are obtained from open faces for commercial or industrial purposes.	Adapted from MRN, 2013
Reference zone	Water frequented by fish that is not exposed to effluent and that has fish habitat that, as far as practical, is most similar to that of the exposure area. It is not necessarily exempt of disturbances. It may effectively present anthropogenic impacts caused by other sources than the operation under consideration.	Adapted from Environment Canada, 2012.
Relative abundance of taxons	Proportion of the different families (taxons) at a given station, expressed as a percentage.	Adapted from Environment Canada, 2012.
Relative humidity	Expressed in per cent, amount of water vapour present in air as compared to its maximum capacity at that temperature.	Adapted from PWGSC, 2013
Residual environmental impact	An environmental effect that remains, or is predicted to remain, even after mitigation measures have been applied.	CEAA, 2013
Resurgence	Reappearance at the surface of a water flow which disappeared underground.	OQLF, 2013

Term	Definition	Source
Road train	Combination of vehicles consisting of a drawbar tractor coupled to a trailer, or of a tractor hitched to two semi-trailers.	Adapted from PWGSC, 2013
Runoff	Rapid flow of atmospheric precipitation on the ground surface, responsible in part for leaching the soil.	Adapted from MDDEFP, 2013a
Sedimentation pond	A basin in which wastewater containing settleable solids is retained to remove by gravity a part of the suspended matter. The decanted water is collected at the top of the basin, while impurities settle at the bottom where they can be extracted.	Adapted from PWGSC, 2013
Service area	Part of the territory of a park allocated to reception, information or management.	Parks Act (c, P-9, a. 9 and 9.1); Parks Regulation (c. P-9, r. 25)
Shrub layer	In a forest, one of the vegetative stages represented by shrubs.	Adapted from PWGSC, 2013
Spawning ground	Area of the aquatic environment where an animal species lays and fecundates eggs.	Adapted from OQLF, 2013
Species at risk	As defined by the *Species at Risk Act* (2002), "species at risk" means an extirpated, endangered or threatened species or a species of special concern.	CEAA, 2013
Species richness	Total number of different taxonomic categories captured at each station.	Adapted from Environment Canada, 2012.
Squamata	In Quebec, refers to snakes.	Adapted from AARQ, 2013
Stage of succession	A characteristic of many ecosystems that experience a change in structure and/or species on a given site in relation to time since major disturbance.	PWGSC, 2013
String bog	Flat peatland in which the spatial arrangement (hills, depressions, ponds) is undifferentiated and appears as a reticulated network.	Adapted from Payette et Rochefort, 2001
Sublethal toxicity (test)	Test used to monitor the quality of an effluent by measuring the survival, growth and/or reproduction parameters of marine or freshwater organisms in a controlled laboratory environment.	Adapted from Environment Canada, 2012

Term	Definition	Source
Suspended matter	Fine particles of solid matter in water, originating from natural sources, municipal or industrial effluent, agricultural runoff and atmospheric particle fallout. The suspended matter is one of the criteria to evaluate the quality of water. They can be eliminated by decantation or filtration.	Adapted from MDDEFP, 2013a
Tailing	Solid residue of the ore concentration process.	Adapted from PWGSC, 2013
Taxon density	Number of invertebrates of each taxon (family) per unit of surface (e.g. Number of invertebrates/m^2).	Adapted from Environment Canada, 2012.
Till	Glacial deposit left direct by the glacier and composed of clay, sand, gravel and boulders in any proportion.	Adapted from OQLF, 2013
Total density	Total number of specimens captured at a given station, all taxonomic categories combined, expressed per unit of surface (e.g. Number of invertebrates/m^2).	Adapted from Environment Canada, 2012.
Transect	Sample area, usually elongated or linear, chosen as the basis for studying a particular characteristic of the environment.	Adapted from PWGSC, 2013
Tree layer	In a forest, one of the vegetative stages represented by the tree canopy.	Adapted from PWGSC, 2013
Turbidity	A condition in water caused by the presence of suspended matter (sediment, clay, micro-organisms, etc.) and colloids, resulting in the scattering and absorption of light.	Adapted from MDDEFP, 2013a
Ultrasound	A wave phenomenon of the same physical nature as sound but with frequencies above the range of human hearing. Ultrasounds are vibrations induced in a material at a frequency higher than the auditory limit, which depends on age (15 Hz to 20 kHz). The upper limit is several thousands of kilohertz.	Adapted from PWGSC, 2013
Vascular plant	Any plant containing, in addition to cell tissue, vessels and organized conducting tissue.	Adapted from PWGSC, 2013
Waste rock	Rock generated by mining activities which does not have a sufficient content of economically extractable mineral.	-

Term	Definition	Source
Watershed	The area in which the runoff and groundwater naturally flows to a water course or to a given point. Also defined as the area feeding a stream or lake.	Adapted from MDDEFP, 2013a
Wildlife reserve	An area constituted for the purpose of preserving wildlife and where the exploitation of resources is regulated.	Adapted from OQLF, 2013
Wintering ground	A habitat that has suitable cover and food, allowing some wild animals (most commonly Cervidae) to winter there.	OQLF, 2013
Wetland	Area of land that is flooded or saturated with water long enough to allow characteristic processes of this type of environment.	Adapted from OQLF, 2013

Table 12-2 List of Abbreviations and Acronyms

Abbreviation	Meaning
-	Not analysed or no criterion for this parameter
<	Less than or smaller than
>	More than or larger than
1X/month	Sampling once per month
1X/wk	Sampling once per week
2X/yr	Sampling twice per year
3X/wk	Sampling three times per week
4X/yr	Sampling four times per year
AARQ	Atlas des amphibiens et des reptiles du Québec
ADL	Analytical detection limit
AERMIC	AMS/EPA Regulatory Model Improvement Committee
ALARP	As Low as Reasonably Practicable
AMS	American Meteorological Society
AONQ	Atlas des oiseaux nicheurs du Québec méridional
APSM	Association paritaire pour la santé sécurité du travail du secteur minier
ATV	All-terrain vehicle
BOD5	Biological oxygen demand over 5 days
BP	Before present
BV1	Watershed 1
BV2	Watershed 2
BV3	Watershed 3
BV4	Watershed 4
BV5	Watershed 5
C.P.	Post office box
CAH	Chlorinated aliphatic hydrocarbons
CAP	Community Advisory Panel
CAR	Clean Air Regulation
CBHSSJB	Cree Board of Health and Social Services of James Bay
CCDC	Compagnie de construction et de développement Crie Ltée/Cree Construction and Development Company
CCME	Canadian Council of Ministers of the Environment
CCQ	Commission de la construction du Québec
CDIS	Cree Diabetes Information System
CDPNQ	Centre de données sur le patrimoine naturel du Québec
CEA Act	Canadian Environmental Assessment Act

Abbreviation	Meaning
CEAA	Canadian Environmental Assessment Agency
CEAEQ	Centre d'expertise en analyse environnementale du Québec
CED	Canada Economic Development
CEHQ	Centre d'expertise hydrique du Québec
CEPA	Canadian Environmental Protection Act
CIM	Canadian Institute of Mining, Metallurgy and Petroleum
CLO	Community liaison officer
CMC	Community Miyupimaatisiiun Center
CMHC	Canada Mortgage and Housing Corporation
CN-	Available cyanide
CNW	Canadian News Wire
CO	Carbon monoxide
COFEX-Sud	Federal Environmental Assessment Review Panel
COMEV	Evaluating Committee
COMEX	Review Committee
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CPUE	Catch per unit effort
CRA	Cree Regional Authority
CREECO	Compagnie des entreprises Cries de développement économique / Holding Cree Regional Economic Enterprises Company
CRRNTBJ	Commission régionale sur les ressources naturelles et le territoire de la Baie-James
CSB	Cree School Board
CTA	Cree Trappers' Association
CVAA	Acute aquatic life criterion
CVAC	Chronic aquatic life criterion
D	Drilling
D (nb:m)	Diamond drilling (number : total metres)
DCO	Dissolved organic carbon
DEM	Digital elevation model
DMS	Dense-media separation
DPJ	Département de protection de la jeunesse
E	East
e.g.	Example
EC	Environment Canada
EDO	Effluent discharge objectives
EEM	Environmental effects monitoring

Abbreviation	Meaning
EEPF	Eeyou-Eenou Police Force
EFE	Exceptional forest ecosystem
EMS	Environmental management system
Env	Environmental study
EQA	Environment Quality Act
ERG2008	Emergency Response Guidebook 2008
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and social management plan
and coll.	and collaborators
etc.	Etcetera
FBMU	Furbearer management unit
FEL	Frequent effect level
FMU	Forest management unit
FNQLHSSC	First Nations of Quebec and Labrador Health and Social Services Commission
FS	Feasibility or market study
G	Geological survey
Gc	Unspecified geochemical
Gc(h)	Geochemical survey in humus
Gc(ro)	Geochemical survey in rock
Gc(s)	Geochemical survey in soil
Gc(t)	Geochemical survey in till
GCC	Grand Council of the Crees
GFMP	General forest management plan
GHG	Greenhouse gas
GpEl	Electrical geophysical survey
GpEm	Electromagnetic survey
GpMa	Magnetometric survey
GpRa	Radiometric survey
HAZID	Hazard identification studies
HAZOP	Hazard & Operability Analysis
HS&E	Health, safety and environment
IAP2	International Association for Public Participation
ICMM	International Council on Mining & Metals
IFC	International Finance Corporation
INSPQ	Institut national de santé publique du Québec

Abbreviation	Meaning
ISAQ	Inventaire des sites archéologiques du Québec
ISQG	Interim sediment quality guidelines
ISP	Cree Hunters and Trappers Income Security Board
ISQ	Institut de la statistique du Québec
JBACE	James Bay Advisory Committee on the Environment
JBNQA	James Bay and Northern Quebec Agreement
K	Hydraulic conductivity
L.C.	Statutes of Canada / Lois du Canada
L.R.Q.	Revised statutes of Quebec / Loi refondue du Québec
LDTV	Likely to be designated as threatened or vulnerable species
MAC	The Mining Association of Canada
MAH	Monocyclic aromatic hydrocarbons
MDDEFP	Ministère du Développement durable, de l'Environnement, de la Faune et des Parcs du Québec
MDDEP	Ministère du Développement durable, de l'Environnement et des Parcs du Québec
MDEIE	Ministère du Développement économique, de l'Innovation et de l'Exportation du Québec
MEF	Ministère de l'Environnement et de la Faune du Québec
MELS	Ministère de l'Éducation, du Loisir et du Sport du Québec
MENV	Ministère de l'Environnement du Québec
MER	Ministère de l'Énergie et des Ressources du Québec
MESS	Ministère de l'Emploi et de la Solidarité sociale du Québec
MMER	Metal Mining Effluent Regulations
MRN	Ministère des Ressources naturelles du Québec
MRNF	Ministère des Ressources naturelles et de la Faune du Québec
MRNFP	Ministère des Ressources naturelles, de la Faune et des Parcs du Québec
MS	Mineralogic study
MSDC	Multiservice day care center
MT	Metallurgical testing
MTQ	Ministère des Transports du Québec
MW	Megawatt
N	Nitrates / nitrites
N	North
NA	Not applicable
NBC	National Building Code of Canada
NEC	Nemaska Eenou Company

Abbreviation	Meaning
NFPA	National Fire Protection Association
NHWL	Natural high water line
$N\text{-}NH_3$	Ammonia nitrogen
NO_2	Nitrogen dioxide
NO_2^-	Nitrites
NO_3^-	Nitrates
NO_x	Nitrogen oxides
NRCan	Natural Resources Canada
NSDB	National Soil DataBase
NTDB	National Topographic Data Base
OEL	Occasional effect level
PAH	Polycyclic aromatic hydrocarbons
PEL	Probable effect level
Pg	Unspecified prospection and geological work
PHAC	Public Health Agency of Canada
PIN	Identification number
PM_{10}	Suspended particulates smaller than 10 microns
$PM_{2.5}$	Suspended particulates smaller than 2.5 microns
PPSRTC	Soil Protection and Rehabilitation of Contaminated Sites Policy / Politique de protection des sols et de réhabilitation des terrains contaminés
Pr	Prospection
QS	Quaternary study
R1	Receptor corresponding to the Bible Camp
R2 to R23	Sensitive receptors corresponding to Cree camps
RDL	Reported detection limit
RDPA	Resource Development Partnership Agreement
REL	Rare effect level
RQA	Regulation respecting the quality of the atmosphere
Rs	Resource and reserve study
S	South
SAAQ	Société de l’assurance automobile du Québec
SARA	Species at Risk Act
SDBJ	Société de développement de la Baie-James
SEBJ	Société d’Énergie de la Baie-James
SÉPAQ	Société des établissements de plein air du Québec
SM	Suspended matters

Abbreviation	Meaning
SO_2	Sulphur dioxide
SO_4	Sulphates
SOPFEU	Société de protection des forêts contre le feu
STC	Sound transmission class
TA	Technical assessment study
TCLP	Toxicity Characterisation Leaching Test
TEL	Threshold effect level
TSP	Total suspended particulates
TSS	Total suspended solids
TVSA	Threatened or Vulnerable Species Act
US EPA	United States Environmental Protection Agency
UV	Ultraviolet
VC	Valued component
W	West

Table 12-3 Units of Measurement

Units	Meaning
$	Dollar
%	Percent
% sat.	Saturation percentage
% HA	Percentage of people highly annoyed
¨	Inch
±	Plus or minus
º	Degree
ºC	Degree Celsius
°W	Degree West
µg	Microgram
µg/l	Microgram per liter
$µg/m^3$	Microgram per cubic meter
µm	Micrometre
µS/cm	Micro-Siemens per centimetre
Bq/l	Becquerel per litre
cm	Centimetre
dB (A)	Decibel A / Weighted decibel A
$G	Billion dollars
g/cm^3	Gram per cubic centimetre
g/g	Gram per gram
g/t	Gram per tonne
h	Hour
ha	Hectare
kg	Kilogram
kg/a	Kilogram per year
kg/month	Kilogram per month
$kgCaCO_3/t$	Kilogram of $CaCO_3$ per tonne
km	Kilometre
km/h	Kilometre per hour
km^2	Square kilometre
kV	Kilovolt
l or L	Litre
l/d	Litre per day
l/m^2	Litre per cubic metre
l/s	Litre per second

Units	Meaning
m	Metre
$M	Million dollars
m/s	Metre per second
m^2	Square metre
m^3	Cubic metre
m^3/h	Cubic metre per hour
m^3/d or m^3/day	Cubic metre per day
mg	Milligram
mg/kg	Milligram per kilogram
mg/l	Milligram per litre
mm	Millimetre
mm/yr	Millimetre per year
Mm^3	Million cubic metres
Mt	Million tonnes
MW	Megawatt
nbr/km^2	Number per square kilometre
p.	Page
m.t./year	Metric tonne per year
t/yr	Tonne per year
CFU	Colony-forming unit
CFU/ml	Colony-forming unit per millilitre
CFU/100ml	Colony-forming unit per 100 millilitres

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