4 COMMUNITY RELATIONS

The Windfall project's host communities includes the territory of the Cree First Nation of Waswanipi (CFNW) as well as that of the James Bay enclaves of Lebel-sur-Quévillon, Chapais, and Chibougamau, as mentioned in section 1.3.1. Osisko has been present in the area since 2015, when it acquired the Windfall project. Osisko's first meeting with Waswanipi representatives was held in October of that year. The first meeting with the Town of Lebel-sur-Quévillon was held a year later, in November 2016. Since then, Osisko has maintained a constant presence in these host communities to develop a relationship of mutual trust.

Over the years, Osisko has developed a good reputation (particularly with Cree stakeholders in the Eeyou Istchee James Bay territory in Northern Quebec) through concrete actions stemming from its sustainable development and community relations strategy and policy. The latter was updated in 2020 and reflects Osisko's values and practices in its host communities (see osiskomining.com).

Osisko has used this policy to develop a community relations approach that simplifies stakeholder identification and encourages dialogue with communities. This approach is broken down into three main steps (Table 4-1).

Table 4-1 Main steps in Osisko's community relations process

1- Planning	2- Implementation	3- Documentation
— Identify what needs to be communicated — Identify and map stakeholders — Contact key stakeholders — Prepare written notices and obtain the necessary permits — Integrate the approach with Osisko's values by involving all relevant internal departments	— Meet and stay in constant contact with stakeholders — Keep employees and contractors informed — Request feedback (questions, comments, and expectations) — Consider concerns and suggestions — Uphold commitments — Provide visibility for the associated follow-ups	— Written notices — Permits — Minutes — Reports — Communication protocols — Concerns and commitments tracking file — Log of stakeholders and outreach/communication activities

This approach is flexible and can be adjusted based on feedback. Osisko aims to understand the views and concerns of its First Nations and non-First Nations stakeholders and openly discusses its operations and performance. The company is committed to encouraging open dialogue, both formally and informally, with the aim of empowering affected communities to voice their opinions and concerns about the project. To that end, Osisko strives to create opportunities for discussion in various ways:

- regular meetings with key stakeholders such as tallymen, land users, local leaders, and strategic committees;
- outreach presentations to communities, schools, governments, land users, and socio-economic partners;
- educational above- and underground site visits for key stakeholders;

- consultation activities in the form of one-on-one and group interviews as well as public assemblies;
- participation in community events and cultural activities;
- organization of activities that benefit the project's host communities;
- distribution of written documentation on the project, sending of newsletters on ongoing activities, and posts on its website.

This outreach allows Osisko to learn more about the culture of the host communities, their activities, and the relationship they have with the land. Osisko regularly solicits their knowledge to help prevent, mitigate, and compensate for potential consequences and to maximize the benefits of its projects for their traditional activities, their cultural sites, and the environment.

Over the years, Osisko has built a relationship of mutual trust with the Cree First Nations people—especially those of the Waswanipi community—by jointly developing communication processes, implementing a joint environmental monitoring committee, hiring members of their communities, and doing business with their local companies and joint ventures.

In the sections that follow, this chapter discusses the elements associated with Osisko's presence in the host communities; the experiences of similar projects it has studied in Northern Quebec; the information and consultation process for the Windfall project; the outreach and consultation activities held during the exploration phase and for the present EIA; the reactions, concerns, and suggestions resulting from these activities; the way in which Osisko was able to address and incorporate these concerns into the realization of the EIA; the resulting issues; as well as future communications for the continuation of the permit process.

4.1 PRESENCE IN THE HOST COMMUNITIES

4.1.1 ENVIRONMENTAL MONITORING COMMITTEE

As part of its community relations activities, Osisko established an Environmental Monitoring Committee jointly with the CFNW in 2019. Members include representatives of the CFNW (including the tallyman for trapline W25B or representatives of his family; the Mining Coordinator; and other community representatives who occasionally attend certain meetings, such as the director of natural resources, the local Environment Officer, members of the Cree Trappers' Association, and the Chief or Deputy Chief) and of Osisko (including the Director, Community Relations and ESG; Community Liaison Officer; and Environmental Supervisor/Superintendent; as well as other representatives who occasionally attend, including the Director, Environment and the Vice President, Environment and Community Relations). It was established to inform the CFNW of data and statistics related to the project's environmental management such as details of accidental spills, waste and hazardous materials management, and drinking water and effluent quality compliance. It also discusses exploration and construction activities. The Environmental Monitoring Committee serves a dual role; it also acts as a liaison committee. To that end, it ensures ongoing consultation with the tallyman, responds to concerns, presents the results of the sectoral environmental EIA reports, and collects traditional knowledge and information on land use. To date, the committee has met nearly 30 times, both virtually and in-person in Waswanipi, at the Windfall site, and in Montreal. Some of this committee's recommendations have already been considered to enhance the Windfall project. Examples are provided in this chapter.

4.1.2 COLLABORATION COMMITTEE

Osisko and the Town of Lebel-sur-Quévillon signed a Collaboration Agreement in 2017, creating a de facto collaboration committee. The Agreement is intended to encourage transparent and effective communication with the town council, promote the social acceptability of the project, and maximize the socio-economic benefits for the town, all in a spirit of partnership. In August 2021, the Town of Lebel-sur-Quévillon passed a resolution confirming its support for the Windfall project. Since 2017, more than a dozen Collaboration Committee meetings have been held virtually and in-person, with the most recent being held in Lebel-sur-Quévillon in February 2023. A representative of the Administration régionale Baie-James (ARBJ) has been attending the committee meetings since 2019.

4.1.3 KEY HIRE

As part of its commitment to establish and maintain a constructive dialogue with the community, Osisko hired a Community Liaison Officer from the CFNW in 2017. They have an office in the community and are responsible for answering community members' questions and addressing their concerns. They also work with the human resources counsellors at the Windfall camp to ensure the integration of First Nations employees, support recruitment efforts in the community, and assist supervisors in their team management, notably by:

- participating in the interview process;
- giving pre-hiring presentations about life at the camp;
- organizing cultural exchange events (e.g., National Indigenous Peoples Day celebration with dancers, drummers, and traditional food);
- sharing information about the Cree way of life at the labour camp (posters explaining aspects of Cree culture);
- facilitating communication with the community/employees and translating information into Cree (as they are English/French/Cree trilingual).

4.1.4 INTEGRATION OF TRADITIONAL KNOWLEDGE AND CULTURAL VALUES

Osisko agrees that Cree land users' knowledge of their social and biophysical environment is essential to properly assessing the impacts of its project. The Crees have their own systems for representing the environment, neighbouring communities, themselves, their past, and their future on the land. For this reason, Osisko has taken many opportunities to collect information from tallymen and other land users since its arrival in the area. The company has worked to relay this information about the land to the field teams and the Environment Department so that it can be incorporated into the knowledge base for the Windfall project as much as possible.

CREE PARTICIPATION IN FIELD INVENTORIES

Land users and the Mistissini-based company EnviroCree participated in environmental data collection campaigns for the project between 2017 and 2022. They collected data from several domains, such as archaeology, surface water and sediments, aquatic fauna, herpetofauna, birds, large fauna, hydrology, and climatology (Table 4-2). The W25B tallyman and/or members of his immediate family participated in the majority of these campaigns. Opportunities to participate in the field campaigns were communicated to the community through the Waswanipi Mining Coordinator, the Osisko Community Liaison Officer, or the Environmental Monitoring Committee. For some components, specific interviews and Environmental Monitoring Committee meetings were held alongside those with the land users. In addition to the community's active participation in the inventories, the Environmental Monitoring Committee meetings are useful for continually documenting traditional knowledge on various aspects of the environment.

Table 4-2 Participation of the Cree community of Waswanipi members

Component	Type of activity	Community member(s) or business	Year
Archaeology	Field inventory	Willie Icebound Jimmy Otter	2018
Surface water and sediments	Field inventory	Willie Icebound	2021
	Field inventory	Judy Trapper	2022
	Regulatory sampling	EnviroCree (Mistissini company)	2019–2022
Aquatic fauna	Field inventory	Marshall Icebound Betsy Shecapio	2017
	Field inventory	Allan Icebound	2020
	Specific meeting	Marshall Icebound Judy Trapper Joshua Blacksmith Johnny Cooper Danny Happyjack	2020
Avian fauna	Field inventory	Benoit Gull	2017
Herpetofauna	Field inventory	Willie Icebound	2021
Large mammals	Field inventory	Marshall Icebound Yanick Plourde (community expert)	2018
	Specific interview	Marshall Icebound Judy Trapper	2019
Hydrology and climatology	Field inventory	Ronnie Nayassit	2017
Vegetation	Specific meeting	Marshall Icebound and family	2020

4.1.5 DONATIONS AND SPONSORSHIPS

Osisko established a donation and sponsorship program for local communities in 2016. It has two main criteria for receiving a donation or sponsorship: the project or organization must promote science and education, the environment, or health and physical activity and support cultural and community activities, socio-economic partners, or mining industry associations. The applicant must indicate whether the project or organization is beneficial to the community and provide a rationale for their request, if applicable.

Over the years, the donation and sponsorship program has supported various actions to encourage school attendance and academic success, notably in partnership with schools in Waswanipi and Lebel-sur-Quévillon, vocational training centres, colleges, and universities. Osisko also supports cultural and sporting events or community organizations that fight poverty and serve vulnerable clients, particularly in Waswanipi and Lebel-sur-Quévillon. For example, the Osisko Mining Inc. Decolonization and Indigenization Initiative was created in 2020 in partnership with the University of Ottawa Faculty of Social Sciences to:

- support the integration of First Nations histories, methodologies, and worldviews into the curriculum;
- better recognize First Nations learners and improve the retention of First Nations students;
- help develop shared understanding between First Nations and non-First Nations students;
- foster greater appreciation for the complexity of the social landscape and a greater collaboration between diverse people.

In 2018, the Cree Nation Government (CNG), the Eeyou Istchee James Bay Regional Government (EIJBRG), the Government of Quebec, and the Fonds Restor-Action Cri (FRAC) signed an agreement for the cleanup of abandoned mining exploration sites on Category II and III lands in Eeyou Istchee James Bay. The Government of Quebec and the FRAC contribute financially, while the CNG and EIJBRG manage and execute the work. Characterization and cleanup work has begun on the land. To date, Osisko has made its full financial contribution to the FRAC and provides in-kind administrative services to manage the fund.

Osisko has also funded research by the Cree Board of Health and Social Services of James Bay (CBHSSJB) on the effects of commuting on workers, their families, and Cree communities, particularly women. The research project includes interviews and focus groups with various stakeholders in the region and in the communities. In addition to a financial contribution, Osisko hosted a research program worker at the Windfall site who conducted a series of interviews with Cree workers. A report on the results of the study, along with recommendations to support workers and families, is expected in the spring of 2023.

Between 2017 and 2022, Osisko financially supported 39 different James Bay community groups or organizations through its donation and sponsorship program (Table 4-3). Of these, nine received donations over several years. In the Cree communities, 17 different groups or organizations were supported by the program. The CFNW received 18 sponsorships for different (and sometimes recurring) activities.

Table 4-3 Organizations supported by Osisko in Northern Quebec between 2017 and 2022

Cree communities	James Bay communities

— Cree Nation Bears (2019)
— Cree Regional Events and Entertainment (2022)
— First Nation Elite Hockey (2019)
— Fonds Restor-Action Cri (2018–2022)
— Joey Blacksmith Memorial Fishing Derby (2020–2022)
— Cree First Nation of Waswanipi, various initiatives:
    – Hockey and broomball team jerseys (2018 and 2022)
    – Mental health committee (2021)
    – Business development conference (2019)
    – Snowmobile races (2021 and 2022)
    – Softball teams (2018)
    – Mining expo (2017)
    – Waswanipi Day (2018)
    – Job fair (2017)
    – Goose and moose break subsidy program (2021 and 2022)
    – Kahnawake Cree Teepee Project (2022)
    – Low-income families committee (2019 and 2022)
    – National Addictions Awareness Week (2021)
    – Basketball tournaments (2017)
    – Golf tournaments (2018 and 2019)
    – Hockey and broomball tournaments (2018–2022)
    – Christmas dinners (2017–2019)
    – Amateur sports (2017)
    – Pow Wow Committee (2019)
— Rainbow Elementary School (2017, 2019, and 2022)
— Secretariat to the Cree Nation Abitibi-Témiscamingue Economic Alliance (2017–2022)
— Waswanipi Educators in Native Childcare Services Program (2020)
— Waswanipi Family Fishing Derby (2019, 2021, and 2022)
— Waswanipi Minor Hockey & Broomball Association (2017 and 2019)
— Waswanipi Old Post Fishing Derby (2017–2022)
— Waswanipi Pentecostal Church (2019)
— Waswanipi volleyball teams (2022)
— Waswanipi Women's Fishing Derby (2018–2022)
— Willie J. Happyjack Memorial School (2017–2019 and 2022)
— Youth Fusion (2018)
	— Action Bonne Nouvelle (2022)
	— Agora Boréale (2021)
	— Lebel-sur-Quévillon minor hockey association (2018 and 2019)
	— Attraction Nord (2019)
	— Cégep de Chibougamau (2019)
	— Centraide Abitibi Nord-du-Québec (2020 and 2021)
	— Centre de formation professionnelle Baie-James (2019 and 2022)
	— Lebel-sur-Quévillon golf club (2019)
	— Lebel-sur-Quévillon snowmobile club (2021)
	— Lebel-sur-Quévillon equestrian club (2017, 2018, and 2021)
	— Comité Lebel Environnement (2018, 2019, and 2022)
	— Lebel-sur-Quévillon suicide prevention committee (2020)
	— Compétition Gaby Labonne (2022)
	— Dynamo Jeunesse (2018)
	— École Boréale (2019)
	— École La Taïga (2019, 2021, and 2022)
	— Festival du doré Baie-James (2022)
	— Festival nautique de Lebel-sur-Quévillon (2019)
	— Festival western de Lebel-sur-Quévillon (2017 and 2018)
	— Fête nationale de Lebel-sur-Quévillon (2018, 2019, and 2022)
	— Fondation Lebel (2017–2022)
	— Buyer/Supplier Day (2022)
	— Heart and Stroke Tree of Life at École Boréale (2018)
	— Lebel-sur-Quévillon Maison de la famille (2018)
	— Lebel-sur-Quévillon Maison des jeunes (2017, 2019, 2021, and 2022)
	— Mythical Eeyou Istchee mural (2022)
	— OSEntreprendre (2022)
	— PACE-Âge (2019)
	— Partenaires à part égale (2019 and 2020)
	— Pavillon de la Rose (2019)
	— Rencontre des aînés Nord-du-Québec (2020)
	— Rencontre jeunesse Nord-du-Québec (2017)
	— Tourisme Baie-James (2020)
	— Salon Talent International (2021)
	— Secondaire en spectacle ARBJ (2018)
	— Lebel-sur-Quévillon Family Week (2018, 2019, 2021, and 2022)
	— Société de développement économique de Lebel-sur-Quévillon (2017)
	— Ressource pour personnes handicapées regional telethon (2017–2022)
	— Tournois de golf du maire de Lebel-sur-Quévillon (2017–2020 and 2022)
	— Town of Lebel-sur-Quévillon: emergency trailer, participatory budgets, and municipal campground (2018, 2021, and 2022)

4.1.6 IMPACT AND BENEFIT AGREEMENT

Since 2017, representatives of Osisko, the CFNW, and the CNG have met several times to discuss an Impact and Benefit Agreement (IBA), which Osisko and its Cree partners are hoping to sign shortly. Various issues related to the cohabitation and harmonization of activities in the area, environmental protection, socio-economic benefits, and culture were discussed during these meetings. Some elements remain to be defined. In addition to the themes typically contained in an IBA (employment and training opportunities, working conditions, business opportunities, social and cultural aspects, environment, financial matters), the Windfall project Agreement will include specific elements and mechanisms that will address the concerns of Waswanipi community members and ensure its implementation. The implementation of the IBA will be a continuation of current initiatives, as some of the issues that typically appear in an IBA were integrated into Osisko's approach at the exploration stage. As such, certain existing processes will be optimized within the framework of the IBA.

4.2 OUTREACH AND CONSULTATION PROCESS FOR THE PROJECT

Osisko's process of informing and consulting with the affected First Nations and non-First Nations communities is meant to facilitate the project's integration into the host communities. The company began this process during its first exploration activities in Eeyou Istchee James Bay in 2015.

4.2.1 APPROACH

Osisko has favoured a proactive communication and consultation approach since its arrival in the area. That approach was established by mobilizing affected stakeholders in ways that were adapted to their needs and by presenting them with easy-to-understand information about the project. After that, it gave the stakeholders time to digest the report, discuss it among themselves, and then send their questions and comments to Osisko for response.

This approach has been implemented progressively as the Windfall project develops. It focuses on involving the communities affected by the project and giving them the opportunity for meaningful participation. More specifically, this approach targets the CFNW and the community of Lebel-sur-Quévillon, the communities closest to the project site. Information has also been sent to the Lac Simon (Anishinaabe) and Opitciwan (Atikamekw) First Nations since the spring of 2017, and to the municipalities of Matagami, Chapais, Chibougamau, and Senneterre since early 2016. All of these communities have expressed an interest in learning more about the project.

The main objectives of this communication and consultation approach are as follows:

- Identify and inform relevant stakeholders (provide information on the project, the consultation methodology, and the impact assessment process) with adapted documents in French and English, and by planning to bring in a Cree translator/interpreter if necessary.

- Plan consultation sessions with community actors (outside of hunting or election periods, for example).
- Gather concerns and feedback.
- Document land use and occupation in the study area.
- Identify the potential social and environmental impacts of the Windfall project.
- Communicate the results of the field studies.
- Improve the project and its social acceptability by considering the traditional knowledge (and more broadly, the contribution) of the CFNW as well as that of the community of Lebel-sur-Quévillon in the design and implementation of the project.
- Give stakeholders enough time to review and validate the content of draft and final reports and documents.

Several measures have been put in place to achieve these objectives. For instance, between October 2015 and 2023, more than 275 communication activities were held with previously identified First Nations and non-First Nations local communities. These were conducted primarily by Osisko, while some of the specific consultations for the EIA were conducted jointly by Osisko and WSP. Note that between March 2020 and May 2022, meetings were held over videoconference because of health restrictions related to COVID-19. Since May 2022, they have been held either in-person or over videoconference, at the participants' choice.

These outreach and consultation activities are part of an ongoing process that will continue throughout the development of the project; the permitting process; and the construction, operation, and closure phases of the project.

It should be noted that the document "Consultations conducted by the proponent: Expectations of the Review Committee" was consulted to ensure that Osisko's proposed methods for the Windfall project meet COMEX's expectations regarding consultation.

4.2.2 COMMUNICATION TOOLS

At every opportunity to inform and consult with stakeholders, the community relations team has been developing impactful communication tools tailored to its different audiences. These bilingual communication tools can take the form of flyers, posters, PowerPoint presentations, multimedia content, social media posts, or appearances in traditional media.

For example, in 2018, Osisko created an informative video on the Windfall project in French (shown at the Lebel-sur-Quévillon cinema), English, and Cree to inform the host communities of its progress as well as its ongoing and upcoming activities.

In 2021, the company produced a video on the updated results of the project's preliminary economic study. This video was presented to members and representatives of the CFNW community (available in English and French on Osisko's social media pages and website).

Osisko shares information about its activities and development on its Facebook and LinkedIn pages, in press releases, and on its corporate website. New communication tools will be used in 2023.

4.3 OUTREACH AND CONSULTATION ACTIVITIES DURING THE EXPLORATION PHASE

The following sections describe the results of outreach and consultation activities that took place during the exploration phase of the Windfall project (2015 to present).

4.3.1 FIRST NATIONS COMMUNITY

ACTIVITIES

Since 2015, Osisko has been holding outreach and consultation activities to better understand the values and traditional knowledge of the CFNW, as well as to encourage community members' involvement and support their understanding of where the Windfall project sits in space and time. In 2016, Osisko worked with an anthropologist and held interviews with tallymen from five traplines that may have been affected by the Windfall and regional exploration projects. This land-use work provided a forum to document knowledge and expectations early in the development of the exploration projects. These meetings were also an opportunity to explain the nature of the planned work and listen to concerns and questions.

In recent years, Osisko has completed exploration programs on its Quévillon and Urban Barry projects, as well as an intensive exploration drilling program on the Windfall project. It has also built infrastructure to support the collection of three bulk samples as well as additional work. This was accomplished by keeping the channels of communication open with the CFNW and gaining their support through council resolutions. Osisko communicated with the tallymen (of traplines W24, W24A, W24C, W24D, W25A, W25B, and W26 and lots 16, 17, and 19) in different ways depending on the project and the location of the work.

Table 4-8 describes the main comments, concerns, and requests collected during these activities, as well as the actions Osisko has taken to address them. They are broken down by theme: the impact of exploration activities on hunting, fishing, and forestry; water and fish; access roads; health and safety; economic benefits to the community; and respect for cultural sites and places of significance. The comments received through various permit applications are also compiled below.

CONCERNS

HUNTING, FISHING, AND FORESTRY

As presented in Chapter 11 of this EIA on cumulative impacts, the traditional lands of the Waswanipi community have been affected by the forestry industry since the 1980s and some community members are concerned about the disturbance of the land, the cumulative impacts of activities, and their effects on their own use of the land. Additionally, areas of intact forest are important for tallymen to protect.

During a presentation by Osisko on a regional drilling program in 2019, some tallymen expressed concerns that the noise from the drills would disturb moose and disrupt trapping. Osisko made some adjustments in response, such as changing the timing of exploration work. More specifically, the family of the W25A tallyman indicated that they hunt in the Lac Thubière sector in the spring and fall, so the exploration team made a habit of planning work outside of those seasons for that specific location. Similar accommodations were also made in some areas of trapline W25B during the fall hunting season and during the winter hare-trapping and partridge- and ptarmigan-hunting season. A valued wildlife area south of the Windfall camp was also completely avoided. Before Noront Resources (now Ring of Fire Metals) installed exploration infrastructure, the father of the W25B tallyman used to hunt, trap, and fish near the Windfall site. However, when Osisko arrived, drilling campaigns took place and the exploration ramp was rehabilitated. As a result, the area is no longer used for traditional activities by users of trapline W25B. Instead, they have moved further east-northeast.

Community members expressed concerns about Windfall workers' right to hunt and fish. They were told that workers are not allowed to hunt or fish while on duty at the Windfall site; an internal measure to this effect clearly states that this is the case.

Cree land users also pick berries (such as blueberries) in the area. However, since it is no longer possible to do so near the exploration ramp, they have moved further west, particularly near the burned area. Generally speaking, blueberries are abundant throughout the area. Some other plants are also harvested, such as cedar to make herbal teas.

WATER AND FISH

Many tallymen have concerns about drilling operations, including their impacts on water quality and fish populations. The Osisko team answered their questions by sharing the protocol for drilling holes, which includes maintaining a buffer zone around lakes, rivers, and streams. It should also be noted that drilling companies use a textile to filter water, retain mud, and prevent particulates from reaching the water. Should an oil spill occur, drilling companies have spill kits on site and must follow a strict recovery protocol.

Unnamed Lake 2 was surveyed in 2018, with the W25B tallyman participating. This lake is home to many species of fish and since the survey, the tallyman and his son sometimes fish there. The tallyman's father and other land users used to fish there 10 or 20 years ago, but had abandoned it even before the work near the main ramp began.

The W25B tallyman and his family, as well as members of the CFNW and the Cree Trappers' Association (CTA), visited the water treatment facilities a few times in 2017, 2018, and 2019. The Environment team on-site explained the protocols and procedures. It should be noted that since 2018, Osisko has been operating the effluent treatment unit itself and that its team of four operators includes 50% members from the CFNW, including one of the main users of trapline W25B.

ACCESS ROADS, HEALTH, AND SAFETY

Community members have expressed concerns about the health and safety of workers and neighbours. Some asked if there were procedures in place to deal with a fire. On that note, the W25B tallyman recommended safe trails for workers to use to access remote locations by snowmobile, as he has observed that some streams do not freeze over enough due to currents. The tallymen are also concerned about workers' visibility during their hunting season and have suggested that workers clearly indicate their location by using roadside signs.

Also, various members of the community are concerned that workers and contractors will not obey the speed limits on the roads, which endangers all users and the environment (risk of accidents with wildlife or other vehicles, dust, and spills). In response, Osisko is applying its forest road access procedure and controls the speed limits at the gatehouse or reception area by calculating the start time. Those who speed face disciplinary measures. In the past, brush has also been cleared along access roads to improve visibility. During the peak goose (spring) and moose (fall) hunting seasons, tallymen bring extended family members to their camps and instruct them to avoid busy areas when there is mining or forestry work being done.

ECONOMIC BENEFITS

From the first meeting in 2015, the representatives of the CFNW council informed Osisko that members of the Waswanipi community were interested in working on the Windfall project as drillers or in food services or in other departments. They even referred interested workers. The Band Council sees the project as an opportunity for community members to access jobs and training. In addition, several of the tallymen Osisko met with (or their family members) have skills and experience in the mining and exploration industry. For example, some have experience as machine operators or line cutters. Several tallymen would be interested in working in a future mine. Additionally, some community members are contractors and would like the opportunity to bid on contracts.

In recent years, Osisko has employed First Nations people, particularly from the Waswanipi community, to work at the Windfall site in positions related to core sampling, equipment and building maintenance, water treatment, health and safety, human resources, community relations, administration, and environment. Osisko regularly receives applications from community members. The company also met with representatives from Apatisiiwin Skills Development (formerly Cree Human Resources Development) to learn about their programs and to present the Windfall project and Osisko's future employment and training needs. Training programs have been set up at the Windfall site to train the next generation of miners: Mining Essentials teaches basic skills to First Nations clients while a training site allows students of the Diploma of Vocational Studies (DVS) in mineral extraction from the training centre in Chibougamau to complete their practicums.

In 2022, an average of 87 First Nations people (mainly Cree and more specifically Waswanipi) were working at the Windfall site, making up 23% of the workforce. Between 2017 and 2022, an average of 78 First Nations workers worked on the Windfall site each year. To support their integration, Osisko has hired a community liaison from Waswanipi as well as human resources advisors at the Windfall site. These people facilitate the recruitment and integration of Cree workers on the site.

In addition, Osisko has awarded contracts totalling more than $23 million in 2017, $21 million in 2018, $40 million in 2019, $35 million in 2020, $85 million in 2021, and $62 million in 2022 to First Nations businesses or joint ventures in the diamond drilling, underground work, civil works, janitorial and food services, environment, fuel, and personnel lending industries. When Osisko issues a request for proposals, the procurement team first checks with the relevant local service companies and invites at least one First Nations company when possible.

CULTURAL SITES AND PLACES OF IMPORTANCE

The tallymen indicated the location of some cultural sites, such as current or former camps and burial sites of their family members. These were completely avoided when work was being planned.

Areas of particular value were also identified on land-use maps during specific outreach and consultation activities, and Osisko avoids them as well. In 2020, as part of the alternative study for the development of the tailings storage facility, meetings were held with users to identify areas that are incompatible with the mining infrastructure. In the proposed project footprint, none of the areas identified in these meetings were impacted.

APPLICATIONS FOR BULK SAMPLING AND CONSTRUCTION OF SUPPORT INFRASTRUCTURE

In 2017, Osisko began the process of continuing the bulk sampling that was abandoned by Noront in 2008. The bulk sampling project was discussed with the Waswanipi community beginning in the fall of 2016. At the time Noront shut down, the Windfall site had an exploration ramp, a lined waste rock and ore stockpile, an unlined waste rock stockpile, an overburden stockpile, and a network of collection ditches around the lined stockpile, a sedimentation pond, and a polishing pond. When the bulk sampling project restarted, some infrastructure needed to be upgraded and more needed to be installed, including a bypass road. For health and safety reasons, Osisko wished to divert traffic to prevent vehicles going to the exploration camp and the W25B tallyman's camp from coming close to the ramp area. Three bypass road options were presented to the tallyman, who selected the final route. Ramp dewatering was completed to collect a bulk sample from zone 27 and Caribou in 2018. At a meeting with the W25B tallyman in the fall of 2017, a site visit was arranged to discuss the facilities and infrastructure as well as the potential impacts associated with the bulk sampling of the Lynx and Underdog areas, namely the clearing of the area where the lined stockpile was to be expanded. In April 2017, the Chief of the CFNW and the W25B tallyman sent a letter of support to Osisko for the Lynx and Underdog work, recognizing that the advancement of the exploration ramp provided a unique opportunity to train CFNW workers in sustainable positions during the exploration and operations phases, should the feasibility study prove positive.

Over the years, some tallymen have expressed concern about the quality of the water in the ramp. During site visits and meetings, the water treatment process was explained to the W25B tallyman, the representatives of the Windfall Environmental Monitoring Committee, and other members of the Waswanipi community. Water quality is monitored through periodic sampling that complies with Directive 019. Two operators from the Cree community have been hired to work at the water treatment plant, so they are first-hand witnesses to the community. In addition, a Mistissini company, EnviroCree, was contracted to sample the water in the receiving environment; its sampling ran from the summer of 2019 until 2022.

In the fall of 2019, the plan to file for a bulk sample in Triple Lynx was presented to the W25B tallyman, his family, and Waswanipi community members. Osisko explained the need to expand the lined stockpile to the west to store additional waste rock and to construct a new pond to collect water. For the family of the W25B tallyman, the removal and reuse of rock material from the unlined stockpile to expand the lined stockpile, and the fact that contact water on this material will now be collected and treated, was a positive as it eliminated the environmental liability of the site. However, the family wanted the bypass road east of the lined stockpile to be widened so that vehicles could pass each other when going in opposite directions, as this would maintain safe access to their hunting grounds further to the north. The road was subsequently widened in the summer of 2020. In November 2019, the Chief of the CFNW sent Osisko a letter of support for the work in the Triple Lynx sector, mentioning that the Environmental Monitoring Committee is the tallyman's preferred consultation method and that the community saw the work as an opportunity to continue training workers.

In the fall of 2020, the family of the W25B tallyman and the Waswanipi Mining Coordinator met over videoconference during the regular monthly Windfall Environmental Monitoring Committee meeting. Osisko described the purpose of the new complementary characterization work and explained that no additional surface infrastructure was required to complete it. The family of the W25B tallyman has expressed no concerns regarding this new work request.

The project to file an application for bulk sampling of Caribou and Lynx 4 and develop the related infrastructure was presented to the Environmental Monitoring Committee in the summer of 2021. At that point, the W25B tallyman asked if the quality of Unnamed Lake 2 had been assessed before and after; Osisko was able to answer that baseline data had, in fact, been collected for the lake. The tallyman also spoke about the expansion of the waste rock stockpile, reminding us that the area contains only small trees. The family of the W25B tallyman wanted contractors from the community to be invited to bid on work for the bulk sampling project, and Osisko confirmed that this will be the case. The Caribou and Lynx 4 bulk sampling project and related infrastructure were also presented to the CFNW Band Council, and no specific concerns were raised by the participants. The progress of the project was also presented to the community at the May 2022 general assembly. The community was in favour of the bulk sampling project, which kept jobs and continued training. The Chief of the CFNW sent a letter of support to Osisko in August 2021.

REQUESTS FOR AUTHORIZATION TO OPEN BORROW PITS

The W25B tallyman was given information about the different borrow pit options being considered for the exploration phase on four occasions in 2022. The borrow pits were also discussed with the W25A tallyman on two occasions. Key comments from both families are described below.

The family of the W25B tallyman reported that they used the trapline and logging roads year-round to fish, hunt, and trap. In particular, they use a road leading to one of the potential options for hunting and trapping. As for the family of the W25A tallyman, they pointed out that the access road leading to that option was on its land.

The family of the W25B tallyman asked how much material had been taken from the existing multi-user borrow pit and how much material was needed for Osisko's exploration activities. This information was given to the tallyman. The family of the W25A tallyman was interested in knowing the nature of the material sampled from an option on their trapline. Information on the grading and quantities assessed for this option was provided to the tallyman.

Since not all of the identified sites were needed for the bulk sampling phase, they were considered in the project.

CONTINUED EXPLORATION ACTIVITIES DURING THE FIRST WAVES OF COVID-19

Like the rest of the world, Canada was affected by the spread of a new strain of coronavirus in December 2019. In Quebec, the government ordered the closure of all non-essential businesses and Osisko suspended operations at Windfall on March 23, 2020. During the suspension, Osisko developed triage protocols and other precautionary measures in accordance with guidelines issued by the Institut national de santé pulques du Québec. It also worked closely with the Cree Nation Government (CNG) and the CBHSSJB.

Osisko's departments developed COVID-19 prevention protocols alongside Cree organizations, public health authorities, and its contractors:

- Health and Safety: procedures and compliance with recommendations;
- Operations: site planning, transportation, implementation of measures, and contractor management;
- Environment: to ensure that new disinfectant products would not alter water management systems;
- Human Resources and Community Relations: internal and external communication.

With the permission of the Quebec government, Osisko resumed operations on May 15, 2020, using protocols developed in close collaboration with the Crees. Later that month, in order to protect their people, the CNG and the nine Cree communities enacted a 14-day mandatory self-isolation law for members returning from at-risk areas, including mineral exploration sites in a Cree community. This local law was hard on Cree workers, who had to self-isolate in their communities before resuming their next rotations at Windfall. During their isolation, they were not allowed to have any contact with their loved ones. Since this was severely affecting their quality of life, many of Osisko's Cree workers opted for a temporary layoff. Osisko's COVID-19 management approach allowed First Nations workers to maintain meaningful employment, financial security, and self-sufficiency while staying close to their families.

A monitoring committee was formed with the CFNW and the CNG to monitor the gradual reopening of the Windfall site and compliance with protocols. Numerous negotiations took place in parallel to address the Crees' concerns and ensure the operational capacity of the Windfall site. The joint strategy developed by Osisko and the Crees led to the purchase of a COVID-19 testing laboratory, the hiring of technicians, and the development of a worker testing protocol for the Windfall site. This was Osisko's commitment to prevent the spread of COVID-19 and to ensure the safe return of workers from the nine Cree communities. As a result, the CNG identified Osisko as the first company with which it wanted to negotiate a protocol for exemption from the local self-isolation law.

In mid-June, Osisko held a series of teleconferences with its employees to present the protocol. The lab and technicians arrived at Windfall on July 22, 2020. All workers at the site were tested on July 28, 2020, and found to be virus-free, creating a "baseline" for COVID-19. After some adjustments to the screening process, the CNG and CBHSSJB agreed to the protocol. The Windfall site was granted exemption from the local self-isolation law on August 18, 2020.

Another series of teleconferences with Cree employees was held to explain the conditions of the exemption. Presentations were also made to the public health and safety officials in each Cree community. Even after the local self-isolation law was lifted, Osisko continued the joint monitoring committee it had formed with the Crees until 2022 to ensure transparent and effective communication should a worker test positive. This committee can be quickly reactivated if necessary.

After this successful experience, Osisko wanted others to benefit from the knowledge it had gained. It shared its experience with communities/municipalities, as well as small and large businesses from various industries in the region. The CNG then used Osisko as an example to negotiate with other companies in the region. On August 12, 2020, CNG identified Osisko in a press release as a model for natural resource development during COVID-19:

"I will always be grateful to Osisko for standing with the Cree First Nation of Waswanipi during our time of need. Their help is not a handout but rather an investment in my people so that we can build a strong and sustainable project allowing Cree workers to be proud providers for their families without having to risk their health."
Chief Marcel Happyjack, Cree First Nation of Waswanipi

"Actions like those of Osisko demonstrate that natural resource development doesn't have to be just about taking or extracting but rather contributing to community life and helping to make us all stronger. If all developers in our territory behaved like this, our region and the Cree Nation could be even greater contributors to what will need to be the greatest economic recovery in the history of Quebec."
Grand Chief Dr. Abel Bosum, Cree Nation Government

In December 2020, a few months after the laboratory was set up and the exemption from the local self-isolation law was obtained, Osisko met with the main First Nations joint ventures working on the Windfall project to provide an update on the year. They all emphasized the competitive advantage of the Windfall laboratory during the pandemic. The peace of mind offered by the lab's testing, in conjunction with the many other safety protocols related to COVID-19, helped to recruit both First Nations and non-First Nations employees; when two contract options were available, they consistently chose Windfall.

Osisko's initiative and cooperation with the Crees in managing the health crisis were recognized at the 2021 Mercuriades gala organized by the Fédération des chambres du commerce du Québec. Osisko won the award in the Desjardins Sustainable Development Strategy category.

EXAMPLES OF ACCOMMODATIONS FOR LAND USERS DURING EXPLORATION

During the exploration period, Osisko made certain accommodations and provided certain services to maintain good relations with land users, lessen the negative effects on their quality of life, and help maintain traditional activities:

- snow removal for hunting and camp roads;
- financial support for the installation of Internet access at the W25B tallyman's camp to facilitate communication;
- donations of fuel to allow traditional activities to continue;
- donations of food after the temporary closure of the camp;
- donations of wood and tents when a former exploration camp was purchased;
- helicopter flights to visualize the work on the traplines;
- contributions to the community fund to allow traditional activities to continue;
- access to a housing unit during the moose hunting season (before the COVID-19 pandemic);
- access to meals at the Windfall exploration camp cafeteria (suspended since March 2020 due to COVID-19 health measures).

OTHER FIRST NATIONS COMMUNITIES

Two other First Nations communities have expressed an interest in the project: the Anishinaabe community of Lac Simon and the Atikamekw community of Opitciwan. The Opitciwan Atikamekw First Nation (whose claimed ancestral homeland is called Nitaskinan and encompasses the Gouin Reservoir) is approximately 70 km southeast of the site as the crow flies. The Lac Simon Algonquin Anishinaabe First Nation is approximately 170 km west-southwest of the site as the crow flies. Osisko has met with the Atikamekw community of Opitciwan seven times since 2017 and the Chief and council visited the Windfall project (above- and underground) in July 2019. The company has met with the council of the Lac Simon Anishinaabe Nation nine times since 2017. In both cases, information on the Windfall project and Osisko's other regional exploration projects was presented. Osisko will continue to provide updates on the Windfall project when requested by these communities.

4.3.2 NON-FIRST NATIONS COMMUNITY

Since 2015, Osisko has also been holding outreach and consultation activities in the non-First Nations community to identify the concerns of land users and communities, with the goal of helping them understand the Windfall and regional exploration projects. More specifically, this process made it possible to document the knowledge, concerns, and expectations of the James Bay communities (Lebel-sur-Quévillon, Chibougamau, Chapais, and Matagami) from the beginning of the project. The following sections describe the results of outreach and consultation activities that took place during the exploration phase (2015 to present).

COMMUNITY OF LEBEL-SUR-QUÉVILLON

Since 2016, Osisko has met with community representatives and members on several occasions to discuss the Windfall and regional exploration projects. Among others, these meetings have involved sharing information about exploration activities, jobs, business opportunities, results, and studies. Lebel-sur-Quévillon is the closest non-First Nations community to the Windfall project, and Osisko established a core library and regional office there in 2017. These served as a home base for the Quévillon exploration project and allowed excess cores from the Windfall site to be sampled.

Osisko signed a Collaboration Agreement with the Town of Lebel-sur-Quévillon in 2017. The Agreement is intended to ensure transparent and effective communication with the town council, promote the social acceptability of the project, and maximize the socio-economic benefits for the town, all in a spirit of partnership. In August 2021, the Town of Lebel-sur-Quévillon passed a resolution confirming its support for the Windfall project.

> *"The Collaboration Agreement Osisko Mining and Lebel-sur-Quévillon signed in 2017 has allowed us to build a solid relationship. We see the positive impacts of the Windfall project and are excited to continue our partnership to maximize the benefits for our citizens and contractors."*
>
> *Alain Poirier, Mayor of Lebel-sur-Quévillon, press release dated August 12, 2021 [translated from French].*

Residents have expressed a desire to collaborate with Osisko to maximize the socio-economic benefits of its project. Elected officials, citizens, and contractors are primarily concerned about communication between Osisko and the population of Lebel-sur-Quévillon; the communication of Osisko's orientations; and the ability to stay informed about the project.

In addition to the Collaboration Committee meetings and meetings with town representatives, Osisko has participated in public events organized by or with the town:

— Mining Week in April 2016, which included meetings with contractors, a public presentation at the local theatre, and an information booth;

— Mining Week in May 2017, which included meetings with contractors, a public presentation at the local theatre, and an information booth;

— mayor's visit to the Windfall site in August 2017;

- open house in Lebel-sur-Quévillon in October 2017;
- open house in Lebel-sur-Quévillon in February 2018;
- Mining Week in May 2018, which included meetings with contractors, a public presentation at the local theatre, and an information booth;
- presentation at the Community Futures Development Corporation (CFDC) annual meeting in September 2019;
- presentation to the town council in June 2022;
- public information sessions in September 2022 that included a meeting with contractors and a public presentation at the community centre;
- a visit by town officials to the Windfall site in September 2022;
- Business Exchange Day, organized by the Société du Plan Nord in November 2022, which included a public presentation at the local theatre and planned business meetings.

During these events, elected officials and citizens brought up the need for new and ongoing training in Lebel-sur-Quévillon to meet Osisko's labour needs. This topic was addressed by members of the Collaboration Committee from its formation in 2017 and reiterated several times throughout the following years, including during the September 2022 public session. Osisko indicated that opportunities would be evaluated to address these requests. The same is true for maximizing local purchasing in order to encourage the consolidation, creation, and/or establishment of businesses in Lebel-sur-Quévillon, as well as the settlement of workers and families. Citizens and elected officials have raised the fact that the town needs new residents for it to maintain certain services (such as schools and daycares) and to contribute to its revenues. The town council has also indicated that it is working on a housing plan and an expansion of its industrial park. Residents and the town council are interested in the measures that Osisko could put in place to encourage people and businesses to come to Lebel-sur-Quévillon. As an example, in 2017, Osisko encouraged one of its suppliers, an analytical laboratory, to move to town. Osisko is willing to encourage such initiatives when it is beneficial to both parties.

Local contractors have also expressed their desire to share an updated list of suppliers with Osisko; this would give them the opportunity to provide their services during the exploration phase and prepare for the upcoming construction, operation, and rehabilitation phases.

Osisko's Responsible Procurement Policy, which ensures that local businesses are supported, was presented to the town council. Additionally, Lebel-sur-Quévillon businesses are invited to bid when they are able to provide a service. Osisko provided the Collaboration Committee with a list of the 25 companies from which it had purchased the most goods and services during the exploration phase of the Windfall project, as well as the list of contractors used with an address in Lebel-sur-Quévillon. Osisko has also hired a buyer from Lebel-sur-Quévillon who is very familiar with local suppliers. Citizens and members of the Collaboration Committee suggested holding outreach events with local contractors. To that end, Osisko organized an event with contractors in Lebel-sur-Quévillon on September 15, 2022, and participated in the Business Exchange Day, organized as part of the Plan Nord, in the town on November 9, 2022. Discussions are underway with the Société du Plan Nord to organize additional networking meetings with local businesses next spring.

The Local Hiring Policy was also shared with the Collaboration Committee. Although it was too early in the exploration phase to develop incentives, Osisko has been open to evaluating this possibility and has made efforts to recruit locally during the exploration phase. For instance, when the CIBC closed in 2017, Osisko recruited one of its former employees to work in the Finance Department, allowing them to telecommute from Lebel-sur-Quévillon. At the same time, statistics on labour needs were regularly sent to the Collaboration Committee.

Although Osisko has not generated any revenue to date, the company has supported various local initiatives, events, and organizations through its donation and sponsorship program. It helped renovate the old municipal garage to house the core library, contributed to the town's 2021 and 2022 participatory budgets to carry out projects designed and voted on by citizens, and contributed to the cost of developing the municipal campground, to name but a few. As with the statistics on labour needs, Osisko regularly provided the Collaboration Committee with information on the local organizations and initiatives it had supported.

Maintenance of the municipal airport is a financial concern for the town. Osisko is a user-payer there.

Some residents were interested in the fact that hauling on forest roads is expected to decrease as the process plant is now planned to be built at the Windfall site, meaning that ore will not be hauled to Lebel-sur-Quévillon. One citizen even pointed out that the fact that heavy trucks will not be on the roads is a positive change to the project.

OTHER JAMES BAY COMMUNITIES

Since 2017, Osisko has met with representatives of James Bay communities and presented the Windfall project at conferences, such as the business exchange days organized by the Société du Plan Nord (Chibougamau in 2017, Chapais in 2018, and Lebel-sur-Quévillon in 2022; all three communities participated in a virtual presentation in 2021).

The citizens of Chapais, Chibougamau, and Matagami believe that they could benefit from the economic spin-offs of the project, either in terms of jobs or business opportunities for local contractors. Like Lebel-sur-Quévillon, these towns are struggling to bring in new families and workers.

After the closure of the Matagami mine, representatives of the Town of Matagami informed Osisko of their interest in offering services and creating synergies for the region's economy. They also mentioned that several workers have found employment with another mining company after the Matagami mine closure, and that others are searching and could work in the underground ramp at the Windfall project. The latter are already in contact with Osisko's Human Resources Department for future recruitment initiatives.

LAC BERTHELOT FISHING LODGE (OUTFITTER WITHOUT EXCLUSIVE RIGHTS)

The Lac Berthelot Fishing Lodge, an outfitter without exclusive rights, owns four camps in the Eeyou Istchee James Bay region that are located near the Windfall and regional exploration projects. Osisko first met with the owner in 2018. He stated that the combination of forestry and mining work threatens the tranquility and wilderness experience he wants to offer his clients, and that tourists are concerned about the visual and auditory ambience of the area as well as restricted access to good fishing and hunting areas. He also mentioned that easy road access is hurting his business by increasing traffic in remote areas. He brings his clients to their camps by seaplane, and he needs a certain number of flights to be profitable. Osisko informs the owner when it plans exploration work near his camps, including the time and nature of the work and whether a helicopter will be used.

VACATION LEASEHOLDERS

Osisko acquired the cottage lease in the vicinity of the Windfall mining camp, as the leaseholder felt his experience was no longer satisfactory due to exploration activities.

In addition, the company met with the holders of the cottage lease on the west shore of Unnamed Lake 1 for the first time in the fall of 2017. During a series of meetings and discussions, Osisko learned that they use the area around three times a year for hunting, fishing, blueberry picking, and ATV riding. They have changed their habits because of the exploration work on the Windfall project. They have a stand near Unnamed Lake 10, but they no longer hunt in the area because moose are scarce. Users spend about a day fishing when they go to their camp. They fish for pike and walleye in Unnamed Lake 10 and pike in Unnamed Lake 1. They used to fish for walleye in Unnamed Lake 2, but with the noise caused by exploration work and the ramp infrastructure, they moved to Barry Lake and the southern Macho River instead. They plan to explore other lakes in the future.

EXAMPLES OF SERVICES FOR LAND USERS DURING THE EXPLORATION PERIOD

During the exploration phase, Osisko offered certain services to maintain good relations with non-First Nations land users:

- digging a pit for sanitary facilities;
- levelling;
- donating drinking water;
- giving permission to dispose of their household waste in Osisko’s dumpsters;
- passing on emergency messages from family in town;
- paying the costs of a cottage lease;
- acquiring a cottage lease.

4.4 OUTREACH AND CONSULTATION ACTIVITIES FOR THE EIA

4.4.1 STAKEHOLDERS IDENTIFICATION AND MEETINGS

One of the first steps in planning the outreach and consultation activities, specifically within the framework of the EIA, was to identify the stakeholders that could be affected by the Windfall project. The first draft was established by compiling a list of key players from processes Osisko began in 2016. The consulting team then used a “snowball” sampling method, a non-probability sampling method that starts with a small group of individuals, then expands it by asking the initial participants to identify others who should participate in the study. This allowed the list to grow throughout the consultation process. Where the scope of the project included the Lebel-sur-Quévillon process plant, consultation activities held in 2018 as part of the EIA covered the stakeholders in the corridor from Lebel-sur-Quévillon to the Windfall site.

Following significant changes to the project, Osisko and its consultant jointly held new interviews in October 2022. These meetings presented the new preliminary layout of the proposed infrastructure to the land users and the First Nations and non-First Nations socio-economic stakeholders. It also re-evaluated the anticipated impacts while determining whether previously expressed concerns had changed.

The consultation process during each interview has also improved over time. At the start of each meeting, the Director, Community Relations & ESG (sometimes supported by the WSP team) explained the objectives of the EIA consultation process to participants. All interviews were accompanied by a presentation of the preliminary layout of the proposed infrastructure as an introduction.

Various methods of communication (phone, email, and a mailout for the public event in Lebel-sur-Quévillon) were used to contact the stakeholders and organizations that had been considered for the communication and consultation process. Also note that in order to invite public land leaseholders to participate in interviews, over 100 letters were mailed in 2018 and 2022. The mailed invitation was accompanied by a backgrounder outlining the project and a map showing the preliminary layout of the proposed infrastructure. Generally speaking, the semi-structured interviews used the project information sheet, interview grids (tailored to each stakeholder and based on different themes), and PowerPoint presentations.

4.4.2 FIRST NATIONS COMMUNITY

Because the Windfall project claims intersect with traplines W25B and W25A, several meetings with the tallymen and primary users of these traplines were held between 2016 and 2023. The main objective was to document current land use in the project area (main users and camps, current land and resource uses, resource status, areas of particular value, accessibility and traditional travel routes, etc.), the anticipated use of the trapline, as well as the anticipated primary and cumulative impacts that may result from the project. These meetings were also intended to gather concerns, comments, and suggestions for improvement and develop measures to mitigate the anticipated negative impacts. It should be noted that generally speaking, the W25B tallyman has been consulted more often as the mine site, including the existing and planned infrastructure, is located entirely on this territory. It should also be noted that Osisko has been in regular contact with the CFNW and the (Eeyou Istchee) Grand Council of the Crees/CNG since the beginning of its activities in the area.

Osisko and its consultant also led semi-structured interviews with the tallymen of traplines W24C, W24D, W25A, and W25B and lots 16, 17, and 19, as well as other land users, in July 2018, when the project was intending to build the process plant in Lebel-sur-Quévillon. Many members of the Cree community were also interviewed, including representatives from various departments of the Band Council, the CBHSSJB, the Cree School Board, the Cree Trappers' Association, local contractors, and women's, elders', and youth groups.

In addition, open house events were held in the fall of 2017 and winter of 2018 in Waswanipi and Lebel-sur-Quévillon and at the Windfall site; they sought to inform the local population about the project description and variants, answer questions, and document the concerns raised to identify mitigation measures and support coexistence on the land.

The 2022 consultation activities also engaged other stakeholders in the project's host community. Osisko turned to the new Chief (elected in late summer 2022) and the Waswanipi community Band Council to identify the stakeholder groups to be consulted, other than the main land users. Beyond the tallymen who will be directly affected, the Band Council identified local contractors; the Cree Trappers' Association; and actors in the workforce education, training, and integration field as stakeholders to be consulted. Osisko and its consultant also agreed to consult with the Waswanipi Women's Association to improve representation of the host community.

The most recent interviews with stakeholders in the Waswanipi community have provided a more up-to-date picture of the host communities and allowed the social acceptability of the project to be gauged once again. These interviews are listed in Table 4-4 below.

It should be noted that Osisko's Community Liaison Officer and the CFNW Mining Coordinator attended all consultation activities with First Nations stakeholders. To ensure that the information gathered during these interviews was accurate and representative of the discussions, a follow-up, feedback, and approval mechanism (up to three discussions) was put in place with the interviewees. The Community Liaison Officer or the Mining Coordinator sent every detailed report, including a summary table of highlights, to the affected individuals for their review and requested consent for Osisko and its consultant to incorporate the information into this EIA. The Community Liaison Officer also phoned the affected tallymen and local contractors to ask them to review the report that had been emailed to them, and printed a copy of the minutes to hand-deliver them to the community's stakeholders. No changes or corrections were requested.

In January 2023, Osisko created another opportunity for stakeholders to have their say on the project. An open house was organized by the company and its consultant at the Waswanipi community and recreation centre to:

- re-present the key information and highlights of the gold project following the filing of the feasibility study (location, schedule, infrastructure under study, project phases, study areas, mock-ups, etc.);
- outline the EIA process and the components that the consultant will be considering in the study;
- explain the methodology for assessing the residual impacts of these components after mitigation measures have been applied;
- disclose the preliminary assessment of the significance of residual impacts;
- collect feedback, concerns, and questions about the EIA process and the project as a whole.

Fifteen posters (24" x 36") were on display for viewing throughout the event and project members were available to answer questions and listen to feedback from the public, either verbally or via a form. Osisko's consultant then documented the questions, concerns, requests, and suggestions. A participant's notebook, containing the feedback form and the content of all the posters, was systematically handed out to each participant to allow them to share their thoughts privately. Maps and additional content on some key components were available on tables. A traditional meal was served to encourage the public to attend, and it created a friendly atmosphere conducive to discussion. The attendance record showed that 61 people participated in part or all of the event, which was held in English and Cree. A designated community member provided simultaneous interpretation of the Osisko presentation and the subsequent question and answer period. The invitation to attend the open house, as well as the presentation and posters presented at the open house, are available in Appendix 4-1.

Table 4-4 First Nations stakeholders met since September 2022

Stakeholder	Role	Date and duration	Meeting place or means of communication	Purpose
Mr. Marshall Icebound and Ms. Judy Trapper (wife)	W25B tallyman and main users	2022-09-14 (1:15)	Windfall	Access to the Windfall site and introduction of the preliminary layout of the proposed infrastructure
		2022-09-29 (1:00)	Collaborative platform (Teams)	Feedback on the preliminary layout of the proposed infrastructure (as part of the Environmental Monitoring Committee)
		2022-10-24 (1:37)	Waswanipi Band Council	Presentation of the preliminary layout of the proposed infrastructure and consultation on land use
		2023-01-25 (1:30)	Collaborative platform (Teams)	Validation of Map 8-2 Local Study Area for the Social Environment – Land Use (as part of the Environmental Monitoring Committee)
		2023-02-01 (0:45)	Windfall	Feedback on the open house in Waswanipi
Mr. Gary Cooper	W25A tallyman	2022-10-26 (0:37)	Waswanipi Band Council	Presentation of the preliminary layout of the proposed infrastructure and consultation on land use
		2023-02-06 (0:20)	Collaborative platform (Teams)	Validation of Map 8-2 Local Study Area for the Social Environment – Land Use
Mr. Harry Grant Mr. Roger Grant Ms. Eliane Grant	W25B main users	2022-10-26 (1:27)	Waswanipi Band Council	Presentation of the preliminary layout of the proposed infrastructure and consultation on land use
		2023-01-30 (1:00)	Open house at the Waswanipi community and recreation centre	Validation of Map 8-2 Local Study Area for the Social Environment – Land Use and discussion about cumulative impacts on moose
Chief Irene Neeposh Ms. Rhonda Oblin-Cooper	Chief and Deputy Chief of the Waswanipi Band Council	2022-09-29 (1:00)	Phone	Request for community consultation
		2022-10-26 (0:49)	Waswanipi Band Council	Introduction of the preliminary layout of the proposed infrastructure and consideration of questions and comments
		2022-11-10 (3:00)	Waswanipi Band Council	Official presentation of the project to the Chief and Deputy Chief and consideration of questions and comments
		2023-02-02 (1:00)	Waswanipi Band Council	Follow-up on the consultation with community members, feedback on the preliminary layout of the infrastructure proposed in the feasibility study, and consideration of questions and comments

Stakeholder	Role	Date and duration	Meeting place or means of communication	Purpose
Chief Irene Neeposh Ms. Rhonda Oblin-Cooper (Deputy Chief) Mr. Paul Gull (Councillor) Mr. Don Saganash Sr. (Councillor) Mr. Michael Neeposh (Councillor) Ms. Naomi Awashish (Acting Executive Director) Mr. Steven Blacksmith (Director of Natural Resources) Mr. Joshua Blacksmith (Mining Coordinator) Ms. Patricia Wapachee (Executive Corporate Secretary) Ms. Serena Snowboy (Secretary of Natural Resources) Ms. Laurie Neeposh (Finance) Mr. Kenny Cheechoo (Advisor) Mr. Kevin Roussel (Lawyer)	Band Council and administration	2022-12-01 (2:00)	Montreal	Presentation of the project and consideration of questions and comments
Mr. Gary Cooper (Cooper/Gilbert) Mr. Josiah Cooper (Cooper Apiitsiiwin) Mr. Mason Cooper (Cooper/Gilbert) Mr. Jimmy Cooper (JCLS) Mr. Charles Katapatuk (Eeyou Eenou Cabinets/Katapatuk Renos) Mr. Ian Oblin (Waswanipi Eenouch Construction) Mr. Marshall Icebound, W25B tallyman (G4 Drilling) Ms. Judy Trapper (Cuisine V.B.)	Local contractors	2022-10-25 (2:15)	Waswanipi community centre	Focus group – Presentation of the preliminary layout of the proposed infrastructure and consultation on the economic component
Ms. Judith Michel	Local high school principal and Cree School Board	2022-10-25 (1:24)	Waswanipi Band Council	Presentation of the preliminary layout of the proposed infrastructure and consultation on workforce training and integration
Mr. Réjean Gascon	Sabtuan Regional Vocational Training Centre	2022-10-25 (1:24)	Waswanipi Band Council	Presentation of the preliminary layout of the proposed infrastructure and consultation on workforce training and integration
Ms. Shannon Isik	Employment Advisor, Apitissiwin Skills Development	2022-10-25 (0:50)	Waswanipi Band Council	Presentation of the preliminary layout of the proposed infrastructure and consultation on workforce training and integration
Mr. Johnny Awashish Mr. Willis Rogers	Cree Trappers Association (CTA)	2022-10-26 (1:18)	Waswanipi Band Council	Presentation of the preliminary layout of the proposed infrastructure and consultation on land use

Stakeholder	Role	Date and duration	Meeting place or means of communication	Purpose
Mr. John Kitchen	President and CEO of Miyuukaa Corporation	2022-11-08 (0:37)	Collaborative platform (Teams)	Presentation of the preliminary layout of the proposed infrastructure and consultation on the economic component
Mr. Tony Gull Mr. Chris Cooper Mr. Bruno Pereira	Mishtuk Corporation	2022-10-27 (0:50)	Collaborative platform (Teams)	Presentation of the preliminary layout of the proposed infrastructure and consultation on the economic component
Ms. Gloria Jolly	Waswanipi Women's Association	2022-12-14 (1:20)	Collaborative platform (Teams)	Presentation of the preliminary layout of the proposed infrastructure and consultation on the social component
61 people from the community (many of whom were elders)		2023-01-30 (6:00)	Open house at the Waswanipi community and recreation centre	Presentation of key project information, the EIA process, the methodology used to assess residual impacts, and the preliminary assessment of impact significance

Photo 4-1 Focus group with local contractors – October 25, 2022 – Waswanipi

Photo 4-2 Open House – January 30, 2023 – Waswanipi

4.4.3 NON-FIRST NATIONS COMMUNITY

As previously indicated in section 4.4.2, Osisko has held outreach and consultation events with the local communities of Matagami, Chapais, Chibougamau, and Senneterre over the past seven years, in addition to collaborating regularly with the town of Lebel-sur-Quévillon, the closest non-First Nations community to the project.

In addition to the numerous outreach events held since 2016, several consultation meetings were held in local communities. This included focus groups and formal interviews in 2018 and 2022 with public land leaseholders, local officials, and community stakeholders.

In 2018, Osisko and its consultant led nearly 40 telephone interviews with leaseholders along the Windfall access road. In addition, various representatives of socio-economic organizations such as the Centre de Santé Lebel, Villes et Villages en santé, Centre de femmes Îlot d'Espoir, Maison des Jeunes, as well as the Table régionale des organismes communautaires, participated in the consultation process in spring 2018. It is important to note that the health situation was different in 2018; it allowed for many more consultations to be held through focus groups and in-person events.

Osisko also organizes consultation activities with local educational institutions. For example, the students of the Attestation of College Studies (ACS) in mineral resources geology from the college in Chibougamau were able to familiarize themselves with exploration work during a career day aimed at introducing them to the work environment and the company.

Another two outreach events were held in September 2022 to update the citizens and economic stakeholders of Lebel-sur-Quévillon on the Windfall project. After these events, Osisko invited the town council to visit the current site and learn about the proposed infrastructure.

Open houses were held on January 31, 2023, in Lebel-sur-Quévillon for the public and from February 1st to 3rd at the Windfall site and over Teams for current employees. The event was held again on February 22nd and 23rd for the second rotation of employees at the site. These activities confirmed some public feedback and answered other questions. Fifteen posters (24" x 36") were on display for viewing throughout the event (photos 4-3 and 4-4) and project members were available to answer questions and listen to feedback from the public. Osisko's consultant then documented the questions, concerns, requests, and suggestions. A participant's notebook, containing the feedback form and the content of all the posters, was systematically handed out to each participant to allow them to share their thoughts privately. Maps and additional content on some key components were available on tables. A meal was served to encourage the public to attend. This fostered a friendly atmosphere conducive to discussion. The attendance record showed that 50 people participated in part or all of the Lebel-sur-Quévillon event, including several service providers and James Bay job seekers. The feedback was overwhelmingly supportive of the project, as evidenced by the comment forms and verbal comments from participants.

As for the current Windfall employees, their questions were mostly about the restoration phase of the mine. They also asked some questions about the ore processing.

The 2022 and 2023 interviews are listed in Table 4-5 below. It should also be noted that other local organizations have been invited to meet, but have not responded so far. These include Carrefour Jeunesse-Emploi de la Jamésie, Attraction Nord, the Club de quad de Quévillon, and the Table régionale des organismes communautaires du Nord-du-Québec.

Photo 4-3 Posters on EIA themes during the open house – January 31, 2023 – Lebel-sur-Quévillon

Photo 4-4 Public presentation at the open house – January 31, 2023 – Lebel-sur-Quévillon

Table 4-5 Non-First Nations stakeholders met since October 2022

Stakeholder	Role	Date and duration	Meeting place or means of communication	Purpose
Mr. Guy Lafrenière, Mayor Ms. Anik Racicot, Director General Mr. Michael Sandapen, Acting Director, Economic Development	Town of Lebel-sur-Quévillon	2022-10-20 (2:00)	Collaborative platform (Teams)	Presentation of the preliminary layout of the proposed infrastructure and collection of questions, concerns, and suggestions
		2023-02-01 (1:30)	Lebel-sur-Quévillon	Follow-up on the consultation with community members, feedback on the preliminary layout of the infrastructure proposed in the feasibility study, and consideration of questions and comments on the preliminary residual impact assessment for the EIA (as part of the Collaboration Committee)
Ms. Sonia Caron, Director of Services and the Centre	Centre de services scolaire de la Baie-James (CSSBJ) – Vocational Training Centre	2022-10-27 (1:30)	Collaborative platform (Teams)	Presentation of the preliminary layout of the proposed infrastructure and collection of questions, concerns, and suggestions
Ms. Marie-Claude Labbé, Community Organizer	Villes et Villages en santé/Centre de santé Lebel	2022-10-27 (1:30)	Collaborative platform (Teams)	Presentation of the preliminary layout of the proposed infrastructure and collection of questions, concerns, and suggestions
Ms. Isabelle Lessard, Mayor Ms. Stéphanie Houde, Strategic Development Assistant and Project Manager Ms. Geneviève Gleeton, Development Officer Ms. Mélanie Gagné, Director General Mr. Simon Blanchet, Foreman, Public Works and Technical Service	Town of Chapais and Corporation de développement économique de Chapais (CDEC)	2022-10-31 (1:30)	Collaborative platform (Teams)	Presentation of the preliminary layout of the proposed infrastructure and collection of questions, concerns, and suggestions
Ms. Julie Pelletier, Assistant to the CEO, Media Relations, Communications, and Legal Affairs Ms. Manon Laporte, Assistant Director of Public Health	Centre régional de santé et de services sociaux de la Baie-James	2022-11-07 (1:30)	Collaborative platform (Teams)	Presentation of the preliminary layout of the proposed infrastructure and collection of questions, concerns, and suggestions
Ms. Stéphanie Fortin, Educational Consultant Ms. Laurence Huss, Teacher	Centre d'études collégiales à Chibougamau Service aux entreprises et aux collectivités	2022-11-07 (1:30)	Collaborative platform (Teams)	Presentation of the preliminary layout of the proposed infrastructure and collection of questions, concerns, and suggestions

Stakeholder	Role	Date and duration	Meeting place or means of communication	Purpose
Mr. Joël Tardif Mr. Dominic Tardif	Leaseholder (Tardif family)	2022-11-11 (1:30)	Collaborative platform (Teams)	Presentation of the preliminary layout of the proposed infrastructure and collection of questions, concerns, and suggestions
		2022-11-23 (1:30)	Quebec City, in person	Follow-up on the 2022-11-23 meeting
		2023-02-10 (1:00)	Collaborative platform (Teams)	Validation of Map 8-2 Local Study Area for the Social Environment – Land Use Presentation of key project information, the EIA process, the methodology used to assess residual impacts, and the preliminary assessment of impact significance
Mr. Pascal Rivard	Leaseholder (Rivard family)	2022-11-21 (1:30)	Collaborative platform (Teams)	Presentation of the preliminary layout of the proposed infrastructure and collection of questions, concerns, and suggestions
Mr. Gary Koch	Leaseholder (Koch family)	2022-11-16 (1:08)	Phone	Presentation of the preliminary layout of the proposed infrastructure and collection of questions, concerns, and suggestions
Ms. Annie Potvin, General Director	Community Futures Development Corporation (CFDC) Chibougamau-Chapais	2022-11-21 (1:30)	Collaborative platform (Teams)	Presentation of the preliminary layout of the proposed infrastructure and collection of questions, concerns, and suggestions
Ms. Nichèle Compartino, President	Développement Chibougamau	2022-11-25 (2:00)	Collaborative platform (Teams)	Presentation of the preliminary layout of the proposed infrastructure and collection of questions, concerns, and suggestions
Ms. Louise Racine, President	Comité Lebel Environnement	2022-11-30 (1:30)	Collaborative platform (Teams)	Presentation of the preliminary layout of the proposed infrastructure and collection of questions, concerns, and suggestions
Ms. Shirley Izidore, Director (Acting) Ms. Jacynthe Barette, President	Agora Boréale – intercultural association	2022-12-12 (1:30)	Collaborative platform (Teams)	Presentation of the preliminary layout of the proposed infrastructure and collection of questions, concerns, and suggestions
50 people from the community		2023-01-31 (6:00)	Open house at the Lebel-sur-Quévillon community centre	Presentation of key project information, the EIA process, the methodology used to assess residual impacts, and the preliminary assessment of impact significance

Stakeholder	Role	Date and duration	Meeting place or means of communication	Purpose
Current employees and workers at the Windfall site		2023-02-01/02	Open house in the conference room at the Windfall exploration camp	Presentation of key project information, the EIA process, the methodology used to assess residual impacts, and the preliminary assessment of impact significance
Employees who were telecommuting or off-site during the open house events at Windfall		2023-02-03	Webinars Collaborative platform (Teams)	Presentation of key project information, the EIA process, the methodology used to assess residual impacts, and the preliminary assessment of impact significance
Current employees and workers at the Windfall site		2023-02-22/23	Open house in the conference room at the Windfall exploration camp	Presentation of key project information, the EIA process, the methodology used to assess residual impacts, and the preliminary assessment of impact significance

4.5 STAKEHOLDER FEEDBACK, CONCERNS, AND SUGGESTIONS

4.5.1 FIRST NATIONS COMMUNITY

The main reactions and concerns, as well as the suggestions raised during the 2018 and 2023 First Nations community consultations, have been collated in Table 4-6. They are classified by element of interest for the First Nations community, namely: First Nations interests and treaty territory; population, economy, and employment; quality of life and well-being; traditional use of the land; heritage and archaeology; and landscape. The colours in Table 4-6 are explained in the legend below the table and indicate the number of times the issue was raised by respondents.

Table 4-6 First Nations community consultations in 2018, 2022, and 2023: Stakeholder reactions, concerns, requests, and suggestions

Element of interest	Reaction/concern	Waswanipi stakeholder	Stakeholder suggestions
First Nations interests and treaty territory	Questioning the impact assessment methodology, i.e., how the elements were selected and whether the study looks at the big picture or just the individual components.	Elder	No suggestions.
Population, economy, and employment	Local contractors want to know about future needs and opportunities so they can prepare and mobilize their human and material resources.	Local contractors	Hold regular information sessions with local contractors from Cree communities, giving priority to those from Waswanipi.
	Questions about the lifespan of the mine.	Various community members	No suggestions.
	Concern raised about the fairness of the subcontracting process. The group mentioned that Miyuukaa Corporation is currently favoured over others.	Local contractors	Hold joint information sessions with local contractors and the Band Council. Work closely with the Waswanipi chamber of commerce (currently being formed).
	Local contractors want to develop their knowledge and expertise in the mining industry.	Local contractors	Hold regular information sessions and working groups with local contractors from Cree communities.
	Some stakeholders would like Osisko to prioritize hiring Waswanipi workers over those from the neighbouring Cree communities of Oujé-Bougoumou and Mistissini, in particular.	Local contractors and community leaders	No suggestions.
	Concern about racism, discrimination, and language barriers in a diverse and inclusive workplace.	Education actors and local contractors	Implement a strict policy on racism, diversity, and inclusion. Offer language courses to Cree employees who wish to learn or improve their French. Have local contractors build a cultural site where Cree workers can gather and practice and share their culture (traditional cooking, oral traditions, crafts, etc.).
	Concern about a potential labour shortage problem for the Waswanipi community.	Education and training actors	No suggestions.
	Concern about a potential issue with integrating and retaining Cree workers.	Education and training actors	Offer career development opportunities to First Nations workers.

Element of interest	Reaction/concern	Waswanipi stakeholder	Stakeholder suggestions
	Concern about the extent of community benefits (business opportunities, meaningful employability of the workforce, career growth and development, promotion based on seniority, relevant and transferable training including financial literacy).	Community leaders	Inclusion of First Nations in all areas of the project.
	Concern about the attractiveness of economic benefits at the expense of Cree culture and the traditional way of life.	CFNW Mining Coordinator and a local contractor	Educate young people about all aspects of the mining industry in order to ensure that they are informed and objective.
Quality of life and well-being	Concern raised about the life and durability of the tailings storage facility's protective geomembrane.	Main users of trapline W25B	Provide photos and additional information on the dry tailings storage facilities ahead of the Eleonore mine site visit (planned for the spring of 2023).
	Concern about potential deterioration of air quality due to discharges from the process plant.	Main users of trapline W25B and community leader	Provide an emergency kit, including masks, to tallymen and their family members.
	Concern about safety on access roads, specifically related to speed and increased traffic.	Local contractors	Implement a driving speed policy.
	Request: Some respondents requested accommodations for employees who wish to return to school.	Education actors and local contractors	Implement a work-study balance program.
	Concern about lowered quality of life due to nuisances such as noise, dust, and light pollution.	Main users of traplines W25B and W25A and Cree Trappers Association (CTA)	No suggestions.
	Concern about the degradation of wildlife habitats due to nuisances such as noise, dust, and light pollution.	Main users of traplines W25B and W25A and Cree Trappers Association (CTA)	No suggestions.
	Concern about the psychosocial impact of rotating work schedules (e.g., absence from home, impact on lack of parental support for children).	Education and training actors and community leader	Implement a work-study balance program. Provide childcare to give the parent at home a break.
	Concern for the health and safety of women working at the Windfall site.	Community leader	Offer support to female workers.
	Light pollution from the surface infrastructure at the current site can be seen from the First Nations camp, raising concerns about light pollution from the proposed infrastructure.	Main users of trapline W25B	No suggestions.

Element of interest	Reaction/concern	Waswanipi stakeholder	Stakeholder suggestions
Traditional land use	Concern about potential contamination of water in surrounding lakes and streams, primarily Unnamed Lake 2.	Main users of trapline W25B and community members	No suggestions.
	Concern about the potential for contaminated water to spill into the environment during heavy rainfall or snowmelt.	Elder	No suggestions.
	Concern about the location of the tailings storage facility.	Main users of trapline W25B	No suggestions.
	Concern about disruption of traditional and subsistence activities: users of traplines W25B and W25A must travel further to hunt and trap because of nuisances like the presence of infrastructure and workers, noise, and truck traffic (experience on the land has changed).	Primarily users of traplines W25B and W25A, but raised by other land users as well as the CTA, among others.	No suggestions.
	Concern about the quality and availability of food resources for future generations due to potential contamination and the disturbance of wildlife habitats.	Main users of traplines W25B and W25A	No suggestions.
	Concern about the risk of spills in the environment.	Primarily users of traplines W25B and W25A, but raised by other land users	No suggestions.
	Concern about unreported spills from Osisko's subcontractors.	Main users of trapline W25B	Hire an environmental officer under the authority of the CFNW.
	Concern about the availability of berries (blueberries) in the area.	Main users of traplines W25B and W25A	Plant native blueberry seedlings in the local study area to support the berry's sustainability and its collection for traditional foods.
	Concern about the pressure on plants and animals (preservation of biodiversity). Moose, bear, beaver, hare, and fish have been identified by the CTA as species to be protected.	Primarily the main users of traplines W25B and W25A, but raised by other land users as well as the CTA	No suggestions.
	Concern about year-round access to water for domestic uses (e.g., showering and laundry).	Main users of trapline W25B	Provide access to a trailer for the tallyman and his immediate family to obtain water year-round.

Element of interest	Reaction/concern	Waswanipi stakeholder	Stakeholder suggestions
	Concern about opening the land to visitors and recreational hunters and fishers, who are not always respectful of the environment.	Main users of trapline W25B	No suggestions.
	Concern about the ability to do traditional activities in the part of the W25B trapline near the mine site once the mine is up and running.	Main users of trapline W25B	Create a relationship of cooperation and mutual trust with the tallymen, who should receive preferential treatment from Osisko over other land users because they are directly affected.
	Concern about vehicle traffic around the borrow pits causing disruption to hare trapping along R1053 (R6000) and the road leading to the borrow pits being studied.	Main users of trapline W25B	No suggestions.
	Concern about heavy vehicle traffic on R1053 (R6000) which crosses almost the entire southern part of trapline W25A from west to east. This is a wildlife habitat area, where users hunt moose.	Main users of the W25A trapline	No suggestions.
	Concerns about the mine restoration process, whether the spills will have been cleaned up completely and all affected areas backfilled.	Elder	Pay particular attention to the risk of spills and, if applicable, ensure that all spills are cleaned up at mine closure, regardless of their size.
Heritage and archaeology	Burial sites were identified during the land-use interview. They are a few kilometres outside the local study area.	Main users of traplines W25B and W25A	Burial sites must remain intact.
Landscape	This component has not been the subject of specific reactions by stakeholders.		

Legend

Raised by almost all respondents

Raised by at least half of the respondents

4.5.2 NON-FIRST NATIONS COMMUNITY

The main reactions and concerns, as well as the suggestions raised during the 2018 and 2023 non-First Nations community consultations, have been collated in Table 4-7. They are classified by component of interest to the non-First Nations community: planning, land use, and land tenure; population, economy, and employment; quality of life and well-being; land and natural resource use; infrastructure and utilities; heritage and archaeology; and landscape. The colours in Table 4-7 are explained in the legend below the table and indicate the number of times the issue was raised by respondents.

Table 4-7 Non-First Nations community consultations in 2018, 2022, and 2023: Stakeholder reactions, concerns, requests, and suggestions

Element of interest	Reaction/concern	Non-First Nations stakeholder	Stakeholder suggestions
Planning, land use, and land tenure	This component has not been the subject of specific reactions by stakeholders.		
Population, economy, and employment	Concern that there will be little or no economic benefit to local communities due to rotating work schedules (e.g., workers will only be transiting through the Lebel-sur-Quévillon airport, so the community will not benefit from the economic activities generated by the project).	Socio-economic actors from Lebel-sur-Quévillon, Chapais, and Chibougamau	Implement a strategy to encourage new families to move into the community (e.g., flexible hours, offer workers the opportunity to go home rather than work on rotation). Provide a financial incentive for local workers.
	Concern about the future of workers after the mine closes.	Socio-economic actors from Lebel-sur-Quévillon, Chapais, and Chibougamau	Develop expertise that will be transferable to other projects.
	Additional pressure on the availability of labour (shortage and transfer).	Socio-economic actors from Lebel-sur-Quévillon, Chapais, and Chibougamau	Prevent salary escalation by developing other incentives.
	Concern about the shortage of housing in enclaves such as Chapais and Chibougamau.	Actors from Chapais and Chibougamau	Participate in funding housing initiatives.
	Concern about the equitable distribution of benefits across the region.	Socio-economic actors from Lebel-sur-Quévillon, Chapais, and Chibougamau	Creation of a regional committee for the maximization of economic benefits.
	Questions about the origin of the targeted workforce (Quebec, Canada, international).	Socio-economic actor	No suggestions.

Element of interest	Reaction/concern	Non-First Nations stakeholder	Stakeholder suggestions
Quality of life and well-being	Concern about the psychosocial impact of rotating work schedules (e.g., absence from home causing a lack of parental support for children).	Socio-economic actors and the general public	Implement work-family balance programs. Get involved in initiatives to create childcare spaces. Offer support to the parents at home. Offer shorter rotations than 14/14.
	Concern about constant noise pollution (background noise).	Cottage leaseholders	Implement mitigation measures to preserve their tranquility.
	Concern about the loss of general peace and quiet (noise, dust, vibrations, traffic).	Cottage leaseholders	Implement mitigation measures to preserve their tranquility.
	Concern about increased pressure on hunting and fishing due to the presence of workers.	Cottage leaseholders	Prohibe mine site workers from hunting and fishing.
	Concern about lost revenue due to nuisances for clients.	Leaseholder for lodging purposes in an outfitter without exclusive rights	Offer financial compensation for loss of clients.
	Concern about light pollution from current and future infrastructure.	Cottage leaseholders and certain socio-economic actors	No suggestions.
Use of land and natural resources	Concern about potential contamination of water in surrounding lakes and streams.	Cottage leaseholders and some socio-economic actors	No suggestions were offered to address this concern.
	Concern about environmental protection if the mine footprint is expanded.	General population	Incorporate a potential expansion and an extended life of the mine in the environmental impact assessment.
	Concern about maintaining access to areas near the mine site for fishing.	Cottage leaseholder	Maintain a bypass road to allow north-south travel and access to unnamed lakes 2 and 6.

Element of interest	Reaction/concern	Non-First Nations stakeholder	Stakeholder suggestions
Infrastructure and public utility services	Concern about road safety and increased risk of accidents.	Socio-economic actors	Consider maintaining a second access road.
	Concern about the distance to health services in case of emergency.	Socio-economic actors	No suggestions.
	Concern about the project's cumulative impacts associated with the proposed power line to the mine.	General population	No suggestions.
Heritage and archaeology	This component has not been the subject of specific reactions by stakeholders.		
Landscape	This component has not been the subject of specific reactions by stakeholders.		

Legend

Raised by almost all respondents

Raised by at least half of the respondents

4.6 OSISKO'S FOLLOW-UP ON STAKEHOLDERS' CONCERNS AND REQUESTS

Since starting exploration activities in the area, Osisko has recognized the wealth of information gathered during the numerous discussions with stakeholders. It has answered questions as thoroughly as possible and made sure to follow up properly on the topics that were discussed. To that end, Osisko's community relations team maintains a table of concerns and commitments. This allows them to centralize the information collected during outreach activities and follow up fully on the actions to be taken.

As part of the environmental assessment process for the project, several responses to the concerns raised by stakeholders were included and discussed in the EIA. Tables 4-8 and 4-9 show the chapters or sections where these concerns of the First Nations and non-First Nations communities are addressed, respectively.

It should be noted that Osisko's discussions with stakeholders over the past few years have led the company to adapt or optimize certain aspects of its exploration activities. They are also being taken into account in the development of the Windfall project. In addition to the examples of developments proposed by the field teams, examples of adjustments or modifications to the project resulting from stakeholder consultations are provided in chapters 2 and 3 of the EIA, among others.

4.6.1 FIRST NATIONS COMMUNITY

Table 4-8 summarizes the major themes and concerns raised by First Nations people and cites where they are addressed in the EIA.

Table 4-8 Interrelationships between First Nations concerns and their treatment in the EIA

Theme	Concern	EIA reference (chapter or section)
Service and opportunity needs	Local contractors want to know about future needs and opportunities so they can prepare and mobilize their human and material resources.	Chapter 8: sections 8.3.2, 8.3.3, and 8.3.4 (Responsible Procurement Policy)
Awarding of service contracts	Concern raised about the fairness of the subcontracting process. The group of local contractors mentioned that Miyuukaa Corporation is currently favoured.	Chapter 8: sections 8.3.2, 8.3.3, and 8.3.4 (Responsible Procurement Policy)
Development of mining expertise	Request: Local contractors want to develop their knowledge and expertise in the mining industry.	Chapter 8: sections 8.3.2, 8.3.3, and 8.3.4 (Professional Development Policy)
Hiring local employees	Request: Some stakeholders would like Osisko to prioritize hiring Waswanipi workers over those from the neighbouring Cree communities of Oujé-Bougoumou and Mistissini, in particular.	Chapter 8: sections 8.3.2, 8.3.3, and 8.3.4 (Hiring Policy)
Racism and discrimination at work	Concern about racism, discrimination, and language barriers in a diverse and inclusive workplace.	Chapter 8: sections 8.4.2 and 8.4.3 (Workplace Harassment Policy)

Theme	Concern	EIA reference (chapter or section)
Labour shortage	Concern about a potential labour shortage problem for the Waswanipi community.	Chapter 8: sections 8.4.2 and 8.4.3
	Questions about the origin of the targeted workforce (Quebec, Canada, international).	
Integration and retention of the Cree workforce	Concern about a potential issue with integrating and retaining Cree workers.	Chapter 8: sections 8.4.2, 8.4.3, and 8.6.2
Community benefits	Concern about the extent of community benefits (business opportunities, meaningful employability of the workforce, career growth and development, promotion based on seniority, relevant and transferable training including financial literacy).	Chapter 8: sections 8.3.2, 8.3.3, 8.3.4, 8.4.2, 8.4.3, 8.4.4, 8.6.2, 8.6.3, and 8.6.4
Integrity of Cree culture and traditional way of life	Concern about the attractiveness of economic benefits at the expense of Cree culture and the traditional way of life.	Chapter 8: section 8.6.2
Lifetime and durability of the technology	Concern raised about the life and durability of the tailings storage facility's protective geomembrane.	Common mitigation measures NOR 08, 09, 10, 13, 14, 15 and HYD 01 Windfall project restoration plan (Appendix 3-7)
Environmental protection	Concern about environmental protection if the mine footprint is expanded.	Common mitigation measures NOR 04 to 17, HYD 01, QUA 01 to 27 Windfall project restoration plan (Appendix 3-7)
	Concern about the restoration of the mine.	
Air quality	Concern about potential deterioration of air quality due to discharges from the process plant.	Chapter 6: section 6.2 Chapter 8: sections 8.4.2 and 8.4.3 Chapter 13: sections 13.2.1 and 13.2.2
Road safety	Concern about safety on access roads, specifically related to speed and increased traffic.	Chapter 8: sections 8.4.2 and 8.4.3 Procedure for accessing the site
Work-study balance	Request: Some respondents requested accommodations for employees who wish to return to school.	Common mitigation measures POP 01 and VIE 04
Quality of life	Concern about lowered quality of life due to nuisances such as noise, dust, and light pollution (visible from camps).	Chapter 8: sections 8.4.2 and 8.4.3
	Light pollution from the surface infrastructure at the current site can be seen from the First Nations camp, raising concerns about light pollution from the proposed infrastructure.	Chapter 8: sections 8.4.2 and 8.4.3
Habitat quality	Concern about the degradation of wildlife habitats due to nuisances such as noise, dust, and light pollution.	Chapter 13: section 13.2 (Biodiversity program)
	Concern about the pressure on plants and animals (preservation of biodiversity). Moose, bear, beaver, hare, and fish have been identified by the CTA as species to be protected.	Chapter 8: sections 8.5.2, 8.5.3, 8.6.2 and 8.6.3 Chapter 13: section 13.2 (Biodiversity program)
Psychosocial impacts of rotating work schedules	Concern about the psychosocial impact of rotating work schedules (e.g., absence from home, impact on parental support for children).	Chapter 8: sections 8.4.2 and 8.4.3
Women's health and safety at the site	Concern for the health and safety of women working at the Windfall site.	Chapter 8: sections 8.4.2 and 8.4.3 (Workplace Harassment Policy)

Theme	Concern	EIA reference (chapter or section)
Quality of waterbodies	Concern about potential contamination of water in surrounding lakes and streams, especially Unnamed Lake 2	Chapter 3: section 3.5.2 Chapter 6: sections 6.6.2, 6.6.3, 6.6.4, 6.7.2, 6.7.3, 6.7.4, 6.9.2, 6.9.3, 6.9.4; 6.10.2, 6.10.3, 6.10.4 Chapter 12 Chapter 13: section 13.2.6
	Concern about year-round access to water for domestic uses (e.g., showering and laundry).	
	Concern about the potential for contaminated water to spill into the environment during heavy rainfall or snowmelt.	
Location of the tailings storage facility	Concern about the location of the tailings storage facility due to its proximity to the water of Unnamed Lake 2 and a valued wildlife area, as well as the encroachment on the existing bypass road.	Chapter 2 (Location and Technology Alternatives)
Maintaining the integrity of traditional activities	Concern about disruption of traditional and subsistence activities: users of traplines W25B and W25A must travel further to hunt and trap because of nuisances like the presence of infrastructure and workers, noise, and truck traffic.	Chapter 8: sections 8.4.3, 8.4.4, 8.6.2, 8.6.3, and 8.6.4
	Concern about vehicle traffic around the borrow pits causing disruption to hare trapping along R1053 (R6000) and the road leading to the borrow pits being studied.	Chapter 8: sections 8.6.2, 8.6.3 and 8.6.4
	Concern about heavy vehicle traffic on R1053 (R6000) which crosses almost the entire southern part of trapline W25A from west to east. This is a wildlife habitat area, where users hunt moose.	
	Burial sites were identified during the land-use interview. They are a few kilometres outside the local study area.	Chapter 4: section 4.4.1
Quality and availability of food resources	Concern about the quality and availability of food resources for future generations due to wildlife disturbances and potential contamination of their habitats.	Chapter 8: sections 8.6.2, 8.6.3, and 8.6.4
	Concern about the availability of berries (blueberries) near infrastructure.	Chapter 8: section 8.6.2
Risk of spills	Concern about the risk of spills in the environment.	Chapter 12: Common mitigation measures QUA 01 to 27 and VIE 02
	Concern about unreported spills from Osisko's subcontractors.	Common mitigation measures QUA 01 to 27, VIE 02 and 03
Lifespan of the mine	Questions about the lifespan of the mine.	Chapter 1: section 1.4 Chapter 3
Impact assessment methodology	Questioning/uncertainty about the impact assessment methodology, i.e., how the elements were selected and whether the study looks at the big picture or just the individual components.	Chapters 5 and 11
Cumulative impacts	Concern about cumulative impacts of the proposed power line to the mine.	Chapter 11

4.6.2 NON-FIRST NATIONS COMMUNITY

Table 4-9 summarizes the major themes and a summary of the concerns raised by non-First Nations people and cites where they are addressed in the EIA.

Table 4-9 Interrelationships between non-First Nations concerns and information in the EIA

Theme	Concerns	EIA reference (chapter or section)
Scope of economic benefits	Concern that there will be little or no economic benefit to local communities due to rotating work schedules (e.g., workers will only be transiting through the Lebel-sur-Quévillon airport, so the community will not benefit from the economic activities generated by the project).	Chapter 8: sections 8.3.2, 8.3.3, and 8.3.4
	Concern about the equitable distribution of benefits across the region.	Chapter 8: sections 8.3.2, 8.3.3, and 8.3.4
Long-term perspective on employability	Concern about the future of workers after the mine closes.	Chapter 8: sections 8.3.2, 8.3.3, and 8.3.4
Workforce	Additional pressure on the availability of labour (shortage and transfer).	Chapter 8: sections 8.4.2 and 8.4.3
Psychosocial impacts of rotating work schedules	Concern about the psychosocial impact of rotating work schedules (e.g., absence from home causing a lack of parental support for children).	Chapter 8: sections 8.4.2 and 8.4.3
Quality of life	Concern about constant noise pollution (background noise).	Chapter 8: sections 8.4.2, 8.4.3, and 8.4.4
	Concern about the loss of general quietness (noise, dust, vibrations, traffic).	Chapter 8: sections 8.4.2, 8.4.3, and 8.4.4
	Concern about light pollution from current and future infrastructure.	Chapter 8: sections 8.4.2 and 8.4.3
Quality and availability of food resources	Concern about increased pressure on hunting and fishing due to the presence of workers.	Chapter 8: sections 8.5.2, 8.5.3, 8.6.2 and 8.6.3 Chapter 13: section 13.2 (Biodiversity program)
Loss of revenue	Concern about lost revenue due to nuisances for clients of an outfitter near the Windfall site.	Chapter 8: sections 8.4.2, 8.4.3, and 8.4.4
Quality of waterbodies	Concern about potential contamination of water in surrounding lakes and streams.	Chapter 3: section 3.5.2 Chapter 6: sections 6.6.2, 6.6.3, 6.6.4, 6.7.2, 6.7.3, 6.7.4, 6.9.2, 6.9.3, 6.9.4; 6.10.2, 6.10.3 and 6.10.4 Chapter 12 Chapter 13: section 13.2.6
Road safety	Concern about road safety and increased risk of accidents.	Chapter 8: sections 8.4.2 and 8.4.3 Procedure for accessing the site
Access to the land	Concern about maintaining access to areas near the mine site for fishing.	Chapter 8: section 8.5.2
Distance to health services	Concern about the distance to health services in case of emergency.	Chapter 12 Emergency response plan
Housing	Concern about the shortage of housing in enclaves such as Chapais and Chibougamau.	Chapter 8: section 8.3.1

4.7 EXPERIENCE WITH SIMILAR PROJECTS IN NORTHERN QUEBEC

To better assess the potential lifestyle changes for communities that live in or use the Windfall project area, as well as those communities' capacity to handle the changes that arise from the project, Osisko turned to the experience of other similar projects in Northern Quebec.

As stated in Chapter 11 of this EIA, past, current, and future local and regional projects were inventoried by reviewing the available documentation and meeting with First Nations and non-First Nations representatives of the region. Websites and environmental impact assessment reports associated with projects in or near the same region as the mine site were also consulted.

The experience of similar projects demonstrates the importance of involving the community in the project development, especially by employing local service providers and promoting workforce training, to allow the project to contribute to the economic development of the surrounding communities. Communicating transparently and sharing information in a way that is fair and equitable for all stakeholders are key to building trust with communities. Involvement of the First Nations community is equally important to project success. This involvement may include setting up a Cree cultural site on the project site and holding scheduled cultural activities, in collaboration with the tallyman, to encourage exchanges between cultural groups. An annual activity to introduce First Nations students to the mining industry also appears to be a useful measure that participants appreciate.

Experience shows that the shortage of skilled labour remains the main challenge that similar projects face. The proliferation of new mining projects could exacerbate the labour shortage in Northern Quebec. To address this situation, similar projects have relied on collaboration with other project proponents, communities, and other local stakeholders to maximize socio-economic benefits and overcome labour shortages. Regional focus groups appear to be a useful solution. Additionally, prioritizing the recruitment of new graduates could prevent competition and the eventual drainage of currently employed workers.

The documents consulted, as well as the discussions with community stakeholders, also brought up road safety issues and anticipated risks, particularly those related to speeding and accidents involving vehicles carrying hazardous materials. The roads in Northern Quebec are not only used for industrial or multi-resource purposes. Other users such as the Cree and James Bay residents also use the roads to travel between communities, for recreation, and to practice traditional activities. To address this safety issue and raise driver awareness, mining companies have put various initiatives in place, such as installing speed limit signs and hiring traffic officers.

There are also many concerns related to accidental spills that could occur during transportation. One solution is to install spill kits near watercourses that are crossed by access roads, to reduce the risk associated with eventual accidental spills.

Given the fight against climate change and the importance of reducing GHG emissions, similar projects have considered the feasibility and practicality of employing electric vehicles. Currently, mining companies use “conventional” (diesel) fuel for their vehicles to limit their exposure to technological risks. To date, electric vehicles are still not widely used in mining and there remains concern about their suitability for the climate of Northern Quebec. Nevertheless, technology is advancing and some similar projects are studying the feasibility of including greener vehicles in their fleets.

In an effort to be at the forefront of environmental management, some companies are using ISO 14001:2015 certification as a model for their environmental management systems and are joining the Mining Association of Canada’s (MAC) Towards Sustainable Mining (TSM) initiative. TSM establishes a set of tools and indicators for an environmental management system that addresses the main risks associated with mining activities while encouraging continuous and sustainable improvement.

The management of non-hazardous residual materials is also an issue for mining projects in northern areas. Industrial composters appear to be a widespread solution for organic materials, but the volume of waste disposed of in trench landfills remains significant. The presence of composters also disrupts the habits of wildlife, including black bears, which in turn causes changes in the traditional customs and activities associated with this resource. Projects similar to Windfall have educated workers on the presence of black bears on mine sites and had specialized biologists produce management plans.

Similar projects with sites that are permanently closed or in the maintenance stage have raised further issues. The importance of prevention rather than reaction is, without doubt, the point that is raised the most often. To that end, it is recommended that a transition strategy be established as soon as the mine site opens. In order to prepare for this eventual transition, the bodies representing affected communities must be given early warning about the reduction or cessation of activities at the site. It is best to plan alternative jobs for workers after closure and provide training to allow for good mobility. Similarly, maintaining the employee assistance program, including counselling on good financial management, after closure can help reduce the negative impacts of closure. Furthermore, when it comes to restoring the mine site, vegetation should be chosen with the support of local stakeholders, such as the tallymen.

Finally, Osisko has considered potential impacts and mitigation measures along the same lines as those used for similar projects in Northern Quebec. These take the Northern context, as well as the issues associated with climate change, into account. Incorporating the experience of similar projects has resulted in the list of project mitigation measures presented in chapter 5.

4.8 ISSUES IDENTIFIED DURING THE EIA CONSULTATIONS

This section presents the major issues that can be identified from the outreach and consultation activities held as part of this impact assessment. The identified issues reflect the concerns raised by many of the stakeholders encountered in the project to date. The significance of an impact was also taken into account in determining these issues. It should be noted that the implementation of standard and specific measures will mitigate the project's anticipated effects on these issues. The monitoring and follow-up programs discussed in chapter 13 also incorporate these issues.

4.8.1 FIRST NATIONS COMMUNITY

Many concerns relate to issues of environmental and ecosystem preservation, traditional land use, and the quality of life of First Nations stakeholders. These issues are as follows:

- **Preservation of environmental quality**: This issue relates to the requirement to preserve the water system and wetlands; maintain surface water, groundwater, and air quality; and minimize GHG emissions that contribute to climate change.
- **Preservation of biodiversity**: This issue includes minimizing the loss of vegetation and wetlands, preserving land and aquatic habitats (including those of birds, fish, moose, and caribou), and protecting at-risk plant and wildlife species.
- **First Nations interests and concerns**: This issue involves maintaining the integrity of traditional activities and Cree culture as well as preserving Cree community and psychosocial well-being.

These three issues are presented individually below to explain their nature and how they interact with the project.

PRESERVATION OF ENVIRONMENTAL QUALITY

Environmental quality is a broad issue that aims to protect the right of all people to a quality environment, the protection of this environment, and the safeguarding of the living species that compose it. This issue specifically addresses the components of the physical environment (the main ones being air, water, sediment, and soil), which are intrinsic to the traditional way of life. These components are described in chapter 6 of this EIA.

PRESERVATION OF BIODIVERSITY

The maintenance and protection of biodiversity and wildlife habitats are governed by several pieces of provincial and federal legislation. Osisko is committed to maintaining as much biodiversity as possible in the area it will be occupying during the mine's operating life, which is currently estimated at 10 years. Osisko intends to develop a biodiversity program that could improve knowledge of one or more valued species during a change in their territory, with the ultimate goal of finding ways to enhance biodiversity (see section 13-2). The biological components, which are intrinsic to the traditional way of life, are described in Chapter 7 of this EIA.

FIRST NATIONS INTERESTS AND CONCERNS

First Nations interests and concerns are an issue that relates specifically to the "First Nations interests and treaty territory," "Quality of life and well-being," and "Traditional First Nations land use" components, described respectively in sections 8.2, 8.4, and 8.6 of this EIA. Accounting for this issue involves sustaining traditional lifestyles, respecting Cree culture, and improving living conditions in the communities.

Maintaining communication with stakeholders from the construction phase through the operations phase and into project closure will facilitate the two-way flow of relevant project information and allow for the early identification of any issues that may be of concern to First Nations stakeholders.

4.8.2 NON-FIRST NATIONS COMMUNITY

Many of the concerns expressed relate to the issues of socio-economic benefits and environmental conservation. These issues are as follows:

- **Concentration of economic benefits at the local level**: This issue includes considerations of the long-term impact on local communities and the local workforce, in particular the post-closure impact.
- **Preservation of environmental quality**: This issue relates to the requirement to preserve the water system and wetlands; maintain surface water, groundwater, and air quality; and minimize GHG emissions that contribute to climate change.

CONCENTRATION OF ECONOMIC BENEFITS AT THE LOCAL LEVEL

Consultations for the project revealed that the concentration of economic benefits at the local level is a concern. This issue refers to the interest of several non-First Nations stakeholders in having the project draw from the local community for goods, services, and labour in order to develop the community's economy. The local and regional economic components are discussed in section 8.3 of the EIA.

PRESERVATION OF ENVIRONMENTAL QUALITY

This issue more specifically addresses the components of the physical environment, the main ones being air, water, sediment, and soil. They are described in chapter 6 of this EIA. The preservation of environmental quality is a broad issue that aims to protect the right of every person to live in a quality environment and to maintain the conditions that protect the species within it.

4.9 SUBSEQUENT OUTREACH AND CONSULTATION ACTIVITIES

After the EIA has been filed, Osisko will continue its outreach and consultation activities with the stakeholders. Osisko's strategy is to maintain its current approach by continuing:

- involvement in the Lebel-sur-Quévillon Collaboration Committee;
- participation in the Environmental Monitoring Committee with the CFNW until it is replaced by the measures to be defined in the IBA;
- presentations on project progress at public events such as the CFNW general assemblies;
- presence of the Community Liaison Officer in the CFNW to facilitate consultation, communication, and recruitment;
- meetings, site visits, and presentations with various parties;
- communication of information on social media and the website;
- publication of press releases.

It should be noted that certain activities have already been scheduled in early 2023. They include a networking day with local contractors in Lebel-sur-Quévillon, with the assistance of the Société du Plan Nord, as well as a second class of the Mining Essentials program.

While considering the advancement of the project and the needs expressed by the stakeholders, Osisko will improve and adapt its approach to outreach and consultation. This will include:

- continuing to negotiate the IBA with the CFNW and the CNG, which will facilitate the creation of new committees and other mechanisms for implementing the Agreement;
- enhancing its website by creating digital tools to explain, illustrate, and share data on the project;
- developing a formal mechanism to receive and address complaints, comments, and concerns in a timely manner.

5 IMPACT IDENTIFICATION AND ASSESSMENT METHODOLOGY

5.1 STUDY AREA BOUNDARIES

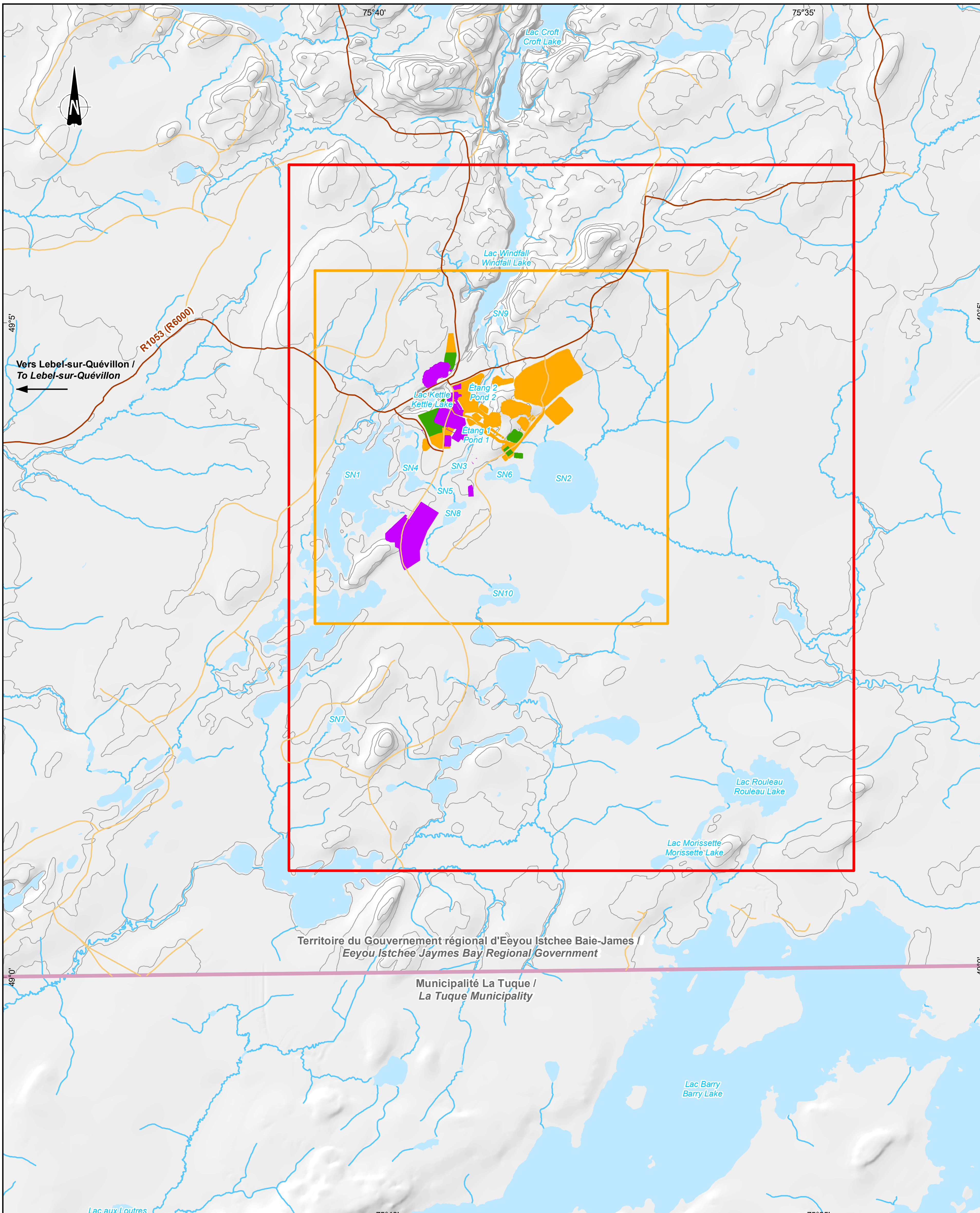
The Windfall mine project is located north of the 49th parallel in the Nord-du-Québec administrative region, on Category III lands in the Eeyou Istchee James Bay territory. The mine site is approximately 270 km from the town of Val-d'Or and 115 km east of the town of Lebel-sur-Quévillon.

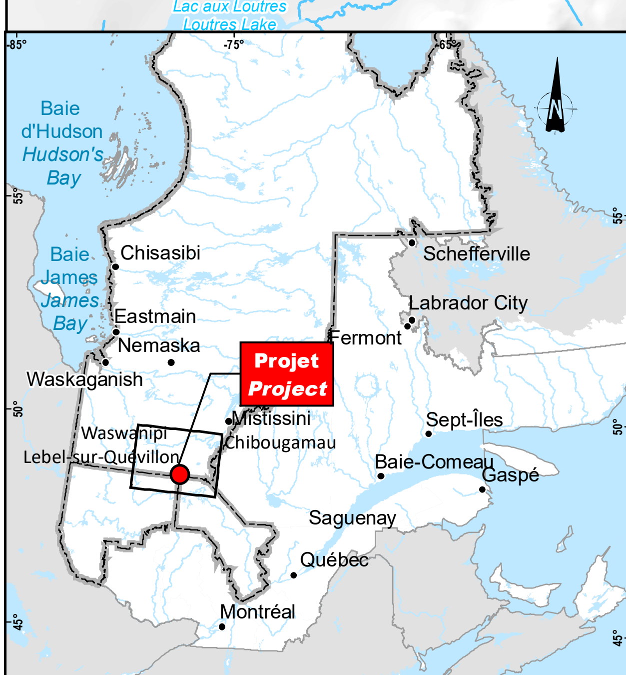
Three study areas were delineated for the purposes of identifying and locating the sensitive environmental components likely to be affected by the project: one for the biophysical environment (section 5.1.1), one for the social environment (section 5.1.2), and a final one to include the more remote social components (section 5.1.3). The need to consider these areas is justified by the fact that in some cases, the project will only affect components close to the Windfall gold mine, while in other cases, the effects will be felt over a wider area, at various scales. These areas are marked on each of the maps in chapters 6 through 8.

5.1.1 LOCAL BIOPHYSICAL STUDY AREA

The local study area for the biophysical environment encompasses the physical and biological components of the host environment that are most likely to be impacted by the construction and operation phases of the project close to the activities (Map 5-1). This zone includes Osisko's existing facilities, as well as the components of the natural environment, including the main lakes around the site. The local study area of the biophysical environment is a 5 km by 5 km square, i.e., an area of 25 km^2. Within this area, components of the biophysical environment were inventoried over appropriate areas representative of the local biophysical study area. The inventoried areas are detailed in the sectorial reports as well as in the sections describing the current conditions of each component.

However, for some components of the physical environment (such as ambient air and noise), the local study area for the social environment (section 5.1.2) is used instead, as the project may affect some components beyond the boundaries of the study area for the biophysical environment.





Limite administrative / *Administrative boundary*

Réseau routier / ***Road Network***

Route nationale / *National road*

Route secondaire / *Secondary road*

Projet / ***Project***

Zone d'étude locale du milieu biophysique / *Biophysical local study area*

Zone d'étude locale du milieu humain / *Human local study area*

Infrastructures du projet / ***Project Infrastructures***

Existante / *Existing*

Existante au moment de l'EIE / *Existing at the time of the EIE*

Projetée / *Projected*

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Projet minier Windfall - Étude d'impact sur l'environnement /
Windfall Mining Project - Environmental Impact Assessment

Site minier Windfall, Eeyou Istchee Baie-James (Québec) /
Windfall Mining Site, Eeyou Istchee Baie-James (Quebec)

Carte 5-1 / ***Map 5-1***
Zones d'étude locale des milieux biophysique et humain / ***Biophysical and Human Local Study Areas***

Sources / Sources:
CanVec+, 1/50 000, RN Can, 2014
SDA, 1/20 000, MERN Québec, 2020
BDTA, 1/250 000, MRN Québec, 2002
BDGA, 1/5 000 000, MRN Québec, 2012

0 0,55 1,1 km

MTM, Fuseau 9 / Zone 9, NAD83

2023-03-06

Préparée par / Preparation : M.-H. Brisson
Dessinée par / Drawing : J. Roy
Vérifiée par / Verification : M.-H. Brisson
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5.1.2 LOCAL STUDY AREA FOR THE SOCIAL ENVIRONMENT

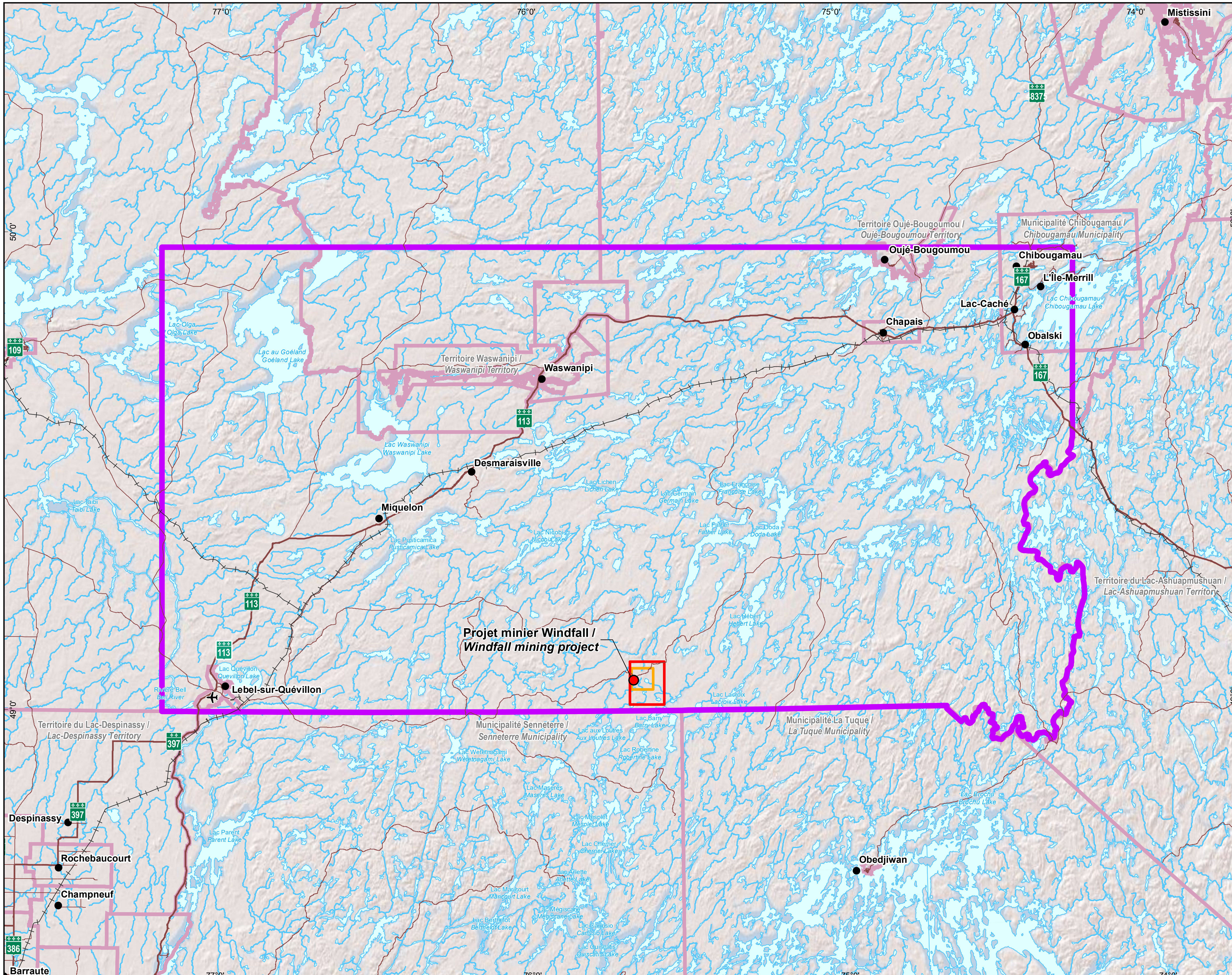
The local study area for the social environment includes that of the biophysical environment (Map 5-1), among others. It measures 8 km by 10 km to include sensitive areas of the region (such as outfitters and camps), but does not extend beyond the borders of the administrative region.

The local study area for the social environment is used to describe and evaluate impacts on components of the land that may be felt beyond the boundaries of the local study area for the biophysical environment. The impact on the users of the territory (both First Nations and non-First Nations) and on the leaseholders for resorts on the territory, as well as the visual effects on the landscape, are evaluated from the local study area for the social environment. Some components of the physical environment must also be assessed at the scale of this study area, as there are sensitive receptors outside the boundaries of the local study area for the biophysical environment where effects on these components are more widespread.

5.1.3 REGIONAL STUDY AREA

The regional study area provides a socio-economic and geographic context for the project (Map 5-2). It serves as a spatial framework for describing the components of the social environment, some of which lie outside the boundaries of the associated local study area. This zone aims to document the demographic and economic characteristics of the non-First Nations communities and the First Nations members affected by the project. The description of these components also covers the development trends of these communities as well as the purposes assigned to the territory. This allows for an adequate assessment of the project’s impacts on the surrounding communities’ current or planned activities.

This study area includes the access road to the mine site, from the municipality of Lebel-sur-Quevillon in the west to the town of Chibougamau at the eastern edge of the study area. It includes the town of Chapais as well as the Cree community of Waswanipi, while remaining within the boundaries of the Nord-du-Québec administrative region. While some 55 km of the access road to the mine site (road R0853) is located in the regional county municipality (RCM) of La Vallée-de-l’Or in the Abitibi-Témiscamingue administrative region, it has no mining infrastructure and is considered marginal. It was therefore excluded from the study area.



Limite administrative / *Administrative boundary*

Projet / *Project*

Zone d'étude régionale / *Regional study*

Zone d'étude locale du milieu biophysique / *Biophysical local study area*

Zone d'étude locale du milieu humain / *Human local study area*

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Projet minier Windfall - Étude d'impact sur l'environnement / *Windfall Mining Project - Environmental Impact Assessment*

Site minier Windfall, Eeyou Istchee Baie-James (Québec) / *Windfall Mining Site, Eeyou Istchee Baie-James (Quebec)*

Carte 5-2 / *Map 5-2*
Zone d'étude régionale / *Regional Study Area*

Sources / Sources:
CanVec+, 1/50 000, RN Can, 2014
SDA, 1/20 000, MERN Québec, 2020
BDTA, 1/250 000, MRN Québec, 2002
BDGA, 1/5 000 000, MRN Québec, 2012

0 9 18 km

MTM, Fuseau 9 / Zone 9, NAD83

2023-03-13

Préparée par / Preparation : M.-H. Brisson
Dessinée par / Drawing : J. Roy
Vérifiée par / Verification : M.-H. Brisson
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5.2 GENERAL APPROACH

The general proposed approach for identifying and assessing the significance of potential environmental impacts is built around detailed descriptions of the project and the environment, as well as public consultations and lessons learned from similar projects. It can be summarized as follows:

1. The project description identifies potential sources of impact using the technical characteristics of the works to be built, as well as the construction activities, methods, and schedule.
2. The description and general knowledge of the environment reveal the environmental and social context of the area in which the project is to be carried out, identify the most sensitive components of the environment as they relate to the project, and highlight, if necessary, certain issues to be considered.
3. Public consultations reveal the communities' concerns about the project.

Consideration of these elements allows for the creation of a list of environmental components for which a detailed analysis of potential impacts is needed. This detailed impact assessment is conducted on changes made only after the start-up of the Windfall mine project—in other words, the changes made during the exploration phase of the project are not assessed. The environmental assessment is streamlined by incorporating various environmental measures into the design at the project development stage to mitigate the number and magnitude of potential impacts. The environmental and social issues identified at the beginning of the analysis are also taken into account when optimizing the project. The incorporation of these factors into the planning stages of the project is evidence of the initiator's concern for the environment.

Finally, lessons learned from similar projects provide relevant information on the nature and intensity of certain impacts associated with this type of project, as well as on the effectiveness of certain mitigation and compensation measures.

For each of the targeted environmental components, the assessment process includes the following steps:

1. Understanding the reference state. This involves researching the sensitive components of the physical, biological, and social environments as they were before development.
2. Describing the potential impacts. This consists of describing anticipated changes based on the sources of project impacts.
3. Developing mitigation measures to reduce the severity of, or even eliminate, the identified impacts. The inclusion of these measures at this stage constitutes a commitment by the project initiator to apply them during the implementation phase.
4. Assessing the magnitude of the residual impacts, i.e., those that remain after mitigation measures have been applied.
5. Describing the compensation or monitoring measures, if any, applicable to certain residual impacts.

5.3 IDENTIFICATION OF POTENTIAL INTERRELATIONSHIPS

5.3.1 POTENTIAL SOURCES OF IMPACT

Potential sources of impact are related to the work and/or activities required to build, operate, and maintain the proposed infrastructure, but also to close the site once resource exploitation has ended. The assessment of the sources of impact aims to identify all aspects of the project that could have an impact on the environment, whether negative or positive. These potential sources of impact are listed below.

SOURCES OF IMPACT – CONSTRUCTION PHASE

Organization of the site, stripping, and clearing: Installation of trailers and site clearing and preparation activities (overburden stripping, etc.) for the proposed infrastructure. This work includes encroachment into wetlands.

Surface preparation and access arrangement: Site grading; excavation and backfilling of surfaces; preparation of surfaces for the construction of the tailings facility and waste rock, overburden, and ore stockpiles (including waterproofing, if required); preparation of the platform for the buildings in the industrial complex and the workers' camp; construction of access roads and ditches, including bridges; construction of haul roads; blasting; and construction of storage areas. This work involves encroaching into waterbodies, in addition to creating crossings. Borrow pits may be created at this stage as well.

Construction of works and infrastructure: All construction work for the structures and buildings (creation of dikes for the development of the ponds; installation of pipes; development of contact water ditches to circumvent the site and the buildings of the industrial complex; construction of the workers' camp and other related buildings; development of the discharge sites (mining and sanitary); construction of the water treatment plant, etc.

Transportation and traffic: Travel of workers and trucks for the provision of granular materials, equipment, and goods and services as well as the use of machinery. Fuelling and machinery maintenance are also to be considered.

Production and management of residual and hazardous materials: Storage and management of hazardous and non-hazardous residual materials.

Workforce and procurement: Employees on site and procurement of goods and services.

SOURCES OF IMPACT – OPERATION PHASE

Presence and operation of new infrastructure: Includes all new infrastructure required to operate the site, such as storage areas, pond dikes, access roads, haul roads, pipelines, and underground development.

Water use and management: Water management basins, drainage ditch system, pump stations, water treatment facility use and expansion, and effluent.

Transportation and traffic: Machinery movement, transport trucks on the tailings and waste rock pile site, access roads and haul roads. Transportation of workers and products to and from the site. Use of other equipment such as pumps and emergency generators. Fuelling and machinery maintenance are also considered in this activity.

Production and management of residual and hazardous materials: Storage and management of hazardous and non-hazardous residual materials.

Workforce and procurement: All activities of employees and subcontractors working at the site, as well as the companies benefiting from supply and service contracts associated with them. Hiring of labour and presence of workers on the site, procurement of goods and materials, and awarding of contracts for various services.

SOURCES OF IMPACT – CLOSURE PHASE

Presence of the remnants of the site: Presence of the waste rock pile and tailings facility.

Final restoration: Work related to the final restoration of the areas used for the waste rock pile and tailings facility, water retention ponds, etc.

Production and management of residual and hazardous materials: Storage and management of hazardous and non-hazardous residual materials.

Workforce and procurement: Osisko employees and subcontractors who will be working on site closure and post-closure environmental monitoring, as well as the companies likely to provide goods and services during this phase.

5.3.2 COMPONENTS OF THE RECEIVING ENVIRONMENT

The purpose of identifying the components of the receiving environment is to establish a list of the elements in the physical, biological, and social receiving environments that are likely to be affected by one or more potential sources of impact related to the project during the construction, operation, and closure phases. These components are detailed below.

PHYSICAL ENVIRONMENT

Climate: Temperature and precipitation at a given location.

Ambient air: Physical and chemical characteristics of the air, including dust content.

Greenhouse gases: Sources of GHG emissions caused by the different phases of the project and their quantification, expressed in kilotonnes of CO_2 equivalent per year.

Sound environment: Characteristics of the sound environment on the ambient environment.

Soil: Physical and chemical characteristics of surface deposits; soil stability, contamination, and vulnerability to erosion.

Hydrology: Movement and replenishment of surface water, hydrology and hydraulics of rivers.

Surface water: Physical and chemical characteristics of surface water (including nutrients) and their vulnerability to contamination.

Sediments: Physical and chemical characteristics of sediments and their vulnerability to contamination.

Hydrogeology: Natural (body) or induced (drainage and pumping) gravity flow of groundwater.

Groundwater: Physical and chemical characteristics of groundwater and its vulnerability to contamination.

BIOLOGICAL ENVIRONMENT

Vegetation and wetlands: Terrestrial, riparian, and aquatic plant groups, including status species.

Ichthyofauna, benthos, and habitats: Populations of fish and benthic organisms in the lakes and rivers and their habitats.

Herpetofauna and habitats: All amphibians and reptiles and their habitats as well as status species.

Avian fauna and habitats: Waterfowl, raptors, shorebirds, and other birds and their habitats as well as status species.

Mammals and habitats: All mammals (large animals, bats, and others [furry animals, small animals, and micromammals]), their habitats, as well as status species.

SOCIAL ENVIRONMENT

Planning, land use, and land tenure: Delimitation, appropriation, and planning.

First Nations interests and treaty territory: First Nations land claims, strategic agreements.

Population, economy, and employment: Local and regional economic development potential.

Quality of life and well-being: Lifestyle, social environment, and health services.

Use of land and natural resources: Land use and development.

Traditional First Nations land use: First Nations land use and traditional activities.

Infrastructure and public utility services: Access road and electrical power.

Heritage and archaeology: Natural heritage (protected areas), areas of archaeological potential, and chance finds.

Landscape: Landscape units and integrity of the visual fields.

5.3.3 *INTERRELATIONSHIPS BETWEEN THE COMPONENTS OF THE ENVIRONMENT AND THE COMPONENTS OF THE PROJECT*

The potential sources of impact and the previously identified environmental components are presented in an interrelationship grid (Table 5-1). The interrelationships, determined by cross-referencing the knowledge from the environmental characterization studies and the experience acquired by specialists and professionals during impact studies for mining and other large-scale projects, reveal the sources of the project's impacts on the environmental components.

5.4 IMPACT ASSESSMENT METHODOLOGY

The general objective of assessing potential impacts is to determine, as objectively as possible, the significance of the project's potential residual impacts on the components of the physical, biological, and social environments, following the application of common and specific mitigation measures. This assessment covers impacts of all kinds, whether they are negative, positive, or indeterminate in nature.

It consists of identifying and evaluating the significance of the anticipated impacts at each stage of the project. Optimized efforts will be made to develop mitigation measures regardless of significance, which is determined based on the intensity of the disturbance (a concept which, itself, integrates the notions of component value and degree of disturbance), its extent, its duration, and its probability of occurrence. Each of these aspects is presented in Appendix 5-1. Common mitigation measures are presented in Appendix 5-2.

5.5 CUMULATIVE IMPACTS ASSESSMENT METHODOLOGY

The cumulative effects assessment (CEA) is now an essential part of any environmental assessment. It is also required by the directive issued for this impact assessment (ref. 3214-14-059; July 2017 and revised January 2022). This approach examines the impact of the effects of the project under assessment in combination with those of past, current, or reasonably foreseeable future projects. The cumulative impacts assessment methodology is presented in Appendix 5-1.

Table 5-1 Grid of interrelationships between impact sources and environmental components

		Physical environment									Biological environment					Social environment						
	Component	Ambient air	Greenhouse gases	Sound environment and vibrations	Soil	Hydrology	Surface water	Sediments	Hydrogeology	Groundwater	Vegetation and wetlands	Ichthyofauna, benthos, and habitats	Herpetofauna and habitats	Avian fauna and habitats	Mammals and habitats	Population, economy, and employment	Quality of life and well-being	Use of land and natural resources	Traditional First Nations land use	Infrastructure and public utility services	Heritage and archaeology	Landscape
Sources of impact																						
Construction	Organization of the site, stripping, and clearing																					
	Surface preparation and access arrangement																					
	Construction of works and infrastructure																					
	Transportation and traffic																					
	Production and management of residual and hazardous materials																					
	Workforce and procurement																					
Operation	Presence and operation of new infrastructure																					
	Water use and management																					
	Transportation and traffic																					
	Production and management of residual and hazardous materials																					
	Workforce and procurement																					
Closure	Presence of the remains of the site																					
	Final restoration																					
	Production and management of residual and hazardous materials																					
	Workforce and procurement																					

a. Only the environmental components affected by the project are shown in the table.

Negative impact

Positive impact

6 CURRENT CONDITIONS AND IMPACTS OF THE PROJECT ON THE PHYSICAL ENVIRONMENT

6.1 CLIMATE

The climate at the study area is humid continental, characterized by a hot, slightly humid summer and a long, cold winter.

The weather data comes from the station located in Lebel-sur-Quévillon 95 km west of the study site. The average data are the climatological means for the period from 1981 to 2010[1].

6.1.1 TEMPERATURE

The temperature varies over a wide range, with extremes observed at the weather station ranging from -43.0 °C to 34.4 °C (Table 6-1). January is the coldest month with an average temperature of -17.9 °C, while July is the warmest month with an average temperature of 17.2 °C. Figure 6-1 shows the average temperature variation for the 1981 to 2020 averages.

On average, the first day of frost occurs around September 11 and the last day of frost around June 10.

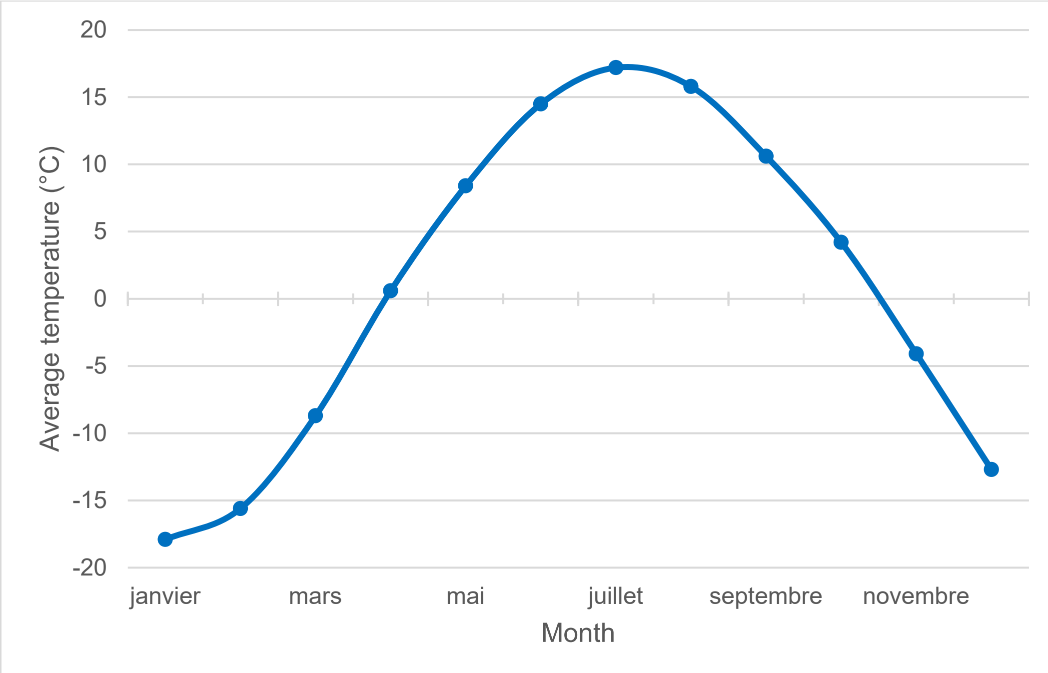
Table 6-1 Temperature normals at the Lebel-sur-Quévillon weather station (1981 to 2010 period)

Month	Daily average (ºC)	Daily maximum (ºC)	Daily minimum (ºC)
January	-17.9	-12.1	-23.6
February	-15.6	-9.3	-21.9
March	-8.7	-2.3	-15.0
April	0.6	6.4	-5.2
May	8.4	14.6	2.1
June	14.5	20.8	8.1
July	17.2	23.1	11.4
August	15.8	21.3	10.2
September	10.6	15.3	6.0
October	4.2	7.9	0.4
November	-4.1	-0.7	-7.4
December	-12.7	-8.1	-17.4
Year	**1.0**	**6.4**	**-4.4**

Source: Environment and Climate Change Canada.

1 Environment Canada: https://climate.weather.gc.ca/climate_normals/results_1981_2010_e.html?searchType=stnName&txtStationName=lebel&searchMethod=contains&txtCentralLatMin=0&txtCentralLatSec=0&txtCentralLongMin=0&txtCentralLongSec=0&stnID=6051&dispBack=1

Figure 6-1 Variation of average temperature (1981 to 2010 period)



6.1.2 PRECIPITATION

Total annual precipitation averages 927.8 mm and is highest from April to October (Table 6-2). Snowfalls occur from October to April and average 226.2 mm of water annually. These climate patterns affect the flows of the watercourses at the Windfall project site.

Figure 6-2 shows the monthly rainfall amounts and Figure 6-3 shows the monthly snowfall amounts.

Table 6-2 Temperature normals at the Lebel-sur-Quévillon weather station (1981 to 2010 period)

Month	Rainfall (mm)	Snowfall (cm)	Total precipitation (mm)	Mean snow cover (cm)	Median snow cover (cm)	Snow cover, end of month (cm)
January	2.3	50.2	52.4	42	42	52
February	2.6	26.2	28.8	52	53	52
March	11.8	31.2	43.0	49	50	35
April	38.8	18.6	56.6	16	15	0
May	78.5	2.9	81.3	0	0	0
June	94.1	0.0	94.1	0	0	0
July	120.6	0.0	120.6	0	0	0
August	103.0	0.0	103.0	0	0	0
September	115.5	0.3	115.8	0	0	0
October	87.8	7.7	95.5	0	0	1
November	39.9	36.9	76.7	7	6	12
December	7.5	52.3	59.8	21	21	30
Year	**702.3**	**226.2**	**927.8**	**16**	**16**	**15**

Source: Environment and Climate Change Canada, 2022.

Figure 6-2 Monthly rainfalls

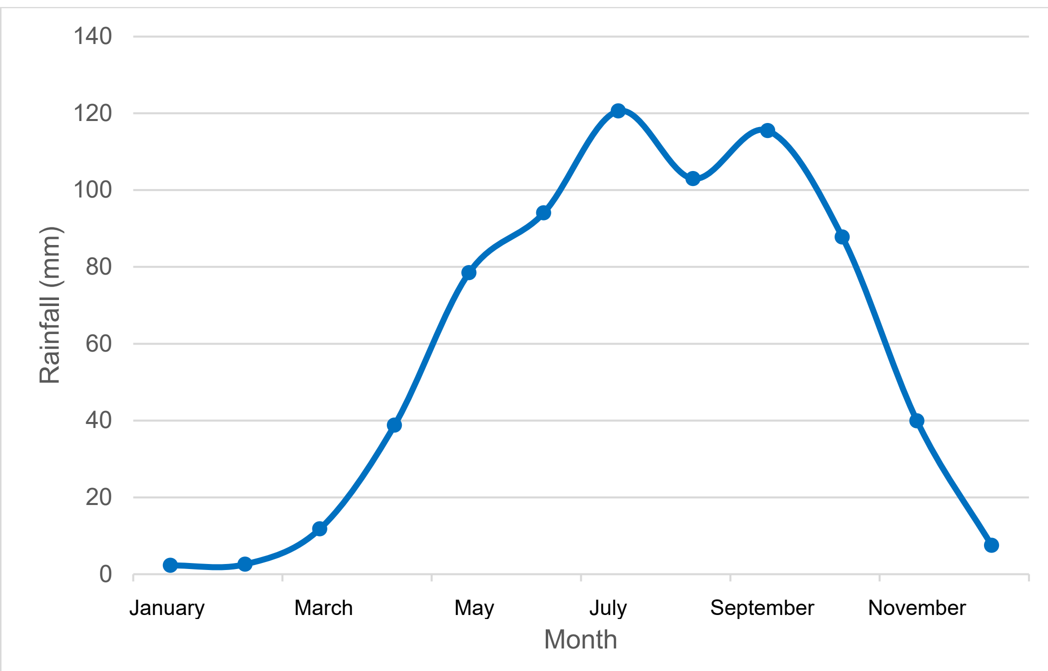
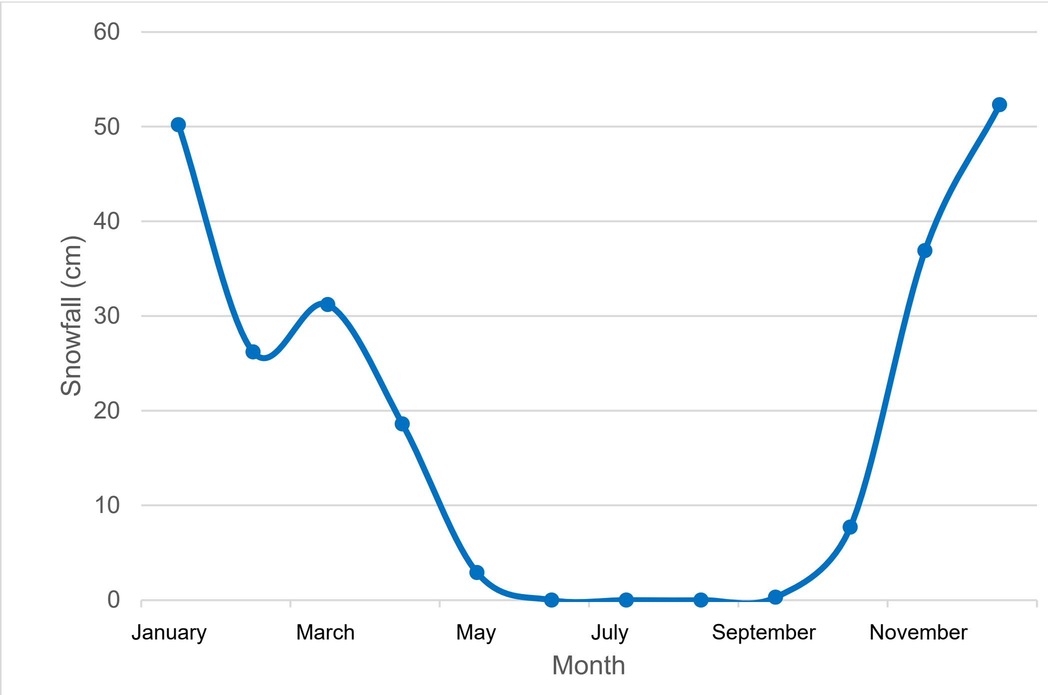


Figure 6-3 Monthly snowfalls



Daily precipitation extremes (Table 6-3) were approximately 78.5 mm of rain, recorded on October 14, 1979, and 40 mm of snow water equivalent, recorded on October 14, 1979. The snow cover on the ground reached a record of 95 cm in March 1997.

Table 6-3 Extreme precipitation at the Lebel-sur-Quévillon weather station (1981 to 2010 period)

Month	Rain (mm)	Date (yyyy/dd)	Snow (cm)	Date (yyyy/dd)	Total precipitation (mm)	Date (yyyy/dd)	Extreme snow cover (cm)	Date (yyyy/dd)
January	22.9	1995/14	31	1978/09	30.5	1978/09	82	1997/25
February	7.8	1981/23	21	1995/15	20.6	1995/15	95	1990/17
March	12.7	1973/11	23	1989/14	23.4	1992/09	95	1997/27
April	33.6	1981/04	14	1986/21	33.6	1981/04	83	1997/01
May	34.4	1986/01	12	1967/16	46.4	1986/01	12	1986/02
June	50.8	1971/20	3	1980/09	50.8	1971/20	0	1981/01
July	52.0	1991/16	0	1967/01	52.0	1991/16	0	1981/01
August	51.0	1988/14	0	1967/01	51.0	1988/14	0	1980/01
September	58.4	1978/02	3	1992/29	58.4	1978/02	0	1980/01
October	43.0	1989/20	40	1979/14	78.5	1979/14	17	1993/10
November	43.2	1974/03	18	1976/27	43.2	1974/03	35	1980/17
December	20.3	1977/01	23	1979/20	22.9	1976/20	45	1980/24

Source: Environment and Climate Change Canada, 2022.

6.1.3 WINDS

Weather data compiled by Environment Canada and recorded at the Matagami weather station. The station identification number according to the World Meteorological Organization is 71821.

The weather station is located at Matagami Airport. The station coordinates are:

- latitude: 49° 45’ 28.02" N;
- longitude: 77° 47' 35.06" W;
- altitude: 281.00 m.

The data included temperature, relative air humidity, barometric pressure, and wind direction and speed. These data were used to construct wind roses for the seasonal periods. The following figures present wind roses for fall (September to November), winter (December to February), spring (March to May), and summer (June to August), based on available data from 1994 to 2022.

Figure 6-4 Wind rose – Fall

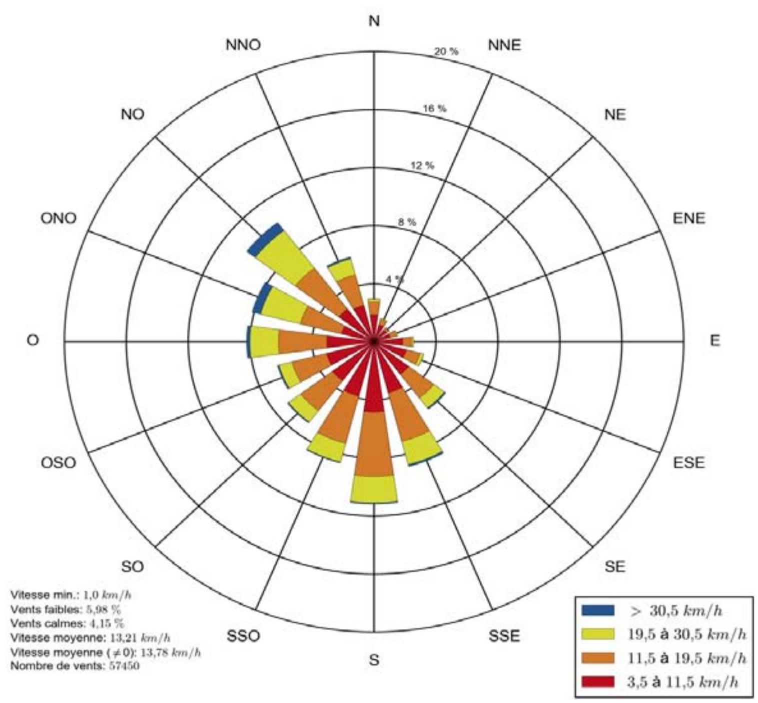


Figure 6-5 Wind rose – Winter

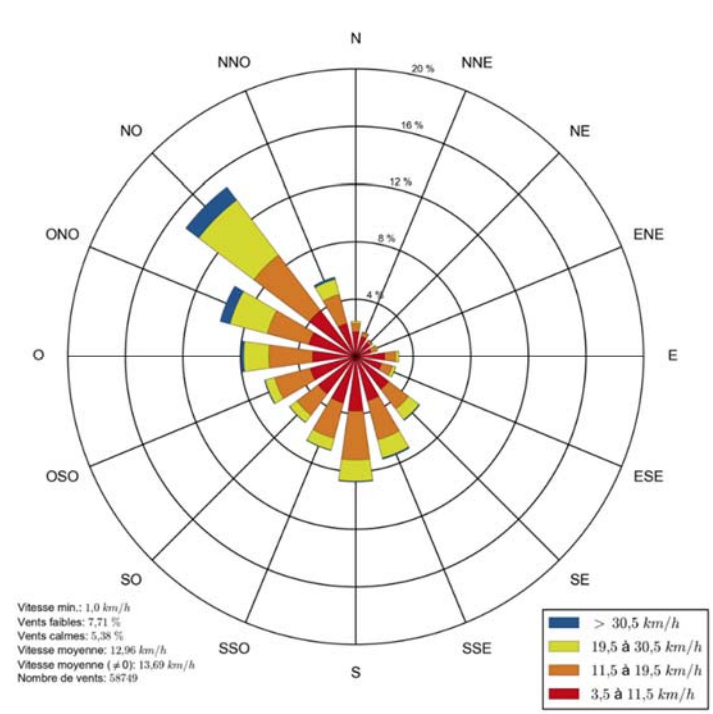


Figure 6-6 Wind rose – Spring

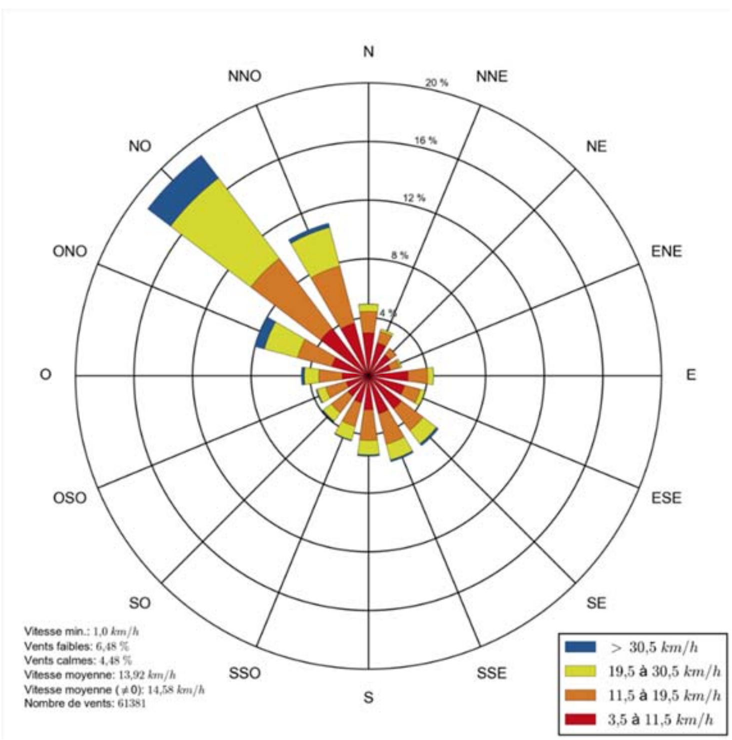
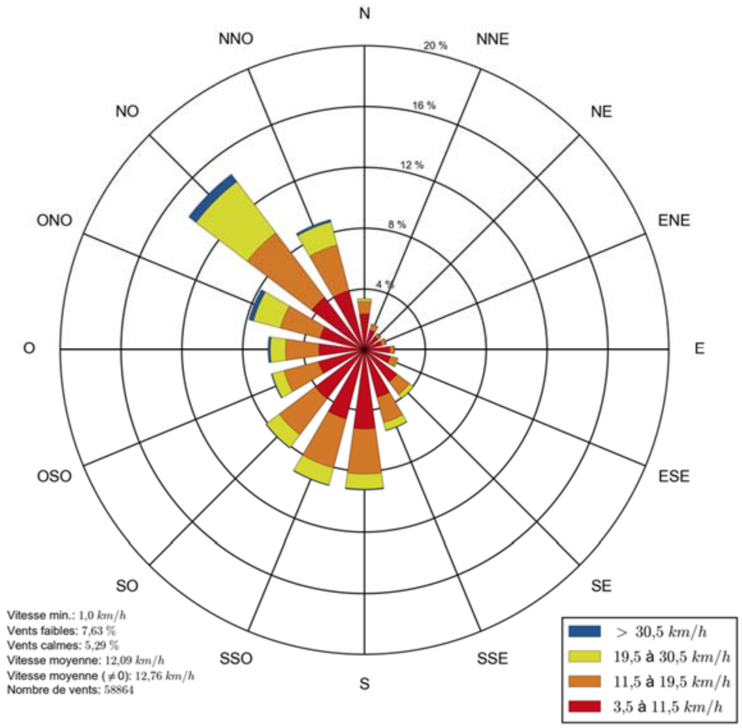


Figure 6-7 Wind rose – Summer



The prevailing winds remain essentially the same on an annual basis, namely northwest winds and a mix of south winds. In spring, winds from the southeast are more frequent than south winds. Winds from the southwest are more significant in summer. Annually, the northwest winds are also those that can reach the highest speeds.

6.1.4 EVAPORATION

Lake evaporation norms are from the Amos station (1981-2010). Table 6-4 shows the average monthly values for daily evaporation rates.

Table 6-4 Evaporation rate

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Evaporation (mm)	0	0	0	0	3.4	4.1	4.1	3.2	2	0	0	0

6.2 AMBIENT AIR

Important facts about ambient air

Existing conditions

Currently, there are no National Air Pollution Surveillance (NAPS) stations near the study area. The initial concentrations used in this study to characterize the current ambient air conditions come from generic initial concentrations prescribed by the MELCCFP for projects located in northern and remote environments (MDDELCC, 2017).

The project is located in a remote area with very little industrial activity nearby. The nearest First Nations camp is located 6 km from the project site, while a private cottage is located 1.4 km from the proposed infrastructure west of Lake SN1.

Potential impacts of the project

In the construction phase, development of the work areas and the access roads, construction of works and associated infrastructure, and mobile equipment traffic will be the source of various atmospheric contaminant emissions. The significance of the residual impact is considered low due to the distance separating the emission sites from the sensitive receptors.

In the operations phase and during construction of the new storage infrastructure of the accumulation and water management areas, the significance of the residual impact is considered medium due to the increase in emissions (crystalline silica) at sensitive receptors. However the duration will be medium because the impact on the ambient air will be felt discontinuously, but throughout operations.

In the closure phase, a low negative impact is anticipated on the ambient air for the associated work, particularly during final restoration of the new infrastructure. A positive impact is also expected after final restoration due to the improvement of air quality compared to the operations phase.

6.2.1 CURRENT CONDITIONS

The initial concentrations used in this study to characterize the current ambient air conditions are from generic initial concentrations prescribed by the MELCCFP for projects in northern and remote environments (MDDELCC, 2017).

Table 6-5 Standards and criteria associated with the modelled compounds

Substance	Acronym, chemical formula or CAS #	Gov. / Org.	Type of threshold	Period	Statistics	Limit value (µg/m³)	Initial concentration reference	Initial concentration (µg/m³)
Total particulate matter	TPM	MELCCFP	Standard	24 hours	1st maximum	120	Northern projects	40
Fine particulate matter	$PM_{2.5}$	MELCCFP	Standard	24 hours	1st maximum	30	Northern projects	15
Carbon monoxide	CO	MELCCFP	Standard	1 hour	1st maximum	34000	Northern projects	600
		MELCCFP	Standard	8 hours	1st maximum	12700	Northern projects	400
Nitrogen dioxide	NO_2	MELCCFP	Standard	1 hour	1st maximum	414	Northern projects	50
		MELCCFP	Standard	24 hours	1st maximum	207	Northern projects	30
		MELCCFP	Standard	1 year	1st maximum	103	Northern projects	10
Sulphur dioxide	SO_2	MELCCFP	Standard	4 minutes	1st maximum	1310	Northern projects	40
		MELCCFP	Standard	4 minutes	99.5th percentile	1050	Northern projects	40
		MELCCFP	Standard	24 hours	1st maximum	288	Northern projects	10
		MELCCFP	Standard	1 year	1st maximum	52	Northern projects	2
Silver	Ag	MELCCFP	Standard	1 year	1st maximum	0.23	Northern projects	0.005
Arsenic	As	MELCCFP	Standard	1 year	1st maximum	0.003	Northern projects	0.002
Barium	Ba	MELCCFP	Standard	1 year	1st maximum	0.05	Northern projects	0.02
Beryllium	Be	MELCCFP	Standard	1 year	1st maximum	0.0004	Northern projects	0
Bromine	Br	MELCCFP	Criterion	4 minutes	1st maximum	330	NCQQA v7	0
Bromine	Br	MELCCFP	Criterion	1 hour	1st maximum	6.6	NCQQA v7	0
Bromine	Br	MELCCFP	Criterion	1 year	1st maximum	0.13	NCQQA v7	0
Ethylbenzene	100-41-4	MELCCFP	Standard	4 minutes	1st maximum	740	NCQQA v7	140
		MELCCFP	Standard	1 year	1st maximum	200	NCQQA v7	3
Styrene (monomer)	100-42-5	MELCCFP	Standard	1 hour	1st maximum	1910	NCQQA v7	0
		MELCCFP	Standard	1 hour	98th percentile	150	NCQQA v7	0
1,3-Butadiene	106-99-0	MELCCFP	Criterion	1 year	1st maximum	0.3	NCQQA v7	0.27
Acrolein	107-02-8	MELCCFP	Criterion	4 minutes	99th percentile	8.3	-	-
		MELCCFP	Criterion	1 year	1st maximum	0.02	-	-
Toluene	108-88-3	MELCCFP	Standard	4 minutes	1st maximum	600	NCQQA v7	260
n-Hexane	110-54-3	MELCCFP	Standard	4 minutes	1st maximum	5300	NCQQA v7	140
		MELCCFP	Standard	1 year	1st maximum	140	NCQQA v7	3
Propanal	123-38-6	MELCCFP	Criterion	4 minutes	1st maximum	460	NCQQA v7	10
		MELCCFP	Criterion	4 minutes	99th percentile	20	NCQQA v7	10
Pyrene	129-00-0	MELCCFP	Criterion	1 year	1st maximum	13	NCQQA v7	0
Xylene (o-,m-,p-)	1330-20-7	MELCCFP	Standard	4 minutes	1st maximum	350	NCQQA v7	150
		MELCCFP	Standard	1 year	1st maximum	20	NCQQA v7	8
Formaldehyde	50-00-0	MELCCFP	Standard	15 minutes	1st maximum	37	NCQQA v7	3
Benzo(a)pyrene	50-32-8	MELCCFP	Standard	1 year	1st maximum	0.0009	NCQQA v7	0.0003
2,2,4-Trimethylpentane	540-84-1	MELCCFP	Criterion	1 hour	1st maximum	3500	NCQQA v7	0
		MELCCFP	Criterion	1 year	1st maximum	350	NCQQA v7	0
Benzene	71-43-2	MELCCFP	Standard	24 hours	1st maximum	10	NCQQA v7	3
Acetaldehyde	75-07-0	MELCCFP	Criterion	4 minutes	99th percentile	3	-	-
		MELCCFP	Criterion	1 year	1st maximum	0.5	-	-
Naphthalene	91-20-3	MELCCFP	Standard	4 minutes	1st maximum	200	NCQQA v7	5
		MELCCFP	Standard	1 year	1st maximum	3	NCQQA v7	0
Cadmium	Cd	MELCCFP	Standard	1 year	1st maximum	0.0036	Northern projects	0.0005
Cobalt	Co	MELCCFP	Criterion	1 year	1st maximum	0.1	Northern projects	0
Chromium (hexavalent chromium compounds)	Cr(VI)	MELCCFP	Standard	1 year	1st maximum	0.004	Northern projects	0.002
Chromium (trivalent chromium compounds)	Cr(III)	MELCCFP	Standard	1 year	1st maximum	0.1	Northern projects	0.01
Copper	Cu	MELCCFP	Standard	24 hours	1st maximum	2.5	Northern projects	0.2
Polycyclic aromatic hydrocarbons (1)	PAH	MELCCFP	Criterion	1 year	1st maximum	0.0024	NCQQA v7	0.0014
Hydrogen chloride	HCl	MELCCFP	Standard	4 minutes	1st maximum	1150	NCQQA v7	0
		MELCCFP	Standard	1 year	1st maximum	20	NCQQA v7	0
Mercury	Hg	MELCCFP	Standard	1 year	1st maximum	0.005	Northern projects	0.002
Manganese	Mn	MELCCFP	Criterion	1 year	1st maximum	0.025	Northern projects	0.005
Nickel	Ni	MELCCFP	Standard	24 hours	1st maximum	0.07	Northern projects	0.002
		MELCCFP	Standard	1 year	1st maximum	0.02	NCQQA v7	0.002
Lead	Pb	MELCCFP	Standard	1 year	1st maximum	0.1	Northern projects	0.004
Dioxins and furans	PCDD/F	MELCCFP	Standard	1 year	1st maximum	0.00000006	NCQQA v7	0.00000004
Antimony	Sb	MELCCFP	Standard	1 year	1st maximum	0.17	Northern projects	0.001
Selenium	Se	MELCCFP	Criterion	1 hour	1st maximum	2	NCQQA v7	0.15
Crystalline silica	SiO_2	MELCCFP	Criterion	1 hour	1st maximum	23	NCQQA v7	6
		MELCCFP	Criterion	1 year	1st maximum	0.07	NCQQA v7	0.04
Tin	Sn	MELCCFP	Criterion	4 minutes	1st maximum	2	-	-
		MELCCFP	Criterion	1 year	1st maximum	0.1	-	-
Titanium	Ti	MELCCFP	Criterion	24 hours	1st maximum	2.5	NCQQA v7	0
Thallium	Tl	MELCCFP	Standard	1 year	1st maximum	0.25	Northern projects	0.005
Vanadium	V	MELCCFP	Standard	1 year	1st maximum	1	Northern projects	0.01
Zinc	Zn	MELCCFP	Standard	24 hours	1st maximum	2.5	Northern projects	0.1

[1] Criterion for all PAHs expressed in toxic equivalent (TE) of B[a]P ($B[a]P_{TE}$).

6.2.2 AMBIENT AIR IMPACTS IN THE CONSTRUCTION PHASE AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the construction phase, the sources of potential impacts and the resulting impacts (**in bold**) that could affect the ambient air are as follows:

- Organization of the site, stripping and clearing, including opening and operating borrow pits, construction of works and infrastructure, and transportation and traffic.

These sources have the potential to result in the following negative impact during the construction phase:

Degradation of ambient air quality by:

- suspension of fine particulate matter;
- increase in concentrations of certain atmospheric contaminants.

MITIGATION MEASURES

Common mitigation measures AIR01 to AIR07 and AIR09 will be applied to limit the project's impact on ambient air (Appendix 5-2). Protection of ambient air is governed by several regulations and standards, particularly in the field of mining projects. Standard NOR01 will also be followed rigorously.

The following specific mitigation measure will also be implemented: P26

DETAILED DESCRIPTION OF RESIDUAL IMPACT

DEGRADATION OF AMBIENT AIR QUALITY

Atmospheric dispersion modelling was completed to simulate the future conditions during construction. Since the intensity of activity in the construction years of the project (2024-2025) was less than when combined with the operations phase, the planning for the subsequent development phases was run through scenarios. The increase in intensity is mainly due to the longer hauling distances, as the Flamb-1 borrow pit will be depleted of certain grain size fractions at the end of the construction phase. In all, four scenarios were studied. The details are provided below:

1 Waste rock stockpile expansion - construction activity in 2029 (two scenarios)

In Year 4 of operations, it will be necessary to expand the waste rock stockpile, i.e., to proceed with site preparation and surface development. Figure 3-8 presents the development sequence of the waste rock stockpile and the sector that will be expanded. To do this, the surplus material must be stripped and moved to the overburden stockpile. It will also be necessary to regrade the surface, which will allow positioning of the lined geomembrane. Backfill will then be placed over the surface of the geomembrane to protect it from puncturing. These activities are included in a first construction modelling scenario.

Parallel to these activities, two new ponds will be constructed, Ponds F and D2, because the surface expansion will lead to greater encroachment and therefore to management of additional water. To create Pond D2, blasting of the rock at the surface will be required. Drilling will allow for the creation of holes to load the explosives. The blasted rock will be trucked to the crusher area where the material will be reduced to the proper fractions for reclamation. Pond preparation and trucking are included in the second modelling scenario.

To proceed with this work, only during the summer season, it will be necessary to use a crusher, bulldozers, excavators, dump trucks and drills. It is anticipated that the construction activities for the waste rock stockpile will not require additional granular material other than that reused on site and that produced by rock blasting.

2 The expansion of the tailings storage facility, i.e., Phase 2 construction, in 2030

In Year 5 of operations, in 2030, the second phase of the tailings storage facility will be initiated. Figure 3-10 presents the development sequence of the tailings storage facility, including Phase 2, which must be ready for operation in Year 6. The nature of the activities presented for the waste rock stockpile expansion will be similar to those required for the tailings storage facility expansion. No additional ponds will be constructed and no blasting is planned. The quantities of material to be moved will be greater, however, since the surface area is twice as large as that of the waste rock stockpile. The necessary material will therefore come from the borrow pits, so the material moved will come from farther away.

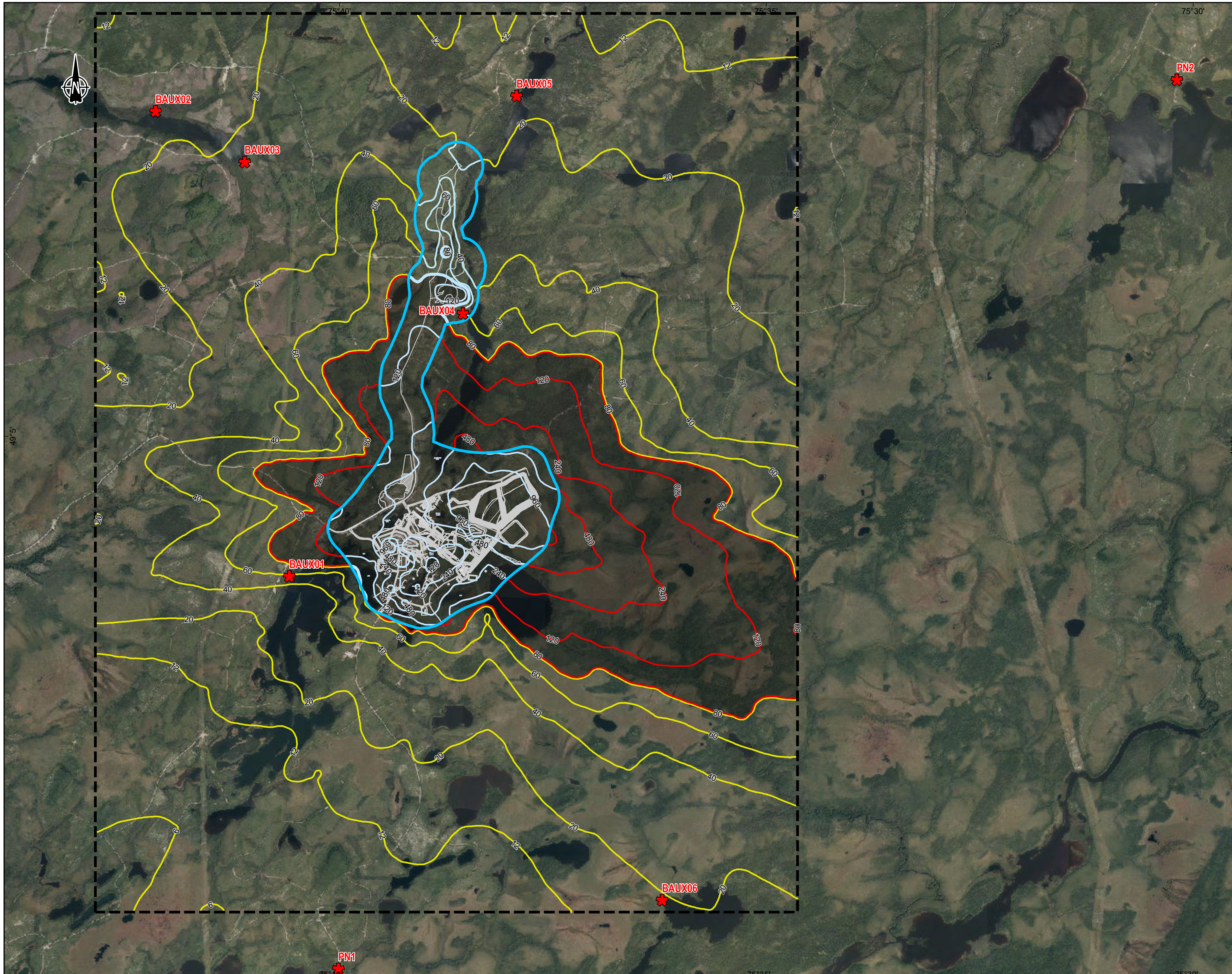
First, the unsuitable topsoil and unconsolidated deposits will be moved to the overburden stockpile. Next, the sand will come from borrow pit Flamb-1, while the other rockfill fractions will be taken from borrow pits Gravtest-3 (mostly) and Gravtest-4. Map 3-7 illustrates the position of the two Gravtest borrow pits (3 and 4) in relation to the Windfall site. To operate the Gravtest-3 borrow pit only, the material will have to be screened. With a loader, it will be possible to separate the material into stockpiles and proceed to load the transport trucks. A certain proportion of the material will be loaded as is (without screening), like the material taken from Gravtest-4 and Flamb-1.

The borrow pit material is suitable for regrading the surface of the tailings storage facility to install the lined geomembrane. Once installed, a protective layer will be added on top, thus allowing the movement of machinery on the geomembrane while ensuring its integrity. The same types of equipment will be used as for the expansion work on the waste rock stockpile. Activities will also be carried out during the summer season.

3 Closure of Phase 1 of the tailings storage facility in 2031

The year following the commissioning of Phase 2 of the tailings storage facility, it will be possible to proceed with the closure of Phase 1, thus ensuring the progressive restoration of the tailings storage facility. Similar to the activities presented in the previous scenario, the area will be closed by performing the following steps in reverse: grading the surfaces, adding the lined geomembrane, adding the top layer of sand mainly on top of the geomembrane, and then adding a layer of material from the overburden stockpile. Seeding will follow to allow regrowth of the vegetation. As in other years, the work will be done in the summer.

The modelling results are shown on Map 6-1. The 24-hour average results for total particulate matter are presented. The maximum values were collected for each receptor point in the four construction scenarios presented above. Thus, the worst case, regardless of the activity performed, is shown on the map.



Domaine de modélisation / *Modeling domain*

Limite d'application des normes et critères / *Application limit for standards and criteria*

Récepteur sensible / *Sensitive receptor*

Infrastructures (existants et projetés) / *Infrastructures (existing and projected)*

Courbe isoconcentration (µg/m³) /
Isoconcentration curve (µg/m³)

Supérieure à la valeur limite / *Above the limit value*

Inférieure à la valeur limite / *Below limit value* (considérant la concentration initiale / *considering the initial concentration*)

Hors domaine d'application / *Outside application domain*

Valeur limite : 120 µg/m³ / *Limit value: 120 µg/m³*
Concentration initiale : 40 µg/m³ / *Initial concentration: 40 µg/m³*

Concentrations maximales modélisées
Substance : Particules totales (PMT)
Période : 24 heures
Scénario : Exploitation CMax
Valeur limite : MELCCFP (Norme)
Concentration initiale : Projets Nordiques /

Maximum Modelled Concentrations
Substance: Total particulates (PMT)
Period: 24-hour
Scenario: Exploitation CMax
Limit value: MELCCFP (Norme)
Initial concentration: Projets Nordiques

OSISKO
MINIÈRE OSISKO

Projet minier Windfall - Étude d'impact sur l'environnement /
Windfall Mining Project - Environmental Impact Assessment
Site minier Windfall, Eeyou Istchee Baie-James (Québec) /
Windfall Mining Site, Eeyou Istchee Baie-James (Quebec)

Carte 6-1 / *Map 6-1*
Concentration maximale de particules totales modélisées sur une période de 24 heures – scénario combiné de construction et d'exploitation /
Maximum modeled 24-hour total particulate matter concentration – combined construction and operation scenario

Source :
Photos aériennes de l'inventaire écoforestier

0 550 1 100 m
UTM, fuseau 18, NAD83

2023-03-28

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The activities scheduled to proceed with development of the site, such as setting up the site, stripping and clearing the work areas, construction of works and infrastructure, and mobile equipment traffic, will temporarily and locally increase the concentrations of particulate matter and atmospheric contaminants. These alterations of the local ambient air may induce impacts on the health of plant life, by deposition, and on wildlife health and human health, by inhalation. It should be noted, however, that for plants and wildlife, the impact of changes in air quality was considered individually for each biological component through the impact of disturbance (see Chapter 7). The impacts on human health are considered through the degradation of ambient air quality and assessed in relation to the potentially affected sensitive receptors, namely the two non-First Nations camps located about 1.4 km and 2.5 km from the centre of the Windfall site, and the First Nations camp located about 6 km from the site.

RESIDUAL IMPACT ASSESSMENT

The ecosystem value assigned to ambient air is medium because contaminants in ambient air are a source of disturbance and can potentially affect the health of land users.

As for the degradation of ambient air quality, given the mitigation measures that will be put in place, the intensity of the residual impact is considered low. Its spatial scope is local since the impacts will essentially be felt within the study area where the construction work will take place, and its duration is short since it is limited to the construction phase. The probability of occurrence is high because it is certain that emissions affecting air quality will be emitted during the work. The result will be a residual impact of low significance.

Impact on ambient air quality in the construction phase		
Nature	Negative	Significance: Low
Ecosystem value	Medium	
Socioeconomic value	Not applicable	
Degree of disturbance	Low	
Intensity	Low	
Spatial scope	Local	
Duration	Short	
Probability of occurrence	High	

6.2.3 AMBIENT AIR IMPACTS IN THE OPERATIONS PHASE AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the operations phase, the sources of potential impacts and the resulting impacts (**in bold**), that could affect ambient air are as follows:

— The presence and operation of new infrastructure, including the process plant and the accumulation areas, transportation and traffic, and production and management of residual and hazardous materials.

These sources have the potential to result in the following negative impacts during the operations phase:

Degradation of ambient air quality by:

- The suspension of fine particulate matter;
- increase in concentrations of certain atmospheric contaminants;
- airborne metal emissions.

The tables in Appendix A of the air dispersion modelling sectorial study (Appendix 6-1) present the estimated particulate matter emission rates and gaseous compound emission rates under the project operations scenario.

MITIGATION MEASURES

The common mitigation measures AIR01, AIR02, AIR04 to AIR09, standard NOR01 and specific measures P01 and P26 will apply in the operations phase to minimize the ambient air disturbances in the vicinity of the new infrastructure.

The modelling results of the operations scenario account for these common and specific mitigation measures. Exceedances nonetheless are expected at the sensitive receptors for crystalline silica. Osisko proceeded with additional adjustments in the operating methods anticipated in relation to the results presented in Appendix 6-1. All of the measures taken in consideration are summarized in Table 6-6.

Table 6-6 Summary of considerations for reducing or controlling SiO_2 concentrations

Category	Measure presented
Material on the road surfaces	Laying of gabbro on the road surfaces since this lithology has a lower percentage of silica.
Mode of operation of the tailings storage facility	Despite the fact that the tailings storage facility is composed of filtered tailings as part of the risk management at the site (absence of water retention dike), Osisko will study the possibility of installing misters to diffuse water into the air above the inactive areas of the tailings storage facility. This will apply only for the areas where the upgrade is not in progress since it is impossible to spray and ensure the integrity of the compaction activity of the tailings storage facility, particularly for safety reasons. This solution will be studied more closely in the detail engineering that is underway.
Ambient air monitoring	Atmospheric dispersion modelling is a predictive tool for concentrations that might be expected but remain uncertain due to the conservatism of the models. To ensure field verification of the concentrations measured for the different substances, including silica, an ambient air monitoring program is proposed. The details of this program are presented in Chapter 13.

DETAILED DESCRIPTION OF RESIDUAL IMPACT

AIRBORNE PARTICULATE MATTER AND METAL EMISSIONS

During the operations phase, ongoing site activities will generate emissions of particulate matter and metals to the air. They mainly involve mobile equipment traffic on the site that will bring ore, waste rock, and tailings into their respective accumulation areas. There will be times (three summers) when the operations activities will be combined with certain construction activities, such as during the waste rock stockpile expansion, including the development of two new ponds in addition to the two subsequent phases of tailings storage facility development. The machinery traffic for extraction of materials from the borrow pits, stripping of surfaces, and development work will generate dust containing silica and metals, in particular.

The list of mobile equipment planned on the site is detailed in Section 3.8.7. Surface equipment as well as that required for underground operations is also included. In addition, Table 3-13 presents the characteristics of the point sources, such as ventilation chimneys and vents. The road surfaces and stockpiles that are likely to generate airborne particulate matter are detailed in Appendix 6-1. Except for the silica criterion, all the thresholds of the Clean Air Regulation standards are met at the potentially affected sensitive receptors, i.e., the two non-First Nations camps (located at approximately 1.4 km and 2.5 km from the Windfall site) and the First Nations camp (located at approximately 6 km from the Windfall site).

GASEOUS CONTAMINANT EMISSIONS

Although the mobile equipment used must conform to the standards of the Regulation respecting environmental standards for heavy vehicles and the fuels used will comply with the regulatory provisions of the Petroleum Products Act, gaseous emissions (NO_x, SO_2 and CO) will be produced during the operations phase. The propane heating units and the various chimneys of the buildings could also generate gaseous compounds. For underground operations, the underground air exhaust via the ventilation stacks was also modelled.

RESIDUAL IMPACT ASSESSMENT

The ecosystem value for ambient air is medium because contaminants in ambient air are a source of disturbance and can potentially affect the health of wildlife and land users.

The degree of disturbance was considered medium due to the increase in airborne particulate matter and gaseous contaminants. Indeed, the results following the implementation of the common and specific mitigation measures presented in the previous sections show compliance with the standards and criteria at all sensitive receptors, except for the modelled crystalline silica concentrations. Thus, the intensity of the anticipated impact is medium.

The spatial scope is considered local because the impact on the ambient air will be felt near the new infrastructure, within the local study area. The duration will be medium, because the impact on air quality will be felt discontinuously, but throughout the operations. The probability of occurrence of the residual impact is assessed as high. Thus, the significance of the residual impact is medium.

Impact on ambient air quality in the operations phase		
Nature	Negative	Significance: Medium
Ecosystem value	Medium	
Socioeconomic value	Not applicable	
Degree of disturbance	Medium	
Intensity	Medium	
Spatial scope	Local	
Duration	Medium	
Probability of occurrence	High	

6.2.4 AMBIENT AIR IMPACTS IN THE CLOSURE PHASE AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the closure phase, the sources of potential impacts and the resulting impacts (**in bold**), that may affect the ambient air are as follows:

— Final restoration.

This source has the potential to result in the following negative impacts during the operations phase:

Degradation of ambient air quality by:

— suspension of fine particulate matter;
— increase in concentrations of certain atmospheric contaminants;
— airborne metal emissions.

It also generates a positive impact while the emissions progressively diminish and eventually cease.

MITIGATION MEASURES

The same common mitigation measures recommended in the operations phase will be applied during the closure phase.

Specific mitigation measures will be identified in the final restoration plan.

DETAILED DESCRIPTION OF THE RESIDUAL IMPACT

The number of machines involved will be very low in the closure phase, considering the shutdown of mineral extraction operations and the shutdown of operations in the various stockpiles. However, the restoration activities will require machinery.

AIRBORNE PARTICULATE MATTER AND METAL EMISSIONS

During the closure phase, the restoration activities will not result in any additional increase in particulate matter and gaseous contaminant emissions relative to the current operations situation. The anticipated impacts will be of the same nature as during the construction of new infrastructure but lower since there will be no new construction.

REDUCTION OF AIRBORNE PARTICULATE MATTER AND METALS AND GASEOUS CONTAMINANT EMISSIONS

At the end of the restoration work and final revegetation of the exposed surfaces, gaseous contaminant emissions will cease completely while particulate matter emissions will be greatly reduced.

RESIDUAL IMPACT ASSESSMENT

The ecosystem value attached to ambient air is medium because contaminants in ambient air are a source of disturbance and can potentially affect the health of land users.

The degree of disturbance was considered low due to the negligible increase in airborne particulate matter and gaseous contaminants compared to the current situation. Thus, the intensity of the impact is qualified as low. The spatial scope is considered local because the impact on ambient air will be felt only near the mine, within the local study area. The duration will be short because the impact on ambient air will be felt temporarily throughout the various sites. The probability of occurrence of the residual impact is assessed as high. Thus, the significance of the residual impact is considered low.

Once the closure phase is finished and the rehabilitation has been completed, a positive impact on the ambient air is expected.

<table>
<tr><th colspan="3">Impact on ambient air quality in the closure phase</th></tr>
<tr><td>Nature</td><td>Negative/positive</td><td rowspan="8">Significance:

increase in particulate matter and gaseous contaminants – Low

Decrease in airborne particulate matter – Positive impact</td></tr>
<tr><td>Ecosystem value</td><td>Medium</td></tr>
<tr><td>Socioeconomic value</td><td>Not applicable</td></tr>
<tr><td>Degree of disturbance/Improvement</td><td>Low</td></tr>
<tr><td>Intensity</td><td>Low</td></tr>
<tr><td>Spatial scope</td><td>Local</td></tr>
<tr><td>Duration</td><td>Short</td></tr>
<tr><td>Probability of occurrence</td><td>High</td></tr>
</table>

6.3 GREENHOUSE GASES

Important facts about greenhouse gases

Current conditions

The assessment of greenhouse gas (GHG) emissions related to the Windfall project is based on the project data and mine plan available at the time of the study. This information was used to estimate the project's GHG emissions based on the data available at this stage of progress.

The project's main sources are related to combustion of fossil fuels, which generate CO_2, CH_4 and N_2O.

It is important to mention that the Windfall project will be connected to the Hydro-Québec power distribution grid. This technological choice saves approximately 173 kT of CO_2eq compared to using generators to produce the same amount of electricity.

The GHG emissions related to construction of the components of the project (excluding transportation and logistics) are estimated at 74.5 Kt of CO_2eq over a period of about 18 months. During the operations phase, the direct GHG emissions would average about 30.1 Kt of CO_2eq/year for 10 years. This represents 0.04% of the total provincial emissions. As an indication, annual emissions from project activities would represent 0.005% of total federal emissions.

Potential impacts of the project

The significance of the residual impact on GHG emissions is considered medium for the construction and operations phases. For each phase of the project, environmental monitoring will allow quantification of the real GHG emissions and produce the emission statements required by the provincial and federal governments.

In the closure phase, the significance of the residual impact is also considered medium.

6.3.1 CURRENT CONDITIONS

Project activities will generate GHG emissions. The scientific consensus is that these GHG emissions are causing global climate change phenomena. Quantities of GHG emissions, which consist primarily of carbon dioxide (CO_2), methane (CH_4), and nitrous oxides (N_2O), are determined using MELCC (2022a) and Environment and Climate Change Canada (2022) estimating methodologies.

The inventory limits considered for the description and analysis of the project's impacts correspond to the construction activities on the stockpiles (waste rock, overburden, and ore), the tailings storage facility, the process plant, the water treatment plant and mine effluent, the tailings filtration and underground fill preparation plant, and the conventional infrastructure for an underground extraction project. The quantities of GHG emissions were compared to the reporting thresholds of the two levels of government, provincial and federal, and put in context by comparison with total emissions on a federal and provincial basis.

The project description data was used to define the scope of the inventory and the sources to be included. The data on use of machinery in construction and the mining plan were consulted to establish the project input data and the intermediate assessments of the emissions of the project's components. These studies were considered sufficient to finalize the quantification of GHG emissions. A technical note in Appendix 6-2 presents the detailed calculations and the references used for the description and analysis of the impacts.

IN CANADA

According to the National GHG Emissions Report 1990–2020 (Environment and Climate Change Canada, 2021), total GHG emissions in 2020 for Canada were 672 Mt of CO_2eq.

According to the sectors of activity defined in the executive summary of the National Inventory Report 1990-2020, the mining activities other than exploitation of oil and gas are classified in the "Heavy Industry" category. This sector emitted 72 Mt of CO_2eq in 2020.

The project's estimated contribution through its annualized average direct emissions would amount to 0.04% of the emissions related to this sector of activity. Annual emissions from project activities would represent 0.005% of total federal emissions. The contribution of direct emissions from project operations is therefore low.

IN QUEBEC

In 2020, Quebec's total GHG emissions were 74 Mt CO_2eq, or 8.6 t per capita, representing 11.0% of Canada's total emissions of 672 Mt CO_2eq.

The sector that produced the most GHG emissions in Quebec in 2020 was transportation (road, air, sea, rail, and off-road). The industry sector ranked second, reaching 22.7 Mt CO_2eq, or 30.6% of total emissions.

These emissions are distributed as follows: 45.2% from energy consumption, 54.2% from industrial processes, and 0.6% from fugitive emissions and the use of solvents and other products (MELCCFP, 2022).

The project studied is part of the industry sector. During the operations of the mine, GHG emissions (direct and indirect) would average approximately 30.1 kt CO_2eq/year. The project emissions would represent 0.1% of industrial emissions and 0.04% of total provincial emissions. The contribution of direct emissions is therefore low.

6.3.2 GREENHOUSE GAS IMPACTS IN THE CONSTRUCTION PHASE AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the construction phase, the sources of potential impacts and the resulting impacts (**in bold**), that may have an impact on GHG, are as follows:

— Organization of the site, stripping and clearing, surface preparation and access arrangement, construction of works and infrastructure, and transportation and traffic.

These sources have the potential to result in the following impacts during the construction phase:

GHG emissions by:

- use of mobile and stationary equipment during construction work;
- clearing of surfaces.

MITIGATION MEASURES

Common mitigation measures AIR02 to AIR07, NOR01, and PLA01 will be applied to minimize GHG emissions.

The following specific mitigation measure will also be implemented: P26

DETAILED DESCRIPTION OF RESIDUAL IMPACT

GHG EMISSIONS

The assessment of the project's emissions during the construction phase includes diesel combustion by mobile and stationary equipment (8,516,951 L of diesel assessed by Osisko over a period of 18 months) for construction of new infrastructure, as well as transportation on the mine site and the emissions emitted by clearing of surfaces (Appendix 6-2). To this number must be added the underground preproduction activities that will open up the areas necessary to begin commercial production in the operations phase. Moreover, propane consumption for heating of the buildings must also be included in the grand total.

The GHG emissions for the combustion portion of construction would amount to 23.4 kT CO_2eq (Table 6-7). Indirect GHG emissions for the logistic transport combustion part would amount to about 5 kT CO_2eq.

Table 6-7 Quantity of GHG emitted by diesel combustion during the construction phase

Phase	Fuel	GHG emissions (tonnes)			
		CO_2	CH_4	N_2O	CO_2eq
Construction, direct emissions	Diesel (off-road)	22,830	0.622	1,933	23,421
Construction, indirect emissions	Road diesel	4,906	0.201	0.276	4,994

The GHG emissions for the surface clearing portion would total 16.8 kT CO_2eq (Table 6-8).

Table 6-8 GHG emissions due to clearing

Natural environment class	Carbon storage CO_2eq (T)
Terrestrial environments	
Hardwood	
Birch stand	220
Mixedwood	
Non-commercial hardwood and unspecified hardwood with unspecified softwood	628
Balsam fir-white birch stand	3,076
Unspecified mixedwood	3,037
Regeneration and planting	
Mixed shrub regeneration	135
Coniferous shrub regeneration	2,710
Softwood	
Black spruce-moss stand	1,902
Wetlands	
Tree swamp	190
Wooded ombrotrophic bog	219
Shrub swamp	0
Wooded fen	439
Open fen	1,494
Open ombrotrophic bog	2,796
Total natural environments	**16,846**

The GHG emissions for the preproduction phase would total 34.2 kT CO_2eq (Table 6-9).

Table 6-9 GHG emissions for the preproduction phase (2024-2025)

Zone	Fuel	Type of source	GHG emissions (tonnes)			
			2024-25			
			CO_2	CH_4	N_2O	CO_2eq
Surface	Diesel (road)	Mobile	1,180	3.0^E-02	9.69^E-02	1,210
	Diesel (off-road)	Mobile	3,039	8.28^E-02	1.02	3,118
	Propane (heating)	Stationary	3,743	5.93^E-02	8.21^E-02	3,823
	Propane (stationary equipment)	Stationary	503	7.96^E-03	3,590^E-02	513
WTP	Propane (heating)	Stationary	1,501	2.38^E-02	1.07^E-01	1,533
Plant	Propane (heating)	Stationary	3,275	5.19^E-02	2.33^E-01	3,345
Mine	Emulsion	Explosives				344
	Propane (heating)	Stationary	7,248	1.15^E-01	5.17^E-01	7,405
	Diesel (off-road)	Mobile	12,289	3.35^E-01	1.04	12,608
Generator	Diesel (stationary)	Stationary	323	8.82^E-03	2.74^E-02	332
Total stationary			16,593	2.67^E-01	1.19	16,953
Total mobile			16,508	4.48^E-01	1.4	16,936
Total explosives			-	-	-	344
Total			33,101	7.14^E-01	2.59^E+00	34,234

Thus, the total GHG emissions for construction would amount to 74.5 kT CO_2eq.

RESIDUAL IMPACT ASSESSMENT

The ecosystem value assigned to GHGs is medium and the degree of disturbance was deemed low because annual emissions are below the mandatory participation threshold in the Quebec carbon market. The anticipated intensity is therefore low. The spatial scope of the impact will be regional and the impact will be felt over a short duration. The probability of occurrence is high due to the direct link between the use of fossil fuels and generation of GHG. Thus, the significance of the residual impact is medium.

Impact on GHG in the construction phase		
Nature	Negative	Significance: Medium
Ecosystem value	Medium	
Socioeconomic value	Not applicable	
Degree of disturbance	Low	
Intensity	Low	
Spatial scope	Regional	
Duration	Short	
Probability of occurrence	High	

6.3.3 GREENHOUSE GAS IMPACTS IN THE OPERATIONS PHASE AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the operations phase, the sources of potential impacts and the resulting impacts (**in bold**), that may affect GHGs, are as follows:

— The presence and operation of new infrastructure, transportation and traffic, production and management of residual and hazardous materials.

These sources have the potential to result in the following impact during the operations phase:

GHG emissions by:

— use of mobile and stationary equipment during operations and use of explosives.

MITIGATION MEASURES

The same common mitigation measures recommended in the construction phase will be applied in the operations phase when work involving the same impact sources will be done.

The following specific mitigation measure will also be implemented: P26

DETAILED DESCRIPTION OF RESIDUAL IMPACT

The direct GHG emission sources in the operations phase of the project include fossil fuel combustion by stationary and mobile mine equipment and explosives. The GHG emissions related to operations are detailed per year in Table 6-10.

Table 6-10 Summary of GHG emissions related to operations

Year	Operations			Transport		Total
	Direct emissions			Indirect emissions		
	Stationary	Mobile	Explosives	Plant	Fuel	
	Tonnes CO_2eq					
2025	2,914	1,841	44	531[a]	691[a]	6,020
2026	19,242	14,229	367	531	691	35,059
2027	19,299	14,265	344	531	691	35,131
2028	19,561	14,595	352	531	691	35,731
2029	19,561	14,595	381	531	691	35,759
2030	19,561	14,595	384	531	691	35,762
2031	19,561	14,595	363	531	691	35,741
2032	19,561	14,595	393	531	691	35,772
2033	19,149	13,820	352	531	691	34,543
2034	18,885	13,341	284	531	691	33,732
2035	13,246	6,807	89	531	691	21,364
Total	**190,540**	**137,280**	**3,352**	**5,841**	**7,601**	**344,614**
	331,172			**13,442**		

[a] The indirect emissions for 2025 include the indirect emissions from preproduction.

The direct GHG emission sources of project operations include fossil fuel combustion by stationary and mobile mine equipment and explosives. It must also be noted that Osisko will be connected to the Hydro-Québec grid by a power line. Thus, direct GHG emissions will be reduced.

The sum of the direct emissions from operations would total about 331 kT of CO_2eq from 2025 to 2035. These direct emissions over this same period represent average emissions of 30.1 kT of CO_2eq per year.

Indirect emissions from the project include the combustion of fossil fuel by transportation associated with project logistics (transportation of inputs, outputs, and personnel). The indirect measures related to operations of the entire project varied by about 16 kT CO_2eq.

The sum of the direct and indirect emissions during the operations period would total about 345 kT CO_2eq

These direct and indirect emissions could be reduced during the project, considering the fact that Osisko will pursue its assessment of the low-emission technologies available on the market during the operations phase.

RESIDUAL IMPACT ASSESSMENT

The ecosystem value attached to GHG is medium and the degree of disturbance was considered low because the annual emissions are below the mandatory participation threshold in the Quebec carbon market. The anticipated intensity is therefore low. The spatial scope of the impact will be regional and the impact will be felt over a medium duration. The probability of occurrence is high due to the direct link between the use of fossil fuels and generation of GHG. Thus, the significance of the residual impact is medium.

Impact on GHG in the operations phase		
Nature	Negative	Significance: Medium
Ecosystem value	Medium	
Socioeconomic value	Not applicable	
Degree of disturbance	Low	
Intensity	Low	
Spatial scope	Regional	
Duration	Medium	
Probability of occurrence	High	

6.3.4 GREENHOUSE GAS IMPACTS IN THE CLOSURE PHASE AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the closure phase, the potential impact source and the resulting impacts (**in bold**), that may affect GHGs are as follows:

— Final restoration

This source has the potential to result in the following impact during the construction phase:

GHG emissions by:

— use of mobile and stationary equipment during restoration work;

MITIGATION MEASURES

The same common mitigation measures recommended in the construction phase will be applied in the operations phase when work involving the same impact sources will be done.

DETAILED DESCRIPTION OF RESIDUAL IMPACT

GHG EMISSIONS

During the closure phase, the activities likely to generate GHG emissions are mainly associated with dismantling of infrastructure. The work planned during this phase will have similar or lesser impacts than during the operations phase. The GHG emissions were not calculated because the necessary details for dismantling are not confirmed at this project stage.

RESIDUAL IMPACT ASSESSMENT

The ecosystem value attached to GHG is medium and the degree of disturbance was considered low because the annual emissions are below the mandatory participation threshold in the Quebec carbon marker. The anticipated intensity is therefore low. The spatial scope of the impact will be regional and the impact will be felt over a short period. The probability of occurrence is high due to the direct link between the use of fossil fuels and generation of GHG. Thus, the significance of the residual impact is medium.

Impact on GHG in the closure phase		
Nature	Negative	Significance: Medium
Ecosystem value	Medium	
Socioeconomic value	Not applicable	
Degree of disturbance	Low	
Intensity	Low	
Spatial scope	Regional	
Duration	Short	
Probability of occurrence	High	

6.4 SOUND ENVIRONMENT

Important facts about the sound environment and vibration

Existing conditions

An assessment of the existing sound environment was conducted in sensitive areas near the proposed surface infrastructure at the project site. The measurements were taken at the sites of the sensitive receptors (hunting and private cottages) geographically nearest to the new infrastructure. The nearest First Nations camp is located 6 km from the project site, while the private cottage is located 1.4 km from the projected infrastructure. During the operations period, the noise criteria of Zone IV of Note d'instructions 98-01 of the MELCC (hereinafter NI 989-01) (55 dBA during the day and 50 dBA at night) apply for all receptor points. Also, during the construction phase, the Lignes directrices concernant les niveaux sonores provenant d'un chantier de construction industrielle (MDDELCC, 2015) (Guidelines for noise levels from an industrial construction site) apply (L_{ar12h} 55 dBA during the day, L_{ar3h} 55dBA in the evening, and L_{ar1h} 45 dBA at night).

Projected conditions

Scenarios for the construction and operations phases, for the year when the maximum amount of equipment is expected to be in use, were determined to simulate the noise impacts at the nearest sensitive receptors. The results of the various simulations indicate that the identified criteria would be met for all receptor points.

Potential impacts of the project

During the construction phase, the significance of the residual impact will be low for all receptor points.

During the operations phase, the significance of the residual impact is low. The noise perceived at the receptor points will conform to the recommended criteria, but will be felt over a medium duration.

During the closure phase, the restoration work will result in an impact of low significance, especially considering the limited equipment required. The return to calm after the end of restoration was considered a positive impact for the sensitive receptors closest to the infrastructure. Once the closure phase is finished and the rehabilitation has been completed, the anticipated impact will be positive.

6.4.1 *CURRENT CONDITIONS*

The local social environment study area is essentially in a natural forested area where resource development is permitted. Only a few cabins are present in this area.

Two points were chosen to carry out the measurements in order to reflect the existing sound environment. The methodology used is presented in Appendix 6-3. These two points are located as follows:

- P1: at the Cree camp (three dwellings approximately 4.5 km south of the project site);
- P2: at the non-First Nations camp (cabins at 925 m south of Road R1053 [R6000] and 1,400 west of the mine site).

The two periods of the day corresponding to daytime from 7 a.m. to 7 p.m. and nighttime from 7 p.m. to 7 a.m., as well as the 24-hour period, are presented in Table 6-11. These periods are used in MELCCFP Note d'instruction NI 98-01.

For information purposes, the results of ambient noise measurements obtained at the two measurement sites, for two periods of the day corresponding to daytime from 7 a.m. to 10 p.m. and nighttime from 10 p.m. to 7 a.m., are also presented in Table 6-11. The noise indicator Ld represents the average noise measured between 7 a.m. and 10 p.m. Indicator Ln represents the average noise measured between 10 p.m. and 7 a.m. Finally, indicator Ldn represents the average daily noise to which a weighting of 10 dBA is added for the nighttime noise levels. These results are used to calculate the % HA (Highly Annoyed) and determine compliance with the Health Canada noise criterion.

Table 6-11 Results of ambient noise characterization

Location		Date	Ambient noise (dBA)					
Description	Coordinates		L_{eq} day	L_{eq} night	L_{eq} 24 h	L_d 7 a.m.-10 p.m.	L_n 10 p.m.-7 a.m.	L_{dn} 24 h
P1 (Cree camp)	N 49.01590 E -75.66520	July 7-9, 2021	40.1	51.0	44.4	45.2	42.4	49.3
P2 (non-First Nations camp)	N 49.06580 E -75.67530	July 7-9, 2021	37.3	40.6	40.4	38.2	42.6	48.6

The main noise source at receptor point P1 was a small-scale generator in the yard between the cabins which was in operation for the entire measuring period (except for a period when the generator was not in operation, from 8 a.m. to 4 p.m. on July 9). As mentioned previously, the presence of this local noise source is conservative, however, because it is reasonable to believe that the users of this site regularly use a generator to meet their electricity needs when they are on the site.

Noise sources identified at receptor point P2 were vegetation rustling in the wind, water lapping on the shoreline, birds singing, and the sound of insects.

6.4.2 IMPACTS ON THE SOUND ENVIRONMENT AND VIBRATION IN THE CONSTRUCTION PHASE, AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the construction phase, the sources of potential impacts and the resulting impacts (**in bold**), that may affect the noise environment and vibration, are as follows:

— Organization of the site, stripping and clearing, surface preparation and access arrangement, construction of works and infrastructure, and transportation and traffic.

These sources have the potential to result in the following impact during the construction phase:

Increased noise and vibration levels in the vicinity of the new infrastructure by:

— use of equipment during the work;
— blasting during construction of roads and ponds.

MITIGATION MEASURES

The common mitigation measures AIR02, NOR02 and NOR03 will be applied to minimize the disturbances created by mobile equipment on the sound environment in the vicinity of the new infrastructure.

The following specific mitigation measure will also be implemented: P26

It should be noted that the projected noise levels will be lower than the limits stated in Section 3.1.2.3 of the Lignes directrices relativement aux niveaux sonores provenant d'un chantier de construction industriel [Guidelines for noise levels from an industrial construction site] (MDDELCC, 2015), but the vibration generated during blasting activities could have impacts on fish habitat. However, compliance with the minimum loads according to the distances presented in Tables 6-14 and 6-15 below will allow mitigation of the impact and minimization of the effects on fish.

DETAILED DESCRIPTION OF RESIDUAL IMPACT

INCREASED NOISE LEVEL ON THE PERIPHERY OF THE NEW INFRASTRUCTURE BY USE OF MOBILE EQUIPMENT DURING THE WORK

For the construction phase, the noise sources will be essentially related to the mobile equipment used to perform construction work during the various stages (considered as assumptions). Table 6-12 presents the list of noise sources present on the site during the main construction stages and their periods and frequencies of use.

Four distinct construction scenarios were established during the busiest periods in terms of equipment and noisy work simultaneously. This data is used as an indication to develop the assumptions for this assessment (Section 4 of Appendix 6-3, sectorial noise environment and vibration report). The construction phase sound propagation - daytime scenario 1 is presented on Map 6-2.

Table 6-12 Noise sources during construction activities

Scenario of the work	Noise sources during the stage	Period/Frequency
1- Site preparation and development	– 3 CAT349 excavators: use time 80%. – 4 Caterpillar D6 bulldozers: use time 75%. – 15 CAT 735 off-road trucks: 25 to 55 trips per day/truck – 3 CAT 982 loaders: use time 75%. – 2 Sandvik Ranger 45 mm drillers: use time 60% drilling/40% moving. – 2 10T road rollers: use time 75%. – 3 crushers: Metso Lt106, Terex Warrior 2400, and Sandvik CH440 cone: use time 90%.	Continuous, 7 a.m. to 7 p.m.
2- Excavation and foundations	– 1 Caterpillar D6 bulldozer: use time 75%. – 3 CAT 7435 off-road trucks: 30 trips per day/truck – 1 CAT 982 wheel loader: use time 75%. – 4 cement mixers: use time 60%. – 2 concrete pumps: use time 50%. – 1 crane truck: use time 50%.	Continuous, 7 a.m. to 7 p.m.
3- Assembly of the steel structure	– 3 Genie telescopic boom lifts: use time 40%. – 2 Skyjack lift platforms: use time 40%. – 2 45T cranes: use time 50%. – 2 generators: use time 100%. – 1 welding machine: use time 10%. – 6 operations with impact screwdrivers: use time 25%.	Continuous, 7 a.m. to 7 p.m.

Scenario of the work	Noise sources during the stage	Period/Frequency
4- Building envelope and roofing	– 3 Genie telescopic boom lifts: use time 40%. – 2 Skyjack lift platforms: use time 40%. – 2 truck cranes: use time 50%. – 2 generators: use time 100%. – 6 operations with impact screwdrivers: use time 25%.	Continuous, 7 a.m. to 7 p.m.

INCREASE IN VIBRATIONS ON THE PERIPHERY OF THE INFRASTRUCTURE BY BLASTING OF THE MAIN SURFACES

During development work, it is anticipated that surfaces will be blasted to allow for the construction of infrastructure. The main areas that require blasting are those of the process plant and the neighbouring surface (including the projected crushed ore silo), the access roads leading from the Lynx portal to the water treatment plant, and Pond C1.

This blasting work will generate vibrations that could have impacts on the building structures, fish habitats, and air suppression in inhabited sensitive zones. Concerning the impacts on the building structures (essentially the three camp dwellings located 4.5 km south of the mine site and the non-First Nations camp located 1.4 km west of the mine site), the results of the vibrations calculated for the surface activities (0.1 mm/s for the Cree camp and 1.3 mm/s for the non-First Nations camp) show compliance with the D019 criterion, which is 12.7 mm/s.

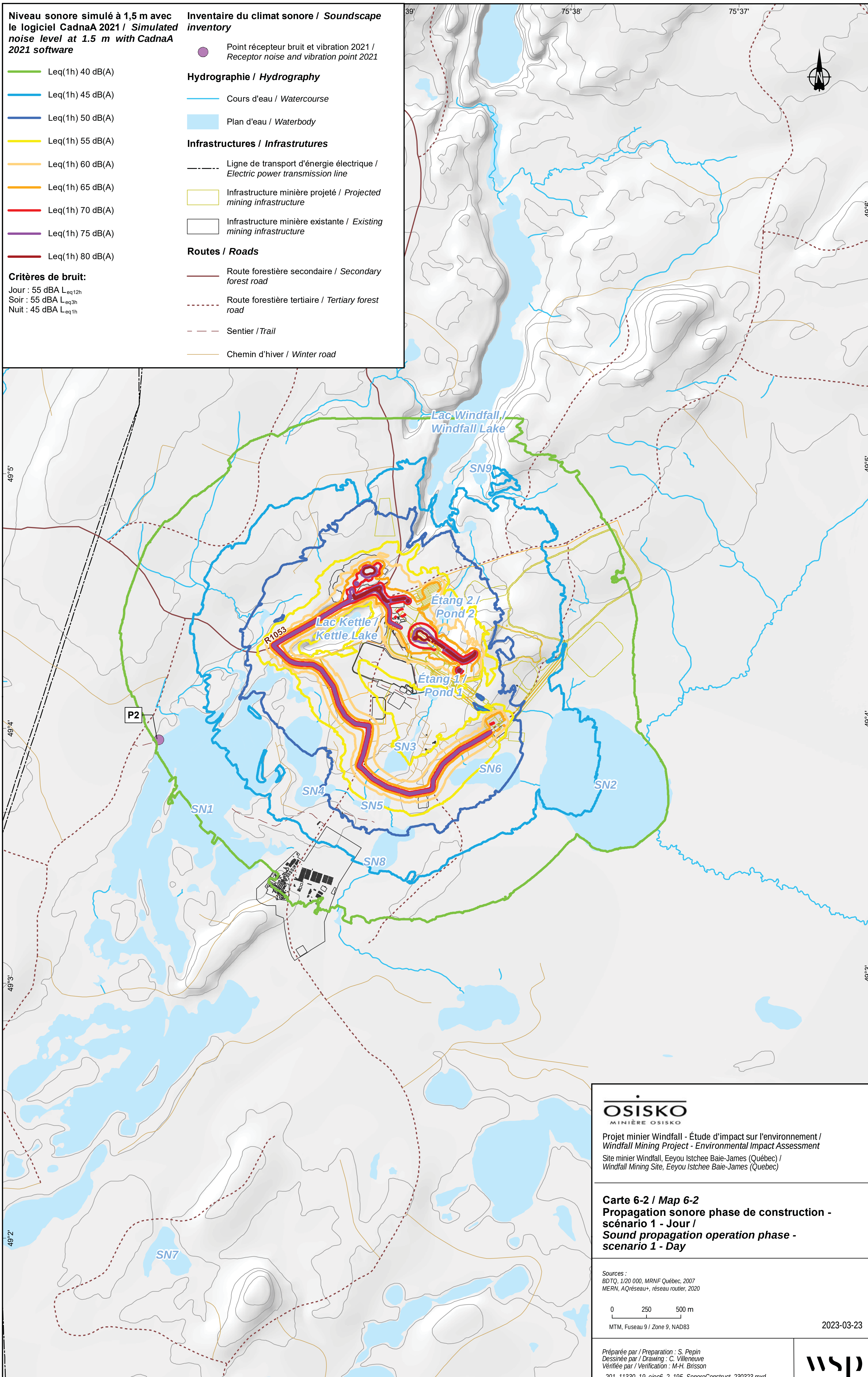
For fish habitat, two distinct parameters must be considered, i.e., the instantaneous change in pressure (measured in kPa) and the peak particle velocity (PPV, measured in mm/s), which must not exceed 100 kPa (impact on the fish's swim bladder) and 13 mm/s (impact on fish eggs in spawning areas). Many bodies of water near the projected blasting areas are considered fish habitats. The calculation of instantaneous pressure changes for the construction phase was done considering the shortest surface distances (80 m) to the closest habitat, the SN4 water body. The results (49 kPa) did not show any exceedance of the standard.

The peak particle velocity was calculated for the construction phase according to the distances from the nearest spawning areas, i.e., those of Water body SN6, which is 240 m away at the surface. The results (6.4 mm/s) did not show any exceedance of the standard.

Finally, regarding the possible impact on air suppression in a populated sensitive area, the limit set by D019 is 128 dB and the results of the calculations based on the position of the Cree camp and the non-First Nations camp show values below this criterion.

RESIDUAL IMPACT ASSESSMENT

A medium ecosystem value was assigned to noise and vibration because noise and vibration emissions are a source of disturbance for land users and animals. Following the modelling carried out (Appendix D – Sound environment and vibration sectorial report), the degree of disturbance was considered low at the sensitive points. Thus, the intensity of the impact is qualified as low.



La précision des limites et les mesures montrées sur ce document ne doivent pas servir à des fins d'ingénierie ou de délimitation foncière. Aucune analyse foncière n'a été effectuée par un arpenteur-géomètre.

The spatial scope is considered local because the noise and vibration impact may be felt as far as the inhabited area near the site, even if below the permitted limits. The duration will be short because the noise impact will be felt temporarily, during construction. Finally, the probability of occurrence of the impact is considered high because it is certain that noise will be generated during the work that will affect the existing sound environment. In short, the residual impact on the sound environment and vibration in the construction phase is considered low.

Impact on the sound environment and vibration in the construction phase		
Nature	Negative	Significance: Low
Ecosystem value	Medium	
Socioeconomic value	Not applicable	
Degree of disturbance	Low	
Intensity	Low	
Spatial scope	Local	
Duration	Short	
Probability of occurrence	High	

6.4.3 IMPACTS ON THE SOUND ENVIRONMENT AND VIBRATION IN THE OPERATIONS PHASE, AND MITIGATION MEASURES

During the operations phase, the sources of potential impacts and the resulting impacts (**in bold**), that may affect the noise environment and vibration, are as follows:

— The presence and operation of new infrastructure, transportation and traffic, production and management of residual and hazardous materials.

These sources have the potential to result in the following impact during the operations phase:

Increased noise and vibration level in the vicinity of the new infrastructure by:

— ore crushing activities;

— tailings and waste rock management;

— blasting in the underground drifts.

MITIGATION MEASURES

Common mitigation measures AIR02 and NOR01 will be applied to minimize the disturbances caused by mobile equipment in the sound environment in around the new infrastructure.

The following specific mitigation measure will also be implemented: P26

However, it should be noted that the anticipated noise levels would be lower than the permitted limits of the MELCCFP NI 98-01 criterion.

DETAILED DESCRIPTION OF RESIDUAL IMPACT

IDENTIFICATION OF NOISE SOURCES AND ACOUSTIC POWER OF EQUIPMENT

The impacts on the sound environment that will occur during the operations period are associated with the following stages:

- transport of ore from the Main portal (eight moves/hour) and the Lynx portal (eight moves/hour);
- unloading of ore in the crushing system;
- transport of ore to the process plant (conveyor);
- transport of waste rock;
- transport of dry tailings (six moves/hour);
- disposal of dry tailings.

Section 4 of the sound environment and vibration sectorial report presents the complete noise modelling during the operations phase (Appendix 6-3).

Table 6-13 presents the list of noise sources that are considered for the assessment of the impact on the sound environment and their periods of frequency and use. Raw material activities will take place 7 days a week, 24 hours a day, while tailings management is planned for daytime periods only.

Table 6-13 Noise sources during operations activities

Equipment	% use or number of trips/hour	Period/Frequency
4 Caterpillar 740 articulated trucks (day and night)	8 trips/hour	7 days per week, 24 h
1 Komatsu WA600 wheel loader (crusher supply, day and night)	80%	7 days per week, 24 h
1 Excavator with hydraulic hammer[b] (day and night)	30%	7 days per week, 24 h
1 FLSmith FJ110 crusher[b] (day and night)	65%	7 days per week, 24 h
1 Grizzly 90/405 HE80 crusher feeder[b] (day and night)	65%	7 days per week, 24 h
3 Closed conveyors (day and night)	100%	7 days per week, 24 h
3 Conveyor drive motors (day and night)	100%	7 days per week, 24 h
3 Caterpillar 740 articulated trucks (tailings transport, day)	6 trips/hour	7 days per week, 12 h
1 Komatsu PC360 hydraulic excavator (tailings, day)	30%	7 days per week, 12 h
1 Caterpillar D6 bulldozer (tailings, day)	60%	7 days per week, 12 h
1 Boomag DH-5 compactor (tailings, day)	25%	7 days per week, 12 h
2 Caterpillar 740 articulated trucks (tailings transport, day)	4 trips/hour	7 days per week, 12 h
1 Caterpillar D8 bulldozer (waste rock stockpile, day)	50%	7 days per week, 12 h
1 Water truck (day)	18%	7 days per week, 12 h
1 John Deere 772G grader (day)	40%	7 days per week, 12 h
9 Backup alarms[c]	5%	7 days per week, 24 h
7 Unloading impacts[d]	2%	7 days per week, 24 h
1 Crusher dust collector	65%	7 days per week, 24 h
1 Silo dust collector	100%	7 days per week, 24 h
1 Gold room dust collector	65%	7 days per week, 24 h
1 Silo dust collector	100%	7 days per week, 24 h

Equipment	% use or number of trips/hour	Period/Frequency
1 Electrolytic extraction air outlet	100%	7 days per week, 24 h
1 Process plant air outlet	100%	7 days per week, 24 h
1 Crusher dust collector	100%	7 days per week, 24 h
1 Silo dust collector	100%	7 days per week, 24 h
1 Gold processing room dust collector	25%	7 days per week, 24 h
1 Pebble crusher dust collector	100%	7 days per week, 24 h
1 Silo hopper fan	100%	7 days per week, 24 h
1 Lime slaker fan	100%	7 days per week, 24 h
1 $CuSO_4$wet dust collector	100%	7 days per week, 24 h
1 Lead/Nitrate wet dust collector	100%	7 days per week, 24 h
7 1000 CFM fans	100%	7 days per week, 24 h
1 7500 CFM fan	100%	7 days per week, 24 h
1 15000 CFM fan	100%	7 days per week, 24 h
3 30000 CFM fans	100%	7 days per week, 24 h
1 Conveyor opening – SAG mill	100%	7 days per week, 24 h

RESULTS OF SIMULATIONS

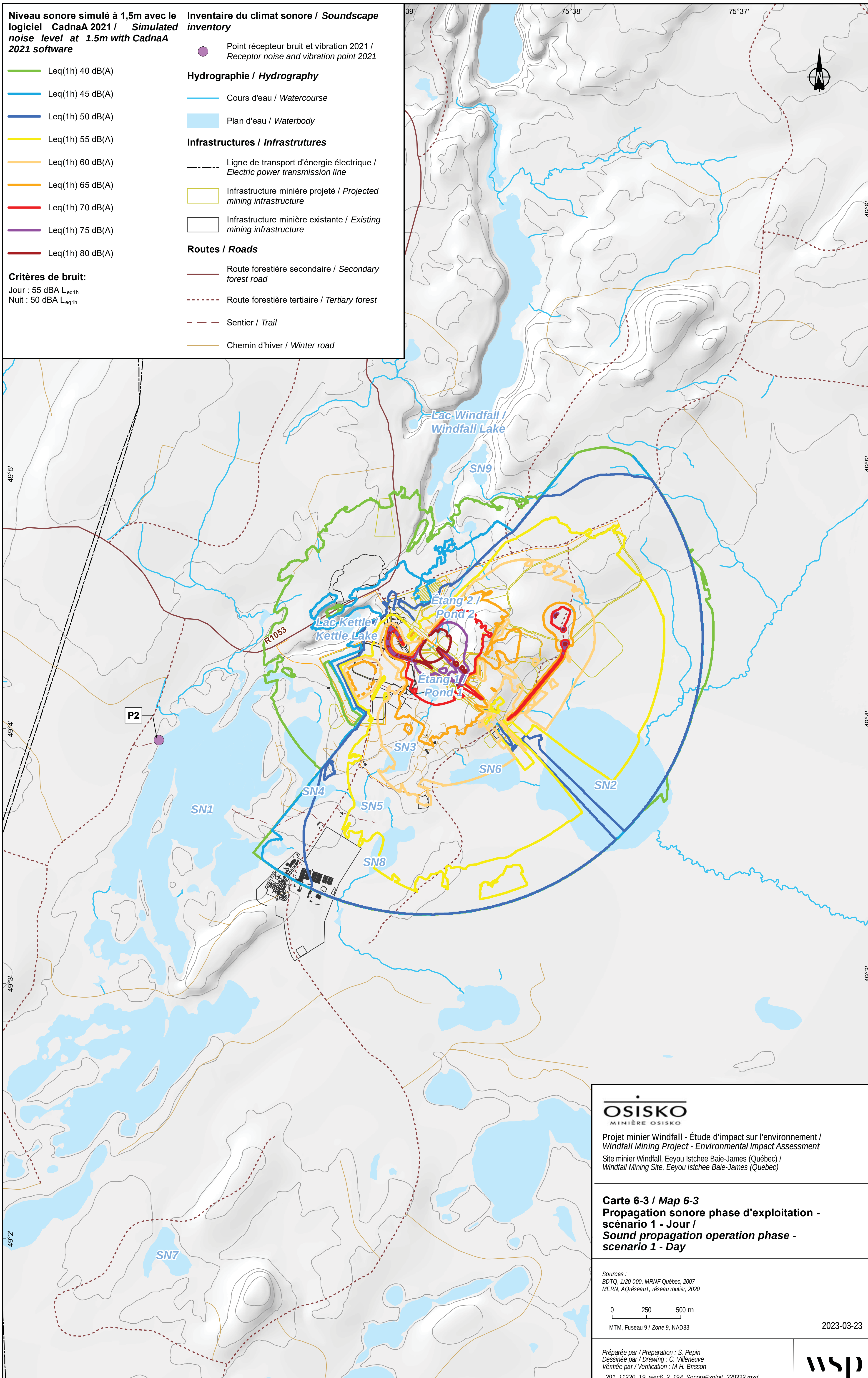
INCREASED NOISE AND VIBRATION LEVELS ON THE PERIPHERY OF THE NEW INFRASTRUCTURE BY ORE CRUSHING ACTIVITIES AND TAILINGS AND WASTE ROCK MANAGEMENT

The mine site activities, particularly transport, crushing, certain equipment peripheral to ore processing (e.g., fan, dust collector, etc.) (Table 6-13), as well as tailings and waste rock management, will have the effect of increasing the noise level in the site's immediate environment. The modelling performed for various scenarios demonstrated compliance with Instruction Note 98-01 (Appendix 6-3). With a sound contribution of 28 dBA or less, at least 6 dBA lower than the ambient noise that currently prevails, the new mine site would not contribute to increase the sound environment of the study area. Sound propagation in the operations phase - scenario 1 daytime is presented in Map 6-3.

INCREASED VIBRATIONS AT THE PERIPHERY OF THE INFRASTRUCTURE DUE TO UNDERGROUND TUNNEL BLASTING

This blasting work will generate vibrations that could have impacts on the building structures and fish habitat. With regard to impacts on the structure of buildings (essentially the three dwellings of the Cree camp located 6 km south of the mine site and the non-First Nations camp located 1.4 km west of the mine site), the results of the vibrations calculated during the operations phase for underground activities (0.1 mm/s to less than 0.1 mm/s for the Cree camp and 0.2 mm/s to 1.4 mm/s for the non-First Nations camp) show compliance with the D019 criterion, which is 12.7 mm/s.

For fish habitat, two distinct parameters must be considered, i.e., the instantaneous change in pressure (measured in kPa) and the peak particle velocity (PPV, measured in mm/s), which must not exceed 100 kPa (impact on the fish's swim bladder) and 13 mm/s (impact on fish eggs in spawning areas). Many bodies of water near the projected blasting areas are considered fish habitats. The instantaneous change in pressure was calculated by considering the shortest underground distances (50 m) relative to the nearest habitat, Water body SN4. The results



La précision des limites et les mesures montrées sur ce document ne doivent pas servir à des fins d'ingénierie ou de délimitation foncière. Aucune analyse foncière n'a été effectuée par un arpenteur-géomètre.

showed an exceedance for production blasting (underground) if adjustments are not made to the standard blast pattern. To address this impact, Table 6-14 presents the maximum loads per delay versus distance for fish habitat protection that will meet a calculated instantaneous pressure change of 85 kPa.

Table 6-14 Maximum load per delay versus distance for fish habitat protection

Blasting distance from the water body (m)	Maximum explosive load per delay (kg)
40	51
50	80
60	115
80	205
100	320
120	460
140	630
160	820

The peak particle velocity was calculated for the operations phase according to the underground distance from the nearest spawning areas (175 m – Water body SN6). The results showed an exceedance for production blasting (underground) if adjustments are not made to the standard blast pattern. To address this impact, Table 6-15 presents the maximum loads per delay depending on distance for protection of a spawning area during the egg incubation period that will achieve a calculated peak particle velocity of 10 mm/s. The areas for which adjustments to the blasting pattern must be made are presented in Appendix 6-3.

Table 6-15 Maximum load per delay depending on distance for protection of a spawning area during the egg incubation period

Blasting distance from the water body (m)	Maximum explosive load per delay (kg)
40	5
60	11
80	20
100	31
120	45
140	62
160	81
180	102
200	126
250	197
300	284
350	387

RESIDUAL IMPACT ASSESSMENT

A medium ecosystem value was assigned to the sound environment and vibration because noise and vibration are a source of disturbance for land users and animals. Following the modelling carried out (see Appendix 6-3, sound environment and vibration sectorial report), the degree of disturbance was considered low at the sensitive points. Thus, the intensity of the impact is qualified as low.

The spatial scope is considered local because the noise impact and the vibrations may be felt up to an inhabited area near the site, even if it is below the permitted limits. The duration will be medium because the noise impact will be felt for the entire life cycle of the plant. Finally, the probability of occurrence of the impact is considered high because it is certain that noise will be generated during the operations activities, which will affect the existing sound environment. In short, the residual impact on the sound environment and vibration in the operations phase is considered low.

Impact on the sound environment and vibration in the operations phase		
Nature	Negative	Significance: Low
Ecosystem value	Medium	
Socioeconomic value	Not applicable	
Degree of disturbance	Low	
Intensity	Low	
Spatial scope	Local	
Duration	Medium	
Probability of occurrence	High	

6.4.4 IMPACTS ON THE SOUND ENVIRONMENT AND VIBRATION IN THE CLOSURE PHASE, AND MITIGATION MEASURES

During the closure phase, the sources of potential impacts and the resulting impacts (**in bold**), that may affect the noise environment and vibration, are as follows:

— Final restoration, production and management of residual and hazardous materials.

These sources have the potential to result in the following impact during the closure phase:

Increased noise levels around rehabilitation projects by:

— use of mobile equipment during the work;

Decrease in noise levels after closure by:

— stoppage of restoration work.

MITIGATION MEASURES

The common mitigation measures mentioned in the construction and operations phases will also apply during the closure phase.

DETAILED DESCRIPTION OF RESIDUAL IMPACT

INCREASED NOISE LEVELS IN THE VICINITY OF REHABILITATION SITES

The site activities, dismantling of the facilities and management of materials, as well as transportation and traffic in relation to the activities, will have the effect of temporarily increasing the noise level near the work areas. The noise in the closure phase should be similar to what was projected for the construction phase. This should be lower than the criteria set out at all sensitive points.

DECREASE IN NOISE LEVELS AFTER CLOSURE

After the site closure activities, the noise level near the work areas and sensitive receptors should be similar to the pre-project level.

RESIDUAL IMPACT ASSESSMENT

A medium ecosystem value was assigned to the sound environment and vibration because noise and vibration are a source of disturbance for land users and animals. The degree of disturbance was considered low at the sensitive points. Thus, the intensity of the impact is qualified as low during the restoration work.

The spatial scope is considered local because the noise impact and the vibration may be felt up to an inhabited area near the site, even if it is below the permitted limits. The duration will be short because the noise impact will be felt temporarily, during closure. Finally, the probability of occurrence of the impact is considered high because it is certain that noise will be generated during closure that will affect the existing sound environment. In short, the residual impact on the sound environment and vibration in the closure phase is considered very low. Once the closure phase is finished and the rehabilitation has been completed, a positive impact on the sound environment and vibration is expected, with values approaching that of the natural environment.

Impact on the sound environment in the closure phase		
Nature	Negative/positive	Significance: increase in noise level – Low Decrease in noise level – Positive impact
Ecosystem value	Medium	
Socioeconomic value	Not applicable	
Degree of disturbance	Low	
Intensity	Low	
Spatial scope	Local	
Duration	Short	
Probability of occurrence	High	

6.5 SOIL

Important facts about soils

Current conditions

The geological and geomorphological conditions of the project area have been defined on the basis of existing documentation and the results of various exploration campaigns conducted by Osisko. It appears that the Windfall deposit is interpreted and classified as a gold deposit. In addition, the area explored shows various types of surface deposits including undifferentiated till with discontinuous cover (39.9%), organic deposits (28.4%), ice-contact deposits (20.7%) and outwash deposits (11.0%).

The environmental quality of the surface soils in the areas planned for the work was also assessed during campaigns completed in 2021 and 2022. Chemical analysis results for 167 samples showed concentrations above background levels established for the Superior and Rae Geological Provinces (generic criteria “A”) for the following parameters: silver, arsenic, cadmium, lead, nickel, tin, and cobalt. Results were also obtained in range “B-C” for arsenic, manganese, and nickel and an exceedance of generic criterion C was noted for manganese. Finally, three samples showed a sulphur concentration in range “A-C” of the generic criteria of the Response Manual.

Potential impacts of the project

In the construction phase, in view of the mitigation measures that will be implemented, the intensity of the residual impact on the soil is considered low. The impact has a specific spatial scope because it is associated with accidental spills quickly contained and recovered or very localized soil erosion. The duration would be short because the contaminated soils will not remain in place and the eroded areas will be stabilized quickly. The probability of occurrence is considered medium for erosion and low for spills because they are low in magnitude, occurring occasionally on the sites. Thus, the significance of the residual impact is considered very low.

In the operations phase, the impact of the stockpiles on the underlying soils in case of a breach of the installed lined membrane, the risks associated with spills (tailings pipes or others) and wind erosion of these stockpiles results in a degree of disturbance considered medium and resulting in a low-impact intensity. The spatial scope is considered specific for seepage and spill risks and local for impacts associated with wind erosion. The duration will be short for spill cases, while it will be long in relation to the risks associated with seepage and wind erosion. The probability of occurrence will be low for risks related to seepage associated with membrane failure and for spills, and high in connection with wind erosion on the stockpiles. The result is a very low significance of impact in the case of spills and seepage and a low significance for the impact of wind erosion on the stockpiles.

In the closure phase, a low accidental spill risk remains during the site rehabilitation work. This risk is characterized by a low intensity, a specific spatial scope, a short duration, and a medium probability of occurrence resulting in a very low significance of the residual impact. Closure also involves revegetation of the tailings storage facility and the waste rock stockpile, dismantling of the mining infrastructure, and rehabilitation of the soils, resulting in a positive impact of local extent and long duration.

6.5.1 CURRENT CONDITIONS

GEOLOGY

The study area is located in the Urban-Barry greenstone belt, which is part of the northern volcanic zone of the Abitibi geological sub-province. The belt, which runs east-west, is dominated by mixed sequences of mafic to felsic volcanics with some sedimentary sequences and is intersected by several shear zones that delineate major structural features (Map 6-4). The belt is bounded on the north by the east-west oriented Urban deformation zone and on the east by the Grenville Province, on the south by paragneisses and granitoids of the Barry Complex, and on the west by syntectonic to tarditectonic granitoid rocks.

The Windfall deposit is hosted in the Windfall Member, which is part of the Macho Formation, located in the central part of the Urban-Barry Belt. The Windfall Member is composed primarily of felsic and intermediate volcanic rocks, including tuf and lava units of tholeiitic affinity. The stratigraphy is oriented to the northeast with a medium dip to the southeast. A series of dikes and quartz-feldspar porphyry layer seams oriented to the east-northeast or the northeast, commonly known as QFP dikes, intersects the volcanic rocks of the Macho Formation, including the rocks of the Windfall Member.

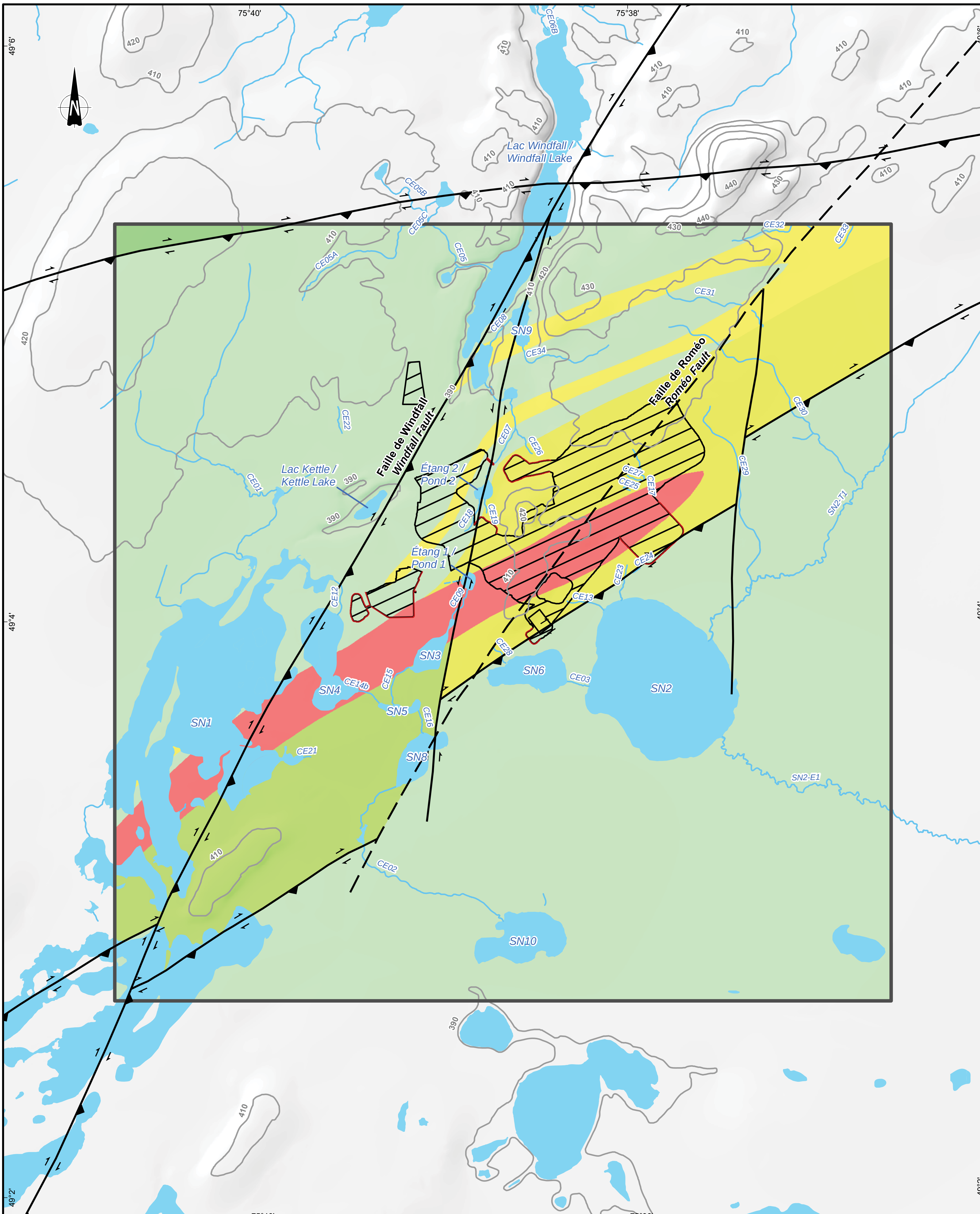
The Macho Formation and the Windfall Member are intersected by several late faults, including the Windfall Fault with its northeast-north orientation and inverse-right movement, the Roméo Fault with its northeast orientation, and several faults oriented east-northeast and north. The alteration in the deposit zone is primarily composed of silica-sericite-carbonates-tourmaline and a sterile zone of chlorite-sericite-rutile on the periphery.

The gold mineralization of the Windfall deposit is presented in two styles: 1) vein-type mineralization, and 2) replacement-type mineralization. Vein-type mineralization is composed of grey to translucent quartz veins. Replacement mineralization is found in contact with vein-type mineralization or in altered and heavily deformed zones where the development of quartz veins is absent. The Windfall deposit is interpreted and classified as a gold deposit associated with Pre-Timiskaming intrusions, due to: 1) the temporal and spatial association of gold with calcium-alkaline affinity QFP intrusive phases; and 2) the main gold event (i.e., Vein-type and replacement mineralization), interpreted as predating regional deformation (Richard, P.-L., Bélisle, M., 2022).

GEOMORPHOLOGY

PHYSIOGRAPHY

The Windfall project area is located in the Mistassini Highlands natural province, which is dotted with hills that have been shaped by successive glaciations, interspersed with interglacial periods. The highest peaks in the local study area of the project are nearly 450 m high, while the middle altitudes are found at water bodies and wetlands.



Zone d'étude locale du milieu biophysique / *Biophysical local study area*

Courbe de niveau intermédiaire / Intermediate level curve

Hydrographie / *Hydrography*

Plan d'eau / *Waterbody*

Cours d'eau / *Watercourse*

Empiètement du projet / *Project Encroachment*

Empiètement permanent / *Permanent encroachment*

Empiètement temporaire / *Temporary encroachment*

Faille / *Fault*

Dextre inverse / *Reverse dexter*

Senestre / *Sinister fault*

Mouvement indéterminée / *Movement indeterminate*

Mouvement indéterminée (existance présumée) / *Movement indeterminate (presumed existence)*

Lithologie / *Lithology*

Formation d'Urban / *Urban Formation*

Basalte gloméroporphyrique, basalte aphyrique / *Glomeroporphyric basalt, aphyric basalt*

Formation Macho / *Macho Formation*

Basalte aphyrique, basalte andésitique; andésite / *Aphyric basalt, Andesitic basalt; andesite*

Membre Windfall / *Windfall Member*

Andésite porphyrique; tuf intermédiaire localement sulfuré / *Porphyritic andesite; locally sulfidic intermediate tuff*

Porphyre, composition granitique à granodioritique / *Porphyry, granitic to granodioritic composition*

Volcanites felsiques, tuf felsique indifférencié / *Felsic volcanics, undifferentiated felsic tuff*

Tufs rhyolitiques, dykes mafiques à intermédiaires / *Rhyolitic tuffs, mafic to intermediate dykes*

OSISKO
MINIÈRE OSISKO

Projet minier Windfall - Étude d'impact sur l'environnement / *Windfall Mining Project - Environmental Impact Assessment*

Site minier Windfall, Eeyou Istchee Baie-James (Québec) / *Windfall Mining Site, Eeyou Istchee Baie-James (Quebec)*

Carte 6-4 / *Map 6-4*
Géologie de la zone d'étude locale /
Geology of the Local Study Area

Sources / Sources:
CanVec+, 1/50 000, RN Can, 2014
SDA, 1/20 000, MERN Québec, 2020
BDTA, 1/250 000, MRN Québec, 2002
BDGA, 1/5 000 000, MRN Québec, 2012
SIGEOM, Géologie, 2019-11

0 250 500 m

MTM, Fuseau 9 / Zone 9, NAD83

2023-03-27

Préparée par / Preparation : G. Beauchamp
Dessinée par / Drawing : J. Roy
Vérifiée par / Verification : A. Bouzaga
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SURFACE DEPOSIT

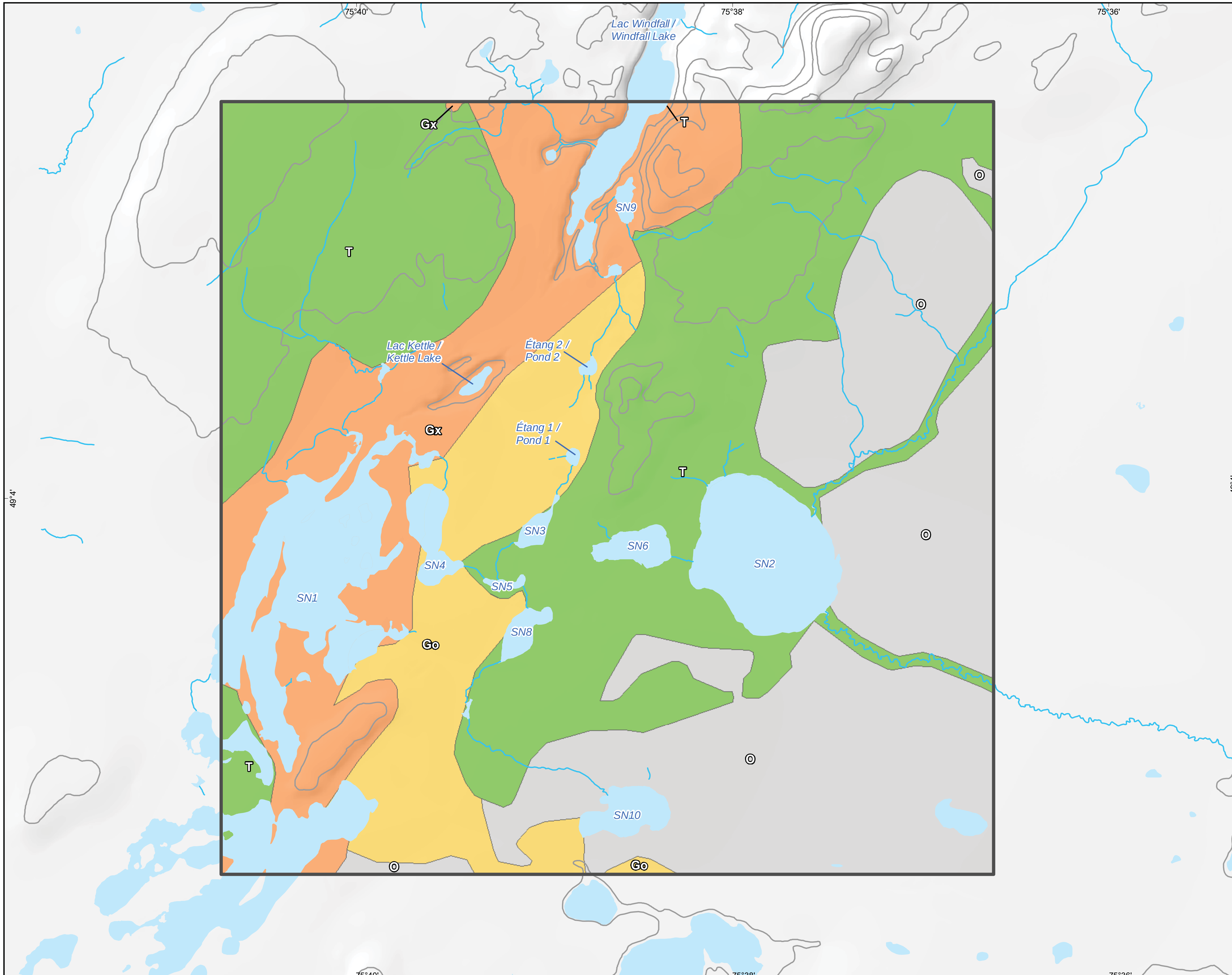
The unconsolidated cover in the region is a legacy of the last glaciation and subsequent deglaciation. The passage of the ice sheet led to the formation of glacial deposits (till) over the entire territory. In the study area, glacial deposits outcrop at some locations, but most often, they are covered by more recent deposits, left in place by the retreating ice. In the region, deglaciation began around 10,000 years before present. As the glacier retreated northward, the waters released by the melting ice transported large volumes of materials (i.e., sand and gravel) and deposited large fluvioglacial complexes (i.e., eskers and outwash) near the current main watercourses, the Bellefeuille, Berry, Harricana and Bell Rivers.

During the ice retreat of the last glaciation, between 10,100 and 8,000 years before present, the study area was mostly flooded due to reverse slope gradient relative to the glacial front because it was located near the eastern limit of a vast proglacial lake, Lake Barlow-Ojibway, occupying part of northern Ontario and western Quebec (Veillette, 1994). The boundaries of the lake were controlled by the presence of the New Quebec glacier to the east and the Hudson glacier to the north, with which the lake was directly in contact. The presence of the lake allowed clay sedimentation in the calm and deep areas of the water body. Clay deposits today partially cover the territory, forming a vast plain. Locally, glaciolacustrine deposits of shallow water, composed of silt and sand, cover the clays. The presence of the lake has also contributed to the reworking of previously emplaced glacial (till) and fluvio-glacial (sand and sand-gravel) deposits. Thus, shorelines shaped by littoral processes can be seen in places on main esker complexes.

About 8,000 years ago, the deglaciation continued and the melting of the glaciers on which the lake was supported caused the water body to drain into Hudson Bay (Hardy, 1977). The lake drained fairly quickly, and, as a result, littoral deposits are rare. Finally, wetlands formed on impermeable or poorly drained clay soils leading to the formation of organic deposits and the present hydrographic network began to develop by cutting into the clay deposits and forming networks of small ravines.

More specifically, the local study area consists of undifferentiated till with discontinuous cover (Map 6-5 Surface deposits of the local study area). This type of deposit occupies nearly 39.9% of the study area. Till is located essentially on the periphery of the central part of the local study area. The materials generally found in this type of deposit are silty sand or sandy silt with the presence of gravel, pebbles, and boulders in varying proportions depending on the area. This type of deposit is intercepted in a discontinuous manner in several drill holes at several locations in the mine.

Organic deposits occupy 28.4% of the local study area and are mainly located in the east, but also sporadically over smaller areas. These deposits are composed mainly of thin, somewhat decomposed peat over pulverulent soil of varying thickness. The absence of cohesive soils is also noticeable in this deposit. This type of deposit is generally poorly drained and the water table is outcropping.



Zone d'étude locale du milieu biophysique / *Biophysical Local Study Area*

Courbe de niveau intermédiaire / *Intermediate Level Curve*

Hydrographie / *Hydrography*

Plan d'eau / *Waterbody*

Cours d'eau / *Watercourse*

Dépôts meubles / *Movable Deposits*

Go : Sédiments d'épandage proglaciaire subaérien / *Subaerial Proglacial Outwash Sediments*

Gx : Sédiments juxtaglaciaires / *Ice-Contact Sediments*

O : Sédiments organiques non différenciés / *Undifferentiated Organic Sediments*

T : Till non différencié / *Undifferentiated till*

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Carte 6-5 / *Map 6-5*
Dépôts de surface de la zone d'étude locale /
Surface Deposits of the Local Study Area

Sources / Sources:
CanVec+, 1/50 000, RN Can, 2014
SDA, 1/20 000, MERN Québec, 2020
BDTA, 1/250 000, MRN Québec, 2002
BDGA, 1/5 000 000, MRN Québec, 2012
SIGEOM, Morphologie sédimentaire, 2021-03

0 250 500 m

MTM, Fuseau 9 / *Zone 9*, NAD83

2023-03-23

Préparée par / Preparation : G. Beauchamp
Dessinée par / Drawing : C. Villeneuve
Vérifiée par / Verification : A. Bouzaga
_201_11330_19_eiec6_5_151_DepSurfaces_230323.mxd

Ice-contact deposits form a long northeast-southwest corridor. A few eskers are present. These deposits were put in place by the meltwater in contact with or near the glacier. The materials of these deposits are essentially formed of sand and gravel with the presence of pebbles and boulders in variable proportions; moreover, depending on the location and depth of the rock, the quantity of silt and gravel increases. This type of deposit occupies nearly 20.7% of the study area. During drilling in this deposit, a till layer was discontinuously intercepted. Subaqueous proglacial outwash deposits tend to occupy the eastern sector and 11.0% of the area of the local study area. The materials encountered for this type of deposit are an amalgam of sand, gravel, and boulders.

The various geotechnical investigation campaigns made it possible to encounter all the above-mentioned deposits; these contain a more exhaustive description of the soils in place (see Chapter 3, Section 3.4 Management of accumulation areas).

SOIL QUALITY

Exploratory drilling (drill holes and trenches) was conducted on the study site in 2021 and 2022 to assess the environmental quality of the soils on the property (Appendix 6-4). Samples were selected from the drill holes and analyzed for metals, C_{10}-C_{50} petroleum hydrocarbons, and total sulphur.

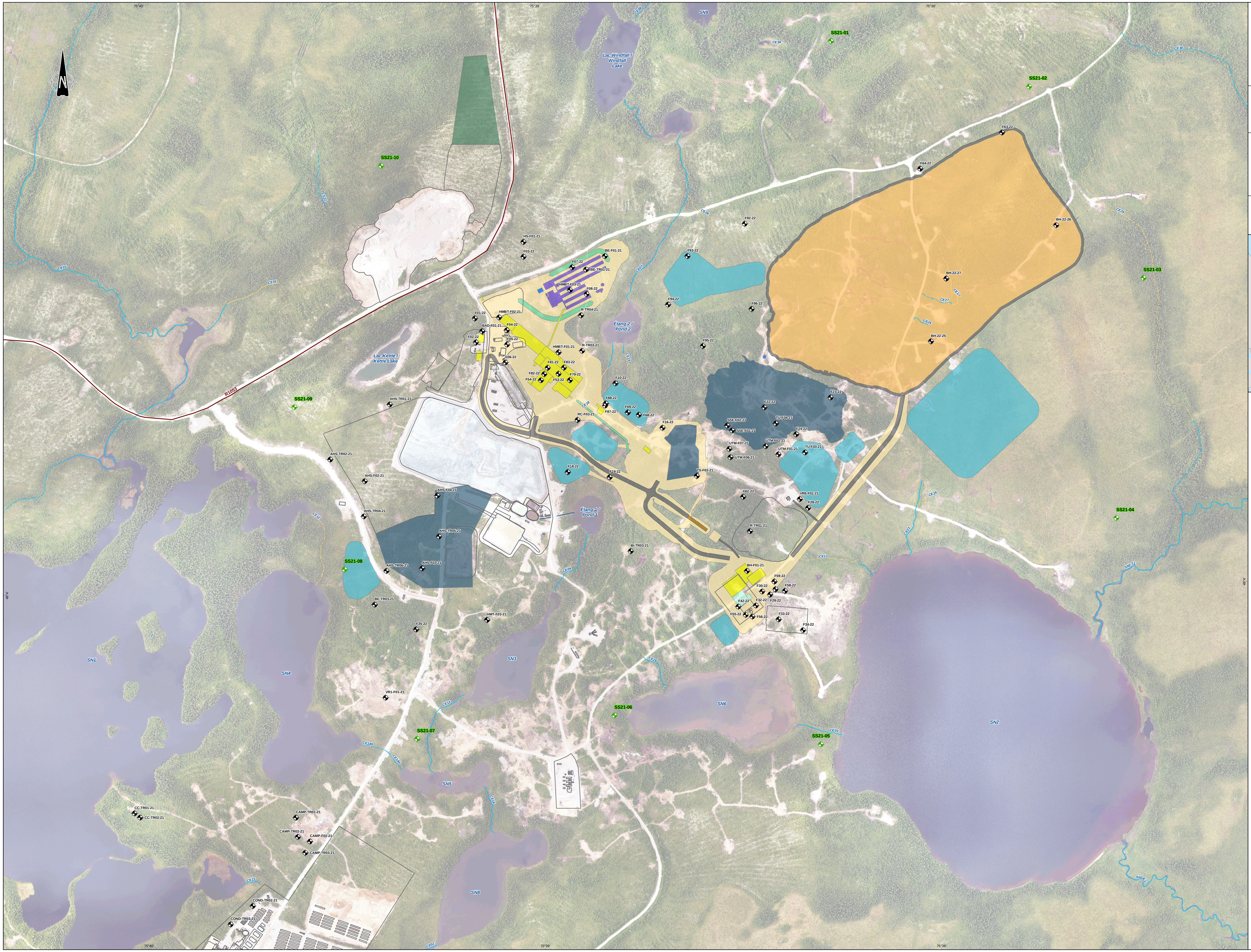
The results of the analyses performed on the soil samples were interpreted according to generic criteria “A,” “B,” and “C” of the MELCC (2021) *Guide d’intervention – Protection des sols et réhabilitation des terrains contaminés (the Response Manual)* and the limit values of Schedule I of the Regulation respecting the burial of contaminated soils (RESC), commonly called criterion “D”.

Chemical analysis results for 167 samples showed concentrations above background levels established for the Superior and Rae Geological Provinces (generic criteria “A”) for the following parameters: silver (F67-22-CF-1B), arsenic (HMT-F03-21-CF-2, TS-F02-21-CF-2, F42-22-CF-4 and F67-22-CF-1B), cadmium (F18-22-CF-1 and F19-22-CF-1), lead (F18-22-CF-1), nickel (BH-22-28-CF-1B), tin (F18-22-CF-1, F19-22-CF-1, and F28-22-CF-1) and cobalt (F92-22-CF-4) (Map 6-6). All results fell within the “A-B” range of the generic criteria in the MELCC Response Manual.

Results in the “B-C“ range of the Response Manual generic criteria were observed for arsenic (F35-22-CF-3), manganese (F92-22- CF-4), and nickel (F92-22-CF-4). Only one exceedance of generic criterion “C” for manganese was observed at F80-22-CF-2, a concentration in the “C-D” range of the generic criteria of the MELCC Response Manual.

For the total sulphur chemical analyses, results from three of the 70 samples analyzed showed a concentration in the “A-C” range of the generic criteria in the Response Manual. All other results for total sulphur were below generic criteria “A.”

In addition, all samples submitted for analysis of C_{10}-C_{50} petroleum hydrocarbons indicated concentrations below the detection limit of the laboratory’s measurement devices.



Projet minier Windfall - Étude d'impact sur l'environnement /
Windfall Mining Project - Environmental Impact Assessment

Site minier Windfall, Eeyou Istchee Baie-James (Québec) /
Windfall Mining Site, Eeyou Istchee Baie-James (Quebec)

Carte 6-6 / *Map 6-6*
Localisation des sondages / *Soundings Location*

Sources :
BDGA, 1/5 000 000, MRNF Québec, 2010
SDA, 1/20 000, MERN Québec, 2019-01
Orthophoto, résolution 80 cm, Osisko Mining inc., 2020-07

0 55 110 m

MTM, fuseau 9 / Zone 9, NAD83

Préparée par / Preparation : S. Boussorra
Dessinée par / Drawing : J. Roy
Vérifiée par / Verification : S. St-Cyr
_201_11330_19_eiec6_6_189_LocSondages_230320.mxd

Sondages / *Soundings*

Échantillon de sols / *Soil sample*

Échantillon de surface seulement / *Surface sample only*

Composantes du projet / *Project Components*

Infrastructure existante / *Existing infrastructure*

Catégories d'infrastructures projetées / *Categories of Planned Infrastructures*

Aire d'activité / *Activity area*

Banc d'emprunt / *Borrow pit*

Bassin / *Pond*

Bâtiment / *Building*

Camp de travailleurs / *Workers camp*

Convoyeur / *Conveyer*

Halde / *Stockpile*

Parc à résidus miniers / *Tailings storage facility*

Route / *Road*

Système de traitement de l'eau potable / *Potable drinking water treatment system*

Souterrain / *Underground*

Structure / *Structure*

Usine de traitement de l'eau / *Water treatment plant*

Hydrographie / *Hydrography*

Cours d'eau permanent / *Permanent watercourse*

Cours d'eau permanent partiellement souterrain / *Partially undeground permanent watercourse*

Cours d'eau intermittent / *Intermittent watercourse*

Cours d'eau intermittent partiellement souterrain / *Partially undeground intermittent watercourse*

Cours d'eau souterrain / *Underground watercourse*

Fossé de drainage / *Drainage ditch*

Canal / *Canal*

La précision des limites et les mesures montrées sur ce document ne doivent pas servir à des fins d'ingénierie ou de délimitation foncière. Aucune analyse foncière n'a été effectuée par un arpenteur-géomètre. /Boundaries and measurements shown on this document must not be used for engineering or land survey delineation. A land register analysis conducted by a land surveyor was not undertaken.

ASSESSMENT OF THE BASELINE CONDITION

This section summarizes the results presented in the sectorial report – Assessment of the natural background level in soils (Appendix 6-4). The natural background levels (NBL) of the soils were established for the two till layers encountered at the site, a sand matrix till layer with traces of silt and a silty sand matrix till layer with sand and silt. To establish the NBL, the chemical analysis results of 108 soil samples for layer 1 and 53 soil samples for layer 2 were assessed. These samples were collected in exploration trenches and during drilling conducted on the study site in 2021 and 2022.

The methodology for the NBL assessment is based on the main grades and references proposed by the MELCC and the EPA. The NBL were calculated for 19 parameters for which at least one result exceeded the RDL: Al, As, Ba, Ca, Cr, Co, Cu, Fe, Li, Mg, Mn, Ni, Pb, K, Na, S_{total}, Ti, V, and Zn. For these parameters, the NBL of the soils was established based on the results of the upper vibrissa calculation, as prescribed in the *Guide de caractérisation physicochimique* (Physicochemical characterization guide) (MDDELCC, 2016). These results were compared to statistical analyses and criteria calculated using EPA's ProUCL software (2015). Moreover, the results for nine parameters were all below the RDL (Sb, Ag, Be, Cd, Hg, Mb, Sn, Pb, Se) for one layer or both at once.

For all the parameters analyzed, the NBL calculated is below generic criteria "A" of the MELCC Response Guide (MELCC, 2021) for layers 1 and 2.

6.5.2 IMPACTS ON SOILS IN THE CONSTRUCTION PHASE AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the construction phase, the sources of potential impacts and the resulting impacts (**in bold**), that may affect soils, are as follows:

— Organization of the site, stripping and clearing, surface preparation and access arrangement, construction of works and infrastructure, transportation and traffic, production and management of residual and hazardous materials.

These sources have the potential to result in the following impacts during the construction phase:

Soil contamination by:

— Accidental introduction of petroleum hydrocarbons, contaminants, or hazardous materials that will contaminate the soils.

Loss of stability and erosion of soils by:

— disturbance of the natural soil structure during activities involving earth moving (stripping, excavation, operation of borrow pits) or traffic on disturbed soils.

MITIGATION MEASURES

Common mitigation measures QUA01 to QUA05, QUA07 to QUA09, QUA15, QUA22 to QUA26 and standards NOR04, NOR05, and NOR10 to NOR12 will be applied to reduce the risks of contamination or accidental spills and the risks of destabilization and creation of erosion zones. Specific measure P26 will also be implemented.

Soil protection is governed by several regulations and standards, particularly in the field of mining projects. They will be followed rigorously and the main ones are listed in Appendix 5-2.

DETAILED DESCRIPTION OF RESIDUAL IMPACT

RISK OF SOIL CONTAMINATION BY THE ACCIDENTAL INTRODUCTION OF PETROLEUM HYDROCARBONS, CONTAMINANTS, OR HAZARDOUS MATERIALS

Road transportation, traffic and refuelling of mobile equipment and temporary storage or handling of residual and hazardous materials will represent potential sources of accidental spills that could contaminate the soils. However, residual and hazardous materials and products that will be produced in the work areas will be managed offsite. The residual materials will be stored temporarily according to the standards in force and access will be protected to prevent groundwater contamination.

Moreover, the risk of accidental spills will be minimized because spills will be managed in accordance with the spill response plan and, given the implementation of many mitigation and control measures, the risk of spills that will have an impact on soil quality is very low; the spill will be contained and the contaminated soils will be recovered quickly, as prescribed in the emergency response plan (see Chapter 12). The impact of a potential spill would depend, among other things, on the volume of contaminants spilled, and one-time occurrences (spills) or recurrence (leaks) of the problem.

RISK OF SOIL DESTABILIZATION AND TRIGGERING EROSION

Organization of the site, including stripping and clearing, surface preparation, soil management, operation of borrow pits, transportation, and traffic are likely to result in alterations of the natural soil structure, favouring destabilization and generating the appearance of erosion zones. However, these risks will be minimized by the application of common mitigation measures. The recommended actions seek to limit the zones where the natural soil structure would be disturbed, to ensure good monitoring of the zones for detection of signs of erosion to implement slope stabilization approaches, and to maintain, when possible, the root system of the cut vegetation, thus favouring rapid regrowth of the plant cover on the surfaces concerned.

ASSESSMENT OF RESIDUAL IMPACT

The long frost period in the Windfall project region facilitates eventual recovery work in case of a spill of petroleum hydrocarbons or hazardous materials. Furthermore, the low topography of the area and the abundant vegetation cover limit the risks of significant consequences on soil stability and erosion. Consequently, the degree of disturbance is considered low for these two aspects. Thus, the intensity of the anticipated impact is also low. In case of accidental spills and soil destabilization, the impact would have a specific spatial scope because the impacts would be felt only in the project sector and any product spilled would be contained quickly and then recovered before it spreads. These impacts would be short-lived because any contaminated soil will not remain in place and responses would be executed immediately to limit the impacts of any soil destabilization.

The soils would then be excavated and shipped to an authorized site depending on their level of contamination. The probability of occurrence is considered low, because even though small spills occur occasionally, this is infrequent. For soil destabilization (erosion), since not all activities would result in erosion risks, the probability of occurrence is considered medium. The significance of the residual impact of soil contamination and soil destabilization risks is considered very low.

Impact on soils in the construction phase		
Nature	Negative	Significance: Very low
Ecosystem value	Low	
Socioeconomic value	Not applicable	
Degree of disturbance	Low	
Intensity	Low	
Spatial scope	Specific	
Duration	Short	
Probability of occurrence	Low (spills) and medium (erosion)	

6.5.3 IMPACT ON SOILS IN THE OPERATIONS PHASE AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the operations phase, the sources of potential impacts and the resulting impacts (**in bold**), that may affect soils are as follows:

— The presence and operation of new infrastructure, water use and management, transportation and traffic, production and management of residual and hazardous materials.

These sources have the potential to result in the following impacts during the operations phase:

Soil contamination by:

— Infiltration of contact water under the new infrastructure;

— airborne propagation of contaminated fine materials stockpiled or transported on the site, which would contaminate the soils;

— accidental introduction of petroleum hydrocarbons, contaminants, or hazardous materials from above-ground or underground tanks, which would contaminate the soils.

MITIGATION MEASURES

Common mitigation measures QUA15, QUA22, QUA23, QUA25, and QUA26 and standards NOR10 and NOR12 will be applied to reduce the soil contamination risks. Specific measure P26 will also be applied.

DETAILED DESCRIPTION OF RESIDUAL IMPACT

RISK OF ALTERATION OF AIR AND SOIL QUALITY BY SEEPAGE OF CONTACT WATER UNDER THE NEW INFRASTRUCTURE

According to the tests performed on the waste rock (Appendix 3-1), certain lithologies are considered potentially acid generating and leachable within the meaning of D019 and the tailings and ore characterization Guide. The tailings and ore are also considered potentially acid generating and leachable.

For all materials, As concentrations above the RES and EC criteria were observed. Several other parameters, such as Cd, Cu, Mn, Mo, Hg, and Zn could also be found in solution in the water.

Water from snowmelt and precipitation that will fall on the tailings storage facility and the waste rock stockpile will percolate in part through the material until it reaches the lined membrane installed at ground level. The water will then be directed to the network of peripheral drainage ditches, thus avoiding seepage into the soil. This water, which may become acidic and which possibly contains metals, will then be directed to the water treatment plant of the Windfall site. However, it should be noted that an eventual breach of the lined membrane could lead to localized metal contamination of the underlying soils and reduce the pH of the groundwater.

On the other hand, in the event of a breach in one of the pipes transporting the tailings, they could alter the soil quality in terms of metal content.

RISK OF SOIL CONTAMINATION BY AIRBORNE FINE MATERIALS FROM TAILINGS AND ORE STOCKPILES OR DURING TRANSPORT OF TAILINGS AND ORE

It is possible that wind erosion of the materials stored on the site (ore and tailings) or during their transport may generate airborne metal contamination on the soil surface. However, the proposed mitigation measures will allow the extent to be limited, and the air quality monitoring program will make it possible to obtain precise data on airborne dust.

RISK OF SOIL CONTAMINATION BY THE ACCIDENTAL INTRODUCTION OF PETROLEUM HYDROCARBONS, CONTAMINANTS, AND HAZARDOUS MATERIALS

The description of this impact is the same as the one presented for the construction phase.

ASSESSMENT OF RESIDUAL IMPACT

Despite the application of the preventive measures, the soils located under the tailings storage facility and the waste rock stockpile could undergo an increase in their metal concentration in the event of a breach of the lined membrane and the same could apply for the neighbouring soils of the tailings pipes in the event one of them is breached. Moreover, wind erosion of the tailings storage facility and the stockpiles could generate airborne contamination of the soil surface. Overall, the degree of disturbance of contamination is considered medium, which results in a low intensity impact. Its impact would have a specific spatial scope (in the case of a breach of the membrane or spills related to the pipe) and local (for the impact related to airborne erosion of the tailings accumulation zones and the material stockpiles). The duration will be short in the case of accidental spills. However, in the event of a breach of the membrane installed on the soils located at the tailings storage facility and the ponds, the duration would be long because the impact will be felt beyond the operations phase. The impact will also have long duration for wind erosion, which will be active throughout operations on the tailings storage facility and the stockpiles. The probability of occurrence is low, both for the risks associated with the breach of the lined membrane under the storage sites and the ponds, and for the risks of accidental spills. However, it will be high for the impact related to wind erosion.

The significance of the residual impact on the soils is therefore very low for accidental spills and for seepage into the soils located under the tailings storage facility, the waste rock stockpile, and the ponds, but low for wind erosion of the stockpiles and the tailings storage facility.

Impact on soils in the operations phase		
Nature	Negative	Significance: Infiltration and risk of accidental spills - Very low Wind erosion - Low
Ecosystem value	Low	
Socioeconomic value	Not applicable	
Degree of disturbance	Medium	
Intensity	Low	
Spatial scope	Specific (seepage and risk of accidental spills) and local (wind erosion)	
Duration	Short (risk of accidental spills) to long (seepage and wind erosion)	
Probability of occurrence	Low (seepage, risk of accidental spills) and high (wind erosion)	

6.5.4 IMPACTS ON SOILS IN THE CLOSURE PHASE AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the closure phase, the sources of potential impacts and the resulting impacts (**in bold**) that may affect soils are as follows:

— The presence of site remnants, final restoration, production and management of residual and hazardous materials

These sources have the potential to result in the following impact during the closure phase:

Soil contamination by:

— Accidental introduction of petroleum hydrocarbons, contaminants, or hazardous materials.

MITIGATION MEASURES

In addition to common mitigation measure QUA06, the same common and specific mitigation measures mentioned in the construction phase will be applied during the closure phase.

DETAILED DESCRIPTION OF RESIDUAL IMPACT

RISK OF SOIL CONTAMINATION BY THE ACCIDENTAL INTRODUCTION OF PETROLEUM HYDROCARBONS, CONTAMINANTS, OR HAZARDOUS MATERIALS

The description of the impact presented in the operations phase applies for the closure phase. However, in the closure phase, final restoration provides for revegetation of the tailings storage facility and the waste rock stockpile, dismantling of the mining infrastructure, and rehabilitation of the soils if they exceed the criteria established for the restoration work. Moreover, a complete soil characterization study will be produced to proceed with the decontamination work, if required. The removal of the potential soil contamination sources thus constitutes a positive impact.

ASSESSMENT OF RESIDUAL IMPACT

The long frost period in the region facilitates eventual recovery work in case of a spill of petroleum hydrocarbons or hazardous materials. Consequently, the degree of disturbance is considered low. Thus, the intensity of the anticipated impact is low. In case of accidental spills, the spatial scope of this impact would be specific because the product would be contained rapidly and then recovered before it spreads. This impact would have a short duration because no contaminated soil will remain in place. The soils would then be excavated and shipped to an authorized site depending on their level of contamination. The probability of occurrence is considered low, with small spills occurring occasionally on most of the large sites, where many mobile equipment units are used. The significance of the residual impact of the soil contamination risks is considered very low.

In the closure phase, final restoration plans for revegetation of the tailings storage facility and the waste rock stockpile, dismantling of the mining infrastructure, and rehabilitation of the soils if they exceed the criteria established for the restoration work. The removal of the potential soil contamination sources thus constitutes a positive impact with a local spatial scope and a long duration.

Impact on soils in the closure phase		
Nature	Negative/Positive	Significance: Risk of accidental spills - Very low Restoration – Positive impact
Ecosystem value	Medium	
Socioeconomic value	Not applicable	
Degree of disturbance	Low (risk of accidental spill)	
Intensity	Low (risk of accidental spill)	
Spatial scope	Specific (risk of accidental spills) and local (restoration)	
Duration	Short (risk of accidental spills) and long (restoration)	
Probability of occurrence	Low (risk of accidental spills)	

6.6 HYDROLOGY

Important facts about hydrology

Existing conditions

Field campaigns have been conducted in recent years (2015 to 2022) to characterize the watercourses in the study area. Twelve points of interest were chosen around the projected site. The watersheds at each of these points were delineated and characterized. The characteristic flows (low water flows, mean monthly flows, and flood flows) were also assessed at each of these points.

Potential impacts of the project

In the construction phase, in view of the mitigation measures that will be implemented, the intensity of the residual impact on surface runoff and the local flow regime is considered low. Its spatial scope is local because the impacts will occur in a limited section of the study area, where the construction work will be done, and its duration is short, because it is limited to the construction phase. The probability of occurrence is high and the significance of the residual impact is therefore low.

In the operations phase, the presence and operation of the new mining infrastructure will lead to changes in the watersheds located in the study area. The intensity of the impact is considered low. Its spatial scope is local and its duration is medium because the impacts will be felt throughout the operations period. The probability of occurrence is high because the impact is certain, and the significance of the residual impact is therefore low.

In the closure phase, once all the work is completed and the water quality on the mine site is sufficient to no longer have to be treated at the WTP, there will be a permanent alteration of the watersheds and the characteristic flows. A positive impact on the hydrology is anticipated compared to the situation that will prevail during operations. Its spatial scope is local and its duration will be long, because the impacts will be felt permanently.

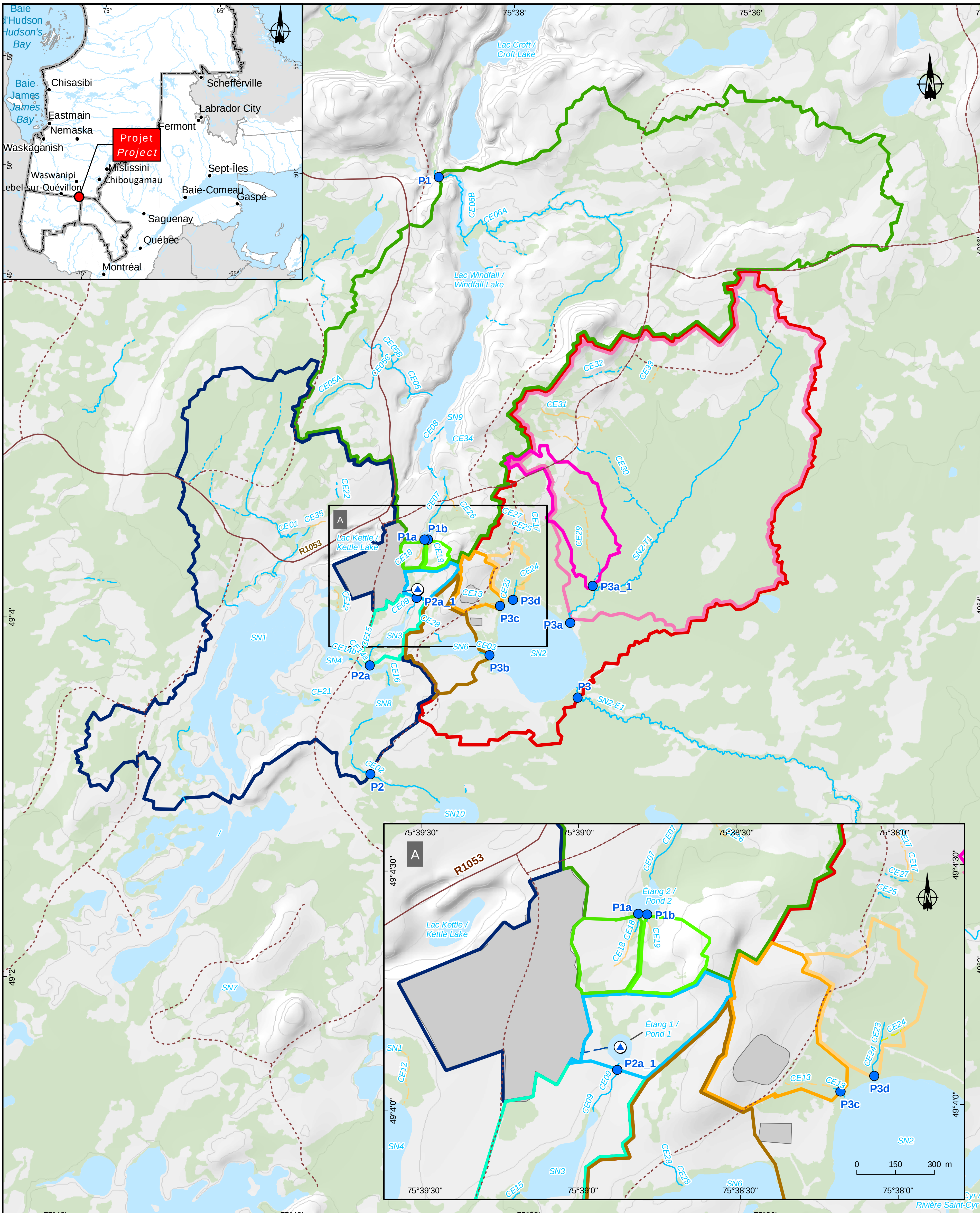
6.6.1 CURRENT CONDITIONS

The sectorial report is summarized in this section (Appendix 6-5). This report can be consulted for more details, particularly on the methodology used to determine characteristic flows.

In the context of this study, several field survey campaigns were conducted over the past few years (2015 to 2022) to characterize the water network in the study area. In particular, rain gauges and level sensors were installed, gauging was done, and profiles were surveyed along watercourses. Then 12 points of interest were chosen in the study area, and the watersheds and characteristic flows were assessed at each of these points.

WATERSHEDS

Table 6-16 presents the watersheds of the 12 points of interest, the watercourse that drains them, their outlet (the station number) and their area in the current state (extra calculation points have been added since the sectorial report was written). It should be noted that at the beginning of the project, the site conditions will be those of the bulk sampling phase, which therefore corresponds to the current state. The watersheds of these 12 points of interest are indicated on Map 6-7.



Hydrogéomorphologie / ***Hydrogeomorphology***

- Point de calcul / *Calculation point*
- Effluent (Étang 1) / *Effluent (Pond 1)*

Bassins versants / ***Watersheds***

- CE06B : 14 km²
- CE18 : < 1 km²
- CE19 : < 1 km²
- CE02 : 9 km²
- CE15 : < 1 km²
- CE09 : < 1 km²
- SN2 : 11 km²
- SN2-T1 : 8 km²
- CE29 : 1 km²
- CE03 : 1 km²
- CE13 : < 1 km²
- CE23 : < 1 km²

Hydrographie / ***Hydrography***

- Cours d'eau permanent / *Permanent watercourse*
- Cours d'eau permanent partiellement souterrain / *Partially undeground permanent watercourse*
- Cours d'eau intermittent / *Intermittent watercourse*
- Cours d'eau intermittent partiellement souterrain / *Partially undeground intermittent watercourse*
- Cours d'eau souterrain / *Underground watercourse*
- Fossé de drainage / *Drainage ditch*
- Canal / *Canal*
- Plan d'eau / *Waterbody*

Végétation / ***Vegetation***

- Milieu humide / *Wetland*

Infrastructures du projet / ***Project Infrastructures***

- Infrastructures aux conditions actuelles (échantillonage en vrac) / *Infrastructure at current conditions (bulk sampling)*

Routes / ***Roads***

- Route forestière secondaire / *Secondary forest road*
- Route forestière tertiaire / *Tertiary forest road*

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Carte 6-7 / ***Map 6-7***
Bassins versants aux conditions actuelles / ***Watersheds at Current Conditions***

Sources / *Sources:*
CanVec+, 1/50 000, RN Can, 2014
SDA, 1/20 000, MERN Québec, 2020
BDTA, 1/250 000, MRN Québec, 2002
BDGA, 1/5 000 000, MRN Québec, 2012
AQRéseau, Réseau routier 32G, 2020

0 400 800 m

MTM, Fuseau 9 / *Zone 9*, NAD83

2023-03-23

Préparée par / *Preparation* : R. Boily
Dessinée par / *Drawing* : C. Villeneuve
Vérifiée par / *Verification* : E. Sormain
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wsp

Table 6-16 Current watersheds (bulk sampling) of the study area

Watercourse	Analysis point	Station number	Watershed area (km²)
Watershed CE06B			
CE06B	About 1 km downstream from Windfall Lake	P1	13.80
CE18	At the confluence with Pond 2	P1a	0.07
CE19	At the confluence with Pond 2	P1b	0.07
Watershed CE02			
CE02	About 850 m upstream of Lake SN10	P2	9.10/9.49 [1]
CE15	At the confluence with Lake SN5	P2a	0.43/0.82 [1]
CE09	Near the outlet of Pond 1	P2a_1	0.14/0.53 [1]
Water treatment plant (WTP)		N.A.	0.38
Watershed SN2			
SN2	On SN2-E1, near the outlet of Lake SN2	P3	11.46
SN2-T1	At the confluence with Lake SN2	P3a	7.88
CE29	Just before the confluence with SN2-T1	P3a_1	0.69
CE03	At the confluence with Lake SN2	P3b	0.57
CE13	At the confluence with Lake SN2	P3c	0.20
CE23	At the confluence with Lake SN2	P3d	0.17

[1] Excluding/including the areas occupied by the mining infrastructure under current conditions draining to the WTP.

CHARACTERISTIC FLOWS

Mine water discharges were considered in the estimate of the characteristic flows at the current conditions. The WTP effluent in the bulk sampling phase is located in Pond 1, which is part of subwatersheds CE09 and CE15, in the watershed of CE02. Consequently, the estimated flows at stations P2, P2a and P2a_1 are increased by the discharge flows from the WTP.

The WTP has a minimum treatment capacity of 150 m^3/h. This value therefore was considered to estimate the flood flows in the receptor watersheds under current conditions. For the annual and summer 7-day consecutive low flows, it was considered that there is no discharge flow to the effluent, which corresponds to a situation where the water is kept in the polishing pond (P pond) or recirculated. In the case of low flows over 30 consecutive years, it would not be realistic to consider any discharge into the effluent for one entire month. The minimum value of the flows at the WTP estimated for the two years of the bulk sampling phase for an average year in terms of climate was considered. The minimum annual value was selected for the annual low water level (1,251 m^3/day in January of the first year), while the minimum value between the months of May and September was considered for the summer low water level (1,873 m^3/day in May of the first year). Finally, the mean monthly discharge flows estimated for the bulk sampling years under average hydrological conditions were added to the monthly flows of the natural watersheds concerned (WSP, 2023).

Table 6-17 presents a summary of the discharge flows considered in the study for the current conditions.

Table 6-17 Discharge flows considered on the study site under the current conditions (bulk sampling)

Parameter	Discharge (L/s)
Flood and low water levels	
Floods	41.7
$Q_{2.7}$ annual	0.0
$Q_{10.7}$ annual	0.0
$Q_{5.30}$ annual	14.5
$Q_{2.7}$ summer	0.0
$Q_{10.7}$ summer	0.0
$Q_{5.30}$ summer	21.7
Average monthly flows	
January	16.3
February	16.3
March	17.6
April	35.5
May	23.5
June	26.7
July	28.5
August	27.2
September	30.2
October	27.1
November	23.7
December	20.5

The average annual low water and flood flows estimated under current conditions are presented respectively in Tables 6-18, 6-19 and 6-20. It should be noted that the rational method was chosen to estimate the flood flows, while the linear regressions coming from the low water flow estimating method in the regions of northern Quebec, developed by the MELCCFP (MDDELCC, 2017) were used for the low water flows. The estimate of the average monthly flows was produced by the watershed transfer method based on station 051003 – Eaux volées. More details on the different methods used are given in the sectorial report (Appendix 6-5).

Table 6-18 Current mean monthly flows (L/s) estimated at the study sites

WATERSHED NAME	WATERSHED CE06B			WATERSHED CE02			WATERSHED SN2					
	CE06B	CE18	CE19	CE02	CE15	CE09	SN2	SN2-T1	CE29	CE03	CE13	CE23
Station number	P1	P1a	P1b	P2	P2a	P2a_1	P3	P3a	P3a_1	P3b	P3c	P3d
Watershed (km^2)	*13.80*	*0.07*	*0.07*	*9.10/9.49* [1]	*0.43/0.82* [1]	*0.14/0.53* [1]	*11.46*	*7.88*	*0.69*	*0.57*	*0.20*	*0.17*
January	172.93	0.91	0.89	114.07	5.43	1.80	143.58	98.81	8.62	7.15	2.47	2.13
February	135.67	0.71	0.70	89.49	4.26	1.41	112.64	77.52	6.77	5.61	1.94	1.67
March	132.16	0.69	0.68	87.18	4.15	1.38	109.73	75.51	6.59	5.46	1.89	1.63
April	465.53	2.45	2.40	307.07	14.62	4.85	386.51	265.99	23.22	19.25	6.65	5.73
May	1498.25	7.87	7.73	988.28	47.05	15.61	1243.95	856.07	74.72	61.94	21.39	18.44
June	697.62	3.67	3.60	460.17	21.91	7.27	579.21	398.61	34.79	28.84	9.96	8.58
July	474.24	2.49	2.45	312.82	14.89	4.94	393.75	270.97	23.65	19.61	6.77	5.84
August	370.06	1.94	1.91	244.10	11.62	3.86	307.25	211.45	18.46	15.30	5.28	4.55
September	375.96	1.98	1.94	247.99	11.81	3.92	312.15	214.82	18.75	15.54	5.37	4.63
October	474.96	2.50	2.45	313.30	14.92	4.95	394.35	271.38	23.69	19.64	6.78	5.84
November	435.88	2.29	2.25	287.51	13.69	4.54	361.89	249.05	21.74	18.02	6.22	5.36
December	254.80	1.34	1.31	168.07	8.00	2.65	211.56	145.59	12.71	10.53	3.64	3.14

[1] Excluding/including the areas of the mine site in the bulk sampling phase, which are treated by the WTP. However, these inflows (WTP discharges) are considered in the analyses.

Table 6-19 Current low water flows (L/s) estimated at the study sites

WATERSHED NAME	WATERSHED CE06B			WATERSHED CE02			WATERSHED SN2					
	CE06B	CE18	CE19	CE02	CE15	CE09	SN2	SN2-T1	CE29	CE03	CE13	CE23
Station number	P1	P1a	P1b	P2	P2a	P2a_1	P3	P3a	P3a_1	P3b	P3c	P3d
Watershed (km^2)	*13.80*	*0.07*	*0.07*	*9.10/9.49* [1]	*0.43/0.82* [1]	*0.14/0.53* [1]	*11.46*	*7.88*	*0.69*	*0.57*	*0.20*	*0.17*
$Q_{2.7}$ annual	22.8	0.1	0.1	15.0	0.7	0.2	18.9	13.0	1.1	0.9	0.3	0.3
$Q_{10.7}$ annual	11.2	0.1	0.1	7.4	0.4	0.1	9.3	6.4	0.6	0.5	0.2	0.1
$Q_{5.30}$ annual	15.2	0.1	0.1	24.5	15.0	14.6	12.6	8.7	0.8	0.6	0.2	0.2
$Q_{2.7}$ summer	55.9	0.3	0.3	36.9	1.8	0.6	46.4	31.9	2.8	2.3	0.8	0.7
$Q_{10.7}$ summer	24.7	0.1	0.1	16.3	0.8	0.3	20.5	14.1	1.2	1.0	0.4	0.3
$Q_{5.30}$ summer	52.9	0.3	0.3	56.5	23.3	22.2	43.9	30.2	2.6	2.2	0.8	0.7

[1] Excluding/including the areas of the mine site in the bulk sampling phase, which are treated by the WTP. However, these inflows (WTP discharges) are considered in the analyses.

Table 6-20 Current flood flows (m³/s) estimated at the study sites

WATERSHED NAME	WATERSHED CE06B			WATERSHED CE02			WATERSHED SN2					
	CE06B	CE18	CE19	CE02	CE15	CE09	SN2	SN2-T1	CE29	CE03	CE13	CE23
Station number	P1	P1a	P1b	P2	P2a	P2a_1	P3	P3a	P3a_1	P3b	P3c	P3d
Watershed (km^2)	*13.80*	*0.07*	*0.07*	*9.10/9.49* [1]	*0.43/0.82* [1]	*0.14/0.53* [1]	*11.46*	*7.88*	*0.69*	*0.57*	*0.20*	*0.17*
2 years	2.89	0.03	0.06	2.49	0.21	0.13	2.39	0.96	0.21	0.36	0.16	0.07
10 years	4.57	0.04	0.10	3.91	0.30	0.18	3.78	1.51	0.33	0.56	0.25	0.12
25 years	5.41	0.05	0.12	4.62	0.35	0.20	4.48	1.79	0.39	0.67	0.30	0.14
50 years	5.87	0.05	0.13	5.01	0.38	0.22	4.87	1.93	0.43	0.74	0.33	0.15
100 years	6.66	0.06	0.15	5.68	0.42	0.24	5.52	2.20	0.48	0.83	0.37	0.17

[1] Excluding/including the areas of the mine site in the bulk sampling phase, which are treated by the WTP. However, these inflows (WTP discharges) are considered in the analyses.

6.6.2 IMPACTS ON HYDROLOGY IN THE CONSTRUCTION PHASE AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the construction phase, the sources of potential impacts and the resulting impacts (**in bold**) that may affect hydrology are as follows:

— Organization of the site, stripping and clearing, surface preparation and access arrangement, construction of works and infrastructure.

These sources have the potential to result in the following impacts during the construction phase:

Change of the local flow regime by:

— alteration of the slope in the watersheds affected by land grading, excavation, and surface backfilling or blasting;
— installation of infrastructure that can alter the watershed boundaries;
— diversion of runoff water onto surfaces not affected by the work;

increase in surface runoff by:

— stripping and clearing that limit water seepage into the soil and accelerate runoff to the watercourses;
— increase in the proportion of impermeable surface of the watersheds.

MITIGATION MEASURES

Common mitigation measures QUA01, QUA08, QUA13, QUA17, VEG01, VEG04, NOR16, PLA01, and PLA02 will be applied to limit the project's impact on surface runoff (Appendix 5-2). Common mitigation measures QUA01, QUA10, QUA11, QUA12, QUA18, QUA19, NOR07, and PLA01 will be applied to limit the project's impact on the local flow regime. Protection of the hydrological regime is governed by several regulations and standards, particularly in the field of mining projects. Specific mitigation measure P26 will also be implemented.

DESCRIPTION OF RESIDUAL IMPACT

INCREASE IN SURFACE RUNOFF AND CHANGE OF LOCAL FLOW REGIME

Construction of access roads, site clearing and preparation activities (overburden stripping, soil compaction, etc.) and construction of watercourse crossing structures will have the effect of reducing the runoff water storage capacity in organic soils and increasing the proportion of impermeable surface of the watershed, and thus the surface runoff; ultimately the peak flow could be increased. Moreover, the land grading, excavation, and surface backfilling and blasting work required for construction of access roads, ditches, dikes, and mining infrastructure, as well as the development of the tailings storage facility and the waste rock and overburden stockpiles, will have the effect of altering the slope and the local flow regime in the watersheds.

These changes made to the local flow pattern result in impacts on the flows in the watercourse. However, the implementation of the mitigation measures will allow the impact to be limited.

It should be noted that the construction works (ponds, roads, ditches, etc.), including surface water management, encroachment on the watersheds of certain lakes and watercourses, and the backfilling of underground watercourse CE18, will have the effect of major to low alteration of the water regime of the watersheds affected by this work, depending on the site. However, the maximum impact will be reached when construction of the structures is completed. The assessment of the impacts of the infrastructure once constructed will therefore be addressed in the operations phase.

ASSESSMENT OF RESIDUAL IMPACT

Concerning the increase in surface runoff and the change in the flow regime, in view of the mitigation measures that will be implemented, the intensity of the residual impact is considered low. Its spatial scope is local because the impacts will occur in a limited portion of the study area, where the construction work will be done, and its duration is medium, because the impact on the flow regime will be felt for the duration of the mine's life cycle. The probability of occurrence is high and the significance of the residual impact is therefore low.

Impact on hydrology in the construction phase		
Nature	Negative	Significance: Low
Ecosystem value	Low	
Socioeconomic value	Not applicable	
Degree of disturbance	Low	
Intensity	Low	
Spatial scope	Local	
Duration	Medium	
Probability of occurrence	High	

6.6.3 IMPACTS ON HYDROLOGY IN THE OPERATIONS PHASE AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the operations phase, the sources of potential impacts and the resulting impacts (**in bold**), that may affect hydrology, are as follows:

— The presence and operation of new infrastructure and water use and management

These sources have the potential to result in the following impacts during the operations phase:

Changes to watersheds in the study area by:

— installation of infrastructure that can alter the watershed boundaries;

— diversion of runoff water onto surfaces not affected by the work;

Changes in the characteristic flows of the study area by:

- change in occupancy of the watersheds;
- change in the boundaries and area of the watersheds.

MITIGATION MEASURES

No common mitigation areas will be applied. However, the new infrastructure was positioned according to the local topography so as to maximize compliance with the delineations of the current watersheds and encroach on as few watersheds as possible. Specific mitigation measure P26 will also be implemented.

DESCRIPTION OF RESIDUAL IMPACT

CHANGES TO WATERSHEDS IN THE STUDY AREA

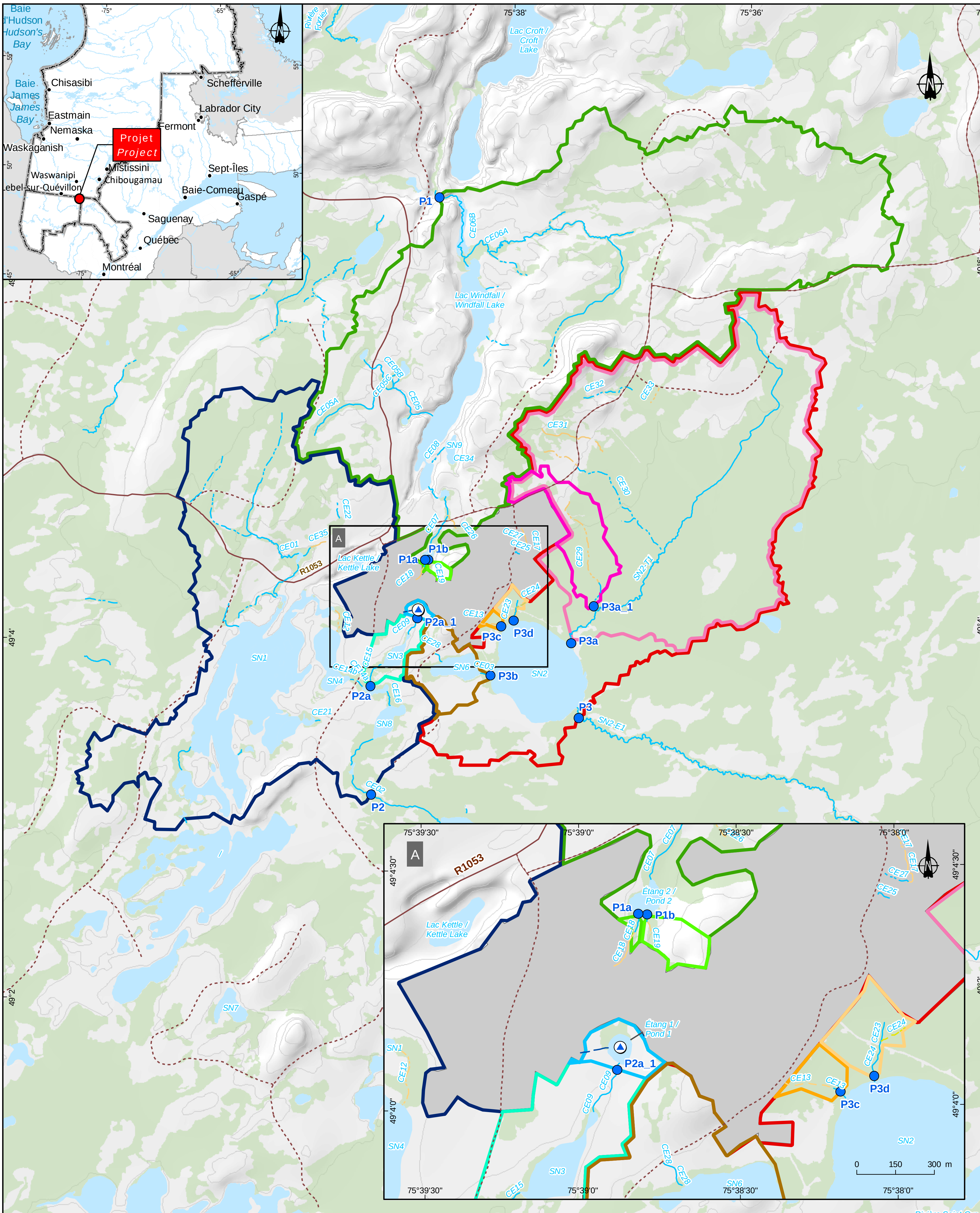
The presence and operation of the new mining infrastructure will lead to changes in the watersheds located in the study area.

Table 6-21 presents the area of these watersheds once the developments are completed and the variation of area of the projected conditions relative to the current conditions is applied. The infrastructure and the watersheds of the projected conditions appear on Map 6-8.

Table 6-21 Projected watersheds of the study area

Watercourse	Analysis point	Station number	Watershed area		
			Current condition (km^2)	Projected condition (km^2)	Variation of projected vs. actual condition
Watershed CE06B					
CE06B	About 1 km downstream from Windfall Lake	P1	13.80	13.47	-2.4%
CE18	At the confluence with Pond 2	P1a	0.07	0.01	-89.8%
CE19	At the confluence with Pond 2	P1b	0.07	0.04	-43.9%
Watershed CE02					
CE02	About 850 m upstream of Lake SN10	P2	9.10/9.49 [1]	8.94/10.62 [1]	-1.8%/+11.9% [1]
CE15	At the confluence with Lake SN5	P2a	0.43/0.82 [1]	0.33/2.01 [1]	-23.0%/+145.9% [1]
CE09	Near the outlet of Pond 1	P2a_1	0.14/0.53 [1]	0.05/1.72 [1]	-66.9%/+226.5% [1]
Water treatment plant (WTP)		N.A.	0.38	1.68	+336.3%
Watershed SN2					
SN2	On SN2-E1, near the outlet of Lake SN2	P3	11.46	10.72	-7.0%
SN2-T1	At the confluence with Lake SN2	P3a	7.88	7.90	+0.2%
CE29	Just before the confluence with SN2-T1	P3a_1	0.69	0.67	-3.2%
CE03	At the confluence with Lake SN2	P3b	0.57	0.51	-9.9%
CE13	At the confluence with Lake SN2	P3c	0.20	0.04	-81.6%
CE23	At the confluence with Lake SN2	P3d	0.17	0.07	-58.6%

1 Excluding/including the areas occupied by the mining infrastructure under current and projected conditions draining to the WTP.



Hydrogéomorphologie / ***Hydrogeomorphology***

- Point de calcul / *Calculation point*
- Effluent (Étang 1) / *Effluent (Pond 1)*

Bassins versants / ***Watersheds***

- CE06B : 13 km²
- CE18 : < 1 km²
- CE19 : < 1 km²
- CE02 : 9 km²
- CE15 : < 1 km²
- CE09 : < 1 km²
- SN2 : 11 km²
- SN2-T1 : 8 km²
- CE29 : 1 km²
- CE03 : 1 km²
- CE13 : < 1 km²
- CE23 : < 1 km²

Hydrographie / ***Hydrography***

- Cours d'eau permanent / *Permanent watercourse*
- Cours d'eau permanent partiellement souterrain / *Partially undeground permanent watercourse*
- Cours d'eau intermittent / *Intermittent watercourse*
- Cours d'eau intermittent partiellement souterrain / *Partially undeground intermittent watercourse*
- Cours d'eau souterrain / *Underground watercourse*
- Fossé de drainage / *Drainage ditch*
- Canal / *Canal*
- Plan d'eau / *Waterbody*

Végétation / ***Vegetation***

- Milieu humide / *Wetland*

Infrastructures du projet / ***Project Infrastructures***

- Infrastructures aux conditions projetées (échantillonage en vrac) / *Infrastructure at projected conditions (bulk sampling)*

Routes / ***Roads***

- Route forestière secondaire / *Secondary forest road*
- Route forestière tertiaire / *Tertiary forest road*

OSISKO
MINIÈRE OSISKO

Projet minier Windfall - Étude d'impact sur l'environnement / *Windfall Mining Project - Environmental Impact Assessment*

Site minier Windfall, Eeyou Istchee Baie-James (Québec) / *Windfall Mining Site, Eeyou Istchee Baie-James (Quebec)*

Carte 6-8 / ***Map 6-8***
Bassins versants aux conditions projetées / ***Watersheds at Projected Conditions***

Sources / Sources:
CanVec+, 1/50 000, RN Can, 2014
SDA, 1/20 000, MERN Québec, 2020
BDTA, 1/250 000, MRN Québec, 2002
BDGA, 1/5 000 000, MRN Québec, 2012
AQRéseau, Réseau routier 32G, 2020

0 400 800 m

MTM, Fuseau 9 / *Zone 9*, NAD83

2023-03-23

Préparée par / Preparation : R. Boily
Dessinée par / Drawing : C. Villeneuve
Vérifiée par / Verification : E. Sormain
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wsp

Table 6-21 shows that the watersheds of stations P1a and P3c will be the most impacted by the project with a loss of area of 89.8% and 81.6% respectively. The watersheds at points P1b, P2a_1, and P3d will also be impacted significantly with area reductions between 43.9% and 66.9%. It should be noted that the substantial loss of area of the watershed at point P2a_1 (66.9%) does not consider the area of the mining infrastructure present during the bulk sampling phase and in the projected state for which the discharge point is located in this watershed, which is also the case for the watersheds at points P2 and P2a. However, it must be remembered that, among the watersheds of the five stations with the greatest percentage reduction, two of them have an area less than 0.1 km^2 and three have an area less than 1.0 km^2 in their initial conditions. For all the watersheds over 1 km^2, the percentage reduction of the watershed is less than 10%.

Watershed P3a will show a slight increase of its area (0.2%). The watersheds at points P2, P2a, and P2a_1 will also see their area increase if one considers the areas occupied by the current and projected infrastructure, which are drained to the WTP and discharged into these watersheds.

CHANGES IN THE CHARACTERISTIC FLOWS OF THE STUDY AREA

The presence and operation of the new infrastructure and water use and management will impact the characteristic flows of certain watercourses in the study area. Within the mine site, rainwater will be collected by a drainage network that will channel it by gravity or by pumping to the different ponds and ultimately to the WTP, where it will be treated before discharge into Pond 1. The area drained by the WTP is increased compared to the current conditions, as previously described, and its maximum capacity will be increased compared to the bulk sampling conditions, rising from 150 m^3/h currently (41.7 L/s) to 1,000 m^3/h on the projected conditions (277.8 L/s). No water will be collected in the watercourses for the purposes of the project. Table 6-22 presents the estimated projected mean discharge flows.

The development of the mine will also have an impact on the hydrogeological conditions of the watersheds affected by the project. Indeed, according to the hydrogeological study (Appendix 6-7), it is anticipated that mine dewatering will trigger a drawdown of the water table over a certain radius around the mine site. This drawdown is considered low but it nonetheless will have an impact on the underground inflows in certain watercourses under study (Appendix 6-7). There are many uncertainties related to hydrogeological analyses and the results are to be considered with caution, but comprehensively. The watercourses of the watershed of CE02 will be the most impacted, with the projected reduction, according to the hydrogeological study, of 30% of the basic flow for CE02 (P2) and 67% for CE15 (P2a). Although CE09 (P2a_1) is outside the model studied, a reduction of 67% (equivalent to that of CE15) was considered. In the watershed of Lake SN2, the impact is negligible for CE13 and CE23 (P3c and P3d). The watercourses at points P3, P3a and P3a_1 are not part of the modelled sector, but the impact at these locations is probably nil. Only CE03 (P3b) thus shows a reduction of 25% of its groundwater inflows. Finally, for the watershed of CE06B and its subwatersheds (P1, P1a, and P1b), the impact is negligible.

Table 6-22 Discharge flows considered in Pond 1 under the projected conditions

Parameter	Discharge (L/s)
Flood and low water levels	
Floods	277.8
$Q_{2,7}$ annual	0.0
$Q_{10,7}$ annual	0.0
$Q_{5,30}$ annual	19.1
$Q_{2,7}$ summer	0.0
$Q_{10,7}$ summer	0.0
$Q_{5,30}$ summer	23.1
Mean monthly flows	
January	42.3
February	44.8
March	58.6
April	126.4
May	122.4
June	92.1
July	93.6
August	96.2
September	105.1
October	101.1
November	73.5
December	47.0

The mean annual low water and flood flows estimated under the projected conditions are presented in Tables 6-23, 6-24, and 6-25, as well as the flow variations between the projected and current conditions. The flows were estimated with the same methodology as the flows under the current conditions.

It should be noted that the mine discharges were considered in the estimate of the projected flows at the mine effluent discharge point. Therefore, the characteristic flows at points P2, P2a, and P2a_1 account for the projected discharge flows from the WTP. To estimate the flood flows, it was considered that the WTP operates at full capacity. To estimate the mean monthly flows, the mean monthly effluent flows presented in Table 6-22 were used. For low water flows over 30 consecutive days, the minimum mean monthly flow during the low water period was considered. Finally, for low flows over seven consecutive days, it was considered that the treatment plant is shut down and thus there is no discharge into the effluent.

Due to the absence of water effluent discharge into their watercourses, the variation of the characteristic flows at sites P1, P1a, P1b, P3, P3a, P3a_1, P3c, and P3d is approximately equal to the variation of area of their respective watersheds. In general, it should be noted that for the flood flows obtained by the rational method, the flow variation is not entirely proportional to the area variation, because the method also accounts for changes in the physical characteristics of the watershed (percentage of lake, slope, etc.). The flows at point P3b vary more greatly due to the drawdown of the water table, which reduces its groundwater inflows.

Thus, a flow reduction is observed at point P1a for CE18 and at point P3c on CE13, -89.8% and -81.6% respectively. The flows at points P1b and P3d will also be impacted with mean flows of 43.9% and 58.6%. Among these watercourses, the mean monthly impacts in projected conditions are reduced to under 1.0 L/s for certain periods of the year and under 0.1 L/s at point P1b on CE18. At points P3, P3a, and P3a_1, the variation is -7.0% to +0.2%.

The impact of the increase of the flows in the mine effluent watersheds decreases with the increase in distance from the discharge point, from a mean (for the mean monthly flows) of 185.6% at calculation point P2a_1 (about 30 m downstream from the effluent) to 19.0% at calculation point P2 (about 2.6 km downstream of the effluent). It should be noted that these large flow increases could have the effect of increasing erosion, primarily in watercourse CE09 directly at the outlet of Pond 1. Indeed, the mean monthly flow for May and June at calculation point P2a_1 under future conditions reaches the 2-year recurring flood flow under current site conditions. This increase in flow may result in higher speeds over longer periods of time and thus erosion in this watercourse. However, the slope of CE09 is low, which can limit the speeds and thus limit the potential erosion. In addition, the values presented are conservative given that the effluent discharge debris will certainly be strained at the calculation points by Pond 1, as well as the lakes further downstream (SN3, SN5, SN8), which was not considered in this study.

Table 6-23 Projected mean monthly flows (L/s) estimated at the study sites (white) and variation (%) between the current and projected conditions (grey)

WATERSHED NAME	WATERSHED CE06B						WATERSHED CE02						WATERSHED SN2											
	CE06B		CE18		CE19		CE02		CE15		CE09		SN2		SN2-T1		CE29		CE03		CE13		CE23	
Station number	P1		P1a		P1b		P2		P2a		P2a_1		P3		P3a		P3a_1		P3b		P3c		P3d	
Watershed (km²)	*13.47*	*-2.4*	*0.01*	*-89.8*	*0.04*	*-43.9*	*8.94 / 10.62[1]*	*-1.8 / +11.9[1]*	*0.33 / 2.01[1]*	*-23.0 / +145,9[1]*	*0.05 / 1.72[1]*	*-66.9 / +226.5[1]*	*10.65*	*-7.0*	*7.90*	*+0.2*	*0.67*	*-3.2*	*0.51*	*-9.9*	*0.04*	*-81.6*	*0.07*	*-58.6*
January	168.8		0.1		0.5		152.2	+16.8	46.3	+113.6	42.9	+137.5	133.5		99.0		8.3		6.3	-11.6	0.5		0.9	
February	132.4		0.1		0.4		130.5	+23.4	47.8	+132.8	45.2	+155.2	104.7		77.7		6.5		4.9	-12.0	0.4		0.7	
March	129.0		0.1		0.4		142.0	+35.5	61.6	+183.0	59.0	+210.7	102.0		75.7		6.4		4.8	-12.1	0.3		0.7	
April	454.5		0.3		1.4		425.8	+24.3	137.4	+174.0	127.9	+216.8	359.4		266.6		22.5		17.2	-10.5	1.2		2.4	
May	1462.6		0.8		4.3		1091.0	+7.8	158.4	+124.7	127.5	+226.4	1156.7		857.9		72.3		55.7	-10.1	3.9		7.6	
June	681.0	-2.4	0.4	-89.8	2.0	-43.9	542.0	+11.3	108.8	+123.9	94.5	+178.3	538.6	-7.0	399.4	+0.2	33.7	-3.2	25.9	-10.3	1.8	-81.6	3.6	-58.6
July	463.0		0.3		1.4		398.7	+16.8	104.8	+141.5	95.1	+184.4	366.1		271.5		22.9		17.5	-10.5	1.2		2.4	
August	361.3		0.2		1.1		333.8	+23.0	104.9	+170.2	97.4	+213.5	285.7		211.9		17.9		13.7	-10.7	1.0		1.9	
September	367.0		0.2		1.1		346.5	+24.6	113.9	+171.5	106.3	+211.9	290.3		215.3		18.1		13.9	-10.7	1.0		1.9	
October	463.7		0.3		1.4		406.6	+19.5	112.3	+167.3	102.6	+220.2	366.7		272.0		22.9		17.6	-10.5	1.3		2.4	
November	425.5		0.2		1.3		353.8	+13.7	83.8	+124.2	75.0	+165.3	336.5		249.6		21.0		16.1	-10.6	1.1		2.2	
December	248.7		0.1		0.7		209.9	+11.3	52.9	+85.6	47.8	+106.3	196.7		145.9		12.3		9.4	-11.0	0.7		1.3	

[1] Excluding/including the areas of the mine site in the bulk sampling phase and under the projected conditions, which are treated by the WTP. However, these inflows (WTP discharges) are considered in the analyses.

Table 6-24 Projected low water flows (L/s) estimated at the study sites (white) and variation (%) between the current and projected conditions (grey)

WATERSHED NAME	WATERSHED CE06B						WATERSHED CE02						WATERSHED SN2											
	CE06B		CE18		CE19		CE02		CE15		CE09		SN2		SN2-T1		CE29		CE03		CE13		CE23	
Station number	P1		P1a		P1b		P2		P2a		P2a_1		P3		P3a		P3a_1		P3b		P3c		P3d	
Watershed (km²)	*13.47*	*-2.4*	*0.01*	*-89.8*	*0.04*	*-43.9*	*8.94 / 10.62[1]*	*-1.8 / +11.9[1]*	*0.33 / 2.01[1]*	*-23.0 / +145,9[1]*	*0.05 / 1.72[1]*	*-66.9 / +226.5[1]*	*10.65*	*-7.0*	*7.90*	*+0.2*	*0.67*	*-3.2*	*0.51*	*-9.9*	*0.04*	*-81.6*	*0.07*	*-58.6*
$Q_{2.7}$ annual	22.23	-2.4	0.01	-89.8	0.07	-43.9	12.54	-16.5	0.32	-55.9	0.00	-100.0	17.58	-7.0	13.04	+0.2	1.10	-3.2	0.73	-22.2	0.06	-81.6	0.12	-58.6
$Q_{10.7}$ annual	10.92		0.01		0.03		5.03	-31.8	0.04	-90.0	0.00	-100.0	8.63		6.40		0.54		0.30	-34.9	0.03		0.06	
$Q_{5.30}$ annual	14.82		0.01		0.04		26.71	+9.0	19.22	+28.5	19.06	+30.2	11.72		8.69		0.73		0.45	-28.4	0.04		0.08	
$Q_{2.7}$ summer	54.57		0.03		0.16		34.01	-7.8	1.12	-36.4	0.11	-80.3	43.16		32.00		2.70		1.97	-14.9	0.15		0.28	
$Q_{10.7}$ summer	24.13		0.01		0.07		13.80	-15.3	0.36	-53.3	0.01	-97.2	19.08		14.15		1.19		0.80	-21.3	0.07		0.13	
$Q_{5.30}$ summer	51.61		0.03		0.15		55.11	-2.5	24.11	+3.3	23.17	+4.2	40.81		30.27		2.55		1.85	-15.2	0.14		0.27	

[1] Excluding/including the areas of the mine site in the bulk sampling phase and under the projected conditions, which are treated by the WTP. However, these inflows (WTP discharges) are considered in the analyses.

Table 6-25 Projected flood flows (m³/s) estimated at the study sites (white) and variation (%) between the current and projected conditions (grey)

WATERSHED NAME	WATERSHED CE06B						WATERSHED CE02						WATERSHED SN2											
	CE06B		CE18		CE19		CE02		CE15		CE09		SN2		SN2-T1		CE29		CE03		CE13		CE23	
Station number	P1		P1a		P1b		P2		P2a		P2a_1		P3		P3a		P3a_1		P3b		P3c		P3d	
Watershed (km²)	*13.47*	*-2.4*	*0.01*	*-89.8*	*0.04*	*-43.9*	*8.94 / 10.62[1]*	*-1.8 / +11.9[1]*	*0.33 / 2.01[1]*	*-23.0 / +145.9[1]*	*0.05 / 1.72[1]*	*-66.9 / +226.5[1]*	*10.65*	*-7.0*	*7.90*	*+0.2*	*0.67*	*-3.2*	*0.51*	*-9.9*	*0.04*	*-81.6*	*0.07*	*-58.6*
2 years	2.82	-2.4	0.00	-88.3	0.05	-12.9	2.68	7.7%	0.41	+96.9	0.34	+170.5	2.24	-7.0	0.96	+0.2	0.20	-3.2	0.35	-0.8	0.03	-79.6	0.03	-56.6
10 years	4.46	-2.4	0.00	-88.3	0.09	-12.7	4.07	4.2%	0.48	+59.1	0.38	+115.7	3.54	-7.0	1.51	+0.2	0.32	-3.2	0.56	-0.7	0.05	-79.5	0.05	-56.5
25 years	5.28	-2.4	0.01	-88.3	0.10	-12.7	4.78	3.3%	0.52	+47.9	0.40	+98.4	4.19	-7.0	1.79	+0.2	0.38	-3.2	0.67	-0.7	0.06	-79.5	0.06	-56.5
50 years	5.73	-2.4	0.01	-88.2	0.12	-12.1	5.16	2.9%	0.54	+42.5	0.42	+89.7	4.55	-7.0	1.94	+0.2	0.42	-3.2	0.73	-0.5	0.07	-79.4	0.07	-56.2
100 years	6.50	-2.4	0.01	-88.2	0.13	-12.6	5.82	2.4%	0.58	+36.1	0.43	+79.5	5.16	-7.0	2.21	+0.2	0.47	-3.2	0.82	-0.6	0.08	-79.5	0.08	-56.5

[1] Excluding/including the areas of the mine site in the bulk sampling phase and under the projected conditions, which are treated by the WTP. However, these inflows (WTP discharges) are considered in the analyses.

ASSESSMENT OF RESIDUAL IMPACT

During the operations phase, and considering the mitigation measures implemented, the delineation of the watersheds and their characteristic flows will be affected. The ecosystem value is low. The degree of disturbance is considered medium because certain impacts will be felt on the watersheds of the study area. However, the intensity of the impact is considered low because the impact of the disturbances on the watersheds of the study area has only few consequences for the biggest watersheds on the regional scale. Its spatial scope is local and its duration is medium because the impacts will be felt throughout the operations period. The probability of occurrence is high because the impact is certain, and the significance of the residual impact is therefore medium.

Impact on hydrology in the operations phase		
Nature	Negative	Significance: Low
Ecosystem value	Low	
Socioeconomic value	Not applicable	
Degree of disturbance	Medium	
Intensity	Low	
Spatial scope	Local	
Duration	Medium	
Probability of occurrence	High	

6.6.4 IMPACTS ON HYDROLOGY IN THE CLOSURE PHASE AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the closure phase, the sources of impacts that may affect hydrology and the resulting impacts (**in bold**) are as follows:

— The presence of site remnants and the final restoration.

These sources have the potential to result in the following impacts during the closure phase:

Final alteration of watersheds and characteristic flows of the study area by:

— The remnants of the mine site that will have altered the boundaries and characteristics of watersheds.

MITIGATION MEASURES

Common mitigation measures QUA13, QUA17, QUA18, QUA20, QUA21, PLA01, and PLA02 and standards NOR07, NOR14, and NOR16 will be applied to maximize restoration of the natural local flow of the watersheds (Appendix 5-2).

DESCRIPTION OF RESIDUAL IMPACT

ALTERATION OF WATERSHEDS AND CHARACTERISTIC FLOWS OF THE STUDY AREA

The main residual impact will consist of light but permanent alterations of the drainage pattern in the study area and the topography (for example, the accentuated slope at the stockpiles and the tailings storage facility).

The restoration work will last two years for the vast majority of the work. Monitoring will continue over a 10-year period and then the water management infrastructure will be dismantled. The impacts in the closure phase are estimated in terms of this period, when all the work is completed, and the water quality on the mine site is sufficient that it no longer has to be treated at the WTP.

The tailings storage facility will be revegetated, which will have the effect of restoring the surface runoff and soil storage conditions. The pumps will be decommissioned and the ponds, ditches, etc. will be breached and graded to allow the gravity flow of water to the nearest receptor watercourses, according to the topography.

ASSESSMENT OF RESIDUAL IMPACT

Once the closure phase is completed, and given the mitigation measures that will be implemented, some permanent alterations of the drainage pattern and the local topography will occur. A positive impact on hydrology is anticipated compared to the situation that will prevail during operations. Its spatial scope is local and its duration will be long, because the impacts will be felt permanently.

Impact on hydrology in the closure phase		
Nature	Positive	Positive impact Significance: Low
Ecosystem value	Low	
Socioeconomic value	Not applicable	
Degree of disturbance	Low	
Intensity	Low	
Spatial scope	Local	
Duration	Long	
Probability of occurrence	High	

6.7 SURFACE WATER

Important facts about surface water

Existing conditions

Surface water quality data were taken from the results of analyses performed on surface water samples collected in the most recent campaign years (2016–2017, 2021, and 2022). The 17 sampling stations are distributed throughout the area around the mine site. According to the results obtained from sampling stations, surface water quality around the Windfall mine site showed relatively few exceedances of the criteria established by the MELCCFP for the protection of aquatic life. However, there appear to be some metal concentrations present. In general, mercury, arsenic, and lead are the three parameters that most often exceed the MELCCFP criteria for chronic effects.

For final effluent water quality, the quality criteria required by D019 and the MDMER were all met in 2019 and 2020, except for one result. The results show that the final effluent is slightly acidic, contains low levels of total suspended solids (TSS), and is very poorly mineralized. Acute toxicity bioassays with daphnia (*Daphnia magna*) and rainbow trout (*Oncorhynchus mykiss*) conducted since January 2019 have never generated noncompliance, except for once in 2022.

Potential impacts of the project

Surface water is considered to have high ecosystem value because it directly influences organisms living in aquatic environments, but also the entire ecosystem.

Given the mitigation measures that will be implemented in the construction phase, the degree of disturbance is considered low because the anticipated impacts do not alter the integrity of the surface water quality or its use, which results in an impact of medium intensity. The impact will generally have a specific spatial scope because it is limited to the immediate area of the work being done and the impact will be felt for a short duration. The probability of occurrence is medium for the introduction of TSS and low for the accidental introduction of petroleum hydrocarbons, contaminants, or hazardous materials, which results in a low significance for residual impact.

In the operations phase, the degree of disturbance or the risk of a spill is considered low at the effluent discharge because, without compromising its environmental integrity, the impact results in an almost imperceptible reduction of water quality thanks to compliance with the aquatic life protection standards. Thus, the intensity of the impact would be medium. The spatial scope of the impact will be local and will be felt over a medium duration, throughout operations, with the exception of a one-time accidental spill or short-term TSS introduction event. The probability of occurrence is high for the impacts related to the effluent discharge, but low for hydrocarbon spill events and TSS introduction events. The significance of the residual impact is medium to low.

In the closure phase, the nature of the anticipated impact is negative when specifically concerning the site closure work, but positive concerning rehabilitation of the site because natural conditions may be established. The residual impact of the mine closure is positive, but negative with low significance for performance of the work related to closure.

6.7.1 CURRENT CONDITIONS

The surface water quality of the receiving environment was analyzed several times since the start of development of the Windfall project. Starting in 2010 and then in 2015, samples were collected in various watercourses and lakes of the area. In 2016 and 2017, new sampling stations were visited, while some stations were abandoned to better represent the project's realities. In 2021 and 2022, two of these stations were sampled again and new stations were added to provide good coverage of the neighbouring surface water and complete the profile of the initial state. Considering the most recent campaigns (2016, 2017, 2021, and 2022), these are the results of 17 stations, including 13 with a minimum of six visits conducted between May and October, which were used for the establishment of the initial state of surface water quality.

All of the information (results and certificates of analysis) concerning surface water quality may be consulted in the sectorial report on surface water and sediment in Appendix 6-6. A summary of the main results obtained is also presented in the following paragraphs.

Moreover, the water quality monitoring results of the current mine effluent are discussed in this section. The final effluent quality is measured on a daily basis (flow, pH, TSS), a weekly basis (metals), and a monthly basis (acute toxicity) in the context of the regular monitoring required by D019 in force in Quebec. The monitoring required under the MDMER began in 2019 and the results available to date combine the measurements from 2019 to 2022.

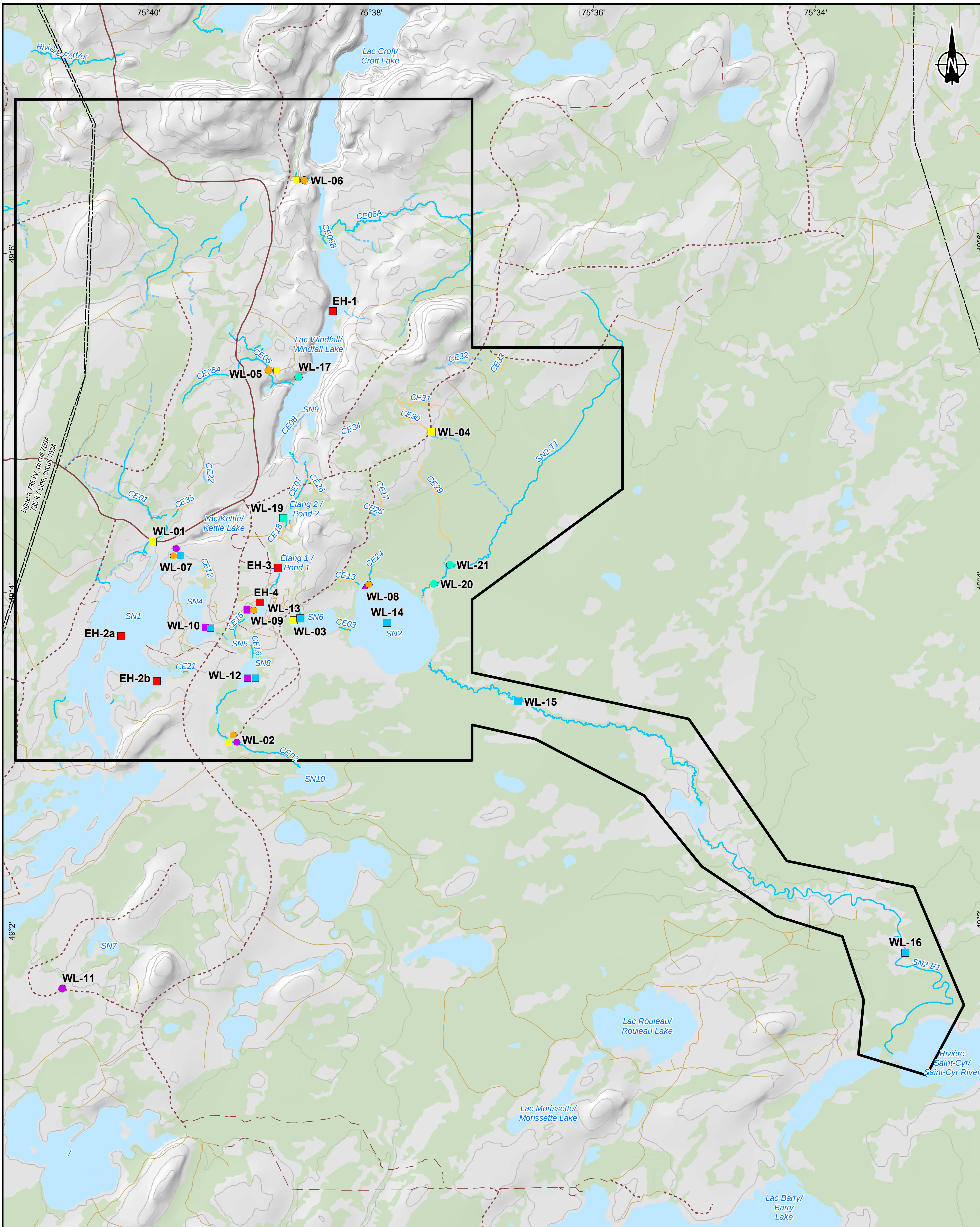
WATER QUALITY ON THE MINE SITE

The location of the surface water sampling stations between 2016 and 2022 is shown on Map 6-9. The results of analyses and the laboratory certificates are provided in the sectorial report in Appendix 6-6. The results were compared to the MELCCFP aquatic life protection water quality criteria (MELCC, 2022b), namely:

- prevention of contamination, water, and aquatic organisms (CPC[O]);
- aquatic life protection, chronic effect (CVAC);
- aquatic life protection, acute effect (CVAA).

Based on the results obtained, the surface water in the Windfall project study area is of good quality. Indeed, the measurements taken *in situ* with a multiparameter sensor reveal no abnormal value that can attest to poor water quality. However, pH measurements varying below the optimum limit (6.5 to 9.5) were detected, which does not necessarily indicate a problem because values below the optimum range are sometimes encountered in the natural environment. For the parameters analyzed, the analytical laboratory results show relatively few exceedances of the criteria established by the MELCCFP for aquatic life protection. Table 6-26 presents all of the parameters for which an exceedance of criteria was noted in the surface water collected in the years 2016-2017, 2021, and 2022.

Concerning major ions, the low calcium concentration shows that the aquatic environment at these locations is more sensitive to acidification. This is the case for the majority of the systems of 2021 and 2022, i.e., WL-07, WL-14, WL-15, WL-16, WL-17, WL-20, and WL-21.



Limite / ***Boundary***

Zone d'inventaire / *Inventory area*

Hydrographie / ***Hydrography***

Cours d'eau permanent / *Permanent watercourse*

Cours d'eau intermittent / *Intermittent watercourse*

Cours d'eau souterrain ou partiellement souterrain / *Undeground or partially udergound watercourse*

Fossé de drainage / *Drainage ditch*

Canal / *Canal*

Plan d'eau / *Waterbody*

Infrastructures / ***Infrastrutures***

Ligne de transport d'énergie électrique / *Electric power transmission line*

Route / ***Road***

Route forestière secondaire / *Secondary forest road*

Route forestière tertiaire / *Tertiary forest*

Sentier /

Chemin d'hiver / *Winter road*

Végétation / ***Vegetation***

Végétation / *Vegetation*

Station d'échantillonnage / ***Sampling station***

Sédiments / ***Sediments***

2017

2022

Eau de surface / ***Surface water***

2015

2016

2017

2022

Eau de surface et sédiments / ***Surface water and sediments***

2010

2015

2017

2021

2022

OSISKO
MINIÈRE OSISKO

Projet minier Windfall - Étude d'impact sur l'environnement /
Windfall Mining Project - Environmental Impact Assessment

Site minier Windfall, Eeyou Istchee Baie-James (Québec) /
Windfall Mining Site, Eeyou Istchee Baie-James (Quebec)

Carte 6-9 / ***Map 6-9***
Localisation des stations d'échantillonnage de l'eau de surface et des sédiments /
Location of Surface Water and Sediments Sampling Stations

Sources
BDTQ, 1/20 000, MRNF Québec, 2007
MERN, AQréseau+, réseau routier
SIEF, MRNF Québec, 2012
Photo-interprétation de la végétation /
Photointerpretation of the vegetation, WSP, 2015 à 2021

0 425 850 m

MTM, Fuseau 9, NAD83

2023-03-23

Préparée par / Preparation : I. Cartier
Dessinée par / Drawing : C. Villeneuve
Vérifiée par / Verification : M.-H. Brisson

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WSP

In terms of metals, aluminum, arsenic, iron, manganese, mercury, lead and zinc are the seven parameters showing values exceeding the contamination prevention criterion, water and aquatic organisms (CPC[O]), or the aquatic life protection criterion, aquatic life (CVAC), of the MELCCFP. Specifically for mercury, nearly all the stations, visited in any year, showed an exceedance of the CPC[O] criterion in at least one of the sampling campaigns. Otherwise, arsenic and lead are the metals, after mercury, where the most widespread exceedances were observed. The background-level analysis of the soils in the area shows that arsenic presents exceedances of the generic criteria used for soils in certain samples (Appendix 6-4).

Finally, exceedances in nutrients (total phosphorus), ammoniacal nitrogen, and in nitrates were measured sporadically in 2016-2017 and 2021; the presence of C_{10}-C_{50} PH was measured significantly in 2016-2017 at some stations.

Table 6-26 Summary of exceedances of criteria for surface water quality

Year	Station	Exceedance of criteria
2016 - 2017	WL-02, WL-07, WL-09, WL-10, and WL-12	pH: value below the optimal range
	WL-05, WL-06. WL-07 and WL-10	Al: value exceeding CVAC
	All stations	Hg: value exceeding CPC[O][1]
	WL-07, WL-08, and WL-10	Pb: value exceeding CVAC
	WL-08	Zn: value exceeding CVAC
	WL-02, WL-07, WL-10, and WL-11	P_{total}: value exceeding CVAC
	WL-05, WL-06, WL-07, WL-08, and WL-09	C_{10}-C_{50} PH: value exceeding CVAC
2021	WL-07, WL-10, WL-14, WL-15, and WL-16	pH: value below the optimal range
	WL-10, WL-14, WL-15, and WL-16	Ca: values showing sensitivity to acidification
	All stations except WL-07	As: value exceeding CPC[O]
	WL-14, WL-15, and WL-16	Fe: value exceeding CPC[O] Pb: value exceeding CVAC
	WL-12, WL-14, and WL-16	Hg: value exceeding CPC[O]
	WL-13, WL-14, and WL-16	Mn: value exceeding CPC[O]
	WL-12	$N_{ammoniacal}$: value exceeding CPC[O] Nitrate: value exceeding CPC[O] and CVAC
2022	WL-17, WL-20, and WL-21	pH: value below the optimal range
	WL-17, WL-20, and WL-21	Ca: value showing sensitivity to acidification
	WL-20	Al: value exceeding CPC[O]
	WL-20 and WL-21	As: value exceeding CPC[O] Fe: value exceeding CPC[O] and CVAC (WL-20) Mn: value exceeding CPC[O] Pb: value exceeding CPC[O]
	WL-17, WL-19 and WL-21	Hg: value exceeding CPC[O]

Note 1: Since trace amounts of mercury were detected in the field and transport blanks, the mercury results should be interpreted with caution, particularly for campaign #6 (Appendix 6-6).

WATER QUALITY OF MINE EFFLUENT

The water quality analysis results of the final effluent (Pond 1) were taken from environmental effects monitoring (EEM) studies for 2019 and 2020 (WSP, 2021) and a compilation for 2021 and 2022, and are presented in Tables 6-27 and 6-28. The results showed that the final effluent is slightly acidic, contains little TSS, and has very low mineralization. Apart from the radium 226 concentration measurements in 2019 (abnormally high value), the MDMER discharge standards and the D019 standards were respected during these years.

The acute toxicity bioassays conducted since January 2019 with daphnia (*Daphnia magna*) and rainbow trout (*Oncorhynchus mykiss*) continuously showed the absence of acute toxicity of the final effluent for these two organisms (Table 6-29, taken from WSP, 2021), except for one event in 2022, which could not be related directly to a non-conformance of a lower effluent water quality.

MIXING ZONE

To validate the extent of the final effluent plume under current operating conditions, a characterization was conducted in September 2019 (WSP, 2021). To do this, the conductivity was measured in the effluent and at different locations in the receptor watercourse, proceeding downstream. The measurements taken during the draft design studies then served as a baseline.

While conducting the effluent plume delineation study in September 2019, the conductivity of the undiluted effluent was 1,288 $\mu S\ cm^{-1}$. The mean conductivity of the ambient medium, measured on the surface in the selected baseline zone, was 21.8 $\mu S\ cm^{-1}$. The raw data from the plume sampling point was presented in the addendum of the initial monitoring study plan. The effluent concentrations at 100 m and 250 m from its discharge point were 83.7% and 48.1% respectively. Subsequently, dilution is very progressive, proceeding downstream, while following the succession of water bodies and watercourses.

In general and based on the results, it is possible to establish the influence of the current effluent plume within 10% downstream of Lake SN8 and within 1.5% downstream of SN11 (WSP, 2020). However, this finding was established during a single sampling campaign in 2019 and is therefore representative of the climate and operating conditions at the time. The situation is possibly different currently and will surely change following the alterations projected in the short term and following the implementation of this project.

Table 6-27 Summary of the water quality of the final effluent for 2019 and 2020

Parameter	2019						2020						Standard of the MDMER[b]
	Number of measurements	Annual mean	Extent (minimum-maximum)			Number of exceedances[a]	Number of measurements	Annual mean	Extent (minimum-maximum)			Number of exceedances[a]	
Alkalinity (mg L^{-1})	3	48	42.8	-	53.3		4	58	45.2	-	72		–
Aluminum (mg L^{-1})	3	0.006	0.005	-	0.006		4	0.018	0.013	-	0.027		–
Arsenic (mg L^{-1})	54	0.0015	<0.0005	-	0.0051	0/0	53	0.0017	<0.0005	-	0.011	0/0	1/0.5
Ammoniacal nitrogen (mg L^{-1})	3	9.31	1.15	-	25.4		57	19.00	6.7	-	33.5		–
Cadmium (mg L^{-1})	3	0.000100	<0.0002	-	<0.0002		4	0.000065	<0.00002	-	0.0002		–
Chlorides (mg L^{-1})	3	38.9	34.9	-	42.2		4	70.3	45.8	-	99		–
Chromium (mg L^{-1})	3	0.00083	<0.001	-	0.001		4	0.00090	<0.0005	-	0.0017		–
Cobalt (mg L^{-1})	3	0.0006	<0.0005	-	0.0009		4	0.0011	0.00063	-	0.00167		–
Conductivity (µmhos cm^{-1})	3	1,507	1,310	-	1,760		4	1,207	966	-	1,520		–
Copper (mg L^{-1})	54	0.0024	<0.0005	-	0.0244	0/0	53	0.0038	<0.0005	-	0.0407	0/0	0.6/0.3
Hardness (mg L^{-1})	3	298	297	-	298		4	315	203	-	434		–
Iron (mg L^{-1})	57	0.52	0.02	-	1.45		57	0.59	0.24	-	1.7		–
Manganese (mg L^{-1})	3	0.0793	0.067	-	0.088		4	0.1290	0.0474	-	0.1916		–
Mercury (mg L^{-1})	3	0.000030	0.00002	-	0.00004		4	0.000051	<0.00001	-	0.00015		–
Total suspended solids (TSS) (mg L^{-1})	151	2.8	<1	-	9	0/0	158	3.9	<1	-	13	0/0	30/15
Molybdenum (mg L^{-1})	3	0.0113	0.011	-	0.012		4	0.0096	0.008	-	0.0111		–
Nickel (mg L^{-1})	54	0.0026	<0.0005	-	0.006	0/0	53	0.0034	<0.0005	-	0.0104	0/0	1/0.5
Nitrates (mg N L^{-1})	3	97.17	77.7	-	134		4	45.55	<0.02	-	95.7		–
pH	152	6.57	5.83	-	7.16	2/0	158	6.50	6.22	-	7.09	0/0	6.0-9.5
Phosphorus (mg L^{-1})	3	0.010	<0.02	-	<0.02		4	0.019	<0.01	-	0.05		–
Lead (mg L^{-1})	54	0.00021	<0.0003	-	0.0014	0/0	53	0.00014	<0.00017	-	<0.0003	0/0	0.4/0.2
Radium 226 (Bq L^{-1})	79	0.1190	<0.002	-	4.3 [c]	1/1	27	0.0045	<0.0002	-	0.012	0/0	1.11/0.37
Selenium (mg L^{-1})	3	0.0020	0.002	-	0.002		4	0.00039	<0.00054	-	0.0005		–
Sulphate (mg L^{-1})	3	187.7	172	-	198		4	174.8	98.3	-	253		–
Thallium (mg L^{-1})	3	0.00050	<0.001	-	<0.001		4	0.00018	<0.00008	-	0.0005		–
Uranium (mg L^{-1})	3	0.00083	0.0007	-	0.0009		4	0.00057	<0.001	-	0.0007		–
Zinc (mg L^{-1})	54	0.0029	<0.001	-	0.033	0/0	53	0.0022	<0.001	-	0.019	0/0	1/0.5

a Number of exceedances of the maximum allowable concentration in a grab sample / maximum allowable monthly mean concentration.
b Maximum allowable MDMER concentration in a grab sample/maximum allowable monthly mean concentration.

Table 6-28 Summary of the water quality of the final effluent for 2021 and 2022

Parameter	2021						2022						Standard of the MDMER[b]
	Number of measurements	Annual mean	Extent (minimum-maximum)			Number of exceedances[a]	Number of measurements	Annual mean	Extent (minimum-maximum)			Number of exceedances[b]	
Alkalinity (mg L^{-1})	4	49.94	17	-	82	–	4	26	13	-	40	–	–
Aluminum (mg L^{-1})	4	0.01	<0.005	-	0.02	–	4	0.0145	0.009	-	0.025	–	–
Arsenic (mg L^{-1})	52	0.001202439	<0.0005	-	0.0025	0/0	57	0.001290196	<0.0005	-	0.0037	0/0	1/0.5
Ammoniacal nitrogen (mg L^{-1})	56	17.55892857	5.46	-	26.61	–	60	10.24933333	0.53	-	29.86	–	–
Cadmium (mg L^{-1})	4	0.00005	<0.00002	-	0.00007	–	4	0.00031	<0.10	-	0.00031	–	–
Chlorides (mg L^{-1})	4	113.1	94.9	-	125.4	–	4	147.125	130.5	-	180	–	–
Chromium (mg L^{-1})	4	0.00044	<0.0006	-	0.00044	–	4	0.000835	<0.0006	-	0.00058	–	–
Cobalt (mg L^{-1})	4	0.00151	0.0012	-	0.00175	–	4	0.00115	0.00073	-	0.00148	–	–
Conductivity (µmhos cm^{-1})	3	1,733	1570	-	1,920	–	3	1,720	1,240	-	2,140	–	–
Copper (mg L^{-1})	52	0.001869231	<0.0005	-	0.0068	0/0	57	0.001290196	<0.0005	-	0.0037	0/0	0.6/0.3
Hardness (mg L^{-1})	4	387	306	-	438	–	4	551.75	256	-	787	–	–
Iron (mg L^{-1})	55	0.787018182	0.28	-	1.52	–	60	0.575116667	0.07	-	1.27	–	–
Manganese (mg L^{-1})	4	0.12275	0.0432	-	0.199	–	4	0.0776	0.0459	-	0.162	–	–
Mercury (mg L^{-1})	4	0.00003	<0.01	-	0.00003	–	4	0.00024	<0.01	-	0.00024	–	–
Total suspended solids (TSS) (mg L^{-1})	157	1.837579618	<1	-	5	0/0	158	1.905075949	<1	-	7	0/0	30/15
Molybdenum (mg L^{-1})	4	0.01019	0.00995	-	0.0108	–	4	0.012975	0.011	-	0.0144	–	–
Nickel (mg L^{-1})	52	0.004311765	<0.0005	-	0.0146	0/0	57	0.003896552	<0.001	-	0.013	0/0	1/0.5
Nitrates (mg N L^{-1})	3	92.5	66.9	-	113	–	3	59.6	31.4	-	102	–	–
pH	157	6.782451613	6.25	-	7.3	0/0	158	6.657088608	6.17	-	7.18	0/0	6.0 -9.5
Phosphorus (mg L^{-1})	4	0.5	<0.02	-	1.42	–	4	<0.01	<0.01	-	<0.01	–	–
Lead (mg L^{-1})	52	0.000425	<0.00017	-	0.0005	0/0	57	<0.00017	<0.00017	-	<0.00017	0/0	0.4/0.2
Radium 226 (Bq L^{-1})	4	0.002	<0.010	-	0.002	0/0	5	<0.010	<0.010	-	<0.010	0/0	1.11/0.37
Selenium (mg L^{-1})	3	0.00018	0.00016	-	0.00022	–	3	0.00027	0.00018	-	0.00032	–	–
Sulphate (mg L^{-1})	4	222.75	206	-	244	–	4	304.25	158	-	358	–	–
Thallium (mg L^{-1})	3	0.00017	<0.2	-	0.00019	–	3	<0.10	<0.10	-	<0.10	–	–
Uranium (mg L^{-1})	3	0.00048	0.00041	-	0.00052	–	4	0.00057	<0.001	-	0.0007		–
Zinc (mg L^{-1})	52	0.003076923	<0.001	-	0.01	0/0	53	0.0022	<0.001	-	0.019	0/0	1/0.5

a Number of exceedances of the maximum allowable concentration in a grab sample/maximum allowable monthly average concentration.
b Maximum allowable MDMER concentration in a grab sample/maximum allowable monthly mean concentration.

Table 6-29 Summary of the sublethal toxicity test results obtained with the final effluent for 2019 and 2020

Year	Effluent collection date	*Pimephales promelas*		*Ceriodaphnia dubia*		*Raphidocelis subcapitata*		*Lemna minor*	
		CL_{50} (% v/v)	CI_{25} (% v/v)	CL_{50} (% v/v)	CI_{25} (% v/v)	CI_{25} (% v/v)	Growth stimulation (% v/v)	CI_{25} (% v/v)	Growth stimulation (% v/v)
2019	June 12	> 100	> 100	N.A.	N.A.	> 97.5	> 1.56 [a]	17.6	> 97.1
	October 23	> 100	> 100	> 100	83.2	> 97.5	> 97.5	23.5	> 97.1
2020	May 25	> 100	> 100	> 100	1.56	> 97.5	> 1.56 [a]	76.6	> 97.1
	August 31	> 100	> 100	> 100	> 100	> 97.5	> 97.5	48.6	> 97.1
Geometric mean		**> 100**	**> 100**	**> 100**	**23.5**	**> 97.5**	**12.3**	**35.2**	**> 97.1**

Notes: The shaded cells indicate a measured toxicity or a detected growth stimulation.
N.A. Not applicable
a Growth stimulated at an effluent concentration beginning at 1.56%.

6.7.2 *IMPACTS ON SURFACE WATER IN THE CONSTRUCTION PHASE AND MITIGATION MEASURES*

SOURCES OF POTENTIAL IMPACTS

During the construction phase, the sources of potential impacts and the resulting impacts (**in bold**) that may affect surface water are as follows:

— Organization of the site, stripping and clearing, surface preparation and access arrangement, construction of works and infrastructure, transportation and traffic, production and management of residual and hazardous materials.

These sources have the potential to result in the following impacts during the construction phase:

Alteration of surface water quality by:

— emission of total suspended solids (TSS) in surface water;

— accidental introduction of petroleum hydrocarbons, contaminants, or hazardous materials.

MITIGATION MEASURES

Common mitigation measures QUA01 to QUA04, QUA08, QUA10 to 13, and QUA18 to QUA20 will be applied to reduce TSS emission in the water. Common mitigation measures QUA07, QUA14 to QUA17, and QUA21 to 26 will be applied to reduce the risks of contamination or accidental spills in the aquatic environment. Protection of water quality is governed by several regulations and standards, particularly in the field of mining projects. These will be followed rigorously and are listed in Appendix 5-2 (NOR6 to NOR8, NOR10, and NOR12). Specific mitigation measure P26 will also be implemented.

DETAILED DESCRIPTION OF RESIDUAL IMPACT

Surface water quality can be altered physically by increased turbidity associated with particulate emissions, or chemically by the introduction of contaminants. TSS or contaminated water can be introduced directly or indirectly, via runoff water.

TSS EMISSIONS IN WATER

Despite the implementation of mitigation measures, it is possible that particulate matter is entrained into the watercourses during stripping, clearing, and construction of new access roads, particularly during installation of culverts that may be required at watercourse crossings or widening of existing culverts. The use of access roads by mobile equipment, particularly in spring and when the soil is soggy, may loosen the soil and cause runoff water containing TSS. However, temporary measures will be implemented to capture this water, such as clean water diversion ditches, until a drainage ditch is functional along the roads.

The clearing and site preparation activities for installation of infrastructure will generate woody debris and expose the soil to bad weather during a period of a few days to a few weeks, depending on the area. Whenever possible, water retention ponds will be constructed first to allow collection of the drainage water from the access roads. Thus, clearing will be performed first and the runoff water on the cleared surfaces will be intercepted by sediment barriers, which will limit entrainment of sediments into the water bodies and watercourses located nearby. If it is impossible to construct water retention ponds before development of the access road, temporary sedimentation ponds will be developed on the construction site and the water will be controlled (pretreated and/or returned to the environment more than 30 m from a watercourse) The exposed surfaces will be revegetated to avoid leaching of soil particles into the watercourses. In the first stages of the construction phase, the particulate matter resulting from leaching will be captured and managed by the water management system. Despite all the control measures that will be implemented, it is nonetheless possible that water containing TSS will reach an adjacent aquatic environment. These episodes, if they occur, will have a short duration because the situation will be corrected once it is observed by the site supervisor (Chapter 13).

The surplus water from the ponds that will not be used in recirculation will be sent to the existing water treatment plant (WTP) or a temporary system before being discharged into the environment via the final effluent or at more than 30 m from a watercourse.

ACCIDENTAL INTRODUCTION OF PETROLEUM HYDROCARBONS, CONTAMINANTS, OR HAZARDOUS MATERIALS INTO THE AQUATIC ENVIRONMENT.

For the entire duration of the construction work, there will be a risk of accidental petroleum hydrocarbon spills related to the use of mobile equipment. The spills may be caused by breakdowns of mobile equipment containing a limited quantity of petroleum products. Refuelling will be performed at a minimum distance of 60 m from the watercourses and water bodies at predetermined locations developed for this activity. Despite the implementation of preventive measures, the risk of accidental spills will remain present during the various work activities. Control measures will also be planned to contain and recover the contaminants in the environment and thus significantly reduce the impact that an accidental spill event could cause for the receiving environment. Such a spill, if it occurs, will contaminate the soils of the spill site. If the volume spilled is significant, a portion of product not fixed to the soil particles could migrate by surface runoff to the water bodies and watercourses.

However, because the spill will be managed in accordance with the spill response plan and given the implementation of many mitigation and control measures, the risk of spills that will have an impact on surface water quality is very low; the product will be contained and the contaminated soils will be recovered quickly, as prescribed in the emergency response plan (see Chapter 12). Finally, if there is a spill, the degree of contamination will depend on the nature of the contaminants and their concentrations.

The construction phase will generate residual materials and hazardous products, such as hydrocarbons and their by-products, which will be handled, stored, and managed offsite. To reduce the risk that the use and storage of residual hazardous or non-hazardous materials may affect the quality of the sediments, the residual materials will be stored according to the standards in force and access will be protected. The storage location exists and is currently used for storage of components associated with the bulk sampling work. The residual materials will continue to be sent regularly for management offsite.

ASSESSMENT OF RESIDUAL IMPACT

The ecosystem value of this component is high because surface water directly affects the organisms living in the aquatic environments, as well as the entire ecosystem. The degree of disturbance is considered low because the anticipated impacts, after application of the mitigation measures, do not alter the integrity of surface water quality or its use, resulting in an impact of medium intensity. The impact will generally have a specific spatial scope, limited to the immediate area of the work, and the impact will be felt for a short duration, only during the construction phase (less than two years). With the implementation of the many mitigation measures planned to control TSS emissions in the watercourses occurring at certain times during the construction period, the probability of occurrence remains medium, considering the large number of watercourses in the study area and the many possible sources. However, the probability of occurrence of contamination by hydrocarbons or other substances is considered low. The significance of the residual impact is therefore low for these two types of impacts on surface water.

Impact on surface water in the construction phase		
Nature	Negative	Significance: Low
Ecosystem value	High	
Socioeconomic value	Not applicable	
Degree of disturbance	Low	
Intensity	Medium	
Spatial scope	Specific	
Duration	Short	
Probability of occurrence	Mean (TSS)/Low (contamination)	

6.7.3 IMPACTS ON SURFACE WATER IN THE OPERATIONS PHASE AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the operations phase, the sources of potential impacts and the resulting impacts (**in bold**) that may affect surface water are as follows:

— The presence and operation of new infrastructure, water use and management, transportation and traffic, and production and management of residual hazardous materials.

These sources have the potential to result in the following impacts during the operations phase:

Alteration of surface water quality by:

— emission of total suspended solids (TSS) in surface water;

— discharge of a mine effluent with chemical qualities different than the water of the receiving environment;

— Accidental introduction of petroleum hydrocarbons, contaminants, or hazardous materials into the surface water.

MITIGATION MEASURES

The same common mitigation measures recommended in the construction phase will be applied in the operations phase when work involves the same sources of potential impacts. Protection of water quality is governed by several regulations and standards, particularly in the field of mining projects. They will be followed rigorously and the main ones are listed in Appendix 5-2 (NOR08 and NOR13). Finally, the following specific mitigation measures will also be applied: P01 and P26.

The monitoring program (NOR13) that will be implemented in the operations phase will ensure that the mitigation measures applied are effective and will rectify the situation, if necessary (Chapter 13).

DETAILED DESCRIPTION OF RESIDUAL IMPACT

TSS EMISSIONS

In the operations phase, the network of ditches redirecting all the surface water on the mine site will be functional so that it is treated and recirculated in the mining process or discharged into the environment. The particles leached by the runoff water should therefore not reach the natural network of watercourses and sediments on most of the mine site. All of the site's water management activities are part of the operations phase. This management ensures that the runoff water will be collected completely and treated according to the use and the projected destination (see Chapter 3, Figures 3-12 and 3-13).

Despite implementation of the mitigation measures and the runoff water management infrastructure, it is possible that sediments will be entrained into the watercourses at the watercourse crossings, particularly during the spring melt and heavy rainfall. However, these events will be less likely than in the construction phase when the protective measures are not permanent.

During the operations phase, wind erosion of tailings is likely to emit dust that may be transported over a certain distance (Section 6.2 on ambient air). Even with the implementation of control measures, during episodes of high winds, a fine film of particles could form on bodies of water and thus affect water quality. The impact of dust nonetheless should remain low, because they are a minimal source of TSS in water. The future tailings storage facility will also be restored progressively, which will limit the surfaces exposed to wind erosion.

PRESENCE OF MINE EFFLUENT

Water management includes collection, analysis, treatment of collected water on the mine site (runoff and contact water), and recirculation in the treatment plant process or discharge in the final effluent. The increase in mining operations will result in an alteration of the quality of contact water (the water that was in contact with the tailings and waste rock), which will be treated accordingly to comply with the various standards in force. Despite the mining company’s commitment to comply with the effluent water quality standards and to tend toward environmental discharge objectives, a minor increase in loads and temperatures is anticipated in the receiving environment downstream from the effluent.

The water treatment plant, the detailed design of which is in development, will be equipped with the necessary equipment to reduce the concentrations anticipated to be problematic for protection of the aquatic environment. This equipment will be designed to treat contact water, comply with the discharge standards in force, and tend toward the environmental discharge objectives, according to the best available and applicable technology. Following water treatment, parameters that will differ from the initial state established will possibly be found in low concentrations in the effluent water while complying with the water quality criteria in force.

An accidental spill of untreated water could occur exceptionally via the emergency spillways of the retention structures. An accidental spill (e.g., breach of tailings and waste rock management infrastructure, treatment equipment failure) could also result in an accidental discharge of untreated contaminated water. However, this risk is unlikely and constitutes a technological risk that is addressed in Chapter 12 - Accident risk management.

ACCIDENTAL INTRODUCTION OF PETROLEUM HYDROCARBONS, CONTAMINANTS, OR HAZARDOUS MATERIALS

There will be a risk of accidental petroleum hydrocarbon spills related to the use of mobile equipment during mine operations. Despite the implementation of preventive measures, the risk of accidental spills will continue to exist during the various work activities. The entire site will be bounded by water management infrastructure, which will limit the dispersion of products in the environment because the water will be contained within the boundaries of the mine site. The spills may be caused only by a breach of mobile equipment containing a limited quantity of petroleum products.

ASSESSMENT OF RESIDUAL IMPACT

The ecosystem value of this component is high because surface water directly affects the organisms living in the aquatic environments, as well as the entire ecosystem. On the whole, the degree of disturbance is considered low at the effluent discharge because, without compromising its environmental integrity, the impact results in an almost imperceptible reduction of water quality thanks to compliance with the aquatic life protection standards, resulting in a medium intensity. The spatial scope of the impact will be local. The impact of the effluent discharge will be felt over a medium duration, not exceeding the life cycle of the project and its closure, but a short duration concerning a potential spill. The probability of occurrence is high, but low for accidental spill events. The significance of the residual impact thus is medium over the entire duration of operations, but low in the event of a spill. A monitoring program will be implemented to measure the quality of the surface water receiving the effluent and to measure the distance of influence of the effluent (Chapter 13).

<table>
<tr><th colspan="3">Impact on surface water in the operations phase</th></tr>
<tr><td>Nature</td><td>Negative</td><td rowspan="8">Significance:
Effluent - Medium
Risk of accidental spill and TSS - Low</td></tr>
<tr><td>Ecosystem value</td><td>High</td></tr>
<tr><td>Socioeconomic value</td><td>Not applicable</td></tr>
<tr><td>Degree of disturbance</td><td>Low</td></tr>
<tr><td>Intensity</td><td>Medium</td></tr>
<tr><td>Spatials scope</td><td>Local (effluent) / specific (risk of accidental spills, TSS)</td></tr>
<tr><td>Duration</td><td>Medium (effluent) / Short (risk of accidental spills, TSS)</td></tr>
<tr><td>Probability of occurrence</td><td>High (effluent) / Low (risk of accidental spill, TSS)</td></tr>
</table>

6.7.4 IMPACTS ON SURFACE WATER IN THE CLOSURE PHASE AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the closure phase, the sources of potential impacts and the resulting impacts (**in bold**) that may affect surface water are as follows:

— Final restoration, production and management of residual and hazardous materials

These impact sources have the potential to result in the following impacts during the closure phase:

— **Alteration of surface water quality;**

— **Improvement of surface water quality**.

MITIGATION MEASURES

The same mitigation measures recommended in the construction and operations phases will be applied during the closure phase, when applicable. Measure NOR14 will also be applied in the context of post-restoration activities.

DETAILED DESCRIPTION OF RESIDUAL IMPACT

ALTERATION OF WATER QUALITY

During the closure phase, the access roads related to the water management facilities will remain in place. The impacts related to the use of these roads by mobile maintenance equipment thus are the same as in the operations phase (TSS emissions and risk of accidental spills).

IMPROVEMENT OF WATER QUALITY

Moreover, during final restoration, which will extend over a period of 1 to 2 years, the residual surfaces of the tailings storage facility, following progressive restoration that will occur in the operations phase, and the waste rock stockpile will be revegetated, which will have the effect of restoring surface runoff and soil storage conditions. At this time, the quality of the water flowing within the site should be sufficient that it no longer has to be treated by the water treatment plant. However, the water quality analysis results will allow validation of this assertion. In all cases, the water treatment plant will continue to operate for the number of years required to restore the quality of percolating water at the site. Thus, when the monitoring will have shown that the quality of the residual water inside the mine site ponds complies with the standards set by the government authorities, the pumps will be decommissioned and the ponds will be dismantled to allow restoration of the gravity flow of the water to the receptor watercourses. Therefore, this is a positive impact on water quality compared to the current conditions. Revegetation of the areas of the tailings storage facilities and the waste rock stockpile will also limit the impact of wind and transport of dust. When the sedimentation pond, the water management infrastructure, and the WTP will have been completely rehabilitated, the access roads may be dismantled and the environment restored to a natural state.

ASSESSMENT OF RESIDUAL IMPACT

The nature of the anticipated impact is negative specifically concerning the site closure work, but positive concerning rehabilitation of the site.

Thus, regarding negative impacts, the degree of disturbance is considered low after the application of the mitigation measures and because the risks remain limited. The disturbance is similar, but less than in the construction phase. Thus, the intensity of the anticipated impact is also medium. This impact will have a specific spatial scope and a short duration, only during the performance of the closure work. The probability of occurrence was considered medium. Consequently, the significance of the residual impact is low.

The restoration of the site, including the stoppage of discharges into the mine effluent, is a positive impact. The stoppage of the flow of effluent will allow the environment to return to conditions similar to the natural environment and will be felt further downstream, in the entire mixing zone (local). These changes will naturally take several years to be felt, but for the stoppage of discharge, the impact will be immediate and long-term.

<table>
<tr><th colspan="3">Impact on surface water in the closure phase</th></tr>
<tr><td>Nature</td><td>Negative/Positive</td><td rowspan="8">Significance:

Alteration of water quality - Low

Restoration – Positive impact</td></tr>
<tr><td>Ecosystem value</td><td>High</td></tr>
<tr><td>Socioeconomic value</td><td>Not applicable</td></tr>
<tr><td>Degree of disturbance</td><td>Low</td></tr>
<tr><td>Intensity</td><td>Medium</td></tr>
<tr><td>Spatial scope</td><td>Specific</td></tr>
<tr><td>Duration</td><td>Short</td></tr>
<tr><td>Probability of occurrence</td><td>Low</td></tr>
</table>

6.8 SEDIMENTS

Important facts about sediments

Current conditions

Sediment characterization campaigns have been conducted around the current project site since 2010. The most recent grain size distribution and chemical results (2017, 2021, and 2022) were measured in samples collected at 10 stations along various watercourses and water bodies. Concerning metals and metalloids, some exceedances of criteria were noted. Overall, cadmium and mercury appeared to exceed the comparison criteria at a few stations, while occasional exceedances were measured for chromium, lead, and zinc. Most of the exceedances were observed at a station located in Lake SN2 (WL-14). For the other parameters analyzed, C_{10}-C_{50} PH concentrations were measured at every substation sampled, without exceeding the quality criterion, at station WL-16 located in Lake SN2.

Potential impacts of the project

In the construction phase, the degree of disturbance is considered low, because the anticipated impacts, after application of the mitigation measures, do not alter the integrity of sediment quality, resulting in an impact of medium intensity. The impact will have a specific spatial scope due to the runoff control measures implemented and the impact will be felt for a short duration. The probability of occurrence is medium for the possibility that TSS will be found in the watercourses in the construction period, and considering the large number of watercourses in the study area and the many possible sources. However, the probability of occurrence of contamination by hydrocarbons or other substances is considered low. Consequently, the significance of the residual impact is very low.

During the operations phase, the activities likely to have an impact on sediment quality are the presence and operation of the new infrastructure, water use and management, transportation and circulation (including use of mobile equipment) and management of residual hazardous materials. The degree of disturbance is considered low, which leaves a low intensity impact. The impact will have a specific spatial scope, due to the runoff control measures implemented and the measures to avoid accidental spills, but will be local for effluent, considering that the effluent plume could have an impact on sediment quality in the receptor watercourse. The duration of the impact will be felt over a short to medium duration. The probability of occurrence is low to medium, considering the large number of watercourses and bodies of water in the study area and the control structures and measures permanently present and functional. Consequently, the significance of the residual impact is very low to low.

In the closure phase, the nature of the anticipated impact is negative specifically concerning the site closure work, but positive concerning site restoration, because natural conditions may be established. The significance of the negative residual impact is considered very low.

6.8.1 CURRENT CONDITIONS

Sediments were collected in 2017, 2021, and 2022 at 14 stations located in seven water bodies, as well as certain influents and effluents of these bodies. All of the information (results and certificates of analysis) concerning sediment quality may be consulted in the sectorial report in Appendix 6-6. A summary of the main results obtained is also presented in the following paragraphs.

The values obtained for the various sediment samples collected were compared to the criteria for assessing sediment quality in freshwater environments, established by Environment Canada and the MDDEP (2007). This reference contains five thresholds that allow assessment of whether a concentration obtain can produce an impact on aquatic fauna. These thresholds are as follows:

- rare effect concentration (REC);
- threshold effect concentration (TEC);
- occasional effect concentration (OEC);
- probable effect concentration (PEC);
- frequent effect concentration (FEC).

The REC and the TEC correspond to the two contamination prevention indicators. Indeed, the achievement of a value equal to or greater than the TEC indicates an onset of contamination, while if the observations are maintained below the REC, no impact is expected on aquatic life. The PEC and the FEC are the two threshold values for guiding restoration decisions for a site. A concentration exceeding the PEC indicates that analyses in greater depth are desirable to assess the relevance of undertaking such work, while the FEC indicates that restoration is desirable.

Some exceedances of criteria were noted for the sediment samples collected (Table 6-30), which indicates a certain condition existing prior to the implementation of this project, which shows concentrations exceeding the reference criteria. Overall, cadmium presents the greatest number of exceedances and therefore seems to be in a higher concentration in the collected sediments. The concentrations measured for this parameter exceed the REC criterion or the TEC criterion (EC and MDDEP, 2007) in the bodies of water Pond 2, SN1, SN2, SN4 and SN6 and in watercourse SN2-E1.

Mercury is also present in concentrations exceeding the REC and the PEC at certain stations, and occasional exceedances were measured for chromium, lead, and zinc. However, they were observed at only one station each and exceed either the PEC or the TEC, the least severe criteria.

Table 6-30 Balance of exceedances of the sediment quality criteria in the 2017, 2021, and 2022 samples

Watercourses or water bodies (stations and samples)	Parameter	Exceedance of criterion[1]
SN4, SN6, Pond 2 (WL-10, WL-13.1, WL-19.5)	Cadmium	REC
SN1, SN2, SN2-E1 (WL-07.3, WL-14.1, WL-14.3; WL-14.4, WL-14.5, WL-15.3)	Cadmium	TEC
SN2-E1 (WL-16.1)	Chromium	TEC
SN2, SN4, SN8 (WL-12, WL-14.1, WL-14.3; WL-14.4)	Mercury	REC
SN4 (WL-10)	Mercury	PEC
SN2 (WL-14.4)	Lead	REC
SN2 (WL-14.4)	Zinc	REC

Note 1: Corresponds to the exceedance of the highest criterion

Other than these exceedances, the measured values for the various variables do not appear to be restrictive to aquatic life, except for the most recent data collected at station WL-19 in 2022, which showed C_{10}-C_{50} petroleum hydrocarbon concentrations above the reported detection limit (RDL) for all samples analyzed, but without exceeding the quality criterion.

At the other stations, traces of C_{10}-C_{50} PH were reported, but at low concentrations and on an occasional basis (at WL-10 and only at one substation out of 5 at WL-15; see Table 3-26 of Appendix 6-6). In general, no station particularly stands out from the others by very low or very high concentrations, except for WL-14 located in Lake SN2 where the greatest number of exceedances were noted.

For the grain size distribution of the samples (Appendix 6-6), a certain variability can be observed among the various points sampled. However, the sandy fraction seems very dominant at most of the stations, except for WL-14 and WL-19 (SN2 and Pond 2). At these stations, silt and clay are present in a greater proportion. The nature of the sediments in SN2 (Station WL-14) could partially explain the results showing more numerous exceedances because the contaminants are more easily attached to the fine particulate matter (Alzieu and Galenne, 1989).

6.8.2 IMPACTS ON SEDIMENTS IN THE CONSTRUCTION PHASE AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the construction phase, the sources of potential impacts and the resulting impacts (**in bold**) that may affect sediments are as follows:

— Organization of the site, stripping and clearing, surface preparation and access arrangement, construction of works and infrastructure, transportation and traffic, production and management of residual and hazardous materials.

These sources have the potential to result in the following impact during the construction phase:

Alteration of sediment quality by:

- Total suspended solids (TSS) emissions in surface water that will be deposited on the original sediments;
- Accidental introduction of petroleum hydrocarbons, contaminants, or hazardous materials into the surface water that will contaminate the sediments.

MITIGATION MEASURES

Common mitigation measures QUA01 to QUA04, QUA08, QUA10 to QUA13, and QUA18 to QUA20 will be applied to reduce TSS emissions in the water that could affect the sediments. Common mitigation measures QUA07, QUA14 to QUA17, and QUA21 to QUA26 will be applied to reduce the risks of contamination or accidental spills in the aquatic environment. Protection of the aquatic environment is governed by several regulations and standards, particularly in the field of mining projects. These will be followed rigorously and the main ones are listed in Appendix 5-2 (NOR06 to NOR08, NOR10, and NOR12). Specific mitigation measure P26 will also be implemented.

DETAILED DESCRIPTION OF RESIDUAL IMPACT

Alteration of sediment quality is generally a consequence of the introduction of particulate matter, contaminated or not, which is deposited and thus alters the initial quality of the sediments in place. Also, a change in sediment quality is possible when the water is altered in the presence of sediments.

TSS EMISSIONS IN WATER THAT ARE DEPOSITED ON THE BOTTOM.

The particles emitted and transported in the water are likely to be deposited on the sediments, particularly in the slowest flow zones favouring deposition of fine particulate matter, such as lakes and ponds, and the slow-flowing channels of streams. The alteration of the sediments can be of physical nature, either by the alteration of the granulometric composition, or chemical by the modification of the concentrations of heavy metals, for example. Unlike water, the sediment quality may take much longer to restore following a spill of untreated water or hydrocarbons. Generally, a response is required to remove the contaminated sediments.

Despite implementation of the mitigation measures, it is possible that particulate matter, sedimentary or not, will be displaced or entrained in the watercourses during the development or construction work, especially if these activities are performed near or in the watercourses (repair or installation of culverts). The particulate matter emitted in the water or the sediments returned to suspension can be carried away and alter the nature or the quality of the sediments further downstream. However, considering the mitigation measures, these inflows would be low and of short duration. Also, the use of access roads by mobile equipment, particularly in spring and when the soil is soggy, may loosen the soil and cause runoff water or sludge flows, even if these activities are not located near the watercourse. During road construction, temporary measures will be implemented to capture this water, avoid runoff, and minimize transport of sediments toward the watercourses and water bodies. The implementation of drainage ditches will allow this impact to be limited.

The clearing and site preparation activities for installation of infrastructure will generate woody debris and expose the soil to bad weather during a period from a few days to a few weeks, depending on the area. Whenever possible, water retention ponds will be constructed first to allow collection of the drainage water from the access roads. Thus, clearing will be performed first and the runoff water on the cleared surfaces will be intercepted by sediment barriers, which will limit entrainment of sediments into the watercourses and water bodies located nearby. If it is impossible to construct water retention ponds before development of the access road, temporary sedimentation ponds will be developed on the construction site and the water will be controlled (pretreated and/or returned to the environment more than 30 m from a watercourse) The exposed surfaces will be revegetated to avoid leaching of soil particles into the watercourses. In the first stages of the construction phase, the particulate matter resulting from leaching will be captured and managed by the water management system. Despite all the control measures that will be implemented, it is nonetheless possible that water containing TSS will reach an adjacent aquatic environment. These episodes, if they occur, will have a short duration because the situation will be corrected once it is observed by the site supervisor (specific mitigation measure P26).

The surplus water from the ponds that will not be used in recirculation will be sent to the existing water treatment plant (WTP) or a temporary system before being discharged into the environment via the final effluent (Pond 1) or more than 30 m from a watercourse.

ACCIDENTAL INTRODUCTION OF HYDROCARBONS, CONTAMINANTS, OR HAZARDOUS MATERIALS

For the entire duration of the construction work, there will be a risk of accidental petroleum hydrocarbon spills related to the use of mobile equipment. The spills may be caused by a breakdown of mobile equipment containing a limited quantity of petroleum products. Refuelling of mobile equipment will be performed at a minimum distance of 60 m from watercourses and water bodies, at predetermined locations developed for this activity. Despite the implementation of preventive measures, the risk of an accidental spill will continue to exist during the various work activities. Control measures will also be planned to contain and recover the contaminants in the environment and thus significantly reduce the impact that an accidental spill event could cause for the receiving environment. Such a spill, if it occurs, will contaminate the soils of the spill site. If the volume spilled is significant, a portion of product not fixed to the soil particles could migrate by surface runoff to the water bodies and watercourses and affect the chemical quality of the sediments. However, because permanent or temporary catchment members will be implemented during the work, the dispersion of the products into the environment or on the mine site will be limited and the spill will be managed in accordance with the spill response plan. Given the implementation of the many mitigation and control measures, the spill risk that will have implications for sediment quality is very low. The product will be contained and the contaminated soils will be recovered quickly, as prescribed in the regulations in force. The intensity of the impact, if applicable, will depend on the nature of the contaminants and their concentrations.

The construction phase will generate residual materials and hazardous products, such as hydrocarbons or their by-products. They will be handled, stored, and managed offsite. To reduce the risks that the use and storage of residual hazardous or non-hazardous materials may affect the quality of the sediments, the residual hazardous materials will be stored on a lined surface, sheltered from bad weather, and with protected access. The storage place exists and is currently used for the mine’s activities. These materials will be sent regularly for management offsite, according to the existing schedule.

ASSESSMENT OF RESIDUAL IMPACT

The ecosystem value of this component is medium because it presents strong interest and qualities recognized for conservation of the aquatic ecosystem. The degree of disturbance is considered low, because the anticipated impacts, after application of the mitigation measures, do not alter the integrity of sediment quality, leaving an impact of low intensity. The impact will have a specific spatial scope, due to the runoff control measures implemented, and the impact will be felt for a short duration (construction period of less than 2 years). The probability of occurrence is medium for the possibility that TSS will be found in the watercourses in the construction period, and considering the large number of watercourses in the study area and the many possible sources. However, the probability of occurrence of contamination by hydrocarbons or other substances is considered low. The significance of the residual impact is therefore low for these two types of impacts on sediments.

Impact on sediments in the construction phase		
Nature	Negative	Significance: Very low
Ecosystem value	Medium	
Socioeconomic value	Not applicable	
Degree of disturbance	Low	
Intensity	Low	
Spatial scope	Specific	
Duration	Short	
Probability of occurrence	Mean (TSS)/Low (Contamination)	

6.8.3 IMPACT ON SEDIMENTS IN THE OPERATIONS PHASE AND MITIGATION MEASURES

During the operations phase, the sources of potential impacts and the resulting impacts (**in bold**) that may affect sediments are as follows:

— The presence and operation of new infrastructure, water use and management, transportation and traffic, production and management of residual hazardous materials.

These sources have the potential to result in the following impact during the operations phase:

Alteration of sediment quality by:

— TSS emissions in surface water that will be deposited on the original sediments;

— discharge of a mine effluent with chemical qualities different than the water of the receiving environment, which could influence the chemical quality of the sediments;

— accidental introduction of petroleum hydrocarbons, contaminants, or hazardous materials into the surface water that will contaminate the sediments.

MITIGATION MEASURES

The same common mitigation measures recommended in the construction phase will be applied in the operations phase when work involves the same impact sources. Moreover, to minimize the surface water contamination risks that could impact the chemical quality of the sediments, measures QUA14 and QUA15 concerning the use of dust suppressant and melting agents will be applied. Protection of the aquatic environment is governed by several regulations and standards, particularly in the field of mining projects. They will be followed rigorously and the main ones are listed in Appendix 5-2 (NOR09 and NOR13). Finally, the following specific mitigation measures will also be applied: P01 and P26.

The monitoring program (NOR13) that will be implemented in the operations phase will ensure that the mitigation measures applied are effective and rectify the situation, if necessary (Chapter 13).

DETAILED DESCRIPTION OF RESIDUAL IMPACT

INTRODUCTION OF TSS

In the operations phase, the presence of infrastructure implies that the new surfaces receiving water from precipitation, which will be redirected to the existing ditches around the new infrastructure, which have the function of channelling the water collected on the mine site to a retention pond. The particles leached by the runoff water therefore should not reach the natural network of watercourses and sediments on most of the mine site. Together, the watercourses within the perimeter of the tailings storage facility and the waste rock stockpiles are considered a tailings and waste rock storage location during operation of the mine, as defined by Schedule 2 of the Metal and Diamond Mining Effluent Regulations (MDMER).

During the operations phase, the presence of the stockpiles implies possible wind erosion of the tailings and the waste rock accumulated in the stockpiles. This wind erosion is likely to emit dust that may be transported over long distances (see Section 6.2 on ambient air). Even with the implementation of preventive control measures, these dusts may be deposited on the water bodies located near the mine site. During high wind episodes, a fine film of particulate matter could form on water bodies and then end up as sediments at the bottom. This particulate matter may also be entrained to the watercourses, where it may also form sediment further downstream. The impact of the dusts nonetheless should remain low, because they constitute a minimal source of sedimentary particulate matter and the mitigation measures put forward to ensure air quality will allow their emissions to be limited.

Despite implementation of the mitigation measures, it remains possible that particulate matter from access roads will be entrained into the watercourses at the watercourse crossings, particularly during the spring melt and heavy rainfall. These sediments are likely to alter the nature of the substrate or the chemical quality. Sediment transport at the watercourse crossings, if it occurs, will be temporary and limited by the mitigation measures applied. The design of the ditches along the accesses allows collection of water potentially containing TSS and sedimentation of the particulate matter before it returns to the receiving environment.

PRESENCE OF MINE EFFLUENT

Water management also includes collection, analysis and treatment of mine water (contact water). Despite the mining company's commitment to comply with the effluent water quality standards and to tend toward environmental discharge objectives, a minor increase in loads and temperatures is anticipated in the receiving environment downstream from the effluent (see Section 6.7 on surface water). This change in surface water quality then could affect the chemical quality of the sediments if the aquatic life protection criteria are respected.

ACCIDENTAL INTRODUCTION OF PETROLEUM HYDROCARBONS, CONTAMINANTS, OR HAZARDOUS MATERIALS.

Although it is projected that all the water on the mine site, both drainage water and contact water, will be channelled to a treatment plant where it will be treated according to the use and the projected destination and that, despite the preventive measures in place, accidental spills of untreated water containing particulate matter that may affect the sediments could exceptionally occur via the emergency spillways of the dikes. An accidental spill (e.g., breach of tailings and waste rock management infrastructure, treatment equipment failure) could also result in an accidental discharge of untreated contaminated water. The magnitude of these spills is difficult to quantify, because it will depend on the volume of water spilled and the water quality. In the short term, the sediment load of the surface water thus could be increased locally until the problem is solved (repair of the breach, plugging of the breach, pumping the water to another pond). The preliminary emergency response plan (ERP) specifies the actions in case such an incident occurs to be able to limit the environmental impacts as quickly as possible (Chapter 12 and Appendix 12-2).

For the entire duration of operations of the tailings storage facility and the waste rock stockpile, there will be a risk of accidental petroleum hydrocarbon spills related to the use of mobile equipment. Despite the implementation of prevention and control measures, the risk of an accidental spill will continue to exist during the various work and the operations of the mine site. As in the construction phase, the spills may be caused only by a breach of mobile equipment containing a limited quantity of petroleum products, and since the entire site is bounded by water management infrastructure, the dispersion of the products in the environment will be limited.

The operations phase will generate residual materials and hazardous products, which will be handled, stored, and managed offsite. The residual hazardous materials will be stored on a contained lined surface, sheltered from bad weather.

ASSESSMENT OF RESIDUAL IMPACT

The ecosystem value of this component is medium, because it presents strong interest and qualities recognized for conservation of the aquatic ecosystem. The degree of disturbance is considered low, which leaves a low intensity impact. The impact will have a specific spatial scope, due to the runoff control measures implemented and the measures to avoid accidental spills, but will be local for effluent, considering that the effluent plume could have an impact on sediment quality in the receptor watercourse. The duration is considered medium for the presence of mine effluent and short for the risk of an accidental spill and the introduction of TSS. The probability of occurrence is medium for effluent and short for the risk of an accidental spill and TSS. Consequently, the significance of the residual impact is considered very low to low.

Impact on sediments in the operations phase		
Nature	Negative	Significance: Effluent - Low Risk of accidental spill and TSS - Very low
Ecosystem value	Medium	
Socioeconomic value	Not applicable	
Degree of disturbance	Low	
Intensity	Low	
Spatial scope	Local (effluent)/ specific (risk of accidental spills, TSS)	
Duration	Medium (effluent)/Short (risk of accidental spills, TSS)	
Probability of occurrence	Medium (effluent)/Low (risk of accidental spills, TSS)	

6.8.4 IMPACTS ON SEDIMENTS IN THE CLOSURE PHASE AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the closure phase, the impact sources and the resulting impacts (**in bold**) that may affect sediments are as follows:

- Final restoration, production and management of residual hazardous materials.

These sources have the potential to result in the following impact during the closure phase:

- **alteration of sediment quality**
- **improvement of sediment quality**

MITIGATION MEASURES

The same mitigation measures recommended in the construction and operations phase will be applied in the closure phase when work includes the same impact sources.

DETAILED DESCRIPTION OF RESIDUAL IMPACT

ALTERATION OF SEDIMENT QUALITY

During the closure phase, the access roads related to the water management facilities will remain in place. The impacts related to the use of these roads by mobile maintenance equipment thus are the same as in the operations phase (sediment transport and risk of accidental spills).

IMPROVEMENT OF SEDIMENT QUALITY

On the other hand, during final restoration, which will take approximately two years, the surfaces of the tailings storage facility and the waste rock will be revegetated, which will have the effect of reducing the erosive nature of the sites and restoring surface runoff conditions. At this time, the quality of the water flowing within the mine site must satisfy the criteria of D019 so that it no longer has to be treated by the water treatment plant.

Thus, when the monitoring will have shown that the quality of the residual water inside the mine site ponds complies with the standards decreed by the government authorities, the pumps will be decommissioned and the dikes will be opened progressively to allow restoration of the gravity flow of the water to the receptor watercourses.

Once the production infrastructure has been dismantled, no more mine water will be discharged into the natural environment. Therefore, this is a positive impact on sediment quality compared to the current conditions. Revegetation of the areas of the tailings storage facility will contribute to reduce any particulate matter that could be found in the neighbouring watercourses and will also limit the impact of wind and transport of dust. When the tailings storage facility and the sedimentation ponds will have been completely rehabilitated, the access roads and canals may be dismantled and the environment restored to a natural state.

ASSESSMENT OF RESIDUAL IMPACT

The nature of the anticipated impact is negative specifically concerning the site closure work, but positive concerning rehabilitation of the site.

Thus, during restoration work regarding negative impacts, the degree of disturbance is considered low after the application of the mitigation measures and because the risks remain limited. The disturbance is similar, but less than in the construction phase. Thus, the intensity of the anticipated impact is also low. This impact will have a specific spatial scope and a short duration, only during the performance of the closure work. The probability of occurrence was considered medium. Consequently, the significance of the residual impact is very low.

Site restoration, including the stoppage of discharges into the mine effluent, is a positive impact. The stoppage of the flow of effluent will allow the environment to return to conditions similar to the natural environments and will be felt further downstream, in the entire mixing zone (local). These changes will naturally take several years to be felt, but for the stoppage of discharge, the impact will be immediate and long-term. These changes will be permanent.

Impact on sediments in the closure phase		
Nature	Negative/Positive	Significance: Very low Restoration- Positive impact
Ecosystem value	Medium	
Socioeconomic value	Not applicable	
Degree of disturbance/Improvement	Low	
Intensity	Low	
Spatial scope	Specific	
Duration	Short	
Probability of occurrence	Low	

6.9 HYDROGEOLOGY

Important facts about hydrogeology

Existing conditions

The compilation of the current exploration work, government mapping of surface formations (Paradis, 2004) and hydrogeological studies conducted in 2007, 2018 and 2020 allows definition of the presence of four stratigraphic units in the work area, i.e., fluvioglacial deposits (sand, silty sand and gravel, northern portion of the site), till (southeastern portion of the site), postglacial deposits (peatland, plant debris, eastern, northeastern and southeastern sectors of the du site) and rock. The groundwater levels are generally near the surface of the soil (between 0 m and 13.5 m, mean of 2.1 m) and its flow is controlled by the topography.

According to the MELCCFP Groundwater Classification System (MDDEFP, 2012), rock and fluvioglacial deposits correspond to Class II aquifers, a potential water supply source. The vulnerability of the rock aquifer is maximum at the locations where the rock is outcropping, in the fracture zones or when the granular deposits are thin. According to the DRASTIC vulnerability index, a score of 159 was assessed for the surface deposits, and 128 for the upper portion of the rock, which is equivalent to a medium degree of vulnerability.

Potential impacts of the project

In the construction phase, in view of the mitigation measures that will be implemented, the intensity of the residual impact on the increase in the runoff and reduction of the water seepage rate on the change of local groundwater flow regime is considered low. Its impact has a specific spatial scope, because the impacts will occur near the work, and its duration is short, because the conditions will be restored at the end of the work. The probability of occurrence is medium and the significance of the residual impact is therefore very low.

In the operations phase, the changes to the flow regime are associated with the operation of the mine. The intensity of the impact is considered low due to the significant importance of the water table required around the mine. Its spatial scope is local because the radius of influence of the drawdown may reach 0.8 km, and its duration is medium, because the impacts will be felt only during the operations period. The probability of occurrence is high because the impact is certain, and the significance of the residual impact is low.

In the closure phase, once dewatering activities have ceased, the groundwater flow regime can be expected to return to its initial state. Nonetheless, the intensity of the impact will be low due to the gradual accumulation of groundwater in the underground parts of the mine. Its spatial scope is local because it will be felt in the same radius as during operations and its duration will be long because the return to the state of equilibrium will take several years. Finally, the probability of occurrence is high and the significance of the residual impact is considered low.

6.9.1 CURRENT CONDITIONS

The conceptual hydrogeological model of the Windfall project site was developed following the review of the existing information. The review included the data on the current exploration work, government mapping of the surface formations (Paradis, 2004), the hydrogeological study conducted in 2007 before the development of the existing exploration (Genivar, 2008) and the Golder hydrogeological study in the context of extension of the ramp to the Underdog zone and the Caribou, Zone 27, Lynx Main sectors, the Lynx and Main zones (Golder, 2018) and the upper portion of Triple Lynx (Golder, 2020).

The summary of available information allows definition of the hydrostratigraphic units, the hydraulic properties of the rock and the unconsolidated deposits, the structure elements (faults), the groundwater flow, groundwater seepage into the existing exploration ramp, and groundwater recharge.

HYDROSTRATIGRAPHIC UNITS

The surface deposits at the Windfall project site are composed primarily of fluvioglacial material (esker – sand and gravel), proglacial (sand, silty sand, gravel in places), glacial material (till) and postglacial material (peat) (Paradis, 2004).

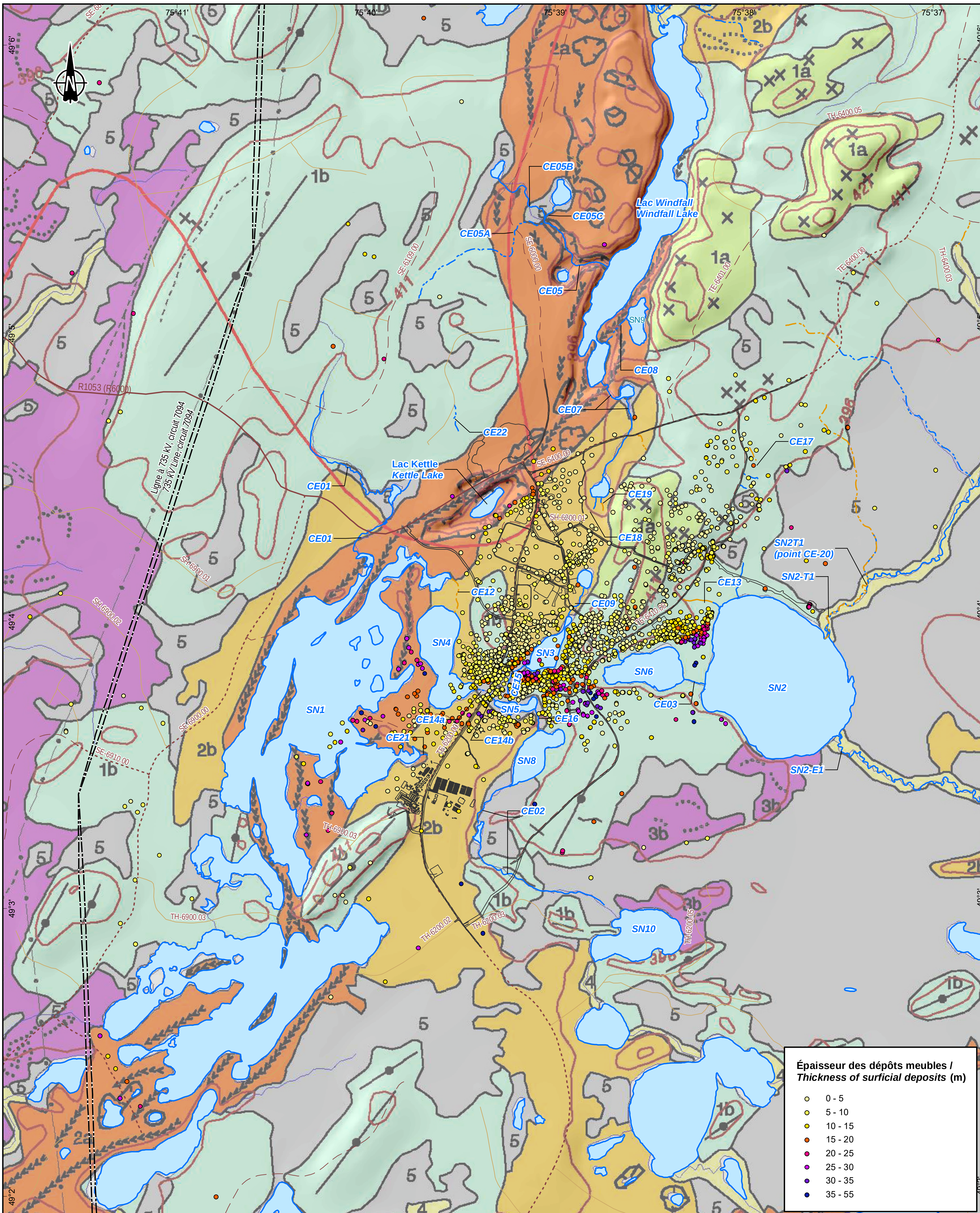
In the mining project sector, the thicknesses of the unconsolidated deposits generally range between 1 m and 10 m. Locally, greater thicknesses of unconsolidated deposits are observed particularly east of Lake SN1, west of Lake SN2 and south of Lake SN3, and may reach 40 m to 45 m. Map 6-10 (thicknesses of unconsolidated deposits) presents the distribution of the unconsolidated deposits and the thicknesses of the deposits observed.

The measured thicknesses of the unconsolidated deposits in the sector were determined according to the lengths of the metal tubing of the mineral exploration drill holes and the 2007 investigations (Genivar, 2008 and see Appendix 6-7), 2017, 2021 and 2022.

Based on the map of surface deposits and the results of the hydrogeological characterization work, four hydrostratigraphic units were defined for the hydrogeological model.

- Fluvioglacial deposits (esker);
- Till;
- Postglacial deposits;
- Rock;
- Structural elements (faults).

The following sections describe in more detail the different hydrostratigraphic units identified in the local study area of the biophysical environment.



Composante du projet / *Project component*

Infrastructure existante / *Existing infrastructure*

Dépôts meubles / *Surficial deposits*

- 1a — Till en converture discontinue / *Till in discontinuous coverage*
- 1b — Till en converture généralement continue / *Till in generally continuous coverage*
- 2a — Sédiments juxtaglaciaires / *Juxtaglacial sediments*
- 2b — Sédiments pro-gralciaires / *Pro-glacial sediments*
- 3b — Sédiments littoraux et pré-littoraux/ *Litorral and pre-littoral sediments*
- 5 — Dépôts organiques / *Organic deposits*

Hydrographie / *Hydrography*

- Cours d'eau permanent / *Permanent watercourse*
- Cours d'eau intermittent / *Intermittent watercourse*
- Cours d'eau souterrain /*Underground watercourse*
- Cours d'eau intermittent partiellement souterrain / *Partially underground intermittent watercourse*
- Plan d'eau / *Waterbody*

Infrastructures / *Infrastrutures*

- Ligne de transport d'énergie électrique / *Electric power transmission line*

Routes / *Roads*

- Route forestière secondaire / *Secondary forest road*
- Route forestière tertiaire / *Tertiary forest*
- Sentier / *Trail*
- Chemin d'hiver / *Winter road*

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MINIÈRE OSISKO

Projet minier Windfall - Étude d'impact sur l'environnement / *Windfall Mining Project - Environmental Impact Assessment*

Site minier Windfall, Eeyou Istchee Baie-James (Québec) / *Windfall Mining Site, Eeyou Istchee Baie-James (Quebec)*

Carte 6-10 / *Map 6-10*
Épaisseur des dépôts meubles /
Surficial Deposits Thickness

Sources :
BDTQ, 1/20 000, MERN Québec, 2007
Géologie des formation superficielles, Commission géologique du Canada, 3463, 32G04, 1997
Réseau routier, AQRéseau+, MERN Québec, 2020

0 250 500 m

UTM, fuseau 18N / zone 18N, NAD83

2023-03-23

Préparée par / Preparation : M. Étienne
Dessinée par / Drawing : C. Villeneuve
Vérifiée par / Verification : A. Hamel
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FLUVIOGLACIAL DEPOSITS

The fluvioglacial deposits are found north of the site and form an esker composed of sand and gravel, extending over the territory in the north-northeast and south-southwest axis. On the edge of the esker, proglacial deposits composed of sand, silty sand and gravel are observed in places. According to the mapping of the Geological Survey of Canada, these fluvioglacial deposits are described as follows (Paradis, 2004):

- Ice-contact sediments: sand and gravel; from 1 to 60 m thick, including eskers and kames; showing a generally bumpy surface marked by kettles and sometimes by beach crests.
- Proglacial outwash sediments in the subaquatic environment: sand, silty sand, gravel in places; from 1 to 20 m thick; including heaps implemented at the mouths of subglacial or intraglacial watercourses that discharged into the proglacial Lake Ojibway.

The fluvioglacial material is mainly composed of sand and gravel. Permeability tests allowed measuring of hydraulic conductivity, which ranges between 2 x 10^{-6} and 7x10^{-4} m/s. The geometric mean of the hydraulic conductivity values is 7 x 10^{-5} m/s.

TILL

Southeast of the site, original glacial deposits composed of till are present and wetlands composed of peat are also observed. Till is a material horizon of glacial origin generally found below the fluvioglacial or postglacial deposits. According to the mapping of the Geological Survey of Canada, these glacial deposits are described as follows (Paradis, 2004):

- Till in generally continuous cover: deposit more than 1 m thick on the average on the interfluves; showing a surface often marked by drumlins, streamlined shapes and minor moraines.
- Till in discontinuous cover: deposit less than 1 m thick on the average on the interfluves; showing a surface often dotted with rock outcrops.

A single hydraulic conductivity value assessed at 3 x 10^{-7} m/s a was measured in this unit. In this type of deposit, hydraulic conductivity may vary and generally ranges between 10^{-5} and 10^{-7} m/s. In the hydrogeological model, a value of 1 x 10^{-5} m/s was assigned to surface till, while a value of 1 × 10^{-6} m/s was assigned to the denser bottom till layer after calibration of the model.

POSTGLACIAL DEPOSITS

Organic deposit zones are present to the east, northeast and southeast of Lake SN2 over large area. According to the mapping of the Geological Survey of Canada, fluvioglacial deposits are described as follows (Paradis, 2004):

- Organic deposits: peat, plant debris; from 0.5 m to 5 m thick, formed in shallow depressions. The greatest extents cover the till units in generally continuous cover.

ROCK

The units encountered in the study area are formed of basalt flows in which volcanoclastic rocks are interspersed, varying in composition from mafic andesitic to felsic rhyolitic. The rock is generally located below the till unit or below the material of fluvioglacial origin.

PIEZOMETRY

The groundwater levels measured in 2022 are generally near the surface of the soil, with measured depths between 0 m and 13.5 m, averaging 2.1 m. In general, the groundwater flow directions are controlled by the topography.

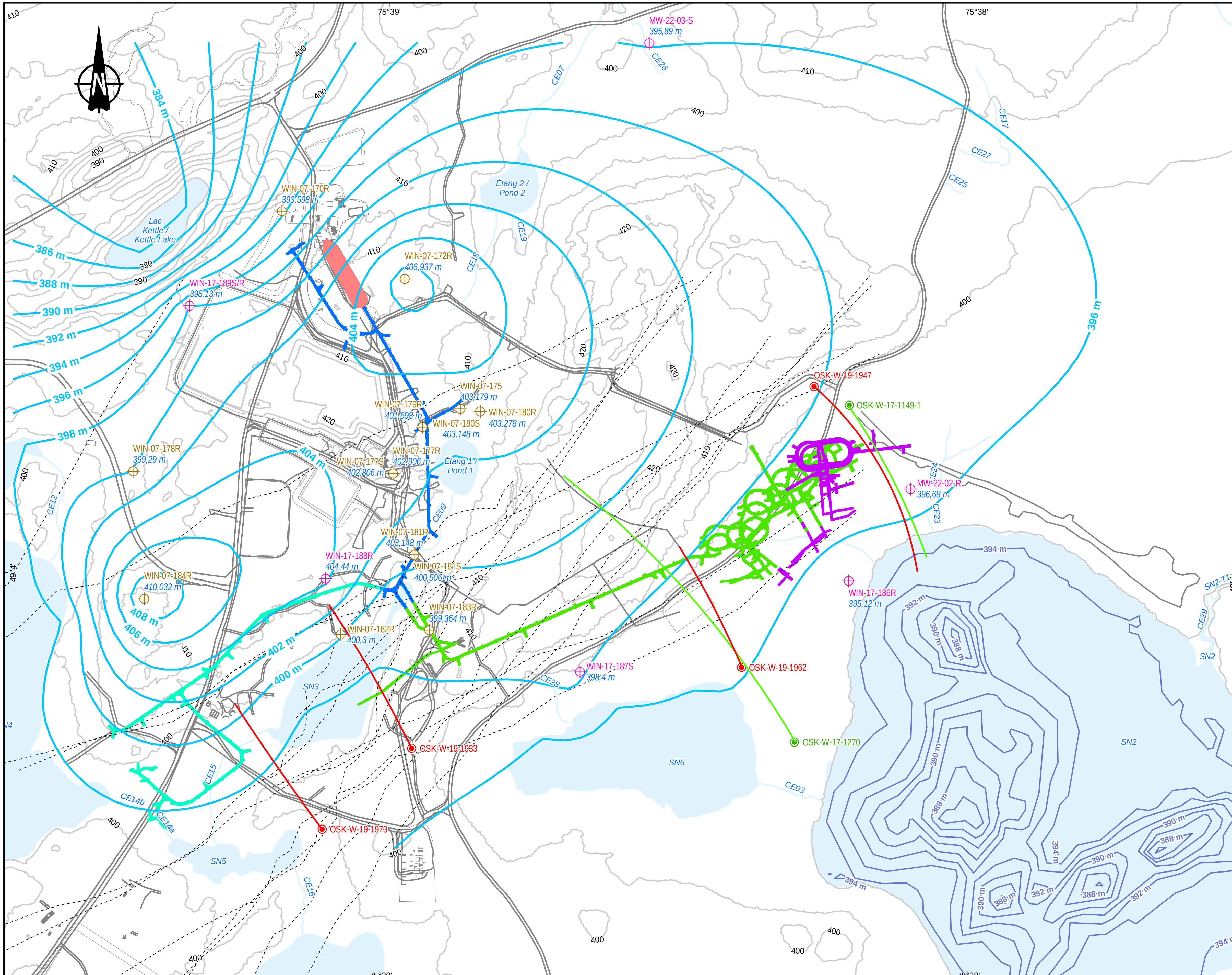
Map 6-11 presents the piezometric map of the rock defined from the survey of groundwater levels conducted in June 2022. In the sector north of the lined stockpile, the groundwater flows northwest, toward a fairly shallow lake in the esker. South of the lined stockpile, the groundwater flows southeast.

The horizontal hydraulic gradient is 0.016 m/m to the southeast in the sector or northwest of Lake SN2. The horizontal hydraulic gradient is 0.02 m/m to the northwest, north of the lined stockpile.

CLASSIFICATION OF THE AQUIFER

According to the MELCCFP Groundwater Classification System (MDDEFP, 2012), groundwater may be Class I, II or III depending on its hydrogeological properties, its quality and its potential use. Class I groundwater is an irreplaceable water supply source. A Class II hydrogeological formation is a common or potential water supply source. Class II formations present a sufficient quantity of water of acceptable quality. Finally, a Class III hydrogeological formation cannot constitute a water supply source (unsatisfactory quality and insufficient quantity).

Based on the information gathered following the investigations conducted in the context of this study, the rock is consistent with a Class II fractured aquifer, which is an aquifer that is a potential water supply source. The fluvioglacial deposit horizon presents a good aquifer potential by its nature. It horizon is considered a Class II aquifer.



Courbe de niveau (m) / *Topographic curve (m)*

Plan d'eau / *Waterbody*

390 m Bathymétrie (m) (WSP, 2017) / *Bathymetry (m) (WSP, 2017)*

Forage d'exploration avec essais hydrauliques avec obstructeurs pneumatiques (GOLDER, 2019) / *Drill hole with packer tests (GOLDER 2019)*

Forage d'exploration avec essais hydrauliques avec obstructeurs pneumatiques (GOLDER, 2017) / *Drill hole with packer tests (GOLDER, 2017)*

Puits d'observation (WSP, 2017-2022) / *Observation well (WSP, 2017-2022)*

Puits d'observation (Qualitas, 2007) / *Observation well (Qualitas, 2007)*

Piézometrie (WSP. juin 2022) / *Piezometry (June 2022)*

401,36 m Élévation du niveau d'eau souterraine (m) / *Measured groundwater elevation (m)*

401 m Courbes piézométriques (m) / *Piezometric curves (m)*

Infrastructures du site minier Windfall / *Windfall Mine Site infrastructures*

Portail existant / *Existing Portal*

Rampe d'exploration existante / *Existing exploration ramp*

Rampe Lynx existante / *Existing Lynx ramp*

Rampe Zone 27 existante / *Existing Zone 27 ramp*

Rampe vers Triple Lynx existant / *Existing ramp to Triple Lynx*

Faille / *Fault*

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Projet minier Windfall - Étude d'impact sur l'environnement / *Windfall Mining Project - Environmental Impact Assessment*

Site minier Windfall, Eeyou Istchee Baie-James (Québec) / *Windfall Mining Site, Eeyou Istchee Baie-James (Quebec)*

Carte 6-11 / *Map 6-11*
Piézométrie du roc (juin2022) /
Rock Piezometry (June 2022)

Sources :
CanVec+, 1/50 000, RN Can, 2014
SDA, 1/20 000, MERN Québec, 2020
BDTA, 1/250 000, MRN Québec, 2002
BDGA, 1/5 000 000, MRN Québec, 2012
Photos aériennes de l'inventaire écoforestier, MFFP Québec, 2011

0 80 160 m

UTM, Fuseau 18, NAD83

2023-03-23

Préparée par / Preparation : A. Hamel
Dessinée par / Drawing : C. Thériault
Vérifiée par / Verification : A. Hamel
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VULNERABILITY OF THE AQUIFER

The unconsolidated deposits in the study area consist mainly of silty and gravelly sands. The permeability of this aquifer is generally medium to high and its aquifer potential is good. The rock is a fractured aquifer; its aquifer potential will vary according to the degree of fracturing. Three drinking water wells are present to supply the exploration camp. They are developed in the two aquifers (fluvioglacial and rock). The vulnerability of the rock aquifer is maximum at the locations where the rock is outcropping, in the fracture zones or when the granular deposits are thin. The rock has very low purifying power. Overall, the rock aquifer must be considered vulnerable, but offering variable potential depending on its degree of fracturing.

The DRASTIC vulnerability index[2] of the groundwater reflects the level of risk of groundwater contamination based on hydrogeological properties. This assessment method was developed by the United States Environmental Protection Agency (US EPA). The DRASTIC method depends on three basic assumptions:

- the contamination sources are found on the surface of the sol;
- the contaminants migrate from the surface of the soil to the aquifer environment via seepage water;
- the contaminants have the same mobility as water.

According to the hydrogeological properties of the site, a groundwater vulnerability index of 159 was assessed for surface deposits and 128 for the upper portion of the rock, which is equivalent to a medium degree of vulnerability[3] based on the levels described in the Water Withdrawal and Protection Regulation, section 53. Table 6-31 presents the detailed weighting for each parameter.

Table 6-31 Vulnerability of aquifers

Unit	Physical parameters	Representative value or interval	Weight	Associated score based on the characteristics	Subtotal	DRASTIC per unit (Total)
Unconsolidated deposit unit (sand)	D – Depth of the layer	Between 0.0 m and 6.9 m (mean of 1.8 m)	5	9	45	159
	R – Recharge of the layer	Between 10 cm and 30 cm per year	4	7	28	
	A – Aquifer environment	Till and Fluvioglacial	3	5	15	
	S – Penology (soil)	Sand	2	9	18	
	T – Topography	Slope between 0 and 6%	1	9	9	
	I – Vadose zone	Sand	5	7	35	
	C – Hydraulic conductivity	Between 0.02 m/d and 29 m/d	3	3	9	
Rock unit	D – Depth of the layer	Between 0 m and 13.5 m - mean of 3.1 m	5	6	30	128
	R – Recharge of the layer	Between 10 cm and 18 cm per year	4	6	24	
	A – Aquifer environment	Rock: igneous or altered metamorphic rocks/basalt	3	3	9	
	S – Pedology (soil)	Sand	2	9	18	
	T – Topography	Slope between 0 and 6%	1	9	9	
	I – Vadose zone	Sand	5	7	35	
	C – Hydraulic conductivity	Mean 0.07 m/d	3	1	3	

2 Aquifer vulnerability index D=Depth to water; R=Recharge, A=Aquifer media, S=Soil media, T=Topography (slope), I=Impact of the vadose zone media, C=Hydraulic conductivity.

3 Vulnerability class: Low – index equal to or less than 100 over the entire protection area; Medium – index less than 180 over the entire protection area, except for an index corresponding to the Low level; High – index equal to or greater than 180 over any portion of the protection area.

6.9.2 IMPACTS ON HYDROGEOLOGY IN THE CONSTRUCTION PHASE AND MITIGATION MEASURES

During the construction phase, the sources of potential impacts and the resulting impacts (**in bold**), likely to have implications for hydrogeological conditions, are as follows:

— Organization of the site, stripping and clearing, surface preparation and access arrangement, construction of works and infrastructure.

These sources have the potential to result in the following impact during the construction phase:

Impact on the local flow regime by:

— increase in the runoff rate and reduction of the water seepage rate;

— change of local groundwater flow regime.

MITIGATION MEASURES

Common mitigation measures QUA01 to QUA04, QUA10 and QUA11 will be applied to reduce the project's impact on the flow regime. These mitigation measures mainly aim to minimize the increase in runoff, because this change may have impacts on the seepage rate and, on a smaller scale, on the local flow regime. In addition, the following measures will be applied: HYD01. A network of monitoring wells will be installed around the periphery of the new infrastructure to detect changes in water table levels. Specific measure P26 will also be implemented.

DETAILED DESCRIPTION OF RESIDUAL IMPACT

INCREASE IN THE RUNOFF RATE AND REDUCTION OF THE WATER SEEPAGE RATE;

Clearing and construction of access roads and the drainage network will alter the water conditions locally by favouring surface flow and reducing the seepage rate. There will be a limited impact on the availability of water, limited to the cleared sites.

CHANGE OF LOCAL GROUNDWATER FLOW REGIME.

The groundwater flow regime will be altered locally around the infrastructure and in the tailings and waste rock stockpiling areas.

ASSESSMENT OF RESIDUAL IMPACT

In the construction phase, the intensity of the impact is considered low, given the fact that minor changes will be noted in the flow regime. The mitigation measures that will be applied will reduce the anticipated impacts. The impacts will have a specific spatial scope because they will be felt near the work. The duration will be short because the return to equilibrium and groundwater flow conditions will occur once the work is completed. In short, the significance of the residual impact on the groundwater flow regime will be very low.

Impact on the hydrogeological regime in the construction phase		
Nature	Negative	Significance: Very low
Ecosystem value	Low	
Socioeconomic value	Not applicable	
Degree of disturbance	Low	
Intensity	Low	
Spatial scope	Specific	
Duration	Short	
Probability of occurrence	Medium	

6.9.3 IMPACTS ON HYDROLOGY IN THE OPERATIONS PHASE AND MITIGATION MEASURES

During the operations phase, the sources of potential impacts and the resulting impacts (**in bold**), likely to have implications for hydrogeological conditions, are as follows:

— The presence and operation of the new infrastructure (dewatering of the mine, stockpiles, and tailings storage facility) and water use and management (pumping water and runoff).

These sources have the potential to result in the following impact during the operations phase:

Impact on the local flow regime by:

— change of local groundwater flow regime.

— mine dewatering.

MITIGATION MEASURES

Measure HYD01 will be applied to monitor the anticipated changes in the local flow regime, the drawdown and the rise of the water table. It plans for a network of monitoring wells to be set up around the periphery of the mining infrastructure. Specific measure P26 will also be implemented.

DETAILED DESCRIPTION OF RESIDUAL IMPACT

CHANGE OF LOCAL GROUNDWATER FLOW REGIME.

Following the characterization of the current groundwater flow regime, digital modelling work was performed for the two projected storage sites (stockpiles and tailings storage facilities). This work, documented in separate reports (Appendix 6-7), aimed to represent the anticipated final conditions of the storage areas and verify the seepage flows below the infrastructure. The summary results are presented in the groundwater quality section. The installation of this storage infrastructure will have the effect of locally altering the flow conditions in these areas by increasing the hydraulic head locally.

MINE DEWATERING.

The necessary pumping activities to ensure dewatering of the underground mine, conducted since the beginning of exploration and which will continue in the operations phase, will lead to changes in the groundwater flow regime, primarily near the infrastructure (ramps and drifts). During the different studies of operations, the groundwater infiltrating into the mine will be pumped to the surface to keep the work areas dry, and a drawdown cone then will be created.

A lowering of the water table in the rock and in the unconsolidated deposits thus will be observed on the perimeter of the underground infrastructure. The influence of the dewatering activities on the groundwater flow regime is controlled by the hydrogeological characteristics, i.e., the hydraulic properties of the pedological formations and the connection between them and the surface water network. These characteristics are particularly complex in the case of hydrogeological systems in the fractured rock environment, as encountered on the site. This is why it is usual to proceed by digital modelling to represent the hydrogeological system and assess the potential impacts of the dewatering activities.

Hydrogeological modelling was performed to assess the impact of the mine's operations on the neighbouring environment (drawdown of the water table) and to obtain an estimate of the dewatering flows at different stages of operation (Appendix 6-7). Predictive simulations were produced to assess the water seepage rate in the exploration ramp and in its proposed extension in permanent regime. The initial conditions of the model will consider that dewatering is already effective in the exploration ramp. The water seepages were assessed for two cases:

- Baseline case, which considers the calibrated parameters. The baseline case considers the mean hydraulic conductivity values for the rock,
- Upper range, which considers a higher hydraulic conductivity in the faults than for the baseline case (5×10^{7} m/s instead of 7×10^{-8} m/s).

The results obtained show that the water inflows in the stopes and drifts would range between 3,860 m^3/d (baseline case – Table 6-32) and 4,570 m^3/d (upper range – Table 6-33) at the end of the underground mine operations period.

The groundwater seepage flow values calculated are presented in Tables 6-32 and 6-33 and Appendix 6-7.

Table 6-32 Groundwater Infiltration in mine openings - Baseline scenario

Year	Dewatering flow
1	1,775 m^3/d
3	2,400 m^3/d
5	2,850 m^3/d
7	3,230 m^3/d
9	3,630 m^3/d
Year end 10	3,860 m^3/d

Table 6-33 Groundwater seepage - Upper range case

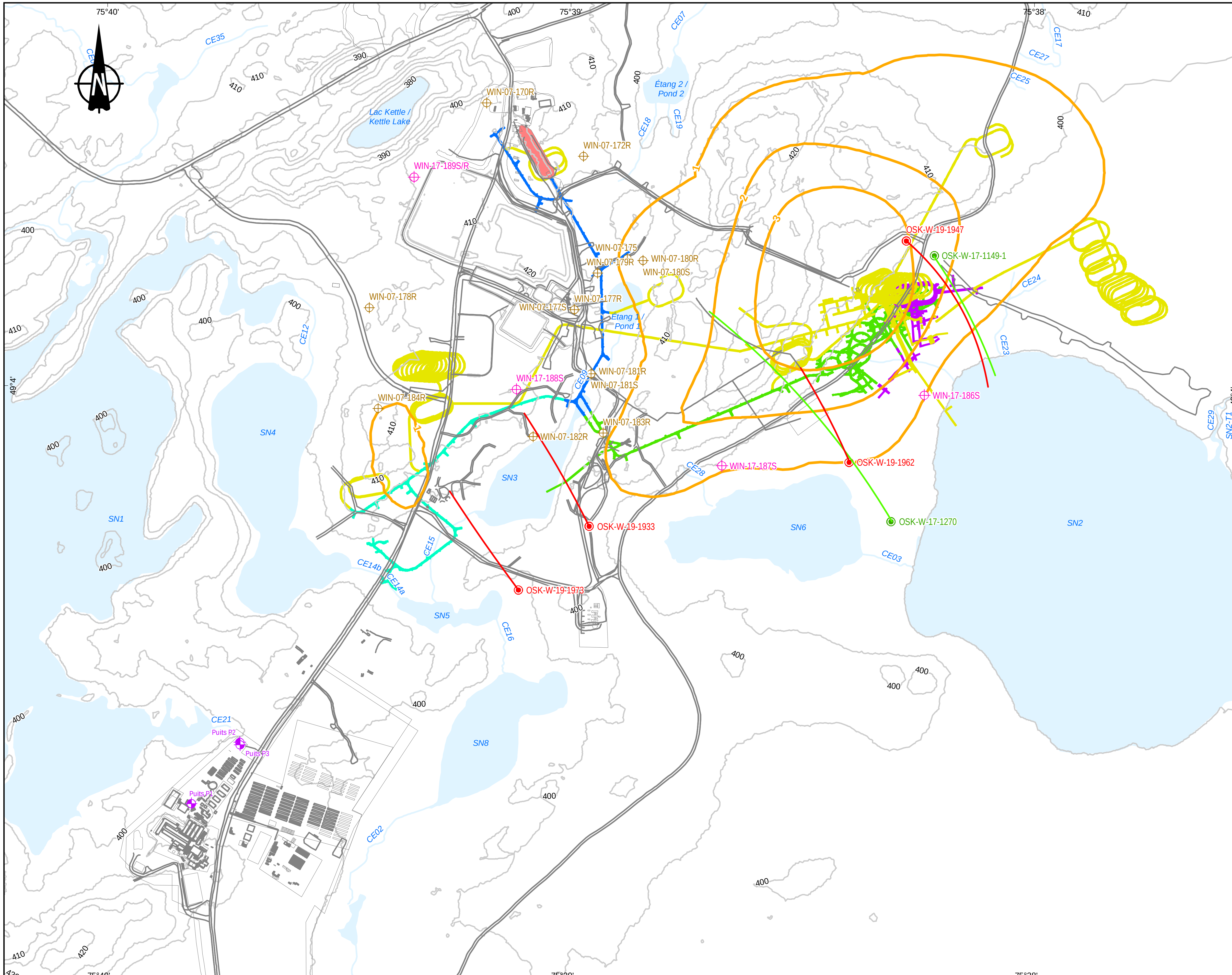
Year	Dewatering flow
1	2,200 m^3/d
3	2,925 m^3/d
5	3,455 m^3/d
7	3,920 m^3/d
9	4,360 m^3/d
Year end 10	4,570 m^3/d

Map 6-12 shows the simulated extent of the potential drawdown zone of the water table, drawdown caused by the dewatering operations for the baseline scenario. These drawdowns are obtained by comparing the water table according to the 2017 baseline conditions with the water table obtained under final operating conditions. As represented, the potential drawdown in the upper portion of the rock corresponds to two water table drawdown zones exceeding 1 m. These zones are respectively centred on the footprint of the existing exploration ramp and on the footprint of the extensions in the Triple Lynx and Underdog sectors.

The main observations made based on these modelling results are as follows:

- In the Main zone of Zone 27 and the Underdog sector, the potential drawdown of the water table exceeding 1 m extends over a maximum length of about 300 m on the northwest/southeast axis and about 150 m on the northeast/southwest axis.
- In the Lynx zone, Triple-Lynx sector, the potential drawdown of the water table exceeding 1 m extends over a maximum length of about 1,600 m on the northeast/southwest axis and about 850 m on the northwest/southeast axis.
- Drawdowns exceeding 1 m, in the order of the seasonal fluctuations generally observed in Quebec, do not reach the water supply well located in the exploration camp sector south of the ramp sector and should not cause loss of use.
- The 1 m potential drawdown zone does not reach the neighbouring lakes.

Map 6-13 shows the elevation contours of the water table and the groundwater flow directions in the upper portion of the rock under final operating conditions. The modelling results show that dewatering of the water table and the proposed extensions should not significantly alter the groundwater flow directions relative to the current conditions.



Courbe de niveau (m) / *Topographic curve (m)*

Plan d'eau / *Waterbody*

Puits d'eau potable, WSP / *Drinking water well (WSP)*

Forage d'exploration avec essais hydrauliques avec obstructeurs pneumatiques (GOLDER, 2019) / *Drill hole with packer tests (GOLDER, 2019)*

Forage d'exploration avec essais hydrauliques avec obstructeurs pneumatiques (GOLDER, 2017) / *Drill hole with packer tests (GOLDER, 2017)*

Puits d'observation (WSP, 2017) / *Observation well (WSP, 2017)*

Puits d'observation (Qualitas 2007) / *Observation well (Qualitas, 2007)*

Isocontour de rabattement simulé (m) / *Simulated drawdown isocontour (m)*

Infrastructures du site minier Windfall /
Windfall Mine Site Infrastructure

Portail existant / *Existing Portal*

Rampe d'exploration existante / *Existing exploration ramp*

Rampe Lynx existante / *Existing Lynx ramp*

Rampe Zone 27 existante / *Existing Zone 27 ramp*

Rampe vers Triple Lynx existant / *Existing ramp to Triple Lynx*

Rampe projetée Underdog / *Projected Underdog ramp*

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Carte 6-12 / *Map 6-12*
Rabattement simulé de la nappe d'eau souterraine - Conditions de dénoyage de la rampe (scénario de base) /
Simulated Groundwater Drawdown - Ramp Dewatering Conditions (Base Case)

Sources :
CanVec+, 1/50 000, RN Can, 2014
SDA, 1/20 000, MERN Québec, 2020
BDTA, 1/250 000, MRN Québec, 2002
BDGA, 1/5 000 000, MRN Québec, 2012
Photos aériennes de l'inventaire écoforestier, MFFP Québec, 2011

0 100 200 m

UTM, Fuseau 18, NAD83

2023-03-23

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Dessinée par / Drawing : C. Villeneuve
Vérifiée par / Verification : A. Hamel
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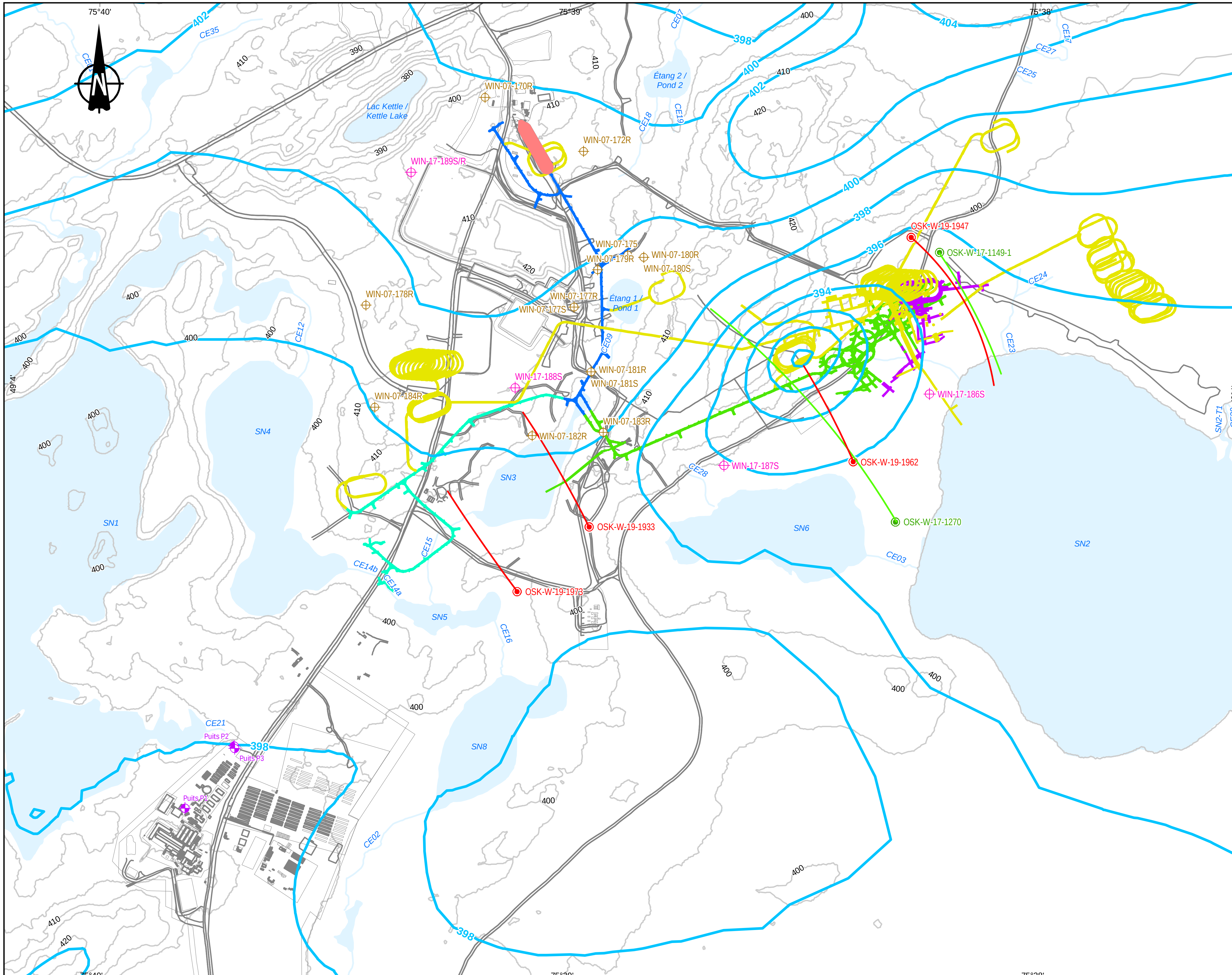

Courbe de niveau (m) / *Topographic curve (m)*

Plan d'eau / *Waterbody*

Puits d'eau potable, WSP / *Drinking water well (WSP)*

Forage d'exploration avec essais hydrauliques avec obstructeurs pneumatiques (GOLDER, 2019) / *Drill hole with packer tests (GOLDER, 2019)*

Forage d'exploration avec essais hydrauliques avec obstructeurs pneumatiques (GOLDER, 2017) / *Drill hole with packer tests (GOLDER, 2017)*

Puits d'observation (WSP, 2017) / *Observation well (WSP, 2017)*

Puits d'observation (Qualitas 2007) / *Observation well (Qualitas, 2007)*

Piézométrie simulée (m) / *Simulated piezometry (m)*

Infrastructures du site minier Windfall /
Windfall Mine Site infrastructure

Portail Existant / *Existing Portal*

Rampe d'exploration existante / *Existing exploration ramp*

Rampe Lynx existante / *Existing Lynx ramp*

Rampe Zone 27 existante / *Existing Zone 27 ramp*

Rampe vers Triple Lynx existant / *Existing ramp to Triple Lynx*

Rampe projetée Underdog / *Projected Underdog ramp*

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Carte 6-13 / *Map 6-13*
Piézométrie simulée en condition de dénoyage de la rampe d'exploration et son extension proposée /
Simulated Piezometry under Dewatering Conditions of the Exploration Ramp and its Extension

Sources :
CanVec+, 1/50 000, RN Can, 2014
SDA, 1/20 000, MERN Québec, 2020
BDTA, 1/250 000, MRN Québec, 2002
BDGA, 1/5 000 000, MRN Québec, 2012
Photos aériennes de l'inventaire écoforestier, MFFP Québec, 2011

0 100 200 m

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The presence of a watershed north of the Main exploration camp entrance should be noted. In this area, water flows northwest toward the small lake in the esker (Kettle). South of the watershed, the water generally flows to the southeast.

ASSESSMENT OF RESIDUAL IMPACT

In the operations phase, the changes to the flow regime are associated with the operation of the mine. The intensity is considered medium, given the fact that a significant drawdown of the water table can be anticipated around the mine. The spatial scope of the impact is considered local because the groundwater flow regime will be altered within a radius of up to 0.8 km. The duration of the impact will be medium, because the flow regime will be altered throughout the operations period. In short, the significance of the residual impact on the hydrogeology is qualified as low.

Impact on the hydrogeological regime in the operations phase		
Nature	Negative	Significance: Low
Ecosystem value	Low	
Socioeconomic value	Not applicable	
Degree of disturbance	Medium	
Intensity	Low	
Spatial scope	Local	
Duration	Medium	
Probability of occurrence	High	

6.9.4 IMPACTS ON HYDROGEOLOGY IN THE CLOSURE PHASE AND MITIGATION MEASURES

During the closure phase, the impact sources and the resulting impact (**in bold**), likely to have implications for the groundwater flow regime, are as follows:

— The presence of site remnants and final restoration.

These sources have the potential to result in the following impact during the closure phase:

Positive impact on hydrology by:

— The shutdown of pumping activities in the post-restoration phase, which will gradually reach a new natural balance in the environment.

MITIGATION MEASURES

No additional mitigation measure is anticipated in the opening phase other than monitoring of the drawdown and the rise of the water table (HYD01). A network of wells located on the periphery of the mining infrastructure will be retained and studied after the end of operations. Specific measure P26 will also be implemented.

DETAILED DESCRIPTION OF RESIDUAL IMPACT

The shutdown of mine dewatering activities at the end of the project will trigger the rise of the groundwater level toward its initial position. It is anticipated that the groundwater flow regime will essentially regain its initial state when the mine is filled.

The impacts presented in the operations phase are similar for the restoration phase concerning the waste rock stockpile. The piezometric level will begin to recover starting at the mining operations. Under post-operating conditions, the waste rock and tailings will drain slowly by gravity to reach a permanent new equilibrium. The recovery period will depend on the hydrogeological conditions.

ASSESSMENT OF RESIDUAL IMPACT

In the restoration phase, the intensity of the impact is considered low, because the groundwater will accumulate gradually within the underground infrastructure. The impact is considered local, because the impact will be felt within a radius around the mine of up to 0.8 km. Its duration is assessed is long, considering the time of return to equilibrium the rock formation, which will take several years. In short, depending on the anticipated impacts, the significance of the impact on hydrogeology is considered low.

Impact on the hydrogeological regime in the closure phase		
Nature	Negative	Significance: Low
Ecosystem value	Low	
Socioeconomic value	Not applicable	
Degree of disturbance	Low	
Intensity	Low	
Spatial scope	Local	
Duration	Long	
Probability of occurrence	High	

6.10 GROUNDWATER QUALITY

Important facts about groundwater quality

Existing conditions

The groundwater quality assessment was produced on the basis of the results of the two most recent groundwater characterization campaigns completed in 2020 and 2021. A total of 23 wells were sampled, including 15 from the rock aquifer and eight from sand deposits. The results of the campaigns were compared with the MELCCFP surface water resurgence (RES) criteria and the drinking water (EC) criteria. Exceedances of the EC criteria were observed for ammoniacal nitrogen, nitrites and nitrates, manganese, arsenic, aluminum, sulphide (H_2S form) and nickel. Exceedances of the RES criterion were also noted for ammoniacal nitrogen, nitrite, phosphorus, sulphide (H_2S form), copper and zinc. Some of these exceedances could be due to exploration activities and also to the fact that the waste rock stockpile was on a non-lined surface before Osisko began its activities.

An assessment of the natural background level was also completed based on all the historical results (since 2007) for groundwater from the two main stratigraphic units, i.e., unconsolidated deposits (soil) and rock. The results obtained during this analysis show that background levels exceeding the EC criteria are noted for aluminum (soil only), arsenic, manganese, ammoniacal nitrogen and sulphides (soil only). Finally, certain NBLs assessed also exceed the alert threshold (Cu) and the RES criterion (sulphides).

Potential impacts of the project

In the construction phase, in view of the mitigation measures that will be implemented, the intensity of the residual impact on groundwater quality is considered low for the contaminant and melting agent seepage risk. It has a specific spatial scope and a short duration because no contaminated soil will remain in place. The probability of occurrence is low and the significance of the residual impact is also very low.

In the operations phase, given the protections implemented to limit seepage and that the runoff and pumping water will be recovered, the intensity of the impact is considered low. The impact has a specific spatial scope because it will be contained near the contaminated site, and its duration is short (spill) to long (seepage). The probability of occurrence is low and the significance of the residual impact is very low.

In the closure phase, the restoration of the tailings storage facility and the waste rock stockpiles, the dismantling of the mining infrastructure and the rehabilitation of the soils allow anticipation of a positive impact. The risks of water seepage through the tailings and the stockpiles are considered minimal and the intensity of the impact is therefore low. Its spatial scope is local and its duration is long, because it is always present. The probability of occurrence is considered low and the significance of the residual impact will therefore be low.

6.10.1 CURRENT CONDITIONS

Groundwater quality data has been available since 2007 and a semi-annual groundwater quality program has been in place since 2017. The monitoring wells are located near the existing infrastructure. The criteria were compared for the 2020 and 2021 results, because this is the most recent data and considered to be the most representative of the current groundwater quality conditions. Map 6-14 presents the location of the wells used to determine the current conditions. Twenty-three (23) wells (15 from the rock aquifer and eight from sand deposits) were sampled in 2020 and 2021 during at least two annual campaigns. The list of wells is presented in Table 6-34. A total of 106 samples were collected during this period.

Table 6-34 List of wells sampled in 2020-2021

No.	Name	Longitude	Latitude	Ground elevation (m)	Intercepted unit	Well depth (m)	Water level depth (m) October 2022
1	WIN-07-170R	75° 39’ 10.78 W	49° 4’ 24.39 N	406.87	Rock	19.61	13.54
2	WIN-07-172R	75° 38’ 58.16 W	49° 4’ 19.94N	407.12	Rock	7.52	0.43
3	WIN-07-175 (drill hole casing)	75° 38’ 52.37 W	49° 4’ 11.26 N	403.28	Rock	45.72	0.52
4	WIN-07-177S	75° 38’ 59.18 W	49° 4’ 6.88 N	404.82	Unconsolidated deposits	5.50	2.32
5	WIN-07-177R	75° 38’ 59.18 W	49° 4’ 6.88 N	404.82	Rock	10.63	2.23
6	WIN-07-178S	75° 39’ 25.72 W	49° 4’ 6.88"N	402.95	Unconsolidated deposits	6.26	4.01
7	WIN-07-178R	75° 39’ 25.72 W	49° 4’ 6.88 N	402.95	Rock	13.49	3.91
8	WIN-07-179	75° 38’ 56.21 W	49° 4’ 10.00 N	403.78	Rock	8.83	3.64
9	WIN-07-180S	75° 38’ 50.33 W	49° 4’ 11.09 N	402.99	Unconsolidated deposits	10.30	0.36
10	WIN-07-180R	75° 38’ 50.33 W	49° 4’ 11.09 N	402.99	Rock	18.30	0.22
11	WIN-07-181S	75° 38’ 56.96 W	49° 4’ 1.45 N	400.09	Unconsolidated deposits	8.90	-0.14
12	WIN-07-181R	75° 38’ 56.96 W	49° 4’ 1.45 N	400.09	Rock	16.60	-0.25
13	WIN-07-182	75° 39’ 4.39 W	49° 3’ 56.05N	400.17	Rock	6.40	0.53
14	WIN-07-183R	75° 38’ 55.34 W	49° 3’ 56.40 N	403.91	Rock	12.14	4.80
15	WIN-07-184	75° 39’ 24.47 W	49° 3’ 58.34 N	411.30	Rock	7.19	1.64
16	WIN-17-186S	75° 38’ 12.54 W	49° 3’ 59.93 N	396.37	Unconsolidated deposits	5.98	1.30
17	WIN-17-186R	75° 38’ 13.77 W	49° 3’ 59.83 N	396.38	Rock	15.06	1.83
18	WIN-17-187S	75° 38’ 40.79 W	49° 3’ 52.97 N	399.22	Unconsolidated deposits	3.96	3.10
19	WIN-17-187R	75° 38’ 39.91 W	49° 3’ 53.69 N	399.16	Rock	8.58	3.86
20	WIN-17-188S	75° 39’ 5.96" W	49° 3’ 59.80" N	405.35	Unconsolidated deposits	5.17	2.14
21	WIN-17-188R	75° 39’ 6.601 W	49° 4’ 0.05 N	405.38	Rock	10.08	2.14
22	WIN-17-189S	75° 39’ 20.10 W	49° 4’ 18.01 N	407.65	Unconsolidated deposits	6.98	Dry
23	WIN-17-189R	75° 39’ 20.10 W	49° 4’ 18.01 N	407.51	Rock	15.09	8.33

Courbe de niveau (m) / *Topographic curve (m)*

Puits de suivi (2020-2021) / *Monitoring well (2020-2021)*

45,72 m Profondeur du puits (m) / *Borehole depth (m)*

0,524 m Profondeur de l'eau dans le puits (m) (oct. 2022) / *Water depth in the borehole (m) (Oct. 2022)*

Sondage / Borehole	Y m (UTM 18)	X m (UTM 18)
WIN-07-170R	5 435 825,420	452 308,810
WIN-07-172R	5 435 685,680	452 563,597
WIN-07-175	5 435 416,600	452 678,720
WIN-07-177R	5 435 282,480	452 539,390
WIN-07-177S	5 435 282,480	452 539,390
WIN-07-178R	5 435 287,300	452 000,960
WIN-07-178S	5 435 287,300	452 000,960
WIN-07-179R	5 435 378,530	452 600,460
WIN-07-180R	5 435 411,080	452 720,050
WIN-07-180S	5 435 411,080	452 720,050
WIN-07-181R	5 435 114,440	452 583,080
WIN-07-181S	5 435 114,440	452 583,080
WIN-07-182R	5 434 949,070	452 430,880
WIN-07-183R	5 434 958,220	452 614,660
WIN-07-184R	5 435 023,200	452 024,100
WIN-17-186R	5 435 060,000	453 484,000
WIN-17-186S	5 435 057,000	453 459,000
WIN-17-187R	5 434 850,000	452 909,000
WIN-17-187S	5 434 872,000	452 927,000
WIN-17-188R	5 435 065,000	452 400,000
WIN-17-188S	5 435 073,000	452 387,000
WIN-17-189S/R	5 435 630,000	452 118,000

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Windfall Mining Site, Eeyou Istchee Baie-James (Quebec)

Carte 6-14 / *Map 6-14*
Localisation des puits de suivi des eaux souterraines /
Groundwater Monitoring Wells Location

Sources :
CanVec+, 1/50 000, RN Can, 2014
SDA, 1/20 000, MERN Québec, 2020
BDTA, 1/250 000, MRN Québec, 2002
BDGA, 1/5 000 000, MRN Québec, 2012
Photos aériennes de l'inventaire écoforestier, MFFP Québec, 2011

0 60 120 m

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Vérifiée par / Verification : A. Hamel

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ANALYTICAL PROGRAM

The choice of parameters was based on the risks associated with use of the site and on the requirements of D019 (MDDEP, 2012). The groundwater samples were submitted for analysis for either of the following parameters:

— inorganic compounds (total cyanides, fluorides, total sulphides);
— nitrogen compounds;
— C_{10}-C_{50} petroleum hydrocarbons (PH);
— major ions (bicarbonates, calcium, carbonates, chlorides, magnesium, potassium, sodium and sulphates);
— dissolved metals;
— radionuclides (2017);
— Physicochemical parameters (pH, electric conductivity, oxidation-reduction potential and temperature).

A similar analysis program was used for the groundwater samples collected in the previous years.

WATER QUALITY CRITERIA

Considering that the groundwater of the local study area of the biophysical environment could be resurgent in the surface water, the chemical analysis results were compared with the resurgence in surface water criteria (RES) of the *Response Manual — Soil Protection and Contaminated Sites Rehabilitation* of the MELCCFP (Beaulieu, 2021). The potential receptors are the streams and lakes.

The results of the groundwater sampling program for 2020 and 2021 were compared to the RES and the drinking water (EC) presented in the Response Manual. All of the 2020-2021 results are presented in the Table of Results of Appendices 6-9 and 6-35 (radionuclides).

Table 6-35 Analytical results of radionuclides (2017)

Parameters	Units	WIN-07-173R	WIN-17-186R	WIN-17-187S	WIN-17-187R	WIN-17-189R
		2017-11-25	2017-11-21	2017-11-21	2017-11-20	2017-11-22
Radionuclides						
$Lead_{-210}$	Bq/L	<1	<1	<1	<1	<1
$Radium_{-226}$	Bq/L	<0.01	<0.01	<0.01	<0.01	<0.01
$Radium_{-228}$	Bq/L	<0.5	<0.5	<0.5	<0.5	<0.5
$Thorium_{-228}$	Bq/L	<0.1	<0.1	<0.1	<0.1	<0.1
$Thorium_{-232}$	Bq/L	<0.01	<0.01	<0.01	<0.01	<0.01
$Uranium_{-234}$	Bq/L	<0.01	<0.01	0.017	0.013	0.031
$Uranium_{-238}$	Bq/L	<0.01	<0.01	0.026	<0.01	0.02

ANALYTICAL RESULTS

For the 2020-2021 campaigns, exceedances of the EC criteria were observed for ammoniacal nitrogen (48 of 106 samples), nitrites and nitrates (29/96), manganese (55/90), arsenic (65/105), aluminum (13/90), sulphide in the form of H_2S (6/86) and nickel (1/105). Exceedances of the RES criterion were also noted for ammoniacal nitrogen (1/106), nitrite (26/101), phosphorus (2/90), sulphide in the form of H_2S (11/86), copper (1/105) and zinc (6/105). Table 6-36 presents the summary of the exceedances observed during this period.

Table 6-36 Summary of exceedances observed for the 2020-2021 campaign

Parameter (criteria At/RES/EC µg/l)	Number of analyses	Frequency of exceedances, 2020-2021 campaign		
		Alert threshold (AT)	Resurgence in surface water (RES)	Drinking water (DW)
Aluminum (- / - /100)	90	-	-	**<u>13</u>**
Arsenic (170/340/0.3)	105	0	0	**<u>65</u>**
Copper (3.65/7.3/1000)	105	17	1	0
Manganese (1150/2300/50)	90	0	0	**<u>55</u>**
Nickel (130/260/70)	105	0	0	**<u>1</u>**
Zinc (33.5/67/5000)	105	3	6	0
Sulphides (16/32/50)	86	0	11	**<u>6</u>**
Nitrites (30/60/1000)	101	5	26	**<u>3</u>**
NO_2+NO_3 (-/-/10000)	96	-	-	**<u>29</u>**
NH_3-NH (10000/20000/50)	106	6	1	**<u>48</u>**
Phosphorus (500/1000/-)	90	0	2	

LEGEND:

100	: > RES criterion
100	: > Alert threshold
<u>100</u>	: > Criterion/recommendation Drinking water

As observed during the 2020-2021 monitoring campaigns, certain exceedances could be associated with exploration activities that occurred on the site. Certain wells could have been impacted before the installation of liners for the existing waste rock stockpile, its ditches, and the new water management infrastructure. Before Osisko begins its activities at the Windfall site, a sector of the current waste rock stockpile was on the non-lined surface. Throughout the expansions done by Osisko for the bulk sampling work, the waste rock on the non-lined surface were displaced and a membrane was added. A trend analysis was also produced to discern the exceedances associated with the activities of those naturally present in the groundwater. The following section also presents the results of the assessment of the natural background levels.

NATURAL BACKGROUND LEVEL

To assess the natural background levels (NBL) in the groundwater, all of the data collected since 2007 was studied. Considering that mineral exploration activities occurred in the local study area during the data collection period, some results were excluded from the assessment of the NBL. The results obtained following the statistical analysis produced aim to provide an estimate of the initial concentrations in the groundwater representative of the natural environment before the development of the mining project. The details of the methodology and the results are presented in the sectorial report presented in Appendix 6-8.

METHODOLOGY

A statistical protocol was used to identify the observation wells in which the groundwater samples are representative of the NBL in the soil and the upper portion of the rock, and thus the baseline of the land.

To do this, the protocol includes a series of stages aiming to identify the observation wells in which the groundwater quality presents evidence of impacts related to the exploration activities that occurred on the site. These observation wells were considered ineligible once one of these factors was observed:

- Identification of at least one parameter showing an exceedance of comparative criteria simultaneously with an upward trend according to the Mann-Kendall statistical test.
- Presence of parameters from anthropogenic sources: C_{10}-C_{50} petroleum hydrocarbons or total cyanides.
- Statistical distribution of at least one parameter with concentrations significantly or frequently greater than all the data by a comparison of the wisker-box graphs.
- Distinct hydrogeochemical signature, related to that of the observation wells recognized as impacted by the mineral exploration activities, according to a principal component analysis (PCA).

Following the withdrawal of these observation wells impacted by the mineral exploration activities, the resulting observation wells, like their samples, were considered representative of the NBL. Then the background levels were assessed for the parameters that fulfil all of these conditions:

- Existence of a groundwater quality criterion according to the *Response Manual — Soil Protection and Contaminated Sites Rehabilitation* of the MELCCFP (Beaulieu, 2021).
- Quantity of analytical results greater than or equal to 30.
- Less than 80% of the measured concentrations are below the detection limit.

Concerning the observation wells developed in the soils and representative of the NBL, the number of analytical results available ranged between 17 and 19 according to the parameter. Although the number is less than 30, the NBL nonetheless was assessed. The NBL may be updated when new results will become available. The background-level results are presented in Table 6-37.

According to the Shapiro-Wilk statistical test, almost all of the parameters analyzed do not follow a normal or log-normal distribution. Thus, the background level values for each parameter were estimated with the following methods to consider this particularity:

— Kaplan-Meier (KM) semi-parametric method: when there is concentration of less than 80% below the detection limit.
— Regression on Order Statistics (ROS) nonparametric method: when there is an absence of concentration below the detection limit.

OUTCOMES

The NBLs estimated for soils and the upper portion of the rock are presented in Table 6-38. Some NBLs exceed the drinking water criteria for the following parameters:

Drinking water

— aluminum (Al)-soil;
— arsenic (As)-soil and rock;
— manganese (Mn)- soil and rock;
— ammoniacal nitrogen ($N\text{-}NH_3$ and $N\text{-}NH_4$)-soil and rock;
— hydrogen sulphide (H2S) -soil;
— Sulphides (S2-)- soil.

Thus, the estimated NBL values indicate that exceedances of groundwater quality criteria for drinking water are anticipated for the above parameters, for the samples that will be collected in the observation wells during mine monitoring programs.

Finally, the NBLs assessed for sulphides (water from soil) would exceed the RES criteria and the NBL for copper in water from unconsolidated deposits exceeding the alert threshold.

Table 6-37 Background levels in groundwater estimated for the soils and the upper portion of the rock in comparison with the MELCCFP quality criteria

Parameter [number of rock data; number of soil data]	Background level (µg/L)		Quality criterion (µg/L) (MELCCFP)		
	Upper portion of the rock	**Soil**	**Drinking water**	**Resurgence in surface water (RES)**	**Alert threshold (RES x 50%)**
Metals					
Aluminum (Al) [32.19]	48	**276 ***	100	-	-
Arsenic (As) [32.19]	**7.5**	**1.2 ***	0.3	340	170
Barium (Ba) [32.19]	100	37 *	1000	600	300
Chromium (Cr) [-.19]	-	1.9 *	50	-	-
Cobalt (Co) [-;19]	-	0.70 *	-	370	185
Copper (Cu) [32.19]	2.2	**5.5 ***	1,000	7.3	3.65
Manganese (Mn) [32.19]	**320**	**405 ***	50	2,300	1,150
Molybdenum (Mo) [32.19]	7.7	8.8 *	40	29,000	14,500
Nickel (Ni) [-.19]	-	4.1 *	70	260	130
Sodium (Na) [32.19]	23,845	19,940 *	200,000	-	-
Other inorganic compounds					
Ammoniacal nitrogen (N-NH_3 and N-NH_4^+) [32.18]	**530**	**878 ***	50	20,000	10,000
Chlorides (Cl) [32.18]	6,800	56,800 *	250,000	860,000	430,000
Fluoride (F) [32.18]	320	218 *	1,500	4,000	2,000
Nitrites (N-NO_2) and nitrates (N-NO_3) [24.18]	1,700 *	1,600 *	10,000	-	-
Nitrates (N-NO_3^-) [30.19]	1,700	1,600 *	-	300,000	150,000
Total phosphorus (P) [32.19]	350	145 *	-	1,000	500
Hydrogen sulphide (H_2S) [-.17]	-	**118 ***	50	3.2	1.6
Sulphides (S^{2-}) [-.18]	-	**106 ***	50	39	19.5

Notes	
118	: Background level value exceeding the RES criterion and NBL for drinking water
5.5	: Background level value exceeding the alert threshold (50%) of the RES criterion
320	: Background level value exceeding the criterion for drinking water
-	: Background level not estimated in the absence of criteria
*	: Number of data available below 30 to estimate the background level

6.10.2 IMPACTS ON GROUNDWATER IN THE CONSTRUCTION PHASE AND MITIGATION MEASURES

During the construction phase, the sources of potential impacts and the resulting impact (**in bold**), likely to have implications for groundwater quality, are as follows:

- Organization of the site, stripping and clearing, surface preparation and access arrangement, construction of works and infrastructure, transportation and traffic, and production and management of residual and hazardous materials.

These sources have the potential to result in the following impact during the construction phase:

Contamination or alteration of groundwater quality by:

- Accidental introduction of petroleum hydrocarbons, contaminants or hazardous materials;
- Infiltration of contaminants from use of melting agents in winter.

MITIGATION MEASURES

Common mitigation measures QUA07, QUA14, QUA05 and QUA22 to 26 will be applied to reduce the risks of contamination or accidental spills. Measures NOR10, NOR12 and NOR15 will also be applied. Groundwater protection is governed by several regulations and standards, particularly in the field of mining projects. Specific measure P26 will also be implemented.

DETAILED DESCRIPTION OF RESIDUAL IMPACT

RISK OF GROUNDWATER CONTAMINATION BY THE ACCIDENTAL INTRODUCTION OF PETROLEUM HYDROCARBONS, CONTAMINANTS OR HAZARDOUS MATERIALS

Road transportation, traffic and refuelling of mobile equipment and temporary storage or handling of residual and hazardous materials will represent potential sources of accidental spills that could contaminate the soils and reach the water table. However, the risk of accidental spills will be minimized by the application of the common preventive measures. These measures will be geared to prevention thanks to regular control of equipment and the addition of emergency systems that will allow rapid intervention in case of accident. Such a spill, if it occurs, will contaminate the soils of the spill site. The impact of a potential spill would depend, among other things, on the volume of contaminants spilled, the one-time occurrence (spill), or the repetition (leak) of the problem.

If the volume spilled is significant, a portion of product not fixed to the soil grains would migrate by surface runoff to the bodies of water and eventually to the water table. Infiltration to the water table would leave a dissolved phase floating in the groundwater. This is why, during an accidental spill, there would be a rapid response to recover the contaminated soils in order to prevent the spilled product from reaching the water table. In the case of heavy solvents, the product would infiltrate until it is completely absorbed by the soil particles or until it reaches an impermeable horizon.

The hydrogeological context of the sector would require a rapid response, in view of the presence of permeable sand deposits on the surface. The depth of the water table is variable, but generally more than 3 m. However, because the spill will be managed in accordance with the spill response plan and, given the implementation of many mitigation and control measures, the risk of spills that will have an impact on soil quality is very low, the product will be contained and the contaminated soils will be recovered quickly, as prescribed in the emergency preparedness plan (see Chapter 12). However, if there is a spill, the degree of contamination will depend on the nature of the contaminants and their concentrations.

RISK OF GROUNDWATER CONTAMINATION BY SEEPAGE OF CONTAMINANTS FROM USE OF MELTING AGENTS IN WINTER

The access roads and traffic routes must be maintained to ensure the workers' safety. The use of melting agents (mixture of salt and abrasive), to ensure the safety of the traffic routes in winter, could result in an increase in the salt concentration in the neighbouring soils and affect water quality. The measure specifying that the use of melting agents will be limited as much as possible will mitigate this impact. Surface water seepage into the soil risks entrainment of a portion of these melting agents to the water table. The salinity of the groundwater could increase under the access roads at the locations where the aquifer is more vulnerable. The salt-abrasive mixture that will be used will be a common type proved by the MTQ or the MELCCFP.

ASSESSMENT OF RESIDUAL IMPACT

Within the study area, the groundwater is used to supply drinking water to the current exploration camp. One additional drinking water well will also be provided for the drinking water supply of the mine site and the future camp. The ecosystem value of this component is considered medium because it is used to supply drinking water.

In the construction phase, the intensity is considered low, whether for the risks related to spills or those related to petroleum products and other hazardous materials. The mitigation measures that will be applied will effectively reduce the anticipated impacts. The long frost period in the Windfall project region facilitates eventual recovery work in case of a spill of petroleum hydrocarbons or hazardous materials. Consequently, the degree of disturbance is considered low. In case of accidental spills, the spatial scope of this impact would have a specific extent, because the product would be contained rapidly and then recovered before it propagates. This impact would have a short duration because no contaminated soil will remain in place, thus minimizing the risk of groundwater contamination. The probability of occurrence is considered low, with small spills occurring occasionally on most of the large sites, where many mobile equipment units are used. The significance of the residual impact of the groundwater contamination risks is considered very low.

Impact on groundwater quality in the construction phase		
Nature	Negative	Significance: Very low
Ecosystem value	Medium	
Socioeconomic value	Not applicable	
Degree of disturbance	Low	
Intensity	Low	
Spatial scope	Specific	
Duration	Short	
Probability of occurrence	Low	

6.10.3 IMPACTS ON GROUNDWATER IN THE OPERATIONS PHASE AND MITIGATION MEASURES

During the operations phase, the sources of potential impacts and the resulting impact (**in bold**), likely to have implications for sediments, are as follows:

— The presence and operation of new infrastructure, water use and management, transportation and traffic, and production and management of residual and hazardous materials.

These sources have the potential to result in the following impact during the operations phase:

Contamination or alteration of groundwater quality by:

— Infiltration of contact water under the new infrastructure;

— Accidental introduction of petroleum hydrocarbons, contaminants or hazardous materials;

— Infiltration of contaminants from use of melting agents in winter.

MITIGATION MEASURES

The same common mitigation measures recommended in the construction phase will be applied in the operations phase when work involving the same impact sources will be done. Moreover, to minimize the groundwater contamination risks, measures QUA14 and QUA15 concerning the use of dust suppressant and melting agents will be applied. Specific measure P26 will also be applied.

The monitoring program (NOR15) that will be implemented in the operations phase will ensure that the mitigation measures applied are effective and will rectify the situation, if necessary (Chapter 13).

DETAILED DESCRIPTION OF RESIDUAL IMPACT

RISK OF ALTERATION OF GROUNDWATER QUALITY BY WATER SEEPAGE UNDER THE NEW INFRASTRUCTURE

Waste rock stockpiles and tailings storage facilities

The waste rock stockpile and the tailings storage facility could be an impact source depending on the geochemical characteristics of the waste rock and tailings. Thus, during operations, runoff water will percolate through the waste rock stockpile and the tailings storage facility and could leach metals.

The waste rock coming from all the lithological units would be qualified as leachable (for certain metals) regarding D019. Certain lithologies would also have variable potential for acid generation. For tailings, the results of the analyses, when compared to the D019 criteria, indicate that all the tailings samples would have acid generation potential and would be leachable for certain metals (Appendix 3-1). Considering the nature of the waste rock and tailings, the development of the infrastructure provides for the implementation of appropriate protective measures.

There is little probability that water loaded with metals will reach the aquifers, given the mitigation measures that will be implemented. The presence of the lined membrane under the infrastructure and lined ditches in the waste rock stockpile and tailings storage facility would minimize the contamination risk. All the runoff water will be recovered via a system of lined peripheral ditches, which will prevent water seepage to the underlying aquifer.

To confirm the low impact of the presence of the infrastructure on groundwater quality, studies were conducted to assess the percolation flows under the waste rock stockpile and under the tailings storage facility (Appendix 6-7). The premise is that a low percolation flow measurement (from tailings or waste rock to the environment) considerably reduces the risk of impact on the human environment because the water will be captured before its seepage into the environment. The detailed results are presented in two distinct technical notes in Appendix 6-7. The summary of the results obtained is presented below.

The percolation flows under the waste rock stockpile and the tailings storage facility were assessed to ensure they comply with the standard set by D 019 (3.3 $l/m^2/d$). For this purpose, the existing calibrated 3D digital model was used for the waste rock stockpile sector and 2D sections were produced in SEEP/W for the tailings storage facility. A ditch on the periphery of the stockpile with a depth of 1 m was considered. For the tailings storage facility, a drain system at the base of the tailings was considered to maintain the lowest possible water table within the tailings. The following hydraulic conductivities were applied to the units:

— waste rock: 1×10^{-5} m/s;
— tailings: 2.5×10^{-7} m/s;
— membrane: 1×10^{-12} m/s.

The annual recharge values for each unit are as follows.

— 180 mm/year for waste rock;
— 60 mm/year for tailings;
— 114 mm/year for granular deposits;
— 18 mm/year for peat.

For the two sectors, in addition to the baseline scenario, several scenarios were tested to assess the impact of the permeability of the membrane and the recharge on the percolation flows. The permeability of the membrane was increased and the recharge doubled in a scenario allowing measurement of the sensitivity of the prediction.

The results show that, in all cases, the percolation flows are largely lower than 3.3 $l/m^2/d$. The following table (Table 6-38) presents the summary of the percolation flows obtained for the stockpile and the tailings storage facility. The detailed results are presented in the two technical notes prepared by WSP (Appendix 6-7).

Table 6-38 Summary of the results of the percolation flows under the infrastructure

Zone	Scenarios	Flow calculated under the area (L/d)	Area of the accumulation zone (m^2)	Daily percolation flow ($L/m^2/d$)
Waste rock stockpiles	Baseline scenario – Model 3D	6,900	241,890	0.03
	Sensitivity studies	9,400 to 152,000		0.04 to 0.6
Tailings storage facility	**Baseline scenario** – Sections 2D – 2 sections	N.A.	461,330*	0.02 and 0.01
	Sensitivity study	N.A.		0.12 and 0.06

*According to the November 2022 design data, N.A. Not applicable, given that these are 2D sections

Other storage areas and dewatering water

The runoff water of the overburden stockpiles will be captured and channelled to a retention pond where the particulate matter will be stabilized. The analyses produced on unconsolidated deposits showed that the material was non-acid generating and low risk. Thus, the water will be returned to the environment after treatment for TSS. No membrane is anticipated on the accumulation zone.

Finally, the dewatering water of the mine could be loaded with metals. There are few groundwater contamination risks related to dry maintenance activities. The water pumped from underground operations will undergo a first treatment to reduce the TSS, and then the water will be pumped and channelled to the main retention pond of the site (Map 3-1). The pumps will be electric and the response time in case of a hazardous product spill will be quick enough for the impacts associated with potential contamination to be considered nil.

RISK OF GROUNDWATER CONTAMINATION BY THE ACCIDENTAL INTRODUCTION OF PETROLEUM HYDROCARBONS, CONTAMINANTS OR HAZARDOUS MATERIALS

The description of the impact presented in the construction phase applies for the operations phase.

For the entire duration of operations of the tailings storage facility and the waste rock stockpiles, there will be a risk of accidental petroleum hydrocarbon spills related to the use of mobile equipment. Despite the implementation of prevention and control measures, the risk of an accidental spill will continue to exist during the various work and the operations of the mine site. As in the construction phase, the spills may be caused only by a breach of mobile equipment containing a limited quantity of petroleum products, and since the entire site is bounded by water management infrastructure, the dispersion of the products in the environment will be limited.

The operations phase will generate residual materials and hazardous products, which will be managed offsite. The residual materials will be stored temporarily according to the standards in force and access will be protected to avoid groundwater contamination.

Although it is projected that all the water on the mine site, both drainage water and contact water, will be channelled to a treatment plant where it will be treated according to the use and the projected destination and that, despite the preventive measures in place, accidental spills of untreated water could exceptionally occur. An accidental spill (e.g., breach of tailings and waste rock management infrastructure, treatment equipment failure) could also result in an accidental discharge of untreated contaminated water. The magnitude of these spills is difficult to quantify, because it will depend on the volume of water spilled and the water quality. In the short term, the groundwater quality could be affected if the potential contaminants reach the water table. Considering the exceptional nature of such an event, the details are discussed in the emergency preparedness plan to be able to limit the environmental impacts as quickly as possible. The information is presented in Chapter 12.

RISK OF GROUNDWATER CONTAMINATION BY SEEPAGE OF CONTAMINANTS FROM USE OF MELTING AGENTS IN WINTER

The description of this impact is the same as the one presented in the construction phase.

ASSESSMENT OF RESIDUAL IMPACT

As mentioned previously, the groundwater is used to supply drinking water to the exploration camp. One or more additional drinking water wells will also be provided for the drinking water supply of the mine site and the future camp. The ecosystem value of this component is considered medium because it is used to supply drinking water.

Given the fact that all the infrastructure at risk will be developed on lined membranes and that the runoff water will be covered via lined ditches, the degree of disturbance is considered low, which confers a potential impact of low intensity. Any mining operation, by its nature, could have a certain impact on groundwater quality. In the present case, the impact will have a specific spatial scope in the case of an accidental spill and seepage because it is circumscribed. The duration will be short (accidental spill) to long (if the water percolates under the tailings storage facility, the waste rock stockpiles and the ponds) and the probability of occurrence for these units is low. The significance of the residual impact is therefore very low for the risks of groundwater contamination by a spill and by seepage.

Impact on groundwater in the operations phase		
Nature	Negative	Significance: Very low
Ecosystem value	Medium	
Socioeconomic value	Not applicable	
Degree of disturbance	Low	
Intensity	Low	
Spatial scope	Specific (risk of accidental spill and seepage)	
Duration	Short (risk of accidental spill and seepage)	
Probability of occurrence	Low	

6.10.4 IMPACTS ON GROUNDWATER IN THE CLOSURE PHASE AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the closure phase, the impact sources and the resulting impact (**in bold**), likely to have implications for groundwater, are as follows:

- Final restoration, production and management of residual and hazardous materials

These sources have the potential to result in the following impact during the closure phase:

Contamination or alteration of groundwater quality by:

- accidental introduction of petroleum hydrocarbons, contaminants or hazardous materials;
- seepage of contact water under and on the periphery of the infrastructure.

MITIGATION MEASURES

No specific mitigation measure was considered during the closure phase

In the closure phase, the tailings storage facility and the waste rock stockpile will be restored, because progressive revegetation will be performed, when possible; otherwise, there will be complete restoration at the end of operations. Measure NOR-15 will always be in place. Groundwater quality will be monitored in accordance with D019 and the Soil Protection and Contaminated Sites Rehabilitation Policy of the MELCCFP. Groundwater monitoring will continue until there are no contamination risks.

DETAILED DESCRIPTION OF RESIDUAL IMPACT

During the restoration phase, the negative impacts related to the risks of groundwater contamination by an accidental spill of petroleum hydrocarbons and hazardous materials and spreading of melting agents in winter are anticipated on the same basis as in the construction period. Moreover, the impacts are similar to those of the operations phase regarding seepage of contact water from the waste rock stockpile and the tailings storage facility, given the fact that the infrastructure will remain in place despite the restoration of the site.

ASSESSMENT OF RESIDUAL IMPACT

The intensity of the impact is considered low, with a local spatial scope. The duration is long because water seepage through the tailings storage facility and the stockpiles, even if minimal, will still be present. Its probability of occurrence is considered low, given the level of protection at the sites (membranes). The significance of the residual impact is considered low.

In the closure phase, final restoration provides for revegetation of the tailings storage facility and the waste rock stockpile, dismantling of the mining infrastructure and rehabilitation of the soils if they exceed the criteria established for the restoration work. The removal of the potential soil contamination sources thus constitutes a positive impact with a local spatial scope and a long duration.

Impact on groundwater in the closure phase		
Nature	Negative/Positive	Significance: Infiltration - Low Restoration – Positive impact
Ecosystem value	Medium	
Socioeconomic value	Not applicable	
Degree of disturbance/Improvement	Low (seepage)	
Intensity	Low (seepage)	
Spatial scope	Local	
Duration	Long	
Probability of occurrence	Low (seepage)	

7 CURRENT CONDITIONS AND IMPACTS ON THE BIOLOGICAL ENVIRONMENT

7.1 VEGETATION AND WETLANDS

Highlights of the natural environment

Current conditions

The study area is located in ecological region 6C the Lake Opémisca Plain region (Blouin et Berger, 2004). The inventory carried out in the inventory area revealed that the vegetation present on the site is characteristic of this ecological region. As described in the Guide de reconnaissance des types écologiques (Guide to the recognition of ecological types) (Blouin et Berger, 2004), in addition to black spruce dominating the landscape, jack pine is present on drier sites, white birch is present primarily on south-facing hillsides in association with balsam fir, and trembling aspen colonizes sites with thin surface deposits.

The study area is also part of the Mistassini Highlands natural province, a hilly plateau whose southern boundary marks the transition between the James Bay and St. Lawrence watersheds (CERQ, 2021). The topography observed on the site corresponds well to the description of this territory, where the large plateaus covered with glaciolacustrine deposits are conducive to the creation of peatlands. A few hills and sand deposits are present in the study area, particularly in the area where the mining infrastructure is located, where peatlands are less common.

In the bioclimatic domain of the spruce-moss forest, the fire cycle is the main component of forest dynamics (MFFP, 2021). Forest fires have a major influence on the composition and structure of plant communities. The effects of these fires on the ecosystem depend on their frequency, extent, and severity (RNCan, 2020). However, the study area has been minimally affected by recent forest fires, while recent evidence of low intensity fires has been observed to the west, outside the study area.

In the study area, forestry activities are the main element that has influenced the development of vegetation groupings. Data from the ecoforestry map and photo-interpretation indicate that more than one third of the study area was logged between 1997 and 2000. These areas were cleared about 20 years ago and now host regenerating plant communities where the shrub layer, which can be fairly dense and tall depending on the area, is dominated by softwoods, namely jack pine (*Pinus banksiana*) and black spruce, sometimes in association with white birch (*Betula papyrifera*). Based on the photo-interpretation and field survey data, it can be concluded that there are no exceptional sites in the area of the study site.

Potential Project Impacts

During the construction phase, the main activities that could affect vegetation and wetlands are loss of area, disturbance of plant associations, and accidental introduction of petroleum hydrocarbons and hazardous materials. The degree of disturbance is considered low to medium. The impact will be felt over a short (spill) to long duration (loss of area). The spatial scope of the impacts is judged to be specific (spill) to local (loss of area) and its intensity is judged to be low. The significance of the impacts is considered to be very low in terrestrial environments and low in wetlands.

During the operations phase, the main activities that could affect vegetation and wetlands are disturbance of plant associations and spills or contamination. The degree of disturbance is considered low. The probability of occurrence is low. The duration of the impact is considered to be short. The spatial scope of the impacts is judged to be specific and the intensity low. The significance of impacts to terrestrial and wetland areas during the operations phase is considered to be very low.

In the closure phase, the main activity that could have an impact on vegetation and wetlands is the increase in vegetated area and wetlands. The impact will be positive in nature, unlike that of the first two phases. However, during the closure work, there is still a risk of spills, the intensity of which is perceived as low. The spatial scope of these impacts will be specific and their duration is thought to be short. Finally, the probability of occurrence will be low for spills and the residual impact will be very low.

7.1.1 CURRENT CONDITIONS

Vegetation and wetlands were described at the level of the local biophysical study area, covering an area of 2,500 ha. The detailed information that was used to assess the project's impacts on this component is presented in the sectorial report in Appendix 7-1.

The project is located in the southern part of the boreal spruce-moss forest, only 38 km north of the balsam fir-white birch forest boundary. The landscapes of the spruce-moss bioclimatic domain are rather uniform since the forest cover is clearly dominated by black spruce while the shrub layer is largely represented by species of the Ericaceae family (MFFP, 2021).

The regional study area is located in Ecological Region 6C, the Lac Opémisca Plain region (Blouin et Berger, 2004) (Map 7-1). The inventory carried out in the inventory area revealed that the vegetation present on the site is characteristic of this ecological region. As described in the Guide de reconnaissance des types écologiques (Guide to the recognition of ecological types) (Blouin et Berger, 2004), in addition to black spruce dominating the landscape, jack pine is present on drier sites, white birch is present primarily on south-facing hillsides in association with balsam fir, and trembling aspen colonizes sites with thin surface deposits. No protected areas or other conservation areas (exceptional forest ecosystems, biological refuges, etc.) are present in the local biophysical study area (Map 7-1).

7.1.1.1 VEGETATION COMMUNITY

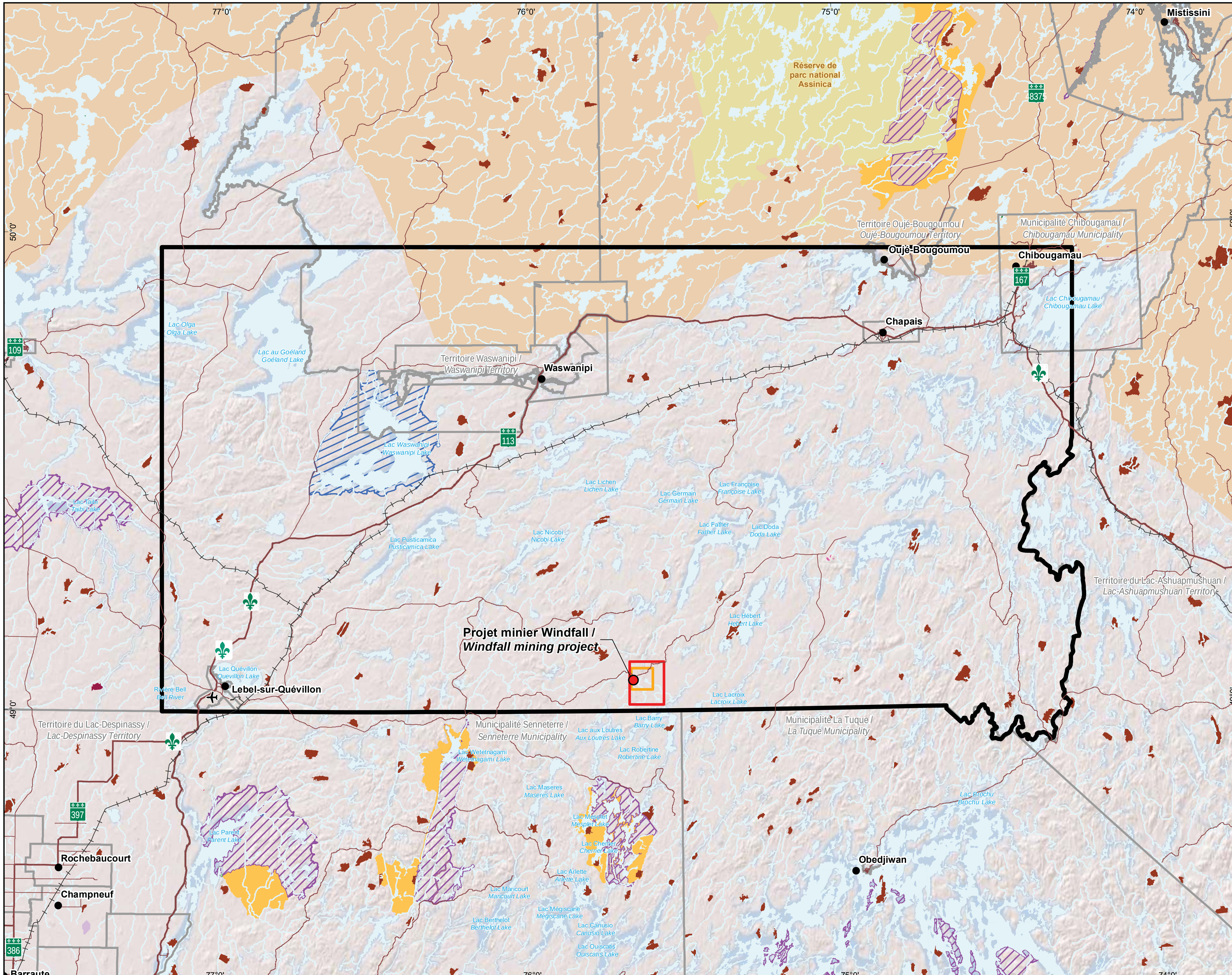
As a result of the 2019 and 2021 field outings and photo-interpretation, fifteen (15) vegetation communities were identified and mapped in the study area (Table 7-1; Appendix 7-1). Terrestrial environments and wetlands account for 37.20% and 44.88% of the study area, respectively (Map 7-2). The main forested terrestrial environment types in the study area are, in ascending order of area, hardwood, mixedwood, regeneration and plantation, and softwood.

Water environments (lakes) cover 306.28 ha, or 12.25% of the study area. The study area also includes anthropogenic environments (141.67 ha, or 5.67%), mainly existing facilities associated with advanced exploration activities.

Table 7-1 Area and proportion of study area covered

Natural environment class	Area of the class (ha)	Proportion of study area (%)
Terrestrial environments		
Hardwoods		
Unspecified hardwoods	1.44	0.06%
Birch stands	42.66	1.71%
Subtotal for the hardwood environment	**44.11**	**1.76%**
Mixedwoods		
Unspecified softwoods with non-commercial hardwoods	0.02	0.00%
Plantation of softwoods and unspecified hardwoods	0.68	0.03%
Black spruce-birch stands	1.23	0.05%
Non-commercial hardwoods and unspecified hardwoods with unspecified softwoods	1.91	0.08%
Unspecified mixedwoods	25.63	1.03%
Balsam fir-white birch stands	37.08	1.48%
Subtotal for the mixedwood environment	**66.54**	**2.66%**
Regeneration and plantation		
Burnt-over areas	0.68	0.03%
Deforestation	1.18	0.05%
Plantation of softwoods and unspecified hardwoods	3.49	0.14%
Mixed shrubland regeneration	8.16	0.33%
Unspecified regeneration	101.87	4.07%
Coniferous shrubland regeneration	348.39	13.94%
Subtotal of the regeneration and plantation environment	**463.76**	**18.55%**
Softwoods		
Jack pine stand	0.45	0.02%
Black spruce-sphagnum stands	5.18	0.21%
Black spruce-lichen stands	6.71	0.27%
Unspecified softwoods	39.38	1.58%
Unspecified black spruce stands	56.71	2.27%
Black spruce-moss stands	247.19	9.89%
Subtotal for the softwoods environment	**355.61**	**14.22%**
Subtotal for the terrestrial environments	**933.20**	**37.20%**
Wetlands		
Marshes	0.03	0.00%
Shallow water	0.06	0.00%
Wooded fens	13.00	0.52%
Tree swamp	26.89	1.08%
Shrub swamp	73.64	2.95%
Open bogs (fens)	118.45	4.74%
Wooded ombrotrophic bog	237.71	9.51%
Open ombrotrophic bog	652.27	26.09%
Wetlands subtotal	**1,122.04**	**44.88%**

Natural environment class	Area of the class (ha)	Proportion of study area (%)
Water environments (water bodies)		
Subtotal for water environments	**306.28**	**12.25%**
Anthropogenic environments		
Subtotal for anthropogenic environments	**141.67**	**5.67%**
Total	**2,500**	**100%**



Limite administrative / *Administrative boundary*

Projet / *Project*

Zone d'étude régionale / *Regional study area*

Zone d'étude locale du milieu biophysique / *Biophysical local study area*

Zone d'étude locale du milieu humain / *Human local study area*

Aires protégées / *Protected Areas* (MELCCFP,

Habitat faunique / *Fauna Habitat*

Aire de concentration d'oiseaux aquatiques / *Aquatic bird concentration area*

Habitat du rat musqué / *Common muskrat habitat*

Héronnière (aire de nidification et bande de protection 0-200 m) / *Heronry (nesting area and 0-200 m protection area)*

Écosystème forestier exceptionnel / *Outstanding Forest Ecosystem*

Forêt ancienne / *Old-growth forest*

Forêt rare / *Rare forest*

Forêt refuge / *Refuge forest*

Réserve de biodiversité / *Biolopgical Reserve*

Réserve de biodiversité projetée / *Projected biological reserve*

Autre désignation / *Other Designation*

Réserve de parc national du Québec / *Quebec national parc reserve*

Réserve de territoire aux fins d'aire protégée / *Protected area territory reserve*

Refuge biologique / *Biological refuge*

Réserve aquatique projetée / *Projected aquatic*

Aire d'application des Plans de rétablissement du caribou forestier au Québec / *Application area of the forest caribou recovery plans in Quebec* (MFFP, sept. 2021)

OSISKO
MINIÈRE OSISKO

Projet minier Windfall - Étude d'impact sur l'environnement / *Windfall Mining Project - Environmental Impact Assessment*

Site minier Windfall, Eeyou Istchee Baie-James (Québec) / *Windfall Mining Site, Eeyou Istchee Baie-James (Quebec)*

Carte 7-1 / *Map 7-1*

Aires protégées et aire d'application des plans de rétablissement du caribou / *Protected Areas and Application Area of the Caribou Recovery Plans*

Sources / Sources:
CanVec+, 1/50 000, RN Can, 2014
SDA, 1/20 000, MERN Québec, 2020
BDTA, 1/250 000, MRN Québec, 2002
BDGA, 1/5 000 000, MRN Québec, 2012

0 9 18 km

MTM, Fuseau 9 / *Zone 9*, NAD83

2023-03-14

Préparée par / Preparation : M.-H. Brisson
Dessinée par / Drawing : J. Roy
Vérifiée par / Verification : M.-H. Brisson
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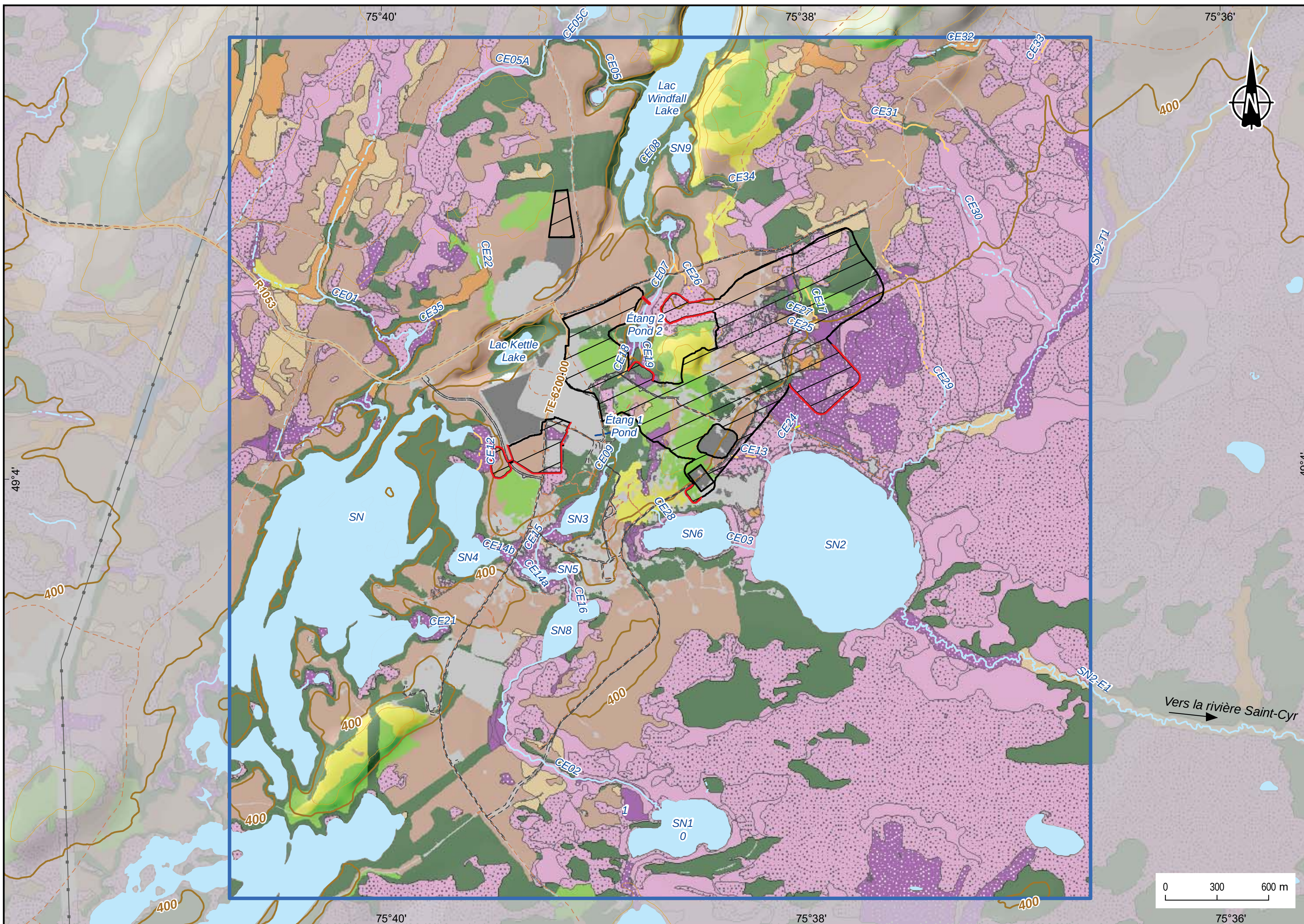

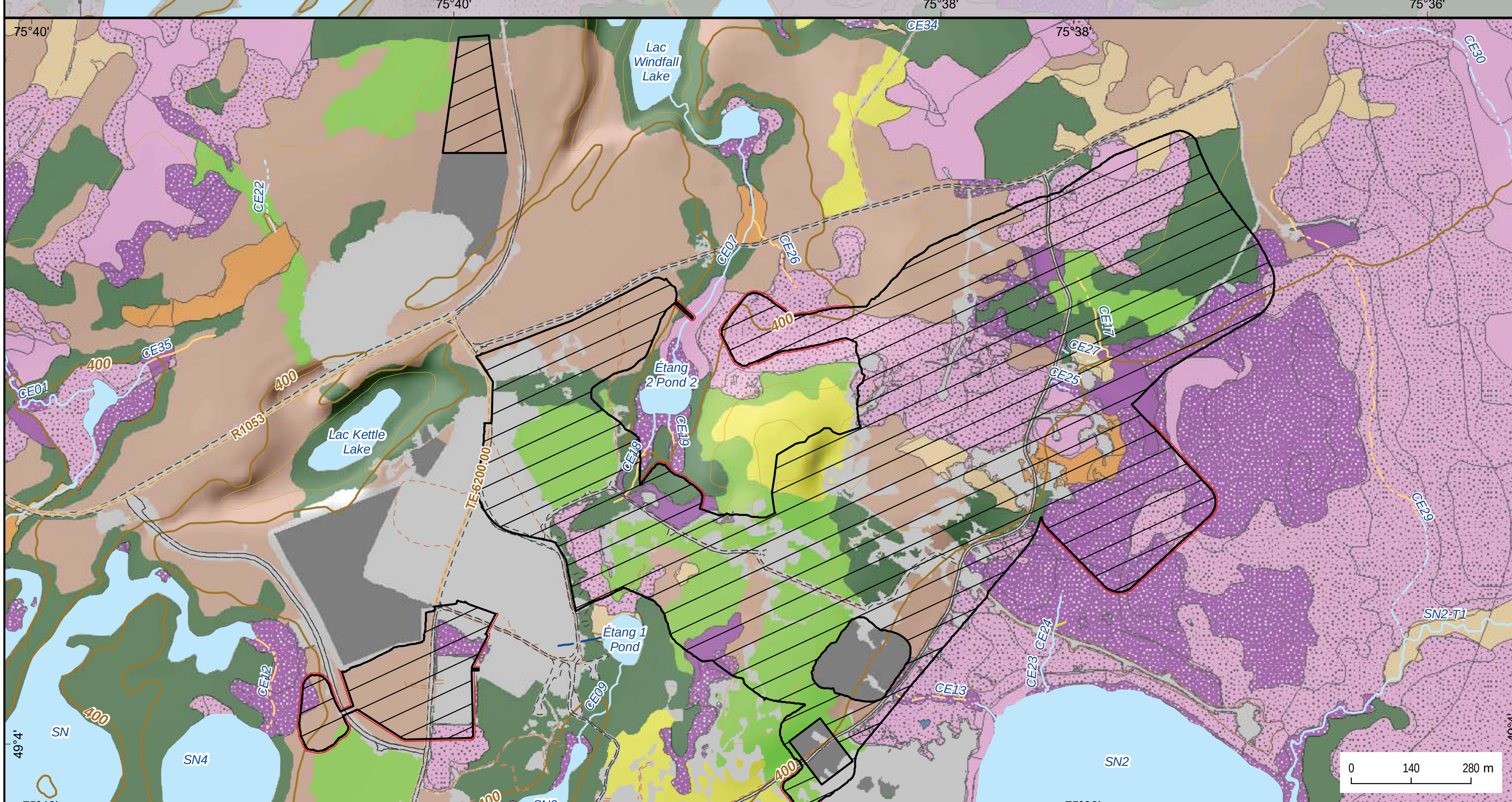

Zone d'étude locale du milieu biophysique/ *Biophysical environment local study area*

Hydrographie / *Hydrography*

- Cours d'eau permanent / *Permanent watercourse*
- Cours d'eau permanent partiellement souterrain / *Partially undeground permanent watercourse*
- Cours d'eau intermittent / *Intermittent watercourse*
- Cours d'eau intermittent partiellement souterrain / *Partially underground intermittent watercourse*
- Cours d'eau souterrain / *Underground watercourse*
- Fossé de drainage / *Drainage ditch*
- Canal / *Canal*
- Plan d'eau / *Waterbody*

Infrastructure / *Infrastructure*

- Ligne de transport d'énergie électrique / *Electric power line*
- Route forestière / *Forest road*
- Chemin de gravier (mine) / *Gravel road (mine)*
- Route d'accès / *Access road*

Empiètement du projet / *Project Encroachment*

- Empiètement permanent / *Permanent encroachment*
- Empiètement temporaire / *Temporary encroachment*

Caractérisation du milieu naturel / *Natural Environment Characterization*

Milieux humide et hydrique / *Wetlands and Hydrous Environment*

- Marais / *Marsh*
- Marécage arborescent / *Forested swamp*
- Marécage arbustif / *Shrubby swamp*
- Tourbière ombrotrophe boisée / *Forested bog*
- Tourbière ombrotrophe ouverte / *Open bog*
- Tourbière minérotrophe boisée / *Forested fen*
- Tourbière minérotrophe ouverte / *Open fen*
- Eau peu profonde / *Shallow water*

Milieu forestier / *Forest Environment*

- Feuillu / *Deciduous*
- Mixte / *Mixed-wood*
- Résineux / *Softwood*
- Régénération forestière et plantation / *Forest regeneration and plantation*

Autres milieux / *Other Environments*

- Anthropique / *Anthropogenic*
- Anthropique autorisé lors de l'échantillonnage en vrac / *Anthropogenic authorized for bulk sampling*

OSISKO
MINIÈRE OSISKO

Projet minier Windfall - Étude d'impact sur l'environnement / *Windfall Mining Project - Environmental Impact Assessment*

Site minier Windfall, Eeyou Istchee Baie-James (Québec) / *Windfall Mining Site, Eeyou Istchee Baie-James (Quebec)*

Carte 7-2 / *Map 7-2*
Composantes du milieu biologique - Végétation / *Biological Environment Components - Vegetation*

Sources :
CanVec+, 1/50 000, RNCan, 2014
MERN, AQréseau+, réseau routier, 2020

MTM, Fuseau 9 / *Zone 9*, NAD83

2023-03-23

Préparée par / *Preparation* : É. D'Astous
Dessinée par / *Drawing* : C. Villeneuve
Vérifiée par / *Verification* : M.-H. Brisson

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7.1.1.2 TERRESTRIAL ENVIRONMENTS

Of the terrestrial environments, the regeneration and plantation area covers the largest portion of the study area (463.76 ha, or 18.55%). Among the terrestrial environments, two early successional groupings (coniferous shrubland and mixed shrubland regeneration) stand out in the study area (450.26 ha or 18.01%). These two groupings are mainly associated with forestry activities, since the sectors that were logged in the late 1990s are now dominated by a shrubby regeneration of black spruce and jack pine, sometimes in association with white birch. In the near future, Barette-Chapais plans to cut close to the Windfall mine site and to the south of it. These cuts will cover a total area of approximately 3,810 ha. Four other types of regeneration and plantation groupings are present on the site: burnt-over areas (0.68 ha or 0.03%), cleared areas (1.18 ha or 0.05%), softwood and unspecified hardwood plantations (3.49 ha or 0.14%), and mixed shrubland regeneration (8.16 ha or 0.33%).

In the shrub layer, in addition to Labrador tea, which is present throughout the study area, a few other species of the Ericaceae family have been observed, notably lowbush blueberry (*Vaccinium angustifolium*), velvetleaf blueberry (*Vaccinium myrtilloides*) and sheep-laurel (*Kalmia angustifolia*), confirming the more xeric water regime of these groups. Among the herbaceous species present in these groupings, bunchberry (*Cornus canadensis*) and wild lily-of-the-valley (*Maianthemum canadense)* are the main species observed. The soil in these groupings is usually characterized by a thin horizon of organic matter on the surface and a horizon of sand or sandy loam. The bedrock has been observed in these groupings.

The various softwood stands form the second most observed terrestrial environment in the study area. The most observed grouping is black spruce-moss stands (247.19 ha, 9.89%). This grouping is often present at the edge of early successional groupings that have been subject to forest cutting. In these situations, they represent portions of territory that have been spared from forest cutting, where the tree layer is composed mainly of black spruce in occasional association with white birch or jack pine. These stands are found on gently to moderately sloping land around watercourses, lakes, or bogs. Black spruce-moss soils are typically characterized by a thin layer of organic matter on the surface over a sandy or sandy loam horizon with bedrock sometimes reached at a depth of less than 30 cm. The dominant species in the shrub and herbaceous strata of the black spruce-moss stand are the same as those found in the regenerating shrubland communities, namely Labrador tea, lowbush blueberry, velvetleaf blueberry, and sheep-laurel, as well as bunchberry and wild lily-of-the-valley. Among the companion species, a greater diversity of species in these two strata of black spruce-moss stands is observed compared to what is present in the regenerating groups. Within the study area, a black spruce-lichen stand was also identified covering an area of 6.71 ha (0.27%). This grouping is distinguished from the black spruce-moss stands by a less dense tree cover and by the presence of a moss cover dominated by lichens. Their plant composition in the tree, shrub, and herbaceous strata is similar to what is observed in the black spruce-moss stands, confirming the more xeric water regime of these groups. Likewise, the soil is similar to what is noted in the black spruce-moss stands, with an organic matter horizon of less than 30 cm on the surface over a layer of sand or sandy loam.

Within the mixedwoods environment, unspecified mixedwoods (25.63 ha or 1.03%) are dominated by balsam fir (*Abies balsamea*), white birch, black spruce, and a few species of the Ericaceae family. The herbaceous stratum supports plant communities similar to those observed in the early successional groups (coniferous shrubland regeneration and unspecified regeneration) previously described. In terms of soil, the organic matter horizon is less than 30 cm thick and the soil in these groupings is primarily sand. White birch-balsam fir stands were identified in the study area (37.08 ha or 1.48%). This type of stand is dominated by balsam fir and white birch in the tree layer. The herbaceous and shrub cover of these stands is more diverse than the other stands found on the site. In total, the various mixedwood stands cover a total area of 66.54 ha (2.66%). Less dominant and uncharacterized stands on the site are unspecified softwood with non-commercial hardwoods (0.02 ha or 0.00%), softwood plantation with unspecified hardwoods (0.68 ha or 0.03%), black spruce-birch (1.23 ha or 0.05%), and non-commercial hardwood and unspecified hardwood with unspecified softwoods (1.91 ha or 0.08%).

Within the hardwood forest environment, white birch-dominated groupings are scattered throughout the study area (42.66 ha or 1.71%). The white birch stands are similar to the mixedwood stands in many respects such as soil type and shrub and herbaceous species present. The other hardwood stand contains unspecified hardwoods over an area of 1.44 ha, or 0.06%.

7.1.1.3 WETLANDS

In the study area, wetlands represent 1,122.04 ha, or 44.88%. According to a conservative assessment of wetland area in the territory, 18.2% of the territory of the Mistassini Highlands Natural Province is covered by wetlands (Pellerin et Poulin, 2013). Based on this comparison, the study area would have a greater proportion of wetlands than on the regional scale. In the study area, wetlands are composed of eight types of groupings.

Of all wetland vegetation groupings, open and wooded ombrotrophic bogs predominate. In fact, these two types of plant groupings represent 79.32% of the wetlands in the study area (889.98 ha out of 1,122.04 ha).

There is one main cluster throughout the distribution of wetlands in the study area. This cluster, primarily composed of open and wooded ombrotrophic bogs and open fens, covers 784.09 ha, which represents 69.85% of the total area covered by wetlands in the study area. Within this area, the continuity between the various peatland types creates large wetland complexes where open and wooded ombrotrophic bogs and fens intersect.

Although most open bogs are not very diverse and are dominated by species of the Ericaceae family, most of those located along streams have a greater diversity of herbaceous and shrubby species. These more diverse riparian bogs are fens, which are distinguished from ombrotrophic bogs based on their water source. Ombrotrophic bogs are wetlands fed mainly by water from precipitation (rain and snow), while fens are also fed by circulating water (groundwater and runoff) that has been enriched with minerals through contact with the soils of adjacent habitats (Leboeuf et coll., 2012). This means that ombrotrophic bogs are more acidic and nutrient poor than fens, which influences vegetation composition and diversity.

Fens therefore show of a greater specific richness. In addition to tamarack (*Larix laricina*) and species of the Ericaceae family typical of fens, speckled alder (*Alnus incana subsp. rugosa*), pear-leaved willow (*Salix pyrifolia*), and bog myrtle (*Myrica gale*) are mainly observed in the shrub layer of these fens. As for the herbaceous stratum, it is dominated by Cyperaceae which are represented by several species of sedges (*Carex canescens, Carex trisperma, Carex oligosperma, Carex aquatilis* var. *aquatilis, Carex magellanica* subsp. *irrigua, Carex pauciflora, Carex echinata, Carex utriculata, Carex lasiocarpa* subsp. *americana)*, fowl manna-grass (*Glyceria striata*), dwarf raspberry (*Rubus pubescens),* three-leaved Solomon's seal (*Maianthemum trifolium*), bluejoint reedgrass (*Calamagrostis canadensis*) and cottongrasses (*Eriophorum vaginatum* var. *spissum, Eriophorum virginicum*), notamment. Fens have a particularly rich flora (Grondin et coll., 2005).

Wooded ombrotrophic bogs (237.71 ha or 9.51%) and wooded fens (13.00 ha or 0.52%) in the study area are distinguished primarily by the presence of greater than 25% tree cover. In both types of groupings, black spruce, tamarack, and common species of the Ericaceae family largely dominate the vegetation present.

Common species of the Ericaceae family include Labrador tea and leatherleaf, sheep-laurel and lowbush blueberry, while three-leaved Solomon's seal, bunchberry and cloudberry (*Rubus chamaemorus*), and sedges are the main species observed in the herbaceous layer.

Furthermore, marshes, shrub swamps, and tree swamps cover only 0.03 ha (0.00%), 73.64 ha (2.95%), and 26.89 ha (1.08%) respectively in the study area. The vegetation present in these groupings is similar to that found in wooded ombrotrophic bogs. The thickness of organic matter (<30 cm) on the surface is the main element differentiating them from peatlands.

Beavers normally have some regional impact given the large areas of flat land that can be flooded by their activities. Some shallow waters are present in the study area (0.06 ha or 0.00%). Their representativeness is therefore rather limited in the study area.

In the study area, ombrotrophic bogs occupy a significant portion of the territory. The inventories confirmed that these environments have the typical characteristics of wetlands and peatlands found throughout the James Bay territory (Payette et Rochefort, 2001).

All of the inventory plots surveyed in the study area's ombrotrophic bogs or fens (open or wooded) revealed a poorly drained deposit of organic matter ranging in thickness from 30 cm to over 100 cm at the surface. This distinctive character of peatlands reflects the process by which the accumulation of plant debris prevails over the decomposition process. In the boreal zones of Quebec, the relatively abundant precipitation and the short growing season are favourable to the accumulation of peat and the formation of peatlands (Leboeuf et coll., 2012), which explains in part their ubiquity in the study area. In contrast, the shrub swamps within the study area had a layer of 0 cm-25 cm of organic matter on the surface over a mineral horizon ranging from sand to sandy loam.

7.1.1.4 PLANT SPECIES OF SPECIAL STATUS

In general, the forests of the James Bay region and northeastern Abitibi-Témiscamingue are unlikely to harbour threatened or vulnerable species or species likely to be so designated (EMVS). In fact, these vast areas of coniferous boreal forest are generally homogeneous in their plant assemblages, which makes them less diverse. The area is generally characterized by a relative scarcity of noteworthy plant species and a low presence of vascular species of status. The field inventories have confirmed this since no EMVS were observed in the inventory area out of the 391 inventory stations surveyed (90 plots in 2016; 68 plots in 2017, and 233 plots in 2021). These results tend to show that the inventory area includes few habitats likely to support species with protected status and that most groupings (wetland and terrestrial) have a low potential for the occurrence of EMVS.

The Centre de Données sur le Patrimoine Naturel du Québec (CDPQN, 2023) confirms this low potential since the species groups or ecological types most likely to support species of status communities are very scarce, if not absent, in the inventory area (e.g., Eastern white cedar stands; cedar swamps-balsam fir). Frequent environmental disturbances such as logging, logging roads, and drilling (locally high intensity) have also impacted the plant communities in the restricted inventory area in recent years. These disturbances reduce the potential for the restricted inventory area to support plant species with legally protected status. It should be mentioned, however, that some specific habitat types, most often associated with the presence of patches of alkaline (calcareous) soils, may support more diverse plant assemblages where the concentration of plants of interest is greater. These habitats are not always inventoried or known, depending on the geographical data available, and special attention was therefore paid in the field to detect their presence. The significant presence of indicator plant species (from richer stations or more alkaline soil) was therefore used in the field to detect the presence of these habitats. However, none of these habitats were identified in the field.

Although no EMVS were observed in riparian habitats, the potential for species of special status to occur is greater in these groupings since they are more diverse. Considering the habitats present in the study area, the potential for the presence of EMVS was evaluated for each species whose presence was initially suspected (Table 7-2).

Of the eight species that may be present in the study area, two species have a potential that is considered to be moderate, namely, purple meadow-rue (*Thalictrum dasycarpum*) and McCall willow (*Salix maccalliana*). These species have a higher potential of occurrence throughout the surveyed area due to the presence of suitable habitats. However, they were not observed during the various inventory campaigns.

All the other species (6) have a low potential of occurrence since the existing habitats only partially correspond to their ecological requirements. Furthermore, several of these species occupy very specific habitats or their known occurrences are located in specific areas of the Nord-du-Québec administrative region.

Table 7-2 List of species of special status potentially present in the study area with their priority rank and preferred habitat

Scientific name	English name	Status[1]	Status rank[2]	Habitat	Potential of occurrence
Canadanthus modestus	Modest aster	LDTV	G5/N5/S2	Open wetlands (sandy shores, wet meadows, marshes). Sometimes in terrestrial environments such as urban areas, ditches, fallow fields, and the edges of farm roads.	Low
Calypso bulbosa var. *americana*	Fairy slipper	LDTV	G5T5/N5/S3	Pure cedar stands, cedar-larch swamps, fir stands, clayey rocky shores, fens, always in calcareous environments.	Low
Corallorhiza striata var. *striata*	Striated coral-root	LDTV	G5T5/N5/S2	Coniferous or mixedwood forests and cedar swamps. Mesic or basic substratum in shaded environments.	Low
Elatine ojibwayensis	Ojibway waterwort	LDTV	G1/N1/S1	Banks of rivers or streams, marshes. Generally in shallow water.	Low
Eleocharis mamillata subsp. *mamillata*	Soft-stemmed spikerush	LDTV	G5T5/N5/S1S2	Wetlands of various types. Banks of lakes, shallow ponds, streams, floating mats, bogs, fens, ditches.	Low
Erythranthe glabrata	Roundleaf monkeyflower	TH	G5/N2/S2	Palustrine environments such as swamps and wet meadows. Generally on wet sandy soil and fed by cold spring water. No affinity for pH.	Low
Thalictrum dasycarpum	Purple meadow-rue	LDTV	G5/NNR/S2	Shores of fens, clearings, and wet meadows. Sometimes colonizes terrestrial wildlands.	Moderate
Salix maccalliana	McCall willow	LDTV	G5/N5/S3	Rocky and gravelly shores, swamps, wooded fens. Heliophilic plant.	Moderate

1 Status of the species in Quebec: LDTV: likely to be designated threatened or vulnerable; V: Vulnerable; TH: threatened. TH*: only the three occurrences south of Region 09 are threatened.

2 NatureServe species conservation status rank is a combination of letters indicating the scale and numbers denoting the status rank: G: global rank; N: national rank; S: subnational rank; T: subspecies or variety rank; NNR: national or subnational unranked; 1: at very high risk; 2: at risk; 3: at moderate risk; 4: apparently not at risk; 5: not at risk.

7.1.1.5 INVASIVE ALIEN SPECIES

Invasive alien species (IAS) are plants that have been introduced outside their natural range and may pose a threat to the environment and biodiversity. Because of their ability to disperse and grow rapidly, these species have competitive advantages over native species, allowing them to become dominant in the plant community of a given environment or even to locally eliminate some uncompetitive native species.

For IAS in Quebec, the Landry document (Landry, 2013) and the MELCC online invasive alien species detection tool (Gouvernement du Québec, 2021) were consulted. Special attention was then given to species considered as priorities or those requiring monitoring in Quebec.

The IAS-specific inventories were conducted simultaneously with the general plant group inventories. The search for species was carried out visually over the entire study area and, where applicable, IAS colonies were delimited and photographed in the field. Particular attention was paid to environments particularly favourable to IAS, such as roadsides, logging roads, anthropogenic environments, disturbed areas, and areas near these environments. During the inventories, no IAS were observed in the area.

7.1.1.6 VASCULAR PLANTS HAVING TRADITIONAL USES

During the plant inventory, particular attention was paid to the presence of plants of interest to the Cree. The documents consulted (Uprety et coll., 2012) list 546 species or groups of species potentially used for medicinal purposes by First Nations peoples throughout Canada.

In total, 36 of the plants observed in the field are used by the Cree. These include eight tree species, 21 shrub species, six herbaceous species, and one invascular moss species (Table 7-3).

Generally speaking, species of medicinal interest observed in the field are common in the study area and in this part of Quebec.

Table 7-3 Vascular and invascular plants with traditional Cree uses observed in the study area

Scientific name	French name	English name	Cree name	Parts used
Trees				
Betula papyrifera	Bouleau à papier	Paper birch	Htik, owkimawa, waskway, waskwah, waskwaha, wasgwah, waskwayahtik, wuskwi-atik	Twigs, buds, stems, leaves, roots, bark, wood, sap
Larix laricina	Mélèze laricin	Tamarack	Waachinaakan	Inner bark
Picea glauca	Épinette blanche	White spruce	Si, minahik, minuhik, eyinatik, wapiskimnahik	Leaves, twigs, inner bark, sap, gum, rotten wood, green wood
Picea mariana	Épinette noire	Black spruce	Inaatuk	Cones
Pinus banksiana	Pin gris	Jack pine	Ushichishk	Cones and inner bark
Populus balsamifera	Peuplier baumier	Balsam poplar	Mathamitos, maymiytos, mayi-mitos, mayi metos, metos	Twigs, buds, stems, leaves, bark, sap
Populus tremuloides	Peuplier faux-tremble	Trembling aspen	Mitos, mitosinipiah	Inner bark
Prunus pensylvanica	Cerisier de Pennsylvanie	Pine cherry	Pasuwiymayatik, pasisawimin, pusawemina	Bark and roots
Shrubs				
Alnus alnobetula subsp. *crispa*	Aulne crispé	Green alder	Mathato	Leaves
Alnus incana subsp. *rugosa*	Aulne rugueux	Mountain alder	Utuspii	Bark
Andromeda polifolia var. *latifolia*	Andromède glauque	Glaucous-leaved bog rosemary	Kakouboushk	Twigs
Cornus sericea	Cornouiller hart-rouge	Red-osier dogwood	Unknown	Bark, fruit, pith, and roots
Diervilla lonicera	Dièreville chèvrefeuille	Northern bush-honeysuckle	Maskocipihk	Stems and roots
Empetrum nigrum subsp. *nigrum*	Camarine noire	Crowberry	Askiminasiht, ebshjimend	Fruit
Gaultheria hispidula	Petit thé	Creeping snowberry	Unknown	Leaves and fruit
Ilex mucronata	Némopanthe mucroné	Mountain holly	Unknown	Leaves
Juniperus communis var. *depressa*	Genévrier commun déprimé	Juniper	Kaahkaachiiminaahtikw	Roots
Juniperus communis var. *megistocarpa*	Genévrier commun	Juniper	Kaahkaachiiminaahtikw	Roots
Juniperus horizontalis	Genévrier horizontal	Creeping juniper	Ahaseminanatik, masekesh, masikeskatik	Twigs and fruit
Kalmia angustifolia	Kalmia à feuilles étroites	Sheep laurel	Uschipikwh	Leaves
Ribes glandulosum	Gadellier glanduleux	Skunk currant	Mithicimin	Stems
Rhododendron groenlandicum	Thé du Labrador	Labrador tea	Kachebuk	Leaves
Rubus idaeus	Framboisier sauvage	Raspberry	Athoskan, athoskunatikwah, ayosikan, uyooskan, ayuwskun, ayooskunak, anosh'kanek	Stems, roots and fruit
Salix bebbiana	Saule de Bebb	Willow	Nipisigibi, nipisiah, nipisi, nipisis, atikwupamuk, wekope, nepiseatik, nepise, nipistakwah	Twigs, stems, and inner bark
Salix planifolia	Saule à feuilles planes	Tea-leaved willow	Waskayabaduk	Bark
Salix sp.	Saules	Willow	Utusphi	Inner bark
Sorbus americana	Sorbier d'Amérique	American mountain-ash	Esniywachiywa, maskominanatik	Bark and roots
Vaccinium myrtilloides	Bleuet	Blueberry	Sipikomin, ithinimina, iynimin, iyinimin, inimena	Stems, roots and fruit
Viburnum edule	Pimbina	Low bush-cranberry	Moosomina, mosomina, moosominahtik, mosomina	Twigs, buds, stems, and leaves
Herbaceous plants				
Aralia nudicaulis	Aralie à tige nue	Wild sarsaparilla	Waposogibi, waposocipihk, waposocepihk	Roots and rhizomes
Equisetum sylvaticum	Prêle des bois	Horsetail	Mistatimosoy, okotawask, enskowusk, kiychiwiykusk	The whole plant
Geocaulon lividum	Comandre livide	Northern comandra	Unknown	Fruit
Maianthemum canadense subsp. *canadense*	Maïanthème du Canada	Wild lily-of-the-valley	Sosowipukosak, soskopukwagoh	Leaves
Nuphar variegata	Grand nénuphar jaune	Yellow pond lily	Waskitipak, oskitipak, waskutamo, waskatamo, waskatamow, oskotamo, pwakumosikum	The whole plant
Sarracenia purpurea	Sarracénie pourpre	Pitcher plant	Ayigadash	The whole plant
Mosses				
Sphagnum fuscum	Sphaigne brune	Peat moss	Uske, muskak, askiyah, mikaskwahkawow, asaskumkwa, eskiya, awasistche	The whole plant

7.1.2 IMPACTS ON VEGETATION AND WETLANDS DURING THE CONSTRUCTION PHASE AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the construction phase, the potential sources of impacts and resulting impacts **(in bold)** that may affect vegetation and wetlands are as follows:

— Organization of the site, stripping and clearing, surface preparation and access arrangement, construction of works and infrastructure, transportation and traffic, production and management of residual and hazardous materials.

These sources have the potential to produce the following impacts during the construction phase:

Loss of vegetated area and disruption of plant associations in terrestrial and wetland areas by:

— surface preparation and access arrangement through stripping and clearing of terrestrial and wetland areas;
— the possibility of bringing in or transporting out seeds or any part of an invasive alien species that could lead to the establishment of a new colony; even if no IAS were observed during the inventories, this does not exclude the possibility of their introduction;
— encroachment of works and mobile equipment for the infrastructure in terrestrial and wetland environments.

Contamination of terrestrial and wetland environments by:

— the use of abrasives in winter or chemical dust suppressants on soils;
— accidental introduction of petroleum hydrocarbons, contaminants, or hazardous materials into natural and wetland environments that will contaminate vegetation, soils, and the water regime.

MITIGATION MEASURES

Common mitigation measures QUA01, QUA17, VEG01 through VEG04, and PLA01 will be applied to limit the area of disturbance or destruction of natural terrestrial and wetland habitat. Common mitigation measures QUA17, QUA18, and QUA22 to QUA26 will be applied to minimize the risks associated with spills or contamination of the natural environment. Specific measure P26 will also be implemented.

RESIDUAL IMPACT DESCRIPTION

The residual impact assessment does not take into account the revegetation of large areas occupied by infrastructure once mining operations cease. This includes waste rock and tailings accumulation areas. Revegetation will result in the establishment of a visually acceptable and viable vegetative cover that does not pose a risk to human health and safety and that is in a condition compatible with future uses.

LOSS OF VEGETATED AREA AND DISRUPTION OF PLANT COMMUNITIES IN TERRESTRIAL AND WETLAND AREAS

In the construction phase, the footprint of planned activities is 136.47 ha (5.46%). Of these footprints, 134.81 ha (5.39%) are permanent and 1.66 ha (0.07%) are temporary. Of these, 113.77 ha are occupied by natural vegetation and 22.69 ha by existing infrastructure (Table 7-4; Map 7-2).

Losses of terrestrial environments, more specifically in the hardwood stands, will have a permanent impact only on a 1.88 ha area of birch stands.

Of the various mixed stands, non-commercial hardwood and unspecified hardwood with unspecified softwood are permanently impacted on 1.91 ha, balsam fir-white birch stands are permanently impacted on 9.35 ha and temporarily on 0.07 ha, and the unspecified mixed woodland is permanently impacted on 9.23 ha and temporarily on 0.04 ha.

In the regeneration and plantation environments, mixed shrubland regeneration is permanently affected on 1.15 ha, while coniferous shrubland regeneration is permanently affected on 23.08 ha and temporarily on 0.25 ha.

Therefore, the softwood environment is also affected by the works and infrastructure, more precisely the black spruce-moss stands which will be permanently affected on 16.20 ha and temporarily on a surface of 0.12 ha.

Other smaller terrestrial environments will not be affected by the project, including unspecified hardwood stands, unspecified softwood stands with non-commercial hardwoods, unspecified softwood and hardwood plantations, black spruce-birch stands, burnt-over areas, clearings, areas of unspecified regeneration, jack pine stands, black spruce-sphagnum stands, black spruce-lichen stands, unspecified softwood stands, and unspecified black spruce stands.

With respect to wetlands, the project will result in the disturbance or loss of 50.49 ha during the construction phase, of which 49.53 ha will be permanently affected and 0.96 ha will be temporarily affected (Table 7-4). This represents 2.02% of the study area (Map 7-2). The proposed infrastructure will result in direct disturbance to various wetlands. Each type of wetland present in the study area will be affected by the project's construction activities and by the presence of the infrastructure. The various types of encroachment are described in Table 7-4.

Table 7-4 Proportion of terrestrial and wetland areas affected by the project

Natural environment class	Surface area of the natural environment in the study area (ha)	Area of permanent encroachment (ha)	Area of temporary encroachment (ha)	Proportion of permanent encroachment (%)	Proportion of temporary encroachment (%)
Terrestrial environments					
Hardwoods					
Birch stands	42.66	1.88	N/A	4.41%	N/A
Mixedwoods					
Non-commercial hardwoods and unspecified hardwoods with unspecified softwoods	1.91	1.91	N/A	100%	N/A
Balsam fir-white birch stands	37.08	9.35	0.07	25.22%	0.19%
Unspecified mixedwoods	25.63	9.23	0.04	36.01%	0.16%
Regeneration and plantation					
Mixed shrubland regeneration	8.16	1.15	N/A	14.09%	N/A
Coniferous shrubland regeneration	348.39	23.08	0.25	6.62%	0.07%
Softwoods					
Black spruce-moss stands	247.19	16.20	0.12	6.55%	0.05%
Subtotal for the terrestrial environments		62.80	0.48		
Wetlands					
Tree swamp	26.89	1.62	N/A	6.02%	N/A
Wooded ombrotrophic bog	237.71	1.99	0.06	0.84%	0.03%
Shrub swamp	73.64	2.93	N/A	3.98%	N/A
Wooded fens	13	3.99	0.03	30.69%	0.23%
Open fens	118.45	13.58	0.42	11.46%	0.35%
Open ombrotrophic bog	652.27	25.42	0.45	3.90%	0.07%
Wetlands subtotal		**49.53**	**0.96**	-	-
Natural environment total		**112.33**	**1.44**	**-**	**-**
Anthropogenic environments					
Anthropogenic environments	141.67	22.48	0.21	15.87%	0.15%
Grand total		**134.81**	**1.66**	**-**	**-**

N/A: Not applicable.

The ecological value of the wetlands in the study area was assessed. Table 7-5 presents the range of ecological values determined for the 36 wetlands that will be affected by the project. The lowest ecological value is 23.12 for an open fen, while the highest value is 62.5 for an open fen and a wooded ombrotrophic bog.

Table 7-5 Range of ecological values of affected wetlands

Wetland type	Number of environments	Ecological value		
		Minimum	Moderate	Maximum
Tree swamp	1	32.5	32.5	32.5
Shrub swamp	5	32.5	39.2	43.5
Wooded fen	4	37.5	44.53	56.25
Open bogs (fens)	10	23.12	48	62.5
Wooded ombrotrophic bog	4	43.75	48.44	62.5
Open ombrotrophic bog	12	29.38	48.49	59.38
Total	**36**			

The ecological value ranges for evaluating wetlands are as follows:

- Very low = 0 to 20
- Low = 21 to 40
- Moderate = 41 to 60
- High = 61 to 85
- Very high = 86 to 100

The distribution of ecological value levels for each wetland type affected by the project is presented in Table 7-6. No wetlands of very low and very high ecological value are found in the project area. High values are found only in open fens and wooded ombrotrophic bogs. At the bottom of the scale, low ecological value environments include all affected environment types except for wooded ombrotrophic bogs. In general, the highest ecological values are associated with greater plant diversity and with environments associated with larger wetland complexes that include several different wetland types.

Table 7-6 Percentage distribution of affected wetlands by ecological value levels

Wetland type	Ecological value (%)				
	Very low	Low	Moderate	High	Very high
Tree swamp	-	2.78	-	-	-
Shrub swamp	-	8.33	5.56	-	-
Wooded fen	-	2.78	8.33	-	-
Open bogs (fens)	-	8.33	13.89	5.56	-
Wooded ombrotrophic bog	-	-	8.33	2.78	-
Open ombrotrophic bog	-	2.78	30.55	-	-
Total		**25.00%**	**66.67%**	**8.33%**	

The tailings storage facility, the enclosed encroachment between the infrastructure and the process plant complex, and its nearby activity area are responsible for almost 60.58% of the area affected by the project for anthropogenic, terrestrial, and wetland environments, or 82.68 ha (Table 7-7). Other infrastructure, roads, and their adjacent activity areas, the overburden stockpile, Pond PAR1, and the waste rock stockpile will affect 10.87 ha, 8.28 ha, 9.86 ha, and 6.86 ha respectively. These facilities account for 22.69% of the area of natural environments affected. The remaining facilities represent 16.73% of the affected natural and anthropogenic environments.

CONTAMINATION OF TERRESTRIAL AND WETLAND ENVIRONMENTS

Mobile equipment use and traffic on the operating site involve the presence and handling of fuels and oils, which could result in accidental spills. If incidents occur, spills or contamination of the natural environment may result in impacts to vegetation and wetlands, although mobile equipment traffic will be confined to the activity site. However, since spills will be managed in accordance with the spill response plan and given the numerous mitigation and control measures in place, the risk of a spill affecting terrestrial and wetland quality is very low; the spill will be contained and contaminated soils will be recovered quickly, as prescribed in the Emergency Response Plan (see Chapter 12). However, if there is a spill, the degree of contamination will depend on the nature of the contaminants and their concentrations.

Access roads and traffic lanes will have to be maintained in a way that ensures the safety of workers and avoids the lifting of dust. The use of ice melters in winter and dust suppressants to ensure the safety of the roadways could result in increased salt concentrations in the surrounding soil. The measure specifying that the use of ice melters will be limited as much as possible will mitigate this impact.

RESIDUAL IMPACT ASSESSMENT

The ecosystem and socioeconomic values of the component were considered low as the impacted vegetation and wetlands have little conservation or development value. Given the mitigation measures that will be implemented, the loss of vegetated areas or disturbance of terrestrial and wetland vegetation will be limited to the right-of-way of the infrastructure to be built on the site. At these locations, the degree of disturbance will be medium and low in intensity and the losses or disturbances will extend for the life of the mine and beyond. The probability of occurrence is high since losses will occur at the time of infrastructure construction. The significance of the residual impact is thus qualified as very low to low. It is important to note that a total of 50.49 ha of wetlands and 63.28 ha of terrestrial environments will be affected by the project’s infrastructures and construction.

The potential for spills or contamination will result in low disturbance and intensity. Major spills likely to occur will be one-time events and rapid response will make them short-lived. The probability of occurrence is low, because although there is a possibility of spills or contamination occurring, the likelihood of them affecting vegetation or wetlands is very low. The significance of the residual impact of spills or contamination on vegetation or wetlands is therefore rated as very low.

Impact on terrestrial environments and wetlands during the construction phase		
Nature	Negative	Significance: Terrestrial and wetland environments Risk of accidental spills – Very low Loss of area – Low
Ecosystem value	Low	
Socioeconomic value	Low	
Degree of disturbance	Low (risk of accidental spill) to medium (loss of surface area)	
Intensity	Low	
Spatial scope	Specific (risk of accidental spill) to local (loss of area)	
Duration	Short (spill) to long (loss of surface area)	
Probability of occurrence	Low (spill) to high (loss of surface area)	

Table 7-7 Area (ha) of terrestrial and wetland environments directly affected by project infrastructure type

Type of environment	Borrow pit	Pond PAR1	Pond PAR2	Pond B	Pond C	Pond C2	Pond D2	Pond U	Pond F	Pond J	Pipe	Domestic effluent	Overburden stockpile	Waste rock stockpile	Mining camp and nearby activity areas	Process plant complex and nearby activity areas	Water treatment plant, paste backfill plant, and nearby activity areas	Tailings storage facility	Haul road and nearby activity areas	Ditch	Enclosed encroachment between infrastructure
Birch stands													1.59								0.28
Non-commercial hardwoods and unspecified hardwoods with unspecified softwoods						0.49										0.78			0.39		0.25
Balsam fir-white birch stands								0.49			0.10				0.12	0.66	1.19	2.80	0.85		3.21
Unspecified mixedwoods	0.01				0.17	0.13			0.13				1.11			5.02			1.00		1.71
Mixed shrubland regeneration																0.51			0.23		0.42
Coniferous shrubland regeneration	2.88		0.02			0.07	1.14		1.14	0.04	0.05	0.01	2.58	3.30	4.14	0.23	0.42	5.09	0.83		1.20
Black spruce-moss stands	0.07	0.01		0.72	0.12		0.45			0.06	0.02	0.01	1.07	0.05	0.32	2.21		8.28	0.70		2.23
Tree swamp		0.64																0.43	0.08		0.46
Wooded ombrotrophic bog		0.10									0.03	0.01						1.68	0.18		0.04
Shrub swamp													0.05			0.18		1.54	0.27		0.90
Wooded fens		0.23		0.46												0.46		1.92	0.71		0.24
Open fens		7.25							0.28	0.06	0			0.67		0.06	0	4.39	1.02		0.24
Open ombrotrophic bog		1.48	3.41	0.004	0.57	0.0005				0.02	0.01			0.31		0.17	0.38	16.55	2.23	0.08	0.67
Anthropogenic		0.15		0.04	0.01	0.31	0.77	0.12	0.09	0.34	0.21		1.87	2.54	1.27	2.94	0.57	3.49	2.38	0.12	5.48
Total per infrastructure	**2.96**	**9.86**	**3.42**	**1.22**	**0.88**	**1.00**	**2.37**	**0.61**	**1.64**	**0.51**	**0.41**	**0.03**	**8.28**	**6.86**	**5.85**	**13.21**	**2.57**	**46.16**	**10.87**	**0.42**	**17.34**

7.1.3 IMPACTS ON VEGETATION AND WETLANDS DURING THE OPERATIONS PHASE, AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the operations phase, the sources of impacts and resulting impacts (**in bold**) that may affect vegetation and wetlands are as follows:

— Transportation and traffic, as well as the production and management of residual and hazardous materials.

These sources may cause the following impacts during the operations phase:

Disturbances of plant associations in terrestrial and wetland environments by:

— the possibility of bringing in or transporting out seeds or any part of an invasive alien species that could lead to the establishment of a new colony; even if no IAS were observed during the inventories, this does not exclude the possibility of their introduction;
— the dewatering of the mine.

Contamination of terrestrial and wetland environments by:

— accidental introduction of petroleum hydrocarbons, contaminants, or hazardous materials into natural and wetland environments that will contaminate vegetation, soils, and the water regime.

MITIGATION MEASURES

Common mitigation measures QUA17 and VEG02 will be applied to limit the area of disturbance or destruction of natural terrestrial and wetland habitats. The same common and specific mitigation measures recommended during the construction phase will be applied during the operations phase for risks attributed to spills or contamination of terrestrial and wetland environments. Specific measures P01 and P26 will also be implemented.

RESIDUAL IMPACT DESCRIPTION

DISTURBANCE OF PLANT ASSOCIATIONS IN TERRESTRIAL AND WETLAND ENVIRONMENTS

Mobile equipment traffic on the operating site may result in the inbound or outbound movement of invasive alien plants in the form of seeds or other plant parts. This may result in the establishment of colonies of unwanted species. However, the application of the mitigation measures provided for in the project will limit this risk. Pumping activities required to dewater the underground mine, which have been ongoing since the start of exploration and will continue into the operations phase, will result in changes to the groundwater flow regime. This could result in disturbance of wetlands in the drawdown zone by reducing their water supply from the water table.

CONTAMINATION OF TERRESTRIAL AND WETLAND ENVIRONMENTS

Mobile equipment use and traffic on the operating site involve the presence and handling of fuels and oils. Should incidents occur, spills or contamination of the natural environment may result in impacts to vegetation and wetlands. However, since spills will be managed in accordance with the spill response plan and given the numerous mitigation and control measures in place, the risk of a spill affecting surface water quality is very low; the spill will be contained and contaminated soils will be recovered quickly, as prescribed in the Emergency Response Plan (see Chapter 12). Finally, if there is a spill, the degree of contamination will depend on the nature of the contaminants and their concentrations.

RESIDUAL IMPACT ASSESSMENT

Due to the mitigation measures that will be implemented, disturbance to terrestrial and wetland vegetation will be limited to the right-of-way of the infrastructure and roads used by the mobile equipment during the operations phase. At these locations, the loss of area has been assessed during the construction phase. As mentioned, the application of mitigation measures controls the risk.

Given the mitigation measures that will be implemented, the potential for spills or contamination will be low in disturbance and intensity. Major spills likely to occur will be one-time events and rapid response will make them short-lived. The probability of occurrence is low, because although there is a possibility of spills or contamination occurring, the likelihood of them affecting vegetation or wetlands is very low. The significance of the residual impact of spills or contamination on vegetation or wetlands is therefore rated as very low.

Impact on terrestrial environments and wetlands during the operations phase		
Nature	Negative	Significance: Very low
Ecosystem value	Low	
Socioeconomic value	Low	
Degree of disturbance	Low	
Intensity	Low	
Spatial scope	Specific	
Duration	Short	
Probability of occurrence	Low	

7.1.4 IMPACTS ON VEGETATION AND WETLANDS DURING THE CLOSURE PHASE, AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the closure phase, the potential sources of impacts and the resulting impact (**in bold**) that may affect vegetation and wetlands are as follows:

— The production and management of residual and hazardous materials and final restoration.

These sources have the potential to produce the following impacts during the closure phase:

Contamination of terrestrial and wetland environments by:

— the accidental introduction of petroleum hydrocarbons, contaminants, or hazardous materials into surface waters and soil that will contaminate the habitat.

Increase in areas of vegetated land and wetlands by:

— site rehabilitation.

MITIGATION MEASURES

The common and specific mitigation measures recommended in the construction and operations phases will be applied in the closure phase. Specific measures related to the restoration of the environment, VEG02, VEG03, VEG04, and NOR16. Specific measure P26 will also be implemented.

RESIDUAL IMPACT DESCRIPTION

ACCIDENTAL INTRODUCTION OF PETROLEUM HYDROCARBONS, CONTAMINANTS, OR HAZARDOUS MATERIALS INTO THE ENVIRONMENT

Accidental spills of petroleum hydrocarbons, contaminants, or hazardous materials will be managed in accordance with the spill response plan (see Chapter 12). With numerous mitigation and control measures in place, the risk of a spill impacting the environment is very low. If a spill does occur, however, the degree of contamination will depend on the nature of the contaminants and their concentrations.

INCREASE IN VEGETATED AREA

At the end of mine operations, revegetation measures are planned to allow for the establishment of a vegetative cover on the tailings storage facility, the stockpiles, and where existing infrastructure will be dismantled. These measures, which may include grading of surfaces, addition of cover material and topsoil, seeding, and planting will increase the amount of vegetated area on the site.

INCREASE IN WETLAND AREA

The dismantling of ditches, the stabilization of ponds, and the re-establishment, in some places, of the natural flow of surface water will have the impact of creating or re-establishing some wetlands.

RESIDUAL IMPACT ASSESSMENT

During the closure phase, the residual impact is related to the risk of accidental spills. The anticipated impacts will be the same as in the construction and operations phases, i.e., very low.

Once the closure phase is over and the rehabilitation work has been completed, a positive impact is expected due to the increase in the area covered by vegetation and wetlands.

Impact on terrestrial environments and wetlands during the closure phase		
Nature	Negative/Positive	Significance: Very low Habitat restoration – Positive impact
Ecosystem value	Low	
Socioeconomic value	Low	
Degree of enhancement	Low	
Intensity	Low	
Spatial scope	Specific	
Duration	Short	
Probability of occurrence	Low	

7.2 ICHTHYOFAUNA AND BENTHOS

Important facts about ichthyofauna and benthos

Current conditions

The main fish-bearing lakes are Windfall, SN1, SN2, SN3, SN4, SN5, SN6, SN8, as well as Pond 2. Pond 1 provides fish habitat, but has very low potential for ichthyofauna and is only marginal habitat. Kettle Lake has no outflows or tributaries, and no fish have been caught there. It does not provide fish habitat.

Of the 31 watercourses in the local study area for the biophysical environment, 20 are considered to be fish habitat. These may support fish or allow fish passage. For six watercourses, only a portion is considered fish habitat, while five watercourses do not qualify as complete fish habitat.

The MELCCFP has identified the following species within the territory of Fishing Area 17 or within a 10 km radius of the local biophysical environment study area: striped bass (*Morone saxatilis*), sauger (*Sander canadensis*), lake sturgeon (*Acipenser fulvescens*), Atlantic sturgeon (*Acipenser oxyrinchus*), splake (*Salvelinus namaycush* [female], *Salvelinus fontinalis* [male]), splake (*Salvelinus fontinalis* [female], *Salvelinus namaycush* [male]) and lake trout (*Salvelinus namaycush*). Fish species present in the local biophysical environment study area include: mottled sculpin (*Cottus bairdii*), lake cisco (*Coregonus artedi*), walleye (*Sander vitreus*), brook stickleback (*Culaea inconstans*), northern pike (*Esox lucius*), lake whitefish (*Coregonus clupeaformis*), burbot (*Lota lota*), lake chub (*Couesius plumbeus*), white sucker (*Catostomus commersonii*), brook trout (*Salvelinus fontinalis*), fallfish (*Semotilus corporalis*), yellow perch (*Perca flavescens*) and trout-perch (*Percopsis omiscomaycus*). No fish species that are threatened, vulnerable, or likely to be designated as threatened or vulnerable have been identified in the study area.

Of the ten fish species recorded in the inventoried lakes, three species are present only in Lake SN2. These are white sucker, lake whitefish, and walleye. In addition, this lake is the only water body in the local biophysical study area where walleye and lake whitefish have been caught. This is the lake with the highest fish diversity in the study area and the highest fishing yield.

Potential project impacts

No direct loss of ichthyofauna and benthos habitat is anticipated.

During the construction phase, the degree of disturbance is considered low. The impact will be felt over a medium duration, i.e., over the entire life of the mine for the alteration of the water regime and over a short duration for the risks of contamination and suspended solids (TSS) emissions. The significance of the residual impact is considered very low for TSS and contamination risks and low for the alteration of the water regime.

During the operations phase, the main activity that could impact ichthyofauna and benthos is the operation of new infrastructure as well as water use and management. Although it is expected that all drainage from road surfaces, work areas, the tailings storage facility, and the waste rock and overburden stockpiles will be directed to the water treatment plant before being released to the environment, there is a risk that untreated water could be released if there is equipment or infrastructure failure. The significance of the residual impact is thus low for accidental spills and sediment transport and medium for the influence of mining effluent.

Due to habitat restoration during the closure phase, the residual impact is positive on ichthyofauna and benthos. However, during the closure work, there will still be a risk of spills, but the significance of the residual impact will be low.

7.2.1 CURRENT CONDITIONS

Inventories for the characterization of fish and benthic invertebrates in the local biophysical environment study area were conducted between 2015 and 2022 to cover all areas potentially impacted, directly or indirectly, by the proposed infrastructure. The local biophysical study area is within the Opawica River basin (Map 1 in Appendix 7-2). This area includes some existing mining infrastructure such as a lined ore and waste rock stockpile and an overburden stockpile. The site is also occupied by a ramp portal dating from 2008, a sedimentation pond, and a polishing pond with water treatment units. However, most of the local biophysical study area is unoccupied, with numerous water bodies and watercourses.

All of the information regarding fish and fish habitat and benthic invertebrates can be found in the sectorial report in Appendix 7-2. All watercourses and water bodies within the local biophysical study area for which field inventories were conducted are presented in Tables 7-8 and 7-9 and can be viewed on Map 7-3.

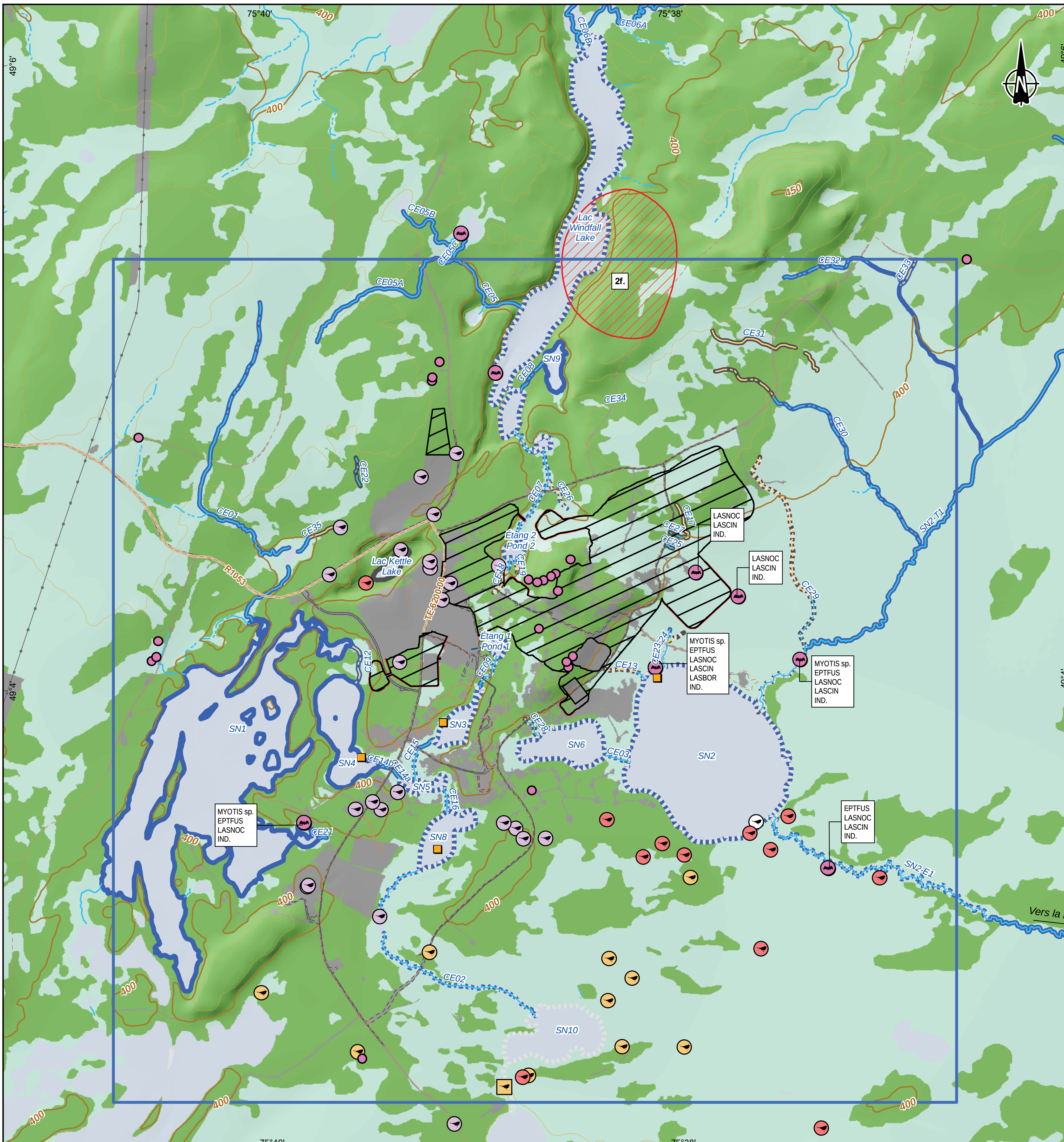
Inventories conducted for the characterization of fish habitat in water bodies included the following activities:

- Measuring basic physicochemical parameters (temperature, pH, specific conductivity, and dissolved oxygen).
- Determining water transparency using a Secchi disk.
- Dividing the banks into segments for the water bodies visited in 2017 and 2018.
- Vertical profiling of temperature and oxygen.
- Setting up experimental gill net fishing stations that will be run according to the Service de la faune aquatique's multi-species inventory protocol (SFA, 2011).
- Running mini-fyke-net fishing stations in Ponds 1 and 2.

For watercourses, the fish habitat characterization activities were as follows:

- Description of the habitat by homogeneous segmentation.
- When water conditions would allow it, running the electrofishing or mini-fyke-net stations.
- Measurement of basic physicochemical parameters (temperature, pH, specific conductivity, and dissolved oxygen). It should be noted that watercourses that were too shallow or dry during the inventories could not be sampled.

Inventories for benthos characterization were undertaken in 2017 and 2021. The coordinates of the inventory stations are presented in Table 7-10 and the stations can be viewed on Map 7-5.



Zone d'étude locale du milieu biophysique/ *Biophysical environment local study area*

Hydrographie / *Hydrography*

- Cours d'eau permanent / *Permanent watercourse*
- Cours d'eau permanent partiellement souterrain / *Partially undeground permanent watercourse*
- Cours d'eau intermittent / *Intermittent watercourse*
- Cours d'eau intermittent partiellement souterrain / *Partially undeground intermittent watercourse*
- Cours d'eau souterrain / *Underground watercourse*
- Fossé de drainage / *Drainage ditch*
- Canal / *Canal*
- Plan d'eau / *Waterbody*

Infrastructure / *Infrastructure*

- Ligne de transport d'énergie électrique / *Electric power line*
- Route forestière / *Forest road*
- Chemin de gravier (mine) / *Gravel road (mine)*
- Route d'accès / *Access road*

Empiètement du projet / *Project Encroachment*

- Empietement permanent / *Permanent encroachment*
- Empiètement temporaire /*Temporary encroachment*

Végétation / *Vegetation*

- Milieu forestier / *Forest Environment*
- Milieux humide et hydrique / *Wetlands and Hydrous Environment*
- Autres milieux / *Other Environments*

Composantes du milieu biologique - faune / *Biological Environment Component - Fauna*

Ichtyofaune et benthos

- Station d'échantillonnage du benthos (2017-2021) / *Benthos sampling station (2017-2021)*
- Habitat du poisson dans le cours d'eau ou le plan d'eau / *Fish habitat in the watercourse or in the waterbody*
- Absence de l'habitat du poisson dans le cours d'eau ou le plan d'eau / *No fish habitat in the watercourse or in the waterbody*
- Cours d'eau ou plan d'eau affecté par une modification du régime hydrique /*Watercourse or waterbody affected by a change in the water regime*

Observations de la faune aviaire/ *Avian Fauna Observations*

- Engoulevent d'Amérique (2016-2017, 2021) / *Common nighthawk (2016-2017, 2021)*
- Moucherolle à côtés olive (2017, 2021) / *Olive-sided flycatcher (2017, 2021)*
- Pygargue à tête blanche (2016-2017) / *Bald Eagle (2016-*
- Quiscale rouilleux (2016-2017, 2021) / *Rusty blackbird (2016-2017, 2021)*
- Nid de quiscale rouilleux (2016) / *Rusty blackbird nest*

Chiroptères / *Chiroptera*

- Station d'inventaire acoustique (2016-2017, 2021) / *Acoustic survey station (2016-2017, 2021)*
- Site d'inventaire de maternité potentiel / *Potential maternity inventory roost*

Résultat d'inventaire des chirpotères / *Chiroptera Inventory Result*

EPTFUS	Grande chauve-souris brune / *Brig brown bat*
LASBOR	Chauve-souris rousse / *Eastern red bat*
LASCIN	Chauve-souris cendrée / *Hoary bat*
LASNOC	Chauve-souris argentée / *Silver-haired bat*
MYOTIS sp.	Complexe Myotis / *Myotis complex*
IND.	Indéterminée / *Indeterminate*

Grande faune / *Big Fauna*

- Réseau de piste de l'orignal / *Moose trail network*

Observation directe d'orignal / *Moose observation*

f. : femelle / *female*
v. : veau / *veal*

OSISKO
MINIÈRE OSISKO

Projet minier Windfall - Étude d'impact sur l'environnement / *Windfall Mining Project - Environmental Impact Assessment*
Site minier Windfall, Eeyou Istchee Baie-James (Québec) / *Windfall Mining Site, Eeyou Istchee Baie-James (Quebec)*

Carte 7-3 / *Map 7-3*
Composantes du milieu biologique - Faune (excluant le caribou forestier) /
Biological Environment Components - Fauna (Excluding Woodland Caribou)

Sources :
CanVec+, 1/50 000, RNCan, 2014
MERN, AQréseau+, réseau routier, 2020

0 250 500 m

MTM, Fuseau 9 / *Zone 9*, NAD83

2023-03-23

Préparée par / Preparation : É. D'Astous
Dessinée par / Drawing : C. Thériault
Vérifiée par / Verification : M.-H. Brisson
_201_11330_19_eimb_c7_3_158_CompMilBio_230323.mxd

wsp

La précision des limites et des mesures montrées sur ce document ne doivent pas servir à des fins d'ingénierie ou de délimitation foncière. Aucune analyse foncière n'a été effectuée par un arpenteur-géomètre. / Boundary accuracy and measurements shown on this document are not to be used for engineering or land delineation purposes. No land analysis was carried out by a land surveyor.

A summary of the information collected from the studied water bodies and watercourses is presented in Tables 7-8 and 7-9 respectively. The MFFP (2018, 2020b) has identified the following species within the territory of Fishing Area 17 or within a 10 km radius of the local biophysical environment study area: striped bass (*Morone saxatilis*), sauger (*Sander canadensis*), lake sturgeon (*Acipenser fulvescens*), Atlantic sturgeon (*Acipenser oxyrinchus*), splake (*Salvelinus namaycush* [female], *Salvelinus fontinalis* [male]), splake (*Salvelinus fontinalis* [female], *Salvelinus namaycush* [male]) and lake trout (*Salvelinus namaycush*). Fish species present in the local biophysical environment study area include: mottled sculpin (*Cottus bairdii*), lake cisco (*Coregonus artedi*), walleye (*Sander vitreus*), brook stickleback (*Culaea inconstans*), northern pike (*Esox lucius*), lake whitefish (*Coregonus clupeaformis*), burbot (*Lota lota*), lake chub (*Couesius plumbeus*), white sucker (*Catostomus commersonii*), brook trout (*Salvelinus fontinalis*), fallfish (*Semotilus corporalis*), yellow perch (*Perca flavescens*) and trout-perch (*Percopsis omiscomaycus*). It should be noted that no threatened or vulnerable fish species, or fish species suspected of being so designated, have been recorded within 10 km of the 49.05750 °N, -75.66220 °W coordinates (MFFP, 2020a).

Of the ten fish species recorded in the inventoried lakes, three species are present only in Lake SN2. These are white sucker, lake whitefish, and walleye. In addition, this lake is the only water body in the local biophysical study area where walleye and lake whitefish have been caught. This lake has the highest fish diversity and highest fishing yield in the local biophysical study area.

Almost all water bodies are fish habitat and some of them show good potential for spawning and feeding habitat for northern pike and yellow perch, especially due to the presence of extensive aquatic grass beds (Table 7-11). In fact, ten water bodies are considered as fish habitat: Windfall, SN1, SN2, SN3, SN4, SN5, SN6 and SN8 Lakes, as well as Pond 1, and Pond 2. However, it should be noted that according to the data collected, Pond 1 is a marginal habitat with low biological potential. In fact, Pond 1 was fished during 4 nights (2 sets of gear) in September 2021 without success. Only 2 brook stickleback were caught at the lake outflow in 2010 (Appendix 7-2). Kettle Lake is the only lake that shows no potential for fish spawning and feeding habitat and is not considered fish habitat. Kettle Lake is a small lake with no outflows or tributaries where no fish have been caught. The shoreline characterization did not identify any aquatic grass beds or potential spawning grounds, so this lake was not deemed to support any fish populations at this time.

Table 7-8 List of water bodies located in the local biophysical study area

Name of water body	Area (ha)	Latitude	Longitude
Pond 1	0.82	49° 4′ 7.22″ N	75° 38′ 53.27″ W
Pond 2	1.01	49° 4′ 26.37″ N	75° 38′ 48.02″ W
Windfall Lake	44.06	49° 05′ 10″ N	75° 38′ 71″ W
Kettle Lake	1.74	49° 4′ 22.09″ N	75° 39′ 24.49″ W
Unnamed Lake 1 (SN1)	109.38	49° 03′ 80″ N	75° 40′ 33″ W
Unnamed Lake 2 (SN2)	73.10	49° 03′ 44″ N	75° 39′ 8″ W
Unnamed Lake 3 (SN3)	3.69	49° 03′ 83″ N	75° 38′ 12″ W
Unnamed Lake 4 (SN4)	13.03	49° 03′ 54″ N	75° 39′ 40″ W
Unnamed Lake 5 (SN5)	1.49	49° 03′ 40″ N	75° 39′ 16″ W
Unnamed Lake 6 (SN6)	9.48	49° 03′ 49″ N	75° 38′ 35″ W
Unnamed Lake 8 (SN8)	5.99	49° 03′ 28″ N	75° 39′ 12″ W

Table 7-9 List of watercourses located in the local biophysical study area

Name	Length (m) [1]	Latitude	Longitude
Watercourse 1 (CE01)	749	49° 04′ 56″ N	75° 40′ 29″ W
Watercourse 2 (CE02) [2]	840	49° 03′ 37″ N	75° 39′ 38″ W
Watercourse 3 (CE03)	171	49° 03′ 46″ N	75° 38′ 18" W
Watercourse 7 (CE07) [2]	800	49° 04′ 75″ N	75° 38′ 71″ W
Watercourse 8 (CE08)	243	49° 04′ 94″ N	75° 38′ 12″ W
Watercourse 9 (CE09)	222	49° 03′ 97″ N	75° 38′ 94″ W
Watercourse 12 (CE12)	253	49° 04′ 12″ N	75° 39′ 58″ W
Watercourse 13 (CE13)	256	49° 04′ 2″ N	75° 38′ 12″ W
Watercourse 14 (CE14)	160	49° 03′ 42″ N	75° 39′ 24″ W
Watercourse 15 (CE15)	298	49° 03′ 46″ N	75° 39′ 17″ W
Watercourse 16 (CE16)	164	49° 03′ 38″ N	75° 39′ 8″ W
Watercourse 17 (CE17)	240	49° 04′ 30″ N	75° 37′ 59″ W
Watercourse 18 (CE18)	241	49° 04′ 21″ N	75° 38′ 50″ W
Watercourse 19 (CE19)	91	49° 04′ 23″ N	75° 38′ 47″ W
Watercourse 21 (CE21)	[3]	49° 04′ 31″ N	75° 39′ 44″ W
Watercourse 22 (CE22)	[3]	49° 04′ 38″ N	75° 39′ 33″ W
Watercourse 24 (CE24)	34	49° 4′ 9.47″ N	75° 37′ 59.55″ W
Watercourse 25 (CE25)	53	49° 4′ 26.35″ N	75° 38′ 2.28″ W
Watercourse 26 (CE26)	213	49° 4′ 36.60″ N	75° 38′ 34.02″ W
Watercourse 27 (CE27)	103	49° 4′ 28.15″ N	75° 37′ 59.21″ W
Watercourse 28 (CE28)	143	49° 3′ 52.26″ N	75° 38′ 42.39″ W
Watercourse 29 (CE29)	330	49° 4′ 12.14″ N	75° 37′ 20.53″ W
Watercourse 30 (CE30)	1801	49° 4′ 50.23″ N	75° 37′ 15.00″ W
Watercourse 31 (CE31)	694	49° 5′ 3.18″ N	75° 37′ 21.82″ W
Watercourse 33 (CE33)	183	49° 5′ 18.17″ N	75° 36′ 51.12″ W
Watercourse 35 (CE35)	288	49° 4′ 29.42″ N	75° 39′ 44.26″ W
Tributary of Lake SN2 (SN2 T1 – verification point CE-20)	4,486	49° 03′ 54″ N	75° 37′ 35″ W
Outflow of Lake SN2 (SN2-E1)	12,190	49° 03′ 33″ N	75° 37′ 32″ W

1 Length of the characterized portion on each of the study watercourses.
2 The length of the characterized portion of these watercourses refers to the characterization conducted in 2015 as part of the environmental baseline study led by WSP (WSP, 2016). In 2016, they were subject to electrofishing.
3 Validation points were identified at specific locations in 2021, so no watercourse lengths were established for these.

Table 7-10 Location of benthos sampling stations in 2017 and 2021

Water body/watercourse	Station	Latitude	Longitude
Lake SN2	BEN-08	49° 04' 01" N	75° 38' 06" W
Lake SN3	BEN-09	49° 03' 53" N	75° 39' 09" W
Lake SN4	BEN-10	49° 03' 46" N	75° 39' 33" W
Lake SN8	BEN-12	49° 03' 29" N	75° 39' 11" W
Outflow of Lake SN2 (SN2-E1), upstream section	WL-ST01	49° 03′ 32″ N	75° 37′ 32″ W
	WL-ST02	49° 03′ 32″ N	75° 37′ 33″ W
	WL-ST03	49° 03′ 31″ N	75° 37′ 33″ W
Outflow of Lake SN2 (SN2-E1), downstream section	WL-ST04	49° 01′ 46″ N	75° 33′ 21″ W
	WL-ST05	49° 01′ 46″ N	75° 33′ 22″ W
	WL-ST06	49° 01′ 46″ N	75° 33′ 22″ W

Of the 31 watercourses studied, 20 provide fish habitat throughout their characterized portion. These provide shelter for fish or allow the passage of aquatic wildlife. These 20 watercourses are CE01, CE02, CE03, CE05, CE05A, CE07, CE08, CE09, CE12, CE14, CE15, CE16, CE21, CE22, CE23, CE26, CE29, CE33, SN2-T1, and SN2-E1. Potential spawning areas for brook trout were observed in watercourses CE05 and CE05A. In addition, suitable spawning areas for northern pike and yellow perch, characterized by the presence of grass beds, were observed at the mouths of watercourses CE01, CE09, CE15, CE16, SN2-T1, and SN2-E1. For six watercourses (CE13, CE18, CE19, CE28 CE30, and CE35), natural barriers, including impassable subsurface portions, do not allow for fish passage along the entire watercourse or for the establishment of aquatic fauna; only a segment of the characterized portion provide fish habitat. Finally, five watercourses do not provide fish habitat in their entirety: CE17, CE24, CE25, CE27, and CE31. These watercourses do not present favourable conditions for the establishment of aquatic fauna and they do not provide access for fish.

As for the benthos, the samples were collected at depths varying between 0.2 m and 1.6 m. Overall, the substrate present at all stations was dominated by sand with a significant fraction of silt. Gravel was virtually absent at the sampled stations. The benthic communities of the four sampled lakes (SN2, SN3, SN4 and SN8) are composed mostly of arthropods (insects), followed by molluscs, and annelids. Among the insects identified, most were the larvae of *Chironomidae* (order Diptera), representing on average 37% of the organisms found in the lakes. It should be noted that these taxa are considered tolerant to disturbance and allow for the assessment of the conditions to which benthic invertebrates are exposed. These chironomid larvae play an important role in water filtration and the mineralization of organic matter, and a high density of these organisms (up to 100,000 larvae/m^2) is generally found in eutrophic lakes. For this reason, the ratios of Ephemeroptera – Plecoptera – Trichoptera (taxa known to be sensitive to habitat quality) to chironomids (EPT/C) are low in the lakes surveyed (ranging from 0.04 to 0.12). However, the density of these larvae in the lakes studied, varying between 167 and 960 larvae/m^2, is very low and does not indicate a significant degradation of the quality of the environment by organic matter. With respect to the composition of the six benthos samples collected in the Lake SN2 outflow (SN2-E1), the upstream stations have a high percentage of molluscs, while arthropods dominate the downstream stations. These six stations have higher EPT/C ratios than the lakes, ranging from 0.20 to 0.63. This indicates that the SN2-E1 watercourse has more favourable habitat for benthic invertebrates sensitive to pollutants or habitat degradation.

Table 7-11 Summary of information collected in water bodies

Lake	Area (ha)	Habitat characterization	Fishing	General description	Physicochemical parameters (surface)				Fish species caught	Fish habitat (yes/no)**
					Water temperature (°C)	Dissolved oxygen (mg/l)	Specific conductivity (µs/cm)	pH		
Windfall	44.06	2016	2016	Windfall Lake receives water from watercourses CE05, CE07, and CE08 and drains via a more northerly watercourse. It has a maximum depth of 20 m. The water transparency is 2.95 m and it displayed thermal stratification at about 8 m depth in 2016. Several grassbeds were observed during the inventories. It offers good potential for yellow perch and northern pike and potential spawning grounds for these two species are present.	20.1	8.0	29.0	8.0	Lake cisco Northern pike Yellow perch Burbot	Yes
SN1	107.2	2016	2016	Lake SN1 receives water from watercourse CE01 to the north and is connected to Lake SN4 by watercourse CE12. The maximum depth recorded was 20 m and the transparency was 2.90 m. Field measurements determined that thermal stratification was well established at approximately 6 m. Although this lake is conducive for aquatic wildlife establishment, fishing results obtained in 2016 rank SN1 with the lowest fishing yields of all inventoried lakes.	19.8	9.0	15.0	7.3	Northern pike Yellow perch	Yes
SN2	73.1	2017	2017	Lake SN2 receives water from Watercourse SN2-T1 to the north and has an outflow, Watercourse SN2-E1, which flows to the southeast. It also receives water from Watercourses CE13 and CE03, which connect it to Lake SN6. The maximum depth of Lake SN2 was approximately 7 m. No thermal stratification was established during the surveys, with the temperature being essentially the same throughout the water column. No transparency measurements were taken. Lake SN2 supports several species of fish and has good potential for aquatic wildlife. It is the lake with the highest fish diversity in the study area. Numerous grass beds have been identified along the shoreline, offering several potential spawning areas for northern pike and yellow perch.	17.5	8.0	29.1	7.1	White sucker Lake cisco Lake whitefish Northern pike Yellow perch Walleye Fallfish	Yes
SN3	3.69	2016	2016	Lake SN3 receives water from watercourse CE09 and is connected to lake SN5 via Watercourse CE15. Despite the shallow depth of the lake (about 7 m), a slight thermal stratification was established at the time of the inventories. The water transparency had a value of 4.5 m. Some grass beds were observed in the lake. However, no potential spawning grounds were identified and SN3 was one of the lakes with the lowest catch per unit effort in the study area.	21.5	8.2	46.0	7.1	Northern pike Yellow perch	Yes
SN4	13.03	2017	2017	Lake SN4 is connected to Lake SN1 via Watercourse CE12. The maximum depth of the lake was 6 m. Without showing a marked thermal stratification, the water temperature decreased gradually from the surface to the bottom. Water transparency was not measured for this lake. Grass beds were observed along the shoreline, offering spawning potential for the species present, i.e., northern pike and yellow perch.	20.6	7.6	11.1	6.9	Northern pike Yellow perch	Yes
SN5	1.49	2017	2017	Lake SN5 receives water from Lakes SN3 and SN4 via Watercourses CE15 and CE16. No vertical temperature profile was conducted for SN5. However, due to the transparency of the water, the bottom of the lake was visible and the maximum depth was established at about 1.2 m. The entire perimeter of the lake is bordered by extensive aquatic grass beds that extend towards its centre. Due to the shallow depth of the water and the presence of extensive aquatic grass beds, this water body would be more consistent with a pond. It provides a suitable habitat for the species captured (northern pike and yellow perch).	19.2	7.5	56.5	6.9	Northern pike Yellow perch	Yes
SN6	9.48	2017	2017	Lake SN6 is connected to Lake SN2 via Watercourse CE03. The maximum depth of this lake is about 3.2 m and no defined thermal stratification was established during the inventories. Due to the transparency of the water, the lake bottom was visible even at its deepest point. The lake shoreline had grass beds in some areas, offering spawning potential for northern pike and yellow perch. It should be noted, however, that the inventories indicated that the lake is at a relatively advanced stage in the eutrophication process.	19.8	8.4	77.1	7.8	Northern pike Yellow perch Fallfish	Yes
SN8	5.99	2017	2017	Lake SN8 is connected to Lake SN5 via Watercourse CE16. Its outflow is the Watercourse CE02 which flows to the southeast of the study area. Due to the shallow depth of the lake (about 5.5 m), no thermal stratification was established. The water transparency was 3.3 m. Several grass beds were observed during the characterization. These offer good habitat potential and potential spawning areas for northern pike and yellow perch.	18.6	7.7	45.3	7.5	Northern pike Yellow perch	Yes
Kettle	1.74	2018	2018	Kettle Lake has no tributaries or outflows. It is an isolated body of water that provides no access to migrating fish. Due to the shallow depth of the lake (about 3 m), no thermal stratification was established. The water transparency was 3 m. No fish were caught in the lake, despite a fishing effort equivalent to four net-nights. No aquatic grass beds were observed and the lake shoreline appeared to be dry due to a significant drop in water levels. Therefore, due to the inconclusive fishing results and the lack of visible watercourses connecting Kettle Lake to any other water body, it can be assumed that this lake is not fish habitat.	20.6	9.1	38.9	8.2	No catches	No
Pond 1	0.82	2021	2021	Pond 1 flows into Watercourse CE09. No fish were caught in the pond (fishing effort of 4 nights/fishing). Its substrate, composed almost exclusively of organic matter, is not conducive for aquatic fauna. This pond provides fish habitat, but with low habitat quality.	14.7	9.6	153.1	7.6	No catches***	Yes
Pond 2	1.01	2021	2021	Pond 2 is connected to Windfall Lake via Watercourse CE07 and drains into two small outflows, Watercourses CE18 and CE19. Although the substrate composition is organic matter and the potential for biological production is low, Pond 2 provides fish habitat.	15.5	9.22	171.0	7.3	Brook stickleback Brook trout	Yes

* Characterization includes in situ water physicochemical surveys and description of fish habitat (aquatic grass beds, potential spawning grounds).
** Yes: corresponds to water bodies where the presence of fish has been confirmed through fishing or observation, as well as those where the presence of fish is presumed since there are no obstacles to the free passage of fish.
*** During an inventory conducted in 2011, brook stickleback was caught in the outflow of Pond 1, upstream of the impassable obstacle. Pond 1 is therefore considered fish habitat, despite the lack of fish caught in 2021 after a four-night effort.

Table 7-12 Summary of information collected in watercourses

Watercourse	Length characterized (m)	Habitat characterization* (m)	Fishing	General description	Fish species caught	Fish habitat (yes/no)**
CE01	749	2016	2016	Watercourse CE01 originates in an underground drainage system and flows to Lake SN1 through a small unnamed pond. This watercourse could be suitable for yellow perch spawning during flood events that create river marshes which could be used by this species. Two old beaver dams were identified in segment S01 (conditionally passable) and a rock pile was identified in segment S02 (conditionally impassable). However, these two obstacles do not completely limit the free passage of fish.	Northern pike Burbot	Yes
CE02	840	2015	2016	Watercourse CE02 is the outflow of Lake SN8. Several species of fish have been caught here and it provides fish habitat.	White sucker Mottled sculpin Northern pike Burbot	Yes
CE03	171	2017 and 2021	2017	Watercourse CE03 connects Lakes SN2 and SN6. It presents no barriers to fish and provides suitable habitat for aquatic wildlife.	Mottled sculpin Burbot	Yes
CE05	597	2015	No fishing	Watercourse CE05 flows into Windfall Lake. It has some areas suitable for brook trout spawning and no significant barriers to fish migration have been identified in this watercourse.	-	Yes
CE05A	1,172	2015	No fishing	Watercourse CE05A flows into Watercourse CE05. During the inventories, areas suitable for brook trout spawning were observed. There are no significant barriers to fish migration in this watercourse.	-	Yes
CE07	800	2015 and 2021	2016	Watercourse CE07 flows through the southern portion of Windfall Lake and has good potential for aquatic wildlife. No barriers or potential spawning areas were identified in this watercourse.	Brook stickleback Brook trout	Yes
CE08	243	2016	No fishing	Watercourse CE08 flows into Windfall Lake at its southeast end. It connects Windfall Lake to Lake SN9. It is an intermittent watercourse that is flood dependent. When water levels are higher, it is possible for fish to pass through.	-	Yes
CE09	222	2016 and 2021	No fishing	Watercourse CE09 originates in Pond 1 and flows into Lake SN3. This watercourse is accessible to fish from Lake SN3 in the first 70 metres. Thereafter, the watercourse is underground and may be accessible to fish only during periods of high water.	-	Yes
CE12	253	2016	No fishing	Watercourse CE12 connects Lakes SN1 and SN4. However, its intermittent, partially subsurface flow means that water connectivity may be limited during low flow periods. Suitable areas for pike and yellow perch spawning have been observed at the mouth of the watercourse to Lake SN4.	-	Yes
CE13	256	2017 and 2021	No fishing	Watercourse CE13 originates in a subsurface drainage system and flows into Lake SN2. At the time of the visit, the flow was very low and it was determined that only the first 60 metres is fish habitat. In fact, the upstream section of the watercourse is inaccessible to fish because of the impassable underground flow.	-	Yes (mouth only)
CE14	160	2017	No fishing	Watercourse CE14 is located between Lakes SN4 and SN5. However, it could limit the progress of fish during low water periods, as this watercourse is dry at certain times of the year and flows through an impassable wetland.	-	Yes
CE15	298	2017 and 2021	No fishing	Watercourse CE15 connects Lakes SN3 and SN5. It offers good potential for aquatic fauna, especially for pike and yellow perch. Three old beaver dams have been identified in Segment S03, but they do not completely limit fish migration (conditionally impassable).	-	Yes
CE16	164	2017 and 2021	2017	Watercourse CE16 connects Lakes SN5 and SN8. Both ends of the watercourse connected to the lakes have grass beds suitable for pike and yellow perch spawning. There is an old beaver dam in the watercourse, but it does not limit fish migration except under certain water conditions (conditionally passable).	Burbot	Yes
CE17	240	2021 and 2022	No fishing	All of Watercourse CE17 is not fish habitat. It is not connected to any watercourse or water body; it has underground segments and intermittent flow, not allowing the establishment of aquatic fauna.	-	No
CE18	241	2021 and 2022	No fishing	Watercourse CE18 receives water from Pond 2. It provides fish habitat only in segment S01. Segment S02 is an intermittent underground section and should not be considered as habitat.	-	Yes (first segment only)
CE19	91	2021 and 2022	2022	Watercourse CE19 receives water from Pond 2. Like Watercourse CE18, only Segment S01 should be considered as fish habitat. Segment S02 has intermittent groundwater flow and is not accessible to fish.	Brook stickleback	Yes (first segment only)
CE21	Single point	2021	No fishing	Watercourse CE21 is a permanent watercourse and has low potential for fish. However, it is connected to Lake SN1 and should be considered as part of fish habitat.	-	Yes
CE22	Single point	2021	No fishing	Watercourse CE22 is very shallow (0.05 m) and has no potential for aquatic life. It is not connected to any watercourse or water body; it has underground segments and intermittent flow, not allowing the establishment of aquatic fauna.	-	No
CE23	Single point	2021	No fishing	Watercourse CE23 flows into Windfall Lake. It is intermittent and has low potential for fish; however, no significant barriers were observed in this stream and it should be considered as part of fish habitat.	-	Yes
CE24	34	2022	2022	Watercourse CE24 flows into Watercourse CE23 (uncharacterized), eventually connecting to Lake SN2. Watercourse CE24 has an intermittent flow and several pools. It is impassable and does not allow the establishment of aquatic fauna.	No catches	No

Watercourse	Length characterized (m)	Habitat characterization* (m)	Fishing	General description	Fish species caught	Fish habitat (yes/no)**
CE25	53	2022	2022	Watercourse CE25 has an intermittent flow with several dry sections. It is not connected to any fish habitat and, being very shallow, does not support the full range of aquatic life functions. It does not provide fish habitat.	No catches	No
CE26	213	2022	2022	Watercourse CE26 is a tributary of Watercourse CE07. It has partially subsurface flow in segment S01 and subsurface flow in segment S02. However, one fish was observed in it during the 2022 visit and it may be accessible to fish depending on water conditions.	No catches, but one fish was observed (undetermined species).	Yes
CE27	103	2022	2022	Watercourse CE27 was created by an accumulation of water caused by mobile equipment and does not provide fish habitat.	No catches	No
CE28	143	2022	No fishing	Watercourse CE28 flows into Lake SN6. Only segment S01 should be considered as fish habitat. In this segment, a culvert passes under a road and may be limiting to fish migration under certain water conditions (conditionally passable). Segment S02 is an underground segment with intermittent flow and is impassable to fish (not a habitat).	-	Yes (first segment only)
CE29	329	2021	No fishing	Watercourse CE29 drains into Watercourse SN2-T1. It is an intermittent watercourse flowing through alders, moss, and peat. It may, however, be accessible by fish and should be considered as fish habitat in its first segment, but its potential remains marginal and of low quality.	-	Yes
CE30	1801	2022	No fishing	Watercourse CE30 drains into Watercourse SN2-T1. It is an intermittent watercourse flowing through alders, moss, and peat. It may, however, be accessible by fish and should be considered as fish habitat, but its potential remains marginal and of low quality.	-	Yes (second segment only)
CE31	694	2022	No fishing	Watercourse CE31 is an intermittent watercourse and does not connect to any other major watercourse. It has no connection to fish habitat and does not support aquatic life. It does not provide fish habitat.	-	No
CE33	183	2022	No fishing	Watercourse CE33 flows into Watercourse CE32 (uncharacterized). It is an intermittent watercourse flowing through alders, moss, and peat. It may, however, be accessible to fish if there are no barriers downstream and should be considered as fish habitat, but its potential remains marginal and of low quality.	-	Yes
CE35	288	2022	No fishing	Watercourse CE35 flows into Watercourse CE01 through a small, adjoining unnamed pond. Only the first segment of the watercourse (S01) provides fish habitat. Segment S02 is located on a floodplain in an alder grove. At several locations in this segment, the bed of the watercourse disappears through very dense buttes, making fish migration not possible in this segment. In addition, Segment S02 has no suitable conditions for fish settlement at any time of the year.	-	Yes (first segment only)
SN2-T1	4,486	2017 and 2021	2021	Watercourse SN2-T1 flows into Lake SN2. A beaver dam at segment S02 (conditionally impassable) has been identified, but fish passage remains possible along the entire watercourse depending on water conditions. The watercourse provides fish habitat due to its connection with Lake SN2. At the mouth of the watercourse, a potential spawning ground for pike and yellow perch has been identified.	No catches	Yes
SN2-E1	12,190	2017 and 2021	2021	Watercourse SN2-E1 is the outflow of Lake SN2 and has good potential for several fish species. At several locations in the watercourse, shoreline grass beds provide potential spawning areas for pike and yellow perch.	White sucker Lake chub Burbot Fallfish Trout-perch	Yes

* Characterization was accomplished by segmenting the watercourse. For some watercourses, single points were surveyed at specific locations.
** Yes: corresponds to water bodies where the presence of fish has been confirmed through fishing or observation, as well as those where the presence of fish is presumed since there are no obstacles to the free passage of fish.

7.2.2 IMPACTS ON ICHTHYOFAUNA AND BENTHOS DURING THE CONSTRUCTION PHASE AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the construction phase, no destruction of fish and benthos habitat is anticipated. The potential sources of impacts and resulting impacts (**in bold)** likely to affect ichthyofauna and its habitats are as follows:

— Organization of the site, stripping and clearing, surface preparation and access arrangement, construction of works and infrastructure, transportation and traffic, production and management of residual and hazardous materials.

These sources have the potential to produce the following impacts during the construction phase:

Alteration of habitat quality by:

— the emission of suspended solids (TSS) into surface waters

— the alteration of the water regime;

— the accidental introduction of petroleum hydrocarbons, contaminants, or hazardous materials into the aquatic environment;

— the use of abrasives in winter or chemical dust suppressants.

MITIGATION MEASURES

Common mitigation measures AIR01, AIR02, QUA01 to QUA04, QUA08, QUA09, QUA10 to QUA13, and QUA17 to QUA20 will be applied to reduce TSS emissions into the water. Common mitigation measures QUA07, QUA14 to QUA16, and QUA21 to QUA26 will be applied to reduce the risk of contamination or accidental spills in the aquatic environment. To limit the effects of the alteration of the water regime, common mitigation measure HYD01 will be applied. The protection of the aquatic environment is governed by several regulations and standards, particularly in the context of mining projects. These will be followed rigorously and the main ones are listed in Appendix 5-2 (NOR07 to NOR14). Finally, common mitigation measure FAU01 will be followed to limit alteration of ichthyofauna and benthos habitat quality.

Specific measure P26 will also be implemented for this component.

DETAILED RESIDUAL IMPACT DESCRIPTION

The alteration of the quality of the ichthyofauna and benthos habitat is generally a consequence of the introduction of particles, contaminated or not, which are deposited and thus alter the initial quality of the existing habitat.

EMISSION OF TSS IN WATER

During the construction phase, organization of the site, stripping and clearing activities, surface preparation and access arrangement, construction of works and infrastructure, as well as transportation and traffic are likely to carry fine particles and woody debris into the watercourses. Clearing activities and soil stripping will generate woody debris and expose the soil to weathering for a period of days to weeks. As a result, woody debris and soil particles could be washed into waterways. This situation will be mitigated by the installation of temporary clean water diversion ditches, lined with granular material or stone in case of steep slopes, which will retain the water and direct it to the sedimentation ponds and either to a water treatment unit or to be pumped back to the natural environment at some distance from the water bodies. The installation of sediment barriers in sensitive areas prior to the start of work will also prevent runoff into water bodies. During surface preparation and access arrangement, the construction of works and infrastructure, as well as during mobile equipment traffic, an increase in TSS could occur in water bodies and watercourses near work areas, particularly during heavy rainfall and spring snowmelt. This impact can be avoided by applying appropriate mitigation measures to reduce the suspension of fine particles and by implementing the measures presented above.

ALTERATION OF THE WATER REGIME.

The construction of new infrastructure will gradually alter the drainage of surface water locally. The alteration will be minor initially, will be localized at the construction site, and will affect the watersheds of Watercourses CE06B and CE02 and Lake SN2 at the end of the construction phase. Details of the water bodies and watercourses that will experience alterations to their water regime are presented in Section 6.6, which deals with hydrology. The main components of the infrastructure that will affect the watersheds are:

— the tailings storage facility (SN2 and a small portion of CE06B)
— the waste rock stockpile (CE02);
— retention ponds D, D2, PAR1, J, P, U (SN2);
— retention ponds B, C, C2, F (CE02);
— the overburden stockpile (SN2);
— the process plant, camp, and other buildings (CE6B).

First, an increase in water inflow to the watercourses in the CE02 watershed is expected since more water will be discharged at the effluent to Pond 1 throughout the year. In fact, an increase in monthly average flows ranging from 108.0% to 235.5% for Watercourse CE09 could be observed. However, the effect would be less downstream of the effluent, where an increase in average monthly flows ranging from 8.1% to 35.7% is expected in Watercourse CE02. It should be noted that, although there is an increase in average monthly flows and flood flows, low water flows could still be potentially reduced. In fact, when there is little precipitation, discharges could be reduced to a strict minimum to maintain a sufficient volume of water in the system while keeping the water treatment system at the plant operational. Pond 1, located directly upstream of Watercourse CE09, is also expected to experience a significant increase in flow at its outlet (226.5% increase compared to current conditions; Section 6.6.3 of Chapter 6). However, it is a marginal and low quality habitat for aquatic fauna. No fish were caught during the surveys conducted in 2021. Furthermore, Watercourse CE09, which is partially subterranean, does not allow for the migration of fish to Pond 1 at all times of the year. Under low water conditions, fish passage is naturally limited. Therefore, if a temporary decrease in flows is expected, the impacts on fish migration would not be very noticeable.

In addition, a decrease in water supply to water bodies in the watersheds of CE06B and SN2 is anticipated (see details in Section 6.6 - Hydrology). A decrease in average annual flows of up to 89.9% may be observed for watercourses located directly upstream of the CE06B watershed, while a smaller decrease is expected for water bodies located further downstream. As such, a decrease of only 2.4% will be observed in Watercourse CE06B. Lake SN2 will experience a decrease in average annual flow of 6.5% and adjacent streams may experience a change in average monthly flows ranging from +0.2% (Watercourse SN2-T1) to -81.6% (Watercourse CE13 – fish habitat only at its mouth). For watercourses that will experience a decrease in average annual flow, losses of ichthyofauna habitat and habitat functions are anticipated, but the magnitude of the impacts will vary depending on the quality of the habitat affected. For watercourses with marginal use and several underground portions, few impacts are anticipated.

However, an indirect impact, i.e., a decrease in watercourse flows with a habitat quality ranging from nil to average, could be observed to a certain degree. This decrease is most noticeable in watercourses with very small watersheds, such as CE13, CE18, CE19, and CE23. Their potential for fish habitat is considered to be nil to low due to their shallow depth and subsurface flow in some areas, making upstream habitats inaccessible. Finally, increased erosion would be expected for watercourses that will experience an increased average flow, and therefore a potentially increased flow velocity.

ACCIDENTAL INTRODUCTION OF PETROLEUM HYDROCARBONS, CONTAMINANTS, OR HAZARDOUS MATERIALS INTO THE AQUATIC ENVIRONMENT

The risks of accidental introduction of petroleum hydrocarbons, contaminants, or hazardous materials into the aquatic environment are essentially related to the use, traffic, refuelling, and breakdown of mobile equipment used during construction. Appropriate work practices will be implemented to avoid accidental spills. However, since spills will be managed in accordance with the spill response plan and numerous mitigation measures are in place, the risk of a spill affecting the quality of the aquatic environment is very low; the spill will be contained and contaminated soils will be recovered quickly, as prescribed in the Emergency Response Plan. However, if there is a spill, the degree of contamination will depend on the nature of the contaminants and their concentrations.

CONTAMINATION DUE TO THE USE OF ABRASIVES IN WINTER OR CHEMICAL DUST SUPPRESSANTS.

Access roads and traffic lanes will have to be maintained in a way that ensures the safety of workers and avoids the lifting of dust. The use of ice melters in winter and dust suppressants to ensure the safety of the roadways could result in increased salt concentrations in the surrounding soil. The measure specifying that the use of ice melters will be limited as much as possible will mitigate this impact.

RESIDUAL IMPACT ASSESSMENT

The ecosystem and socioeconomic values of this component are medium as it is of interest for biodiversity conservation and has social and cultural value. However, there are no unique or exceptional habitats or fish species of status in the local biophysical study area. The degree of disturbance is considered low since the effect on the component will be hardly noticeable. The intensity of the impact is therefore low. The spatial scope of fish habitat alteration (TSS and risk of accidental spill) will be specific to the immediate vicinity of the spill. The spatial scope will also be local for the alteration of the water regime since the effects on the component will be limited to some of the watercourses in the local study area. The impact will be felt over a short (TSS emission) to medium (alteration of the water regime) period, i.e., during the entire life of the mine and on a temporary basis. The probability of occurrence is high for the alteration of the water regime and medium for the possibility of TSS entering the watercourses during the construction period. However, the probability of occurrence of contamination by hydrocarbons or other substances is considered low. The significance of the residual impact is therefore low for the emission of TSS and the risk of contamination, and medium for the alteration of the quality of fish habitat and the alteration of the water regime.

Impact on ichthyofauna and benthos during the construction phase		
Nature	Negative	Significance: Risk of accidental spills and emission of TSS - Very low Alteration of the water regime - Low
Ecosystem value	Medium	
Socioeconomic value	Medium	
Degree of disturbance	Low	
Intensity	Low	
Spatial scope	Local	
Duration	Short (TSS emission and risk of accidental spills) to medium (alteration of the water regime)	
Probability of occurrence	Low (risk of accidental spills), medium (emission of TSS) and high (alteration of the water regime)	

7.2.3 IMPACTS ON ICHTHYOFAUNA AND BENTHOS DURING THE OPERATIONS PHASE, AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the operations phase, potential sources of impacts and resulting impacts (**in bold)** that may affect ichthyofauna and benthic invertebrate communities are as follows:

— The presence and operation of new infrastructure, water use and management, transportation and traffic, and the production and management of residual materials.

These sources have the potential to produce the following impacts during the operations phase:

Alteration of habitat quality by:

- the emission of TSS into surface waters;
- the discharge of mining effluent with chemical properties that are different from those of the receiving water environment, which could result in a change in surface water quality;
- the accidental introduction of petroleum hydrocarbons, contaminants, or hazardous materials into the aquatic environment.

MITIGATION MEASURES

The same common and specific mitigation measures recommended in the construction phase will be applied during the operations phase. In addition, to minimize the risk of surface water contamination, measures QUA14 to QUA16 regarding the use of dust suppressants and snow management will be applied. The protection of water quality is governed by several regulations and standards, particularly in the context of mining projects. These will be followed rigorously and the main ones are listed in Appendix 5-2 (NOR08 to NOR10).

Specific measures P01 and P26 will also be implemented.

The follow-up program (NOR13) that will be implemented during the operations phase will ensure that the mitigation measures applied are effective and that the situation can be rectified if necessary (Chapter 13).

DETAILED RESIDUAL IMPACT DESCRIPTION

EMISSION OF TSS INTO SURFACE WATERS

During the operations phase, the presence of infrastructure means that the new surfaces will receive water from precipitation, which will be redirected to the existing network of ditches around the new infrastructure, whose function is to channel the water collected on the mine site to a retention pond. Particles leached from runoff water should not enter the natural watercourse system.

During the operations phase, the presence of accumulation areas implies possible wind erosion of the tailings and accumulated waste rock. This erosion is likely to produce dust that can be transported by the wind over long distances (Section 6.2 on ambient air). Even with the implementation of preventive control measures (compliance with standards and air quality monitoring measures), this dust could be deposited on the water bodies located near the mine site. During high wind events, a thin film of particles forms on top of water bodies and eventually settles to the bottom. These particles may also be carried to watercourses where they may also sediment further downstream. The effect of dust from the accumulation areas is still expected to be small as it is a minimal source of sediment particles, and the surface areas will be kept to a minimum and gradually restored.

Despite the implementation of mitigation measures, it is still possible that particles may be washed into the watercourses at their crossings, particularly during spring melt and heavy rainfall. This influx of particulate matter is likely to alter surface water quality by increasing TSS concentrations and altering the nature of the substrate or the chemical quality of the water. Sediment transport, if it occurs, will be temporary and limited by the mitigation measures applied. The design of the ditches along the access roads allows for the collection of all water potentially loaded with TSS and directs it to the ponds where it will be treated before being returned to the receiving environment. A clean water diversion ditch in the area west of the tailings storage facility captures water and redirects it to the mouth of a permanent watercourse.

PRESENCE OF MINE EFFLUENT

During the operations phase, the main activity that could impact ichthyofauna and benthos is the operation of new infrastructure as well as water use and management. Water management includes collection, analysis, and treatment of mine water (clean and contact), and recirculation to mine processes or discharge to final effluent. In addition, drainage from the new infrastructure will be directed to the final effluent.

The MELCCFP (Directive 019) and MDMER requirements for discharge limits of certain substances will have to be met so that the water quality of the effluent will not be altered from the current situation. Despite the mine's commitment to meet effluent water quality standards and criteria and to work towards the Environmental Discharge Objectives (EDOs), an increase in minor contaminant loadings to the receiving environment downstream of the effluent is anticipated. Habitats within the effluent mixing zone are therefore likely to experience changes in habitat quality. The water treatment plant, which is currently being designed, will be equipped with the necessary equipment to reduce the concentrations considered problematic for the protection of the aquatic environment. This equipment will be designed to treat contact water, meet current discharge standards, and work towards EDOs, according to the best available and applicable technology. It is expected that the influence of the effluent plume, at least in terms of conductivity, will be felt beyond the effluent discharge point.

Changes in water quality can also lead to changes in benthic invertebrate communities, which are the food source for many fish species. These changes can also have a direct effect on fish health depending on the nature of the change (metal contamination of fish flesh). Under the MDMER, an environmental effects monitoring program must be maintained to determine if the mine effluent is having an effect on fish communities and their habitat.

An accidental spill of untreated water could, in exceptional cases, occur via the emergency spillways of the dikes. An accidental spill (e.g., failure of tailings and waste rock management infrastructure, failure of processing equipment) could also result in an accidental release of untreated contaminated water. However, this is unlikely to occur and is a technological risk that is addressed in Chapter 12 – Accident Risk Management. The magnitude of these spills is difficult to quantify as it will depend on the volume and quality of the water spilled. In the short term, water quality will be altered until the problem is resolved (repairing the failure, sealing the breach, pumping the water to another pond, etc.). Depending on the volume of water discharged and the TSS concentration, the substrate composition of the receiving water bodies could be altered, resulting in habitat alteration.

ACCIDENTAL INTRODUCTION OF PETROLEUM HYDROCARBONS, CONTAMINANTS, OR HAZARDOUS MATERIALS INTO THE AQUATIC ENVIRONMENT

Throughout operations, there will be a risk of accidental spills of petroleum hydrocarbons related to the use and breakdown of mobile equipment. Despite the implementation of preventive and control measures, the risk of accidental spills will remain during the various work and operating activities at the mine site. As for the construction phase, spills can only be caused by breakdowns of mobile equipment that contain a limited quantity of petroleum products; as the entire site is surrounded by water management infrastructure, the dispersion of products in the environment will be limited.

The operations phase will produce residual materials and hazardous products that will be stored and managed off-site. The residual materials will be stored according to current standards to prevent any water contamination that could affect sediments.

RESIDUAL IMPACT ASSESSMENT

The ecosystem and socioeconomic values of this component are medium. The degree of disturbance is rated as medium, and the impact is of medium intensity. The spatial scope of the impact will be specific. The impact will be felt over a short period for spills or over a long period for the introduction of TSS since the effluent will flow throughout the life of the mine and until the post-closure stage. The probability of occurrence is low for accidental spills or the introduction of TSS, but high for effluent effects. The significance of the residual impact is thus low for accidental spills and sediment transport, and medium for the increase in effluent flow. The monitoring program that will be implemented will help control the effluent's impacts on the receiving environment through the application of corrective measures if necessary.

<table>
<tr><th colspan="3">Impact on ichthyofauna and benthos during the operations phase</th></tr>
<tr><td>Nature</td><td>Negative</td><td rowspan="8">Significance:
Risk of accidental spills and introduction of TSS - Low
Effluent discharge - Medium</td></tr>
<tr><td>Ecosystem value</td><td>Medium</td></tr>
<tr><td>Socioeconomic value</td><td>Medium</td></tr>
<tr><td>Degree of disturbance</td><td>Medium</td></tr>
<tr><td>Intensity</td><td>Medium</td></tr>
<tr><td>Spatial scope</td><td>Specific</td></tr>
<tr><td>Duration</td><td>Short (risk of accidental spill and TSS) to medium (effluent discharge)</td></tr>
<tr><td>Probability of occurrence</td><td>Low (risk of accidental spill and TSS) to high (effluent discharge)</td></tr>
</table>

7.2.4 IMPACTS ON ICHTHYOFAUNA AND BENTHOS DURING THE CLOSURE PHASE, AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the closure phase, potential sources of impacts and resulting impacts (**in bold**) that may affect ichthyofauna and benthic invertebrate communities are as follows:

— Final restoration, production and management of residual and hazardous materials.

These sources have the potential to produce the following impacts during the construction phase:

Habitat alteration by:

— the accidental introduction of petroleum hydrocarbons, contaminants, or hazardous materials into the aquatic environment;
— the emission of TSS into surface waters.

Improving habitat quality by:

— altering the water regime;
— Improving surface water quality.

MITIGATION MEASURES

The same common and specific mitigation measures recommended for the construction and operations phases will be applied during the closure phase, when applicable. Measure NOR14 will also be implemented as part of the post-restoration activities.

DETAILED RESIDUAL IMPACT DESCRIPTION

ACCIDENTAL INTRODUCTION OF PETROLEUM HYDROCARBONS, CONTAMINANTS, OR HAZARDOUS MATERIALS INTO THE AQUATIC ENVIRONMENT

At the end of mining operations, all buildings and infrastructure will be dismantled. Mobile equipment will be used for these operations. Thus, to avoid altering the quality of the ichthyofauna and benthos habitat, measures will have to be taken so that no residual or dangerous material reaches the aquatic environment during this work. The application of the planned preventive measures should ensure that this impact is negligible. In addition, the site characterization planned as part of the restoration will verify the presence of contaminated soils and propose rehabilitation measures.

EMISSION OF TSS INTO SURFACE WATERS

During the closure phase, access roads linked to the water management facilities will remain in place. Impacts associated with the use of these roads by mobile maintenance equipment will be the same as in the operations phase.

ALTERATION OF THE WATER REGIME

Restoration of the storage areas will take approximately two years. During this time, the tailings storage facility, waste rock stockpile, and industrial areas will be revegetated, thereby restoring surface runoff conditions. In addition, pumping activities will be phased out and dikes, ponds, and ditches will be progressively restored over a 10-year period to allow gravity flow of water to the nearest receiving watercourses, depending on the topography. Overall, the site's water regime will tend towards a return to natural conditions. Only a few permanent alterations will remain at the level of drainage and topography. Overall, this return to natural conditions will have a positive impact on aquatic wildlife as gains in habitat and habitat function are expected.

IMPROVEMENT OF SURFACE WATER QUALITY

The cessation of mine operations and final revegetation of the site will have a positive long-term impact on water quality as the discharge of mine effluent will be gradually discontinued. In the early years following site closure and restoration, as water levels stabilize, treatment and discharge of water at the effluent will continue. When test results indicate that the water quality meets the prescribed standards, the ponds and ditches will be emptied and graded and the water will drain naturally. Once the site is fully restored, water quality parameters should return to values relatively similar to those found in local watercourses and water bodies. This improvement in water quality will benefit aquatic wildlife and habitat.

RESIDUAL IMPACT ASSESSMENT

The degree of disturbance is low with a low intensity. Once the closure phase is complete and the rehabilitation work has been carried out, a positive impact on aquatic fauna is expected due to the restoration of habitat with an improvement level considered low. The intensity is considered low and the spatial scope specific for the introduction of TSS into surface waters at the time of the works and for accidental spills. The duration of these impacts will be short. The significance of residual negative impacts on fish is low.

As for the positive impacts, the alteration of the water regime and the improvement of fish habitat will be felt over a long period of time.

<table>
<tr><th colspan="3">Impact on ichthyofauna and benthos during the closure phase</th></tr>
<tr><td>Nature</td><td>Negative/Positive</td><td rowspan="8">Significance:
Risk of accidental spills and emission of TSS - Low

Water regime and surface water quality improvement (restoration) – Positive impact</td></tr>
<tr><td>Ecosystem value</td><td>Medium</td></tr>
<tr><td>Socioeconomic value</td><td>Medium</td></tr>
<tr><td>Degree of disturbance</td><td>Low</td></tr>
<tr><td>Intensity</td><td>Low</td></tr>
<tr><td>Spatial scope</td><td>Specific</td></tr>
<tr><td>Duration</td><td>Short (risk of accidental spills and emission of TSS)</td></tr>
<tr><td>Probability of occurrence</td><td>Low</td></tr>
</table>

7.3 HERPETOFAUNA

Important facts about herpetofauna

Existing conditions

The literature review determined that seventeen species are likely to occur in and around the study area, while inventories completed in 2016, 2017, and 2021 confirmed the presence of eight species (five anurans, two urodeles, and one snake). Only two species likely to occur in the territory are considered to be of status, namely the snapping turtle and the wood turtle. However, they were not detected during the inventories, despite the presence of suitable habitats.

Potential Project Impacts

During the construction phase, impacts are associated with habitat loss and fragmentation, disturbance, risk of collision and mortality, and alteration of habitat quality. Given the mitigation measures that will be implemented, the intensity of the residual impact on herpetofauna is considered low. The spatial scope is specific, given that these impacts occur essentially in the work area, and the duration will be short for disturbance, risk of collision and mortality, and risk of spills, while it will be long for habitat loss. The probability of occurrence is low for risk of spills and high for disturbance, risk of collision and mortality, and loss of habitat. The result is a residual impact of very low significance for the risk of spills, and low for disturbance, the risk of collision and mortality, and the loss of habitat.

In the operations phase, the impacts are associated with disturbance and the risk of collision and mortality, as well as the alteration of habitat quality (spills). The intensity of the impact is considered to be low and its spatial scope specific. Its duration will be medium (disturbance and risk of collision and mortality) since it will be felt during the entire operations period, to short (spills). The probability of occurrence is medium (disturbance and risk of collision and mortality) to low (spills), and the significance of the residual impact will therefore be very low for all aspects considered.

During the closure phase, site rehabilitation should have a positive impact on the restoration of the habitat. However, during the closure work, there remains a risk of spills, disturbance, and collision and mortality, the intensity of which is perceived as low. The spatial scope of these impacts will be specific and their duration is deemed to be short. Finally, the probability of occurrence will be low for the risk of spills and medium for disturbance and the risk of collision and mortality; the significance of the residual impact will be very low.

7.3.1 CURRENT CONDITIONS

As part of this project, inventories covering the various types of herpetofauna (anurans, urodeles, snakes, and turtles) were conducted in 2016, 2017, and 2021. The 2016 study area was larger and encompassed the 2021 study area. The details of this study are presented in the sectorial report in Appendix 7-3. A summary of these details and the results obtained are presented below.

EXISTING LITERATURE

A request for information was sent to the Centre de données sur le patrimoine naturel du Québec (CDPNQ) in 2017 to obtain reports of species of special status present on the territory within a 10 km radius of the project centre. CDPNQ's interactive map was also consulted in 2022 (CDPNQ, 2022).

According to the literature consulted, 17 species of herpetofauna are likely to occur in and around the study area (Table 7-13). The 2016, 2017, and 2021 inventories confirmed the presence of eight (8) of these species (five anurans, two urodeles, and one snake) (Map 7-2; Table 7-13). Although they were observed at low densities, the herpetofauna species recorded are all common species in Quebec. None of the species observed are at the northern limit of their range.

Table 7-13 List of species observed in the study area or likely to occur there

Order	Species	Scientific name	Literature consulted	WSP (2016)	WSP (2017)	WSP (2021)
Anurans	American toad	*Anaxyrus americanus*	X[a,b]	X	-	X
	Wood frog	*Lithobates sylvaticus*	X[a,b]	X	X	X
	Mink frog	*Lithobates septentrionalis*	X[a]	X	-	X
	Northern leopard frog	*Lithobates pipiens*	X[a,b]	-	-	-
	Northern green frog	*Lithobates clamitans melanota*	X[a]	X	X	X
	Bullfrog	*Lithobates catesbeianus*	X[a]	-	-	-
	Spring peeper	*Pseudacris crucifer*	X[a]	X	X	X
Salamanders	Two-lined salamander	*Eurycea bislineata*	X[a]	X	-	-
	Blue-spotted salamander	*Ambystoma laterale*	X[a]	X	-	X
	Four-toed salamander	*Hemidactylium scutatum*	X[c]	-	-	-
	Red-backed salamander	*Plethodon cinereus*	X[a]	-	-	-
	Spotted salamander	*Ambystoma maculatum*	X[a]	-	-	-
	Eastern newt	*Notophthalmus viridescens*	X[a,b]	-	-	-
Squamata	Redbelly snake	*Storeria occipitomaculata*	X[a]	-	-	-
	Common garter snake	*Thamnophis sirtalis*	X[a]	X[d]	-	X
Testudines	Wood turtle	*Glyptemys insculpta*	X[c]	-	-	-
	Snapping turtle	*Chelydra serpentina*	X[c]	-	-	-

a Atlas des amphibiens et reptiles du Québec (2021).
b Entraco (2011).
c The study area is outside the known range of the species, but potential habitat for this species is present.
d Sightings by workers.

ANURAN INVENTORY

The class of anurans (toads, frogs, and tree frogs) was mainly inventoried using the active search method and the acoustic method, which consists of noting and quantifying the songs heard during the breeding period of the various species. (Bouthillier et coll., 2015a; SHNVSL, 2006).

For this inventory, automated recording devices were installed at the edge of potential breeding habitats (Map 2 in the sectorial report in Appendix 7-3). Four (4) *iSwamp®* were installed in 2017 and three (3) *Song Meter Mini Bat Ultrasonic* were installed in 2021. The analysis consisted of establishing a relative index of abundance for each species heard, according to the abundance ratings proposed in the Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs (MELCCFP) protocol (Bouthillier et coll., 2015a).

Acoustic surveys detected the presence of five (5) species, namely the American toad (*Anaxyrus americanus*), the wood frog (*Lithobates sylvaticus*), the mink frog (*Lithobates septentrionalis*), the northern green frog (*Lithobates clamitans melanota*), and the spring peeper (*Pseudacris crucifer*). The spring peeper had the highest index of abundance (3), and most often (12 times).

The presence of five (5) species of anurans was also detected opportunistically during the three years of inventories. These are common species in Quebec and none of the species observed are at the northern limit of their range.

URODELE INVENTORY

For the class of urodeles, the four-toed salamander (*Hemidactylium scutatum*) was particularly targeted as it is probably the only species of urodeles of precarious and vulnerable status likely to occur in the study area. Active nest searches were conducted in suitable habitats during the 2021 egg-laying season, as described in the inventory protocol for four-toed salamanders in Quebec (*Protocole d'inventaire des salamandres à quatre orteils au Québec*) (MFFP, 2019d).

Inventories of stream salamanders were conducted in the spring and summer of 2021 according to the method proposed in the inventory protocol for stream salamanders in Quebec (*Protocole d'inventaire des salamandres de ruisseaux en situation précaire au Québec*) (MFFP, 2019e). Inventory sites were determined in situ, based on observed potential for success.

Forest salamanders were actively searched in the vicinity of the small mammal inventory transects (Map 2 in the sectorial report in Appendix 7-3) in 2021 (Bouthillier et coll., 2015b).

No salamanders were observed during the specific inventories conducted in 2016 and 2021. However, three (3) blue-spotted salamanders were opportunistically observed in ditches intended for the small mammal inventory in both 2016 and 2021.

In 2016, about thirty two-lined salamanders, a common species in Quebec, had been observed during electrofishing inventories and a few individuals were found in Watercourse CE16, connecting Lakes SN5 and SN8. The habitat was characterized by the presence of woody debris, pebbles, rocks, and abundant vegetative cover. These habitat characteristics were not present in the watercourse segments inventoried in 2021.

SNAKE INVENTORY

Two methods were used for the snake inventory: the sampling grid using artificial shelters (shingles) and active search, in accordance with the standardized inventory protocol for snakes in Quebec (*Protocole standardisé d'inventaire des couleuvres au Québec)* (MFFP, 2019b).

Five (5) grids, each with 25 stations, were positioned in potential snake habitats (Map 2 in the sectorial report in Appendix 7-3) in 2021. Visits were divided into two periods, spring and late summer.

Active search method inventories were conducted at the small mammal capture transects in August 2016 (Map 2 in the sectorial report in Appendix 7-3). Where potential shelters were present, searching was also conducted along the edges of water bodies during anuran inventories. Active searches of natural shelters were conducted while travelling between stations. Any opportunistic snake sightings were also noted.

Artificial shelter snake inventories recorded two (2) common garter snakes (*Thamnophis sirtalis*) in 2021. A third common garter snake was detected through active searching and opportunistic observations in 2021. No snakes were recorded in 2016-2017.

WOOD TURTLE INVENTORY

Although the study area is outside the known range of the wood turtle (*Glyptemys insculpta*), a threatened species in Canada according to Schedule 1 of the Species at Risk Act, habitats suitable for the species are present. Therefore, wood turtle inventories were conducted within the designated study areas in 2016-2017 and 2021, as well as in an additional inventory area (highest habitat potential for this species in the area) in 2021. The inventories were conducted along three (3) watercourses, selected by photo-interpretation, that have potential for this species according to the MELCCFP (Giguère et coll., 2011). These watercourses include the Windfall Lake outflow (2017) and two additional watercourses connecting to Lake Sans Nom 2 (SN2) (2017 and 2021).

The method used for the wood turtle inventory is based on the protocol developed by the MELCCFP for this species (MFFP, 2019c). The inventory was conducted in the spring, after the flood period, along previously targeted watercourses (Map 2 in the sectorial report in Appendix 7-3). Each watercourse section was visited three (3) times between late May and June.

During these inventories, particular attention was paid to the presence of the snapping turtle (*Chelydra serpentina*). This species is also listed on Schedule 1 of the Species at Risk Act. Its status is of special concern in Canada.

No opportunistic sightings of turtles (any species) or signs of their presence were noted in 2016, 2017, and 2021.

SPECIES OF SPECIAL STATUS

For the purposes of this project, of the herpetofauna species likely to occur in the territory, the snapping turtle (special concern) and the wood turtle (threatened) are listed on Schedule 1 of SARA. Only the wood turtle is listed as a vulnerable species in Division II of the Regulation respecting threatened or vulnerable wildlife species and their habitats (REFMVH; CQLR chapter E-12.01, r.2). However, they were not detected during the searches, despite the presence of suitable habitats.

The same is true for species likely to be designated as threatened or vulnerable, including the boreal chorus frog (*Pseudacris maculata*) and the four-toed salamander, which have been inventoried but not detected.

7.3.2 IMPACT ON HERPETOFAUNA DURING THE CONSTRUCTION PHASE, AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the construction phase, the potential sources of impacts and resulting impacts (**in bold)** that may affect herpetofauna are as follows:

- Organization of the site, stripping and clearing, surface preparation and access arrangement, construction of works and infrastructure, transportation and traffic, production and management of residual and hazardous materials.

These sources have the potential to produce the following impacts during the construction phase:

Habitat loss and fragmentation by:

- the activities involved in the organization of the site, stripping, and clearing that will result in habitat loss;
- dewatering of drifts and encroachment of watersheds that could influence water volume; the time required for water renewal could be longer in some lakes and have an indirect impact on the habitats located along the edges of these water bodies.

Disturbance and risk of collision and mortality by:

- transportation and traffic of mobile equipment on the site;
- vibration and noise and light emissions during the construction of new infrastructure.

Alteration of habitat quality by:

- the accidental introduction of petroleum hydrocarbons, contaminants, or hazardous materials into surface waters and soil that will contaminate the habitat.

MITIGATION MEASURES

Common mitigation measures QUA01 to QUA04, QUA09, QUA11 to QUA21, NOR07, VEG01 to VEG04, PLA01, and PLA02 will be applied to reduce the impact of stripping and clearing on habitat loss and fragmentation. For impacts related to disturbance and the risk of collision and mortality, mitigation measures AIR01 to AIR04, NOR01 and NOR02, FAU08, and FAU09 will be applied. Finally, mitigation measures QUA06 through QUA08, QUA22 through QUA26, and NOR10 will reduce the project’s impacts on spill risks.

Specific measure P26 will also be implemented for this component.

DETAILED RESIDUAL IMPACT DESCRIPTION

HABITAT LOSS AND FRAGMENTATION

The project has been optimized to minimize ground encroachment and thus limit impacts on terrestrial wildlife, including herpetofauna. However, clearing and grubbing, stripping and excavation, and in-water works (Watercourses CE17, CE18, CE25, and CE27) will cause loss and changes in habitat structure for these species. Habitat loss is also one of the main causes cited for the decline of some amphibian populations (Wind, 1999; Gibbons et al., 2000; Jutras, 2003). The inventories conducted in the inventory areas resulted in the identification of eight herpetofauna species.

Considering the total footprint of the project that could be conducive to the establishment of the eight inventoried species, 136.47 ha of potential habitat will be affected by the project, of which 1.66 ha are temporary losses and 134.81 ha are permanent losses. Thus, the affected environments are the following: 63.29 ha of forest environment (1.88 ha of hardwood forest, 20.60 ha of mixedwood forest, 16.32 ha of softwood forest and 24.49 ha of regeneration and plantation environments), 50.49 ha of wetlands (1.62 ha of tree swamp, 2.93 ha of shrub swamp, 6.06 ha of wooded peatland and 39.88 ha of open peatland), and 22.69 ha of non-forest (anthropized) environments. However, it should be noted that several wetlands and terrestrial environments of interest are located on the periphery of the facilities and may be home to the same species as those identified during the inventories.

No lake is directly impacted by the project. According to modelling, the potential groundwater drawdown zone does not reach the surrounding lakes. However, Pond 1 is partially located in one of the two drawdown zones greater than 1 m. Since this pond receives the mining effluent from the project, no decrease is anticipated.

DISTURBANCE OF POPULATIONS AND RISK OF COLLISION AND MORTALITY

Indirect impacts caused by increased disturbance such as vibration, noise, light, and dust emissions are expected during the construction phase. In addition, collision and mortality risks related to the presence of infrastructure and traffic on the construction site are also possible.

The effect of noise has been shown in the literature to have a potential negative effect on herpetofauna (Sun and Narins, 2005; Tennessen et al., 2014; Kunc and Schmidt, 2019). In fact, noise from infrastructure construction, site traffic, and refuelling and maintenance of mobile equipment could result in avoidance of certain noisy areas, changes in the reproductive success of certain species, and changes in interspecific communication. The threshold at which impacts could be felt is 60 dBA (Shannon et al., 2015). However, the noise caused by the project will not exceed this threshold beyond 700 m from the central point of the emission sources for all scenarios studied. As for vibration, some studies have shown that it can induce immobilization behaviour in some amphibian species (Mazerolle et al., 2005). The main source of vibration during the construction phase of the project will be surface blasting activities. It should be noted, however, that these activities will be carried out on a sporadic basis and will be concentrated in specific areas, such as for the construction of roads and ponds.

In the case of light disturbance, nighttime lighting could disturb herpetofauna (Buchanan, 2006; Gaston and Bennie, 2014). In fact, light can potentially affect the feeding and breeding activities of frogs and salamanders (Wise, 2007). However, given the mitigation measures in place, the residual impact will be limited.

ACCIDENTAL INTRODUCTION OF PETROLEUM HYDROCARBONS, CONTAMINANTS, OR HAZARDOUS MATERIALS INTO THE ENVIRONMENT

As for the risks of accidental spills of petroleum hydrocarbons, they will be mainly associated with the refuelling and breakdown of mobile equipment. However, since spills will be managed in accordance with the spill response plan and given the numerous mitigation and control measures in place, the risk of a spill impacting the environment is very low; the spill will be contained and contaminated soils will be recovered quickly, as prescribed in the Emergency Response Plan (see Chapter 12). However, if there is a spill, the degree of contamination will depend on the nature of the contaminants and their concentrations.

RESIDUAL IMPACT ASSESSMENT

During the construction phase, the potential residual impacts on herpetofauna are related to activities that cause habitat loss, disturbance, the risk of collision and mortality, and the risk of accidental spills of petroleum hydrocarbons into the environment. It should be noted that no species of special status is present in the project's area of influence.

With respect to habitat loss, the intensity of residual impacts on herpetofauna is considered low. This assessment considers the reduction in the degree of disturbance to the component through the project's mitigation measures as well as the application of and compliance with existing standards and regulations, primarily for clearing activities. The degree of disturbance is considered low. In addition, this component has a low ecosystem value due to the small area affected, low species richness, and a low social value (low overall value). The spatial scope of the anticipated residual impacts is established as specific since they are likely to be felt over a small area, i.e., at the infrastructure level. The duration of the impacts is considered to be long since they result from clearing activities that cause permanent loss. The probability of occurrence is considered high. Therefore, the residual impact of habitat loss on the herpetofauna component is defined as low.

With regard to disturbance and the risk of collision and mortality, the residual impact is considered to be of low intensity. The degree of disturbance is considered low since the impact does not significantly alter the component's characteristics, and so it will maintain its integrity. The spatial scope of the anticipated residual impacts is established as specific since they will be felt over a small area, i.e., at the infrastructure level. The duration of the impacts is considered to be short, i.e., during the construction period, so the impacts will be discontinuous. The probability of occurrence is considered medium since the construction activities will cause a disturbance due to noise. Therefore, the residual impact of disturbance on the herpetofauna component is defined as low.

The magnitude of potential residual impacts on herpetofauna is related to the risk of accidental spills of hazardous materials into the environment and is considered low. This assessment considers the reduction of the degree of disturbance to the component through the combination of project optimization and mitigation measures, as well as the application of and compliance with applicable standards and regulations, thereby making the degree of disturbance low. The spatial scope of the residual impacts is established as specific since the impacts are likely to be felt over a small area within the work zone. The duration of the impacts is considered to be short as they result from specific activities with a fixed duration in the construction schedule. The probability of occurrence is considered low. Therefore, the residual impact on the herpetofauna component is defined as very low.

Impact on herpetofauna during the construction phase		
Nature	Negative	Significance: Risk of accidental spills - Very low Risk of disturbance, collision, mortality, and habitat loss - Low
Ecosystem value	Low	
Socioeconomic value	Low	
Degree of disturbance	Low	
Intensity	Low	
Spatial scope	Specific	
Duration	Long (habitat loss), short (disturbance, risk of disturbance, collision and mortality, risk of accidental spills)	
Probability of occurrence	Low (risk of accidental spills), medium (risk of disturbance, collision and mortality) and high (habitat loss)	

7.3.3 IMPACT ON HERPETOFAUNA DURING THE OPERATIONS PHASE, AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the operations phase, the potential sources of impacts and resulting impacts (**in bold)** likely to affect herpetofauna are as follows:

— The presence and operation of new infrastructure, water use and management, transportation and traffic, and the production and management of residual and hazardous materials.

These sources may cause the following impacts during the operations phase:

Disturbance and risk of collision and mortality by:

— transportation and traffic of mobile equipment on the site;

— vibration and noise and light emissions from existing infrastructure and activities.

Alteration of habitat quality by:

— the accidental introduction of petroleum hydrocarbons, contaminants, or hazardous materials into surface waters and soil that will contaminate the habitat.

MITIGATION MEASURES

The mitigation measures listed for the construction phase will also be applied to mitigate impacts related to disturbance, the risk of collision and mortality, and the risk of spills.

DETAILED RESIDUAL IMPACT DESCRIPTION

DISTURBANCE OF POPULATIONS AND RISK OF COLLISION AND MORTALITY

The impact of the presence of the facilities and of mobile equipment traffic (disturbance and risk of collision and mortality) will be similar to what was assessed during the construction phase. However, the number of workers and mobile equipment will be significantly reduced. Traffic will also be restricted to designated roads. Noise levels will not exceed 60 dBA beyond a distance of 1 km centred on the noise sources for all scenarios studied.

ACCIDENTAL INTRODUCTION OF PETROLEUM HYDROCARBONS, CONTAMINANTS, OR HAZARDOUS MATERIALS INTO THE ENVIRONMENT

As for the potential for accidental hydrocarbon spills, since they will be managed in accordance with the spill response plan and with numerous mitigation and control measures in place, the risk of a spill impacting the environment is very low; the spill will be contained and contaminated soils will be recovered quickly, as prescribed in the Emergency Response Plan (see Chapter 12). However, if there is a spill, the degree of contamination will depend on the nature of the contaminants and their concentrations.

RESIDUAL IMPACT ASSESSMENT

During the operations phase, the residual impacts are disturbance, the risk of collision and mortality, and the risk of accidental spills.

The impacts are essentially the same as during the construction period, with the exception of the duration (evaluated as medium for disturbance and the risk of collision and mortality, and short for the risk of accidental spills), and the probability of occurrence (evaluated as low for the risk of accidental spills and medium for disturbance and the risk of collision and mortality). Therefore, the residual impact is defined as very low.

Impact on herpetofauna during the operations phase		
Nature	Negative	Significance: Very low
Ecosystem value	Low	
Socioeconomic value	Low	
Degree of disturbance	Low	
Intensity	Low	
Spatial scope	Specific	
Duration	Short (risk of accidental spills) to medium (disturbance, risk of collision and mortality)	
Probability of occurrence	Low (risk of accidental spills), medium (disturbance, risk of collision and mortality)	

7.3.4 IMPACT ON HERPETOFAUNA DURING THE CLOSURE PHASE, AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the closure phase, potential sources of impacts and resulting impacts (**in bold**) likely to affect herpetofauna are as follows:

— Final restoration, as well as the production and management of residual and hazardous materials.

These sources have the potential to produce the following impacts during the closure phase:

Habitat creation by:

— site rehabilitation.

Disturbance and risk of collision and mortality by:

— mobile equipment transportation and traffic for site rehabilitation.

Alteration of habitat quality by:

— the accidental introduction of petroleum hydrocarbons, contaminants, or hazardous materials into surface waters and soil that will contaminate the habitat.

MITIGATION MEASURES

In the closure phase, all mitigation measures listed for the construction and operations phases will be applied when they address the same impact sources.

DETAILED RESIDUAL IMPACT DESCRIPTION

DISTURBANCE OF POPULATIONS AND RISK OF COLLISION AND MORTALITY

Dismantling activities, including mobile equipment traffic, will cause disturbance and risk of collision and mortality. Mortality risks are also associated with the storage, handling, and management of residual materials. The anticipated impacts are similar to those assessed during the construction and operations phases, if not smaller in magnitude.

RISK OF ACCIDENTAL INTRODUCTION OF PETROLEUM HYDROCARBONS, CONTAMINANTS, OR HAZARDOUS MATERIALS INTO THE ENVIRONMENT

As for the risk of accidental hydrocarbon spills, since they will be managed in accordance with the spill response plan and with numerous mitigation and control measures in place, the risk of a spill impacting the environment is very low; the spill will be contained and contaminated soils will be recovered quickly, as prescribed in the Emergency Response Plan (see Chapter 12). However, if there is a spill, the degree of contamination will depend on the nature of the contaminants and their concentrations.

HABITAT RESTORATION

Following decommissioning, the habitats will be restored and can again be used by herpetofauna. It should be noted that the restoration will be gradual. Initially, the vegetation will be herbaceous, but over the years, trees and shrubs will gradually become established.

RESIDUAL IMPACT ASSESSMENT

In the closure phase, the residual impacts are related to disturbance, the risk of collision and mortality, and the risk of accidental spills. Since the same mitigation measures as those applied in the construction and operations and maintenance phases will be in effect in the operations phase, the residual impacts will be the same, i.e., very low.

Once the closure phase is over and the rehabilitation work has been completed, a positive impact is expected due to habitat restoration. The spatial scope is specific, with a long duration.

Impact on the herpetofauna during the closure phase		
Nature	Negative/Positive	Significance: Very low Habitat restoration – Positive impact
Ecosystem value	Low	
Socioeconomic value	Low	
Degree of disturbance/enhancement	Low	
Intensity	Low	
Spatial scope	Specific	
Duration	Short	
Probability of occurrence	Low (risk of accidental spills), medium (disturbance, risk of collision and mortality)	

7.4 AVIFAUNA

Important facts about avian fauna

Existing conditions

The various inventories conducted in 2016, 2017, and 2021 have identified 12 species of waterfowl and other aquatic birds, seven species of birds of prey and corvids, 56 species of land and forest birds, and 30 species of wetland birds and shorebirds. In addition, 5 species of special status are likely to occur in the study area: bald eagle (*Haliaeetus leucocephalus*), common nighthawk (*Chordeiles minor*), rusty blackbird (*Euphagus carolinus*), olive-sided flycatcher (*Contopus cooperi*), and Canada warbler (*Cardellina canadensis*).

Potential Project Impacts

During the construction phase, impacts are associated with habitat loss and fragmentation, disturbance and risk of collision and mortality, and alteration of habitat quality. Given the mitigation measures that will be implemented, the intensity of the residual impact on bird species in general is considered low for all anticipated impacts, while it is medium for species of status. The spatial scope is specific, given that these impacts occur essentially in the work area, and the duration will be short for disturbance, risk of collision and mortality, and risk of spills, while it will be long for habitat loss. The probability of occurrence is low for risk of spills and high for disturbance and risk of collision and mortality, as well as for habitat loss. The result, for birds in general, is a residual impact of very low significance for the risk of spills and disturbance/collision/mortality, and low for the loss of habitat. For species of special status, the significance of the residual impact is low for risk of spills and disturbance/risk of collision/mortality, and medium for habitat loss.

In the operations phase, the impacts are associated with disturbance and the risk of collision and mortality, as well as the alteration of habitat quality (spills). The intensity of the impact is considered low for birds in general but medium for species of status. The spatial scope remains specific for the two avian groups considered as the impact is mainly concentrated within the area of activity. The duration will be medium for disturbance and risk of collision and mortality since it will be felt during the entire operations period, and short for the risk of accidental spills. The probability of occurrence is high (disturbance and risk of collision and mortality) and low (spills) for the two avian groups considered. As a result, the residual impact to birds in general will be very low. For species of special status, the significance of the impact will be medium (disturbance and risk of collision and mortality) and low (spills).

During the closure phase, the rehabilitation of the site, in conjunction with the restoration of the habitat, will have a positive impact on birds in general and on species of special status. However, during the closure work, there remains a risk of spills and collision and mortality, the intensity of which is considered low for birds in general and medium for species of special status. The spatial scope of these impacts will be specific and their duration is deemed to be short. Finally, the probability of occurrence will be medium (disturbance and risk of collision and mortality) to low (spills). This results in a very low significance of residual impact for birds in general, and low significance for species of status.

7.4.1 CURRENT CONDITIONS

As part of this project, several avifauna inventories were conducted, including of nesting waterfowl and nesting landbirds, as well as a targeted search for species at risk.

The details of this study are presented in the sectorial report in Appendix 7-4. A summary of these details and the results obtained are also presented below.

EXISTING LITERATURE

A literature review was conducted to provide a picture of the avian fauna likely to use the study area. To do so, a request for information was sent to the CDPNQ. The data available from the CDPNQ via the interactive map available online was also consulted. Data from the second Quebec Bird Breeding Atlas (QBBA), data available through the online platform of eBird Quebec, the Canadian Wildlife Service (CWS), and the Christmas Bird Count were also consulted.

Finally, a literature review was carried out to gather any relevant data or information on mining and industrial projects located in the surroundings of the study area. The same research was done for projects from other agencies (government, clubs, associations, etc.).

INVENTORY OF WATERFOWL, OTHER AQUATIC BIRDS, BIRDS OF PREY, AND CORVIDS

Waterfowl and aquatic bird inventories were conducted using two complementary methods:

- helicopter overflights;
- ground observation from stations located on the edge of potential resting and nesting sites.

Aerial surveys were conducted to cover all water bodies during the nesting period and for brood observation in 2016. Potential nesting areas for the bald eagle, a species of special status, were also surveyed (Map 2 in the sectorial report in Appendix 7-4). These environments were overflown at low altitude and reduced speed, as proposed by the method used by Environment and Climate Change Canada in the Black Duck Joint Venture (Bordage et al., 2003).

For ground stations, the methodological approach used was that of standardized area counts (Environment Canada, 2007), which consists of recording the presence of all individuals of species encountered during a visit. The inventories were conducted during the nesting period. To accomplish this, seven (7) observation stations were set up in June 2021 along the edges of water bodies.

During all inventories conducted in 2016, 2017, and 2021, a total of 12 species of waterfowl and other aquatic birds were observed. Of these, six (6) species were confirmed as nesting: Canada goose (*Branta canadensis*), American black duck (*Anas rubripes*), common teal (*Anas crecca*), ring-necked duck (*Aythya collaris*), common goldeneye (*Bucephala clangula*) and sandhill crane (*Grus canadensis*). No species of special status were observed.

A total of 49 waterfowl (37 diving ducks, nine dabbling ducks, three geese) were counted in the surveyed areas (Table 7-14). Considering the waterfowl indicated pairs calculated with the 2016 inventory data, overall, diving ducks (5.5 IP/25 km²) were observed in slightly higher densities than dabbling ducks (4.3 IP/25 km²). Among diving ducks, the ring-necked duck is the species with the highest density (2.5 IP/25 km²) compared to the other three species listed (1.0 IP/25 km²). As for dabbling ducks, only the black duck was inventoried. It is undoubtedly the waterfowl species with the highest density (4.3 IP/25 km²). For Canada goose, 1.0 IP/25 km² was observed. It should also be mentioned that a nest was discovered in the south plot.

The dominant species of Anatidae in the study area (black duck and ring-necked duck) are the same as those generally found in the region (Lemelin et coll., 2004). The densities of diving and dabbling ducks inventoried at the regional scale are also similar to those obtained in the study area.

For the duck brood survey that took place in July 2016, the density was found to be very low in the study area. In fact, only four broods belonging to four species of ducks have been inventoried: common goldeneye, ring-necked duck, black duck and common teal.

Table 7-14 Abundance and density of waterfowl and other aquatic bird species inventoried during the May 24, 2016, helicopter nesting pair survey.

Group	Species	North plot					South plot					Total			
		Abundance (number of individuals)				Density (IP/25 km²)	Abundance (number of individuals)				Density (IP/25 km²)	Abundance (number of individuals)		Density (IP/25 km²)	
		M	F	U	Total		M	F	U	Total		Mean	Standard deviation	Mean	Standard deviation
Goose	Canada goose	0	0	0	0	0	0	0	3	3	2	1.5	2.1	1.0	1.4
	Sub-total	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*3*	*3*	*2*	*1.5*	*2.1*	*1.0*	*1.4*
Dabbling duck	American black duck	0	0	4	4	4	0	0	5	5	4.5	4.5	0.7	4.3	0.4
	Sub-total	*0*	*0*	*4*	*4*	*4*	*0*	*0*	*5*	*5*	*4.5*	*4.5*	*0.7*	*4.3*	*0.4*
Diving duck	Ring-necked duck	2	2	0	4	2	10	3	0	14	3	9.0	7.1	2.5	0.7
	Common goldeneye	2	1	0	3	2	0	0	0	0	0	1.5	2.1	1.0	1.4
	Common merganser	0	0	2	2	0	2	0	10	12	2	7.0	7.1	1.0	1.4
	Hooded merganser	2	0	0	2	2	0	0	0	0	0	1.0	1.4	1.0	1.4
	Sub-total	*6*	*3*	*2*	*11*	*6*	*12*	*3*	*10*	*26*	*5*	*18.5*	*10.6*	*5.5*	*0.7*
	Total	**6**	**3**	**6**	**15**	**10**	**12**	**3**	**18**	**34**	**11.5**	**24.5**	**13.4**	**10.8**	**1.1**
Other water birds	Bonaparte's gull	0	0	1	1	1	0	0	2	2	1	1.5	0.7	1.0	0.0
	Common loon	0	0	2	2	1	0	0	4	4	2	3.0	1.4	1.5	0.7
	Sandhill crane	0	0	3	3	2	0	0	2	2	1	2.5	0.7	1.5	0.7

IP: indicated pair
M: male, F: female, U: sex unknown

During all inventories conducted in 2016, 2017 and 2021, a total of six (6) species of birds of prey were observed, including Northern harrier (*Circus hudsonius*), red-tailed hawk (*Buteo jamaicensis*), American kestrel (*Falco sparverius*), merlin (*Falco columbarius*), long-eared owl (*Asio otus*), and bald eagle (*Haliaeetus leucocephalus*), a species of special status. Common raven (*Corvus corax*) was also observed. The nesting status of these species has not been confirmed.

Only one pair of long-eared owls was confirmed in the study area. Potential pairs of Northern harriers, American kestrels, red-tailed hawks, merlins, and common ravens were seen in 2016 and/or 2021 (Tables 7-15 and 7-16).

Table 7-15 Bird of prey and corvid observations in the study area in 2016 and 2017

Species	Adult	Immature	Minimum distance for the determination of potential pairs (km	Number of pairs	
				Potential	Confirmed
Northern harrier	3	0	6.0	1	0
Bald eagle	0	4	10.0	0	0
American kestrel	2 (1 male, 1 female)	0	2.0	1	0
Red-tailed hawk	1	0	4.0	1	0
Long-eared owl	2 (1 pair)	0	N/A	0	1
Total	**7**	**4[a]**	-	**3**	**1**
Common raven	3	0	5.0	1	0

a One individual observed in 2017
N/A: Not applicable.

Table 7-16 Bird of prey and corvid observations in the study area in 2021

Species	Adult	Immature	Minimum distance for the determination of potential pairs (km)	Number of pairs	
				Potential	Confirmed
Northern harrier	1 male	0	6.0	1	0
American kestrel	1 individual	0	2.0	1	0
Merlin	1 individual	0	N/A	1	0
Total	**3 individuals**	**0**	**-**	**3**	**0**
Common raven	13 individuals	0	5.0	2	0

N/A: Not applicable

FOREST LAND BIRD INVENTORY

Breeding passerines were primarily inventoried using the listening station method (Blondel et al., 1970; Environment Canada, 1997 and 2007). Stations were divided into four habitat categories: mature stands, young stands, regenerating softwood stands, and regenerating mixedwood stands. To account for the breeding periods of potentially present species, 63 stations were visited in June 2016 and 2021.

During all inventories conducted in 2016, 2017, and 2021, a total of 56 species of land and forest birds were observed, including 48 species in 2016 and 40 species in 2021. In total, nesting was confirmed for nine (9) species. Among the land and forest birds observed, the presence of four species of special status was confirmed, namely the common nighthawk (*Chordeiles minor*), the olive-sided flycatcher (*Contopus cooperi*), the Canada warbler (*Cardellina canadensis*), and the rusty blackbird (*Euphagus carolinus*).

Estimated populations are obtained by multiplying the IP density/ha by the area associated with each habitat. Estimated land bird populations in the study area averaged 4,055 IP (2,571–5,540 IP) in 2016 and 4,894 IP (2,782-7,007 IP) in 2021.

Table 7-17 Estimated mean density and population size of land birds in the study area in 2016 and 2021

Type of habitat	2016		2021		Area of the habitat (ha) [a]	Estimated population (IP)					
						2016			2021		
	Mean density (IP/ha)	Standard deviation	Mean density (IP/ha)	Standard deviation		Min.	Ave.	Max.	Min.	Ave.	Max.
Adult	2.99	1.12	3.34	1.05	253.52	476	759	1,042	581	846	1,112
Young	3.73	1.22	4.16	1.86	490.33	1,235	1,831	2,427	1,128	2,039	2,950
Regeneration	3.16	1.31	4.33	2.02	463.76	860	1,465	2,071	1,073	2,009	2,945
Total	**3.27**	**1.26**	**4.19**	**1.90**	**1,207.61**	**2,571**	**4,055**	**5,540**	**2,782**	**4,894**	**7,007**

Min.: minimum, Ave. : average, Max. : maximum.

a: The area of habitat presented is that of the 2021 inventory area corresponding to the biophysical environment study area.

Note: The mean and standard deviation values are calculated on all stations, all habitats combined.

WETLAND-ASSOCIATED LAND BIRDS AND SHOREBIRDS

Selected wetlands were visited to verify their use by passerine species and shorebirds. The presence of species at risk was also confirmed during these visits. The transect inventory method (linear abundance index) was used. The species targeted by this inventory are those that use wetlands for nesting and feeding, as well as species found on the edges of these environments.

In 2016, 17 transects were walked, in open bogs and bordering a pond. In 2021, 12 transects were surveyed in open bogs and wooded wetlands along a watercourse.

During all inventories conducted in 2016, 2017, and 2021, a total of 30 species of wetland-associated land birds and shorebirds were observed within the inventoried wetlands, including 14 in 2016 and 26 in 2021. One species of special status was spotted, the rusty blackbird.

Estimated populations are obtained by multiplying the IP density/ha by the area associated with each habitat. Of the wetlands analyzed, open bogs are the type with the largest area. In fact, these environments cover 770.72 ha of the study area, while the mainly wooded wetlands represent an area of 277.60 ha (Table 7-18). Estimated land bird populations associated with open bogs averaged 422 IP in 2016 and 1,291 IP in 2021. For predominantly wooded wetlands, the estimated populations are 266 IPs in 2016 and 78 IPs in 2021.

Table 7-18 Estimated mean density and population size of wetland-associated birds in the inventory areas in 2016 and 2021

Type of habitat	2016		2021		Area of the habitat (ha) [a]	Estimated population (IP)					
	Mean density (IP/ha)	Standard deviation	Mean density (IP/ha)	Standard deviation		2016			2021		
						Min.	Ave.	Max.	Min.	Ave.	Max.
Open peatland	0.55	0.51	1.68	1.00	770.72	28	422	816	520	1,291	2,062
Mostly wooded wetland	0.96	0.73	0.28	0.40	277.60	63	266	469	0	78	188
Wooded and open wetland	0.14	-	1.45	0.39	-	-	-	-	-	-	-
Open bog and shallow water	12.63	-	-	-	-	-	-	-	-	-	-
Total	**1.33**	**2.96**	**1.25**	**0.89**	-	91	688	1,285	520	1,369	2,250

Min. : minimum, Ave. : average, Max. : maximum.
a: The area of habitat presented is that of the 2021 inventory area corresponding to the biophysical environment study area.
Habitat area and populations were estimated only for homogeneous environments.

SPECIES WITH A VULNERABLE STATUS

Based on the literature and known distributions, 19 species with a vulnerable status have been observed or are likely to be observed within 100 km of the study area on an annual basis. The list of these species, their status, and their preferred habitat are presented in the sectorial report in Appendix 7-4.

According to two Orders Amending Schedule 1 to the Species at Risk Act (SARA) that were issued on February 3, 2023, changes regarding the status of certain bird species have been made. Thus, a new species, the Harris's sparrow, has been added to the list of species of special concern. This species, which nests in northern Canada, could be observed in rare cases during migration. Therefore, since the species does not nest in the area, it does not represent an issue for the project. Among other changes, the peregrine falcon is no longer listed as a species of special concern in Schedule 1. It should be noted that this species does not nest in the study area. Finally, the threatened species status was changed for two species observed in the study area, the common nighthawk and the olive-sided flycatcher. They are now listed as species of special concern.

During the 2016 and 2017 field campaigns, five species of vulnerable status were observed at the exploration site (Maps 7-3 through 7-5), including bald eagle, common nighthawk, rusty blackbird, olive-sided flycatcher, and Canada warbler. In 2021, only three species of vulnerable status were observed during the field campaigns, namely the common nighthawk, the rusty blackbird, and the olive-sided flycatcher.

In addition to the methods described above, other specific inventories were conducted to validate the presence of vulnerable species. These methods are detailed in this section, as are the main results obtained. This section presents the species that have been identified during the nesting period, as well as those that have been inventoried and, therefore, are most likely to be impacted by the project. In addition, although bank swallows were not observed, they could use the borrow pits in the biophysical study area if the slopes were suitable for their settlement. It was therefore considered in the analysis.

Zone d'étude locale du milieu biophysique/ *Biophysical environment local study area*

Hydrographie / *Hydrography*

- Cours d'eau permanent / *Permanent watercourse*
- Cours d'eau permanent partiellement souterrain / *Partially underground permanent watercourse*
- Cours d'eau intermittent / *Intermittent watercourse*
- Cours d'eau intermittent partiellement souterrain / *Partially underground intermittent watercourse*
- Cours d'eau souterrain / *Underground watercourse*
- Fossé de drainage / *Drainage ditch*
- Canal / *Canal*
- Plan d'eau / *Waterbody*

Infrastructure / *Infrastructure*

- Ligne de transport d'énergie électrique / *Electric power line*
- Route forestière / *Forest road*
- Route d'accès / *Access road*

Empiètement du projet / *Project Encroachment*

- Empietement permanent / *Permanent encroachment*
- Empiètement temporaire /*Temporary encroachment*

Végétation / *Vegetation*

- Milieu forestier / *Forest Environment*
- Milieux humide et hydrique / *Wetlands and Hydrous Environment*
- Non forestier

Faune aviaire / *Avian Fauna*

- Observation de l'Engoulevent d'Amérique (2016-2017, 2021) / *Common nighthawk observation (2016-2017, 2021)*
- Habitat potentiel de l'engoulevent d'Amérique / *Common Nighthawk Potential Habitat* (1 375,1 ha)

Empiètement du projet sur l'habitat potentiel de l'engoulevent d'Amérique / *Project Encroachment on Potential Common Nighthawk Habitat*

Permanent / *Permanent* (85,7 ha)

Temporaire / *Temporary* (1,3 ha)

OSISKO MINIÈRE OSISKO

Projet minier Windfall - Étude d'impact sur l'environnement / *Windfall Mining Project - Environmental Impact Assessment*

Site minier Windfall, Eeyou Istchee Baie-James (Québec) / *Windfall Mining Site, Eeyou Istchee Baie-James (Quebec)*

Carte 7-4 / *Map 7-4*
Empiètement du projet sur l'habitat potentiel de l'engoulevent d'Amérique / *Project Encroachment on Common Nighthawk Potential Habitat*

Sources :
CanVec+, 1/50 000, RNCan, 2014
MERN, AQréseau+, réseau routier, 2020

0 225 450 m

MTM, Fuseau 9 / *Zone 9*, NAD83

2023-03-23

Préparée par / *Preparation* : É. D'Astous
Dessinée par / *Drawing* : C. Thériault
Vérifiée par / *Verification* : M.-H. Brisson
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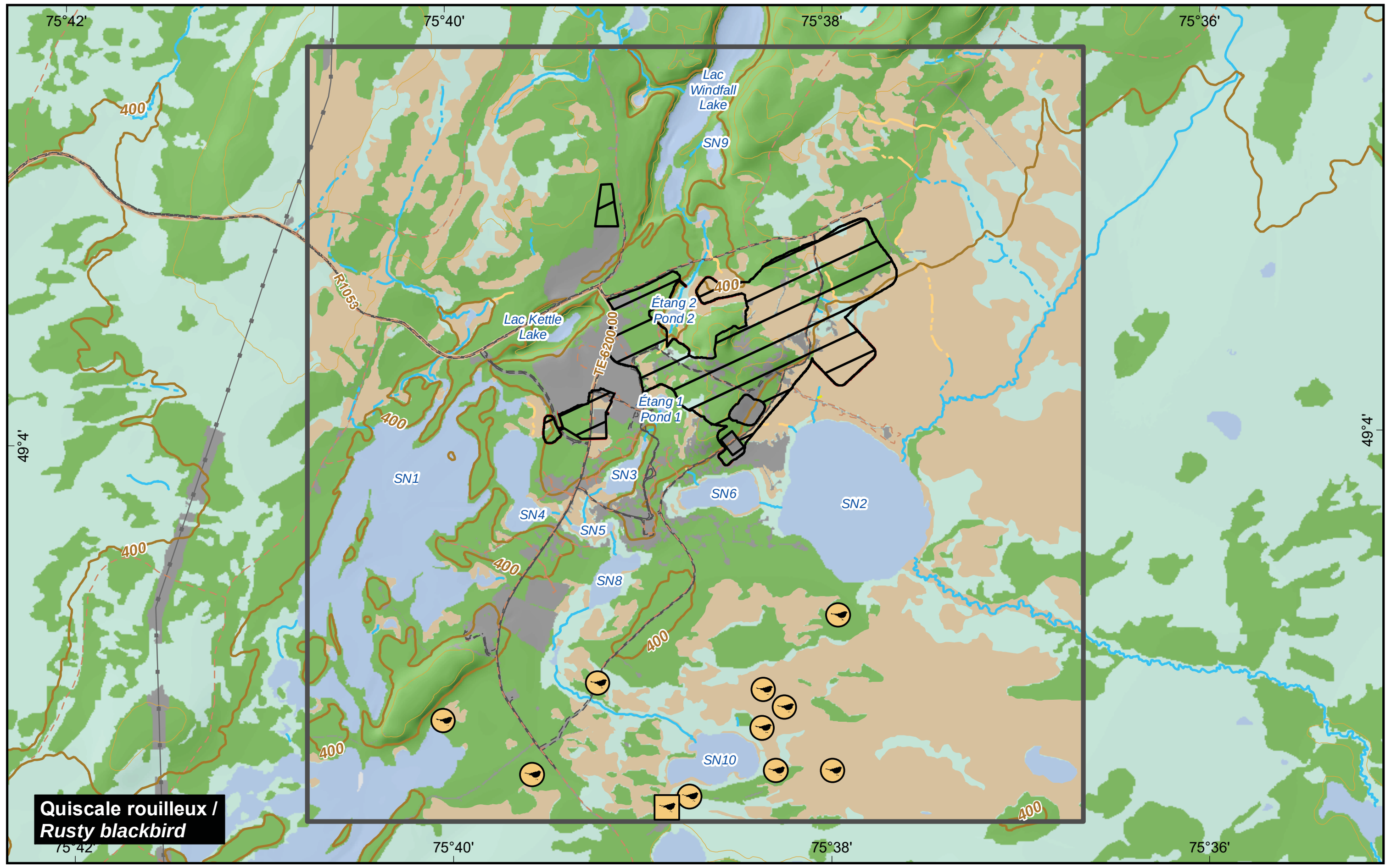

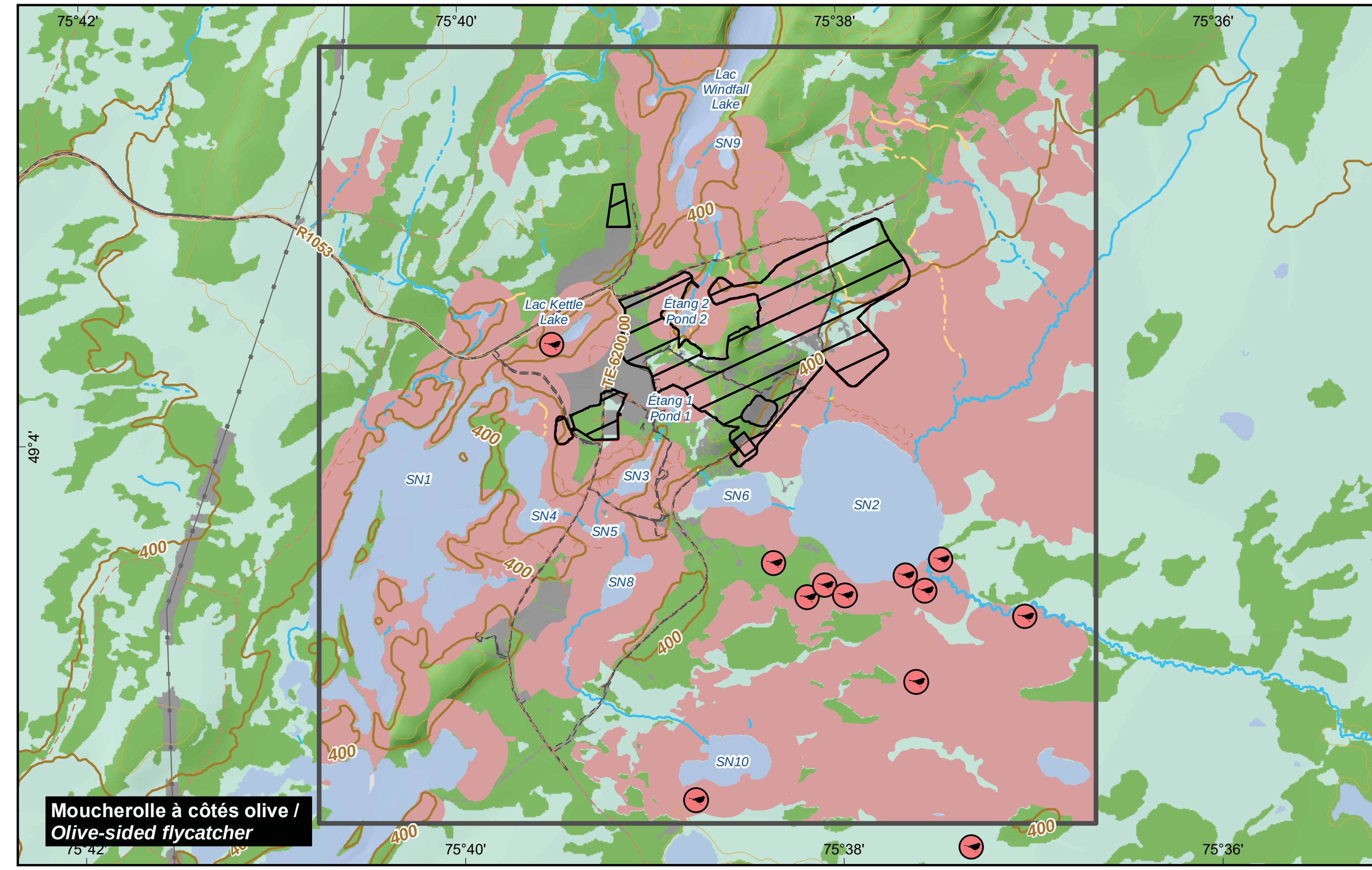

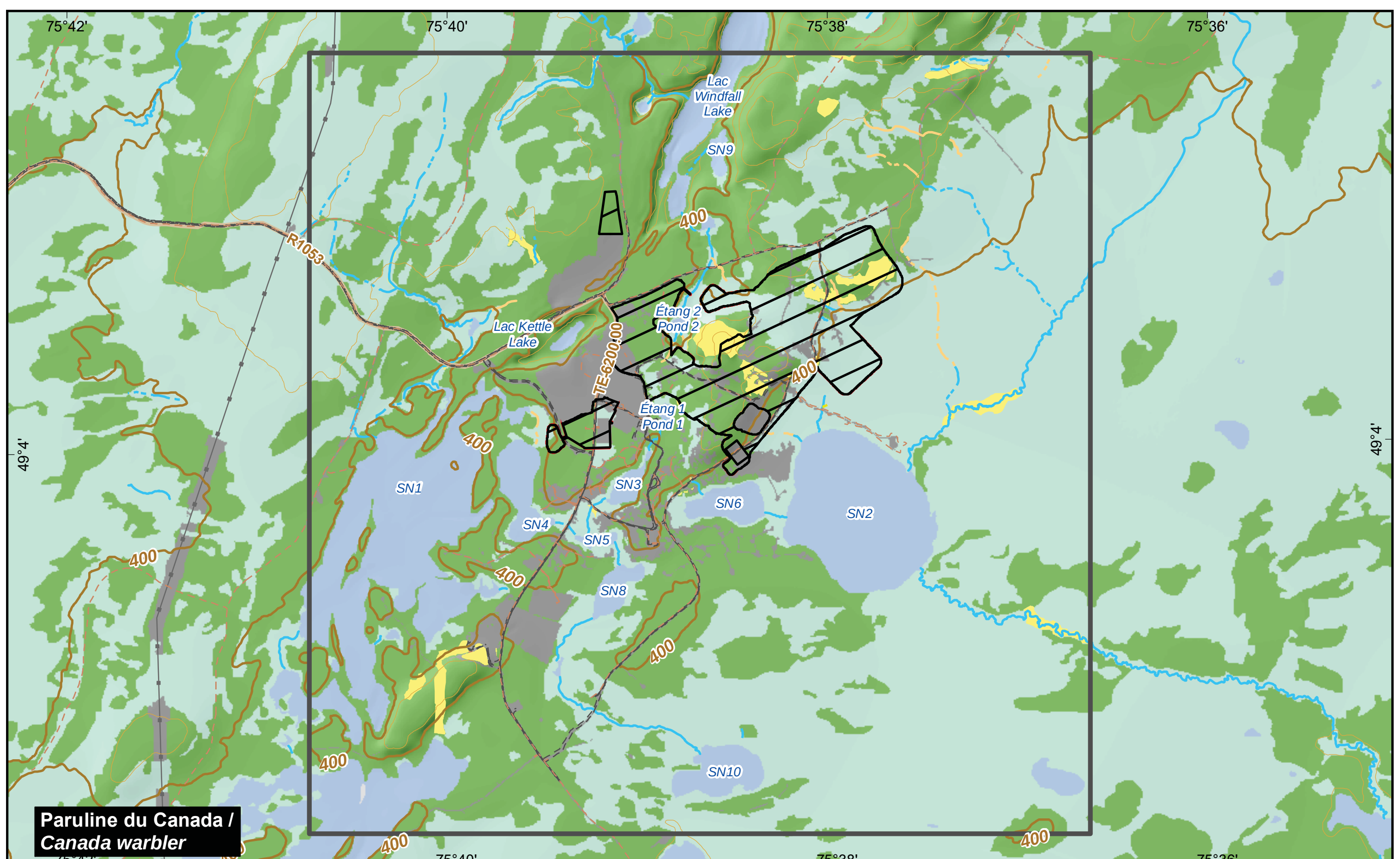

Zone d'étude locale du milieu biophysique/ *Biophysical environment local study area*

Hydrographie / *Hydrography*

- Cours d'eau permanent / *Permanent watercourse*
- Cours d'eau permanent partiellement souterrain / *Partially undeground permanent watercourse*
- Cours d'eau intermittent / *Intermittent watercourse*
- Cours d'eau intermittent partiellement souterrain / *Partially undeground intermittent watercourse*
- Cours d'eau souterrain / *Underground watercourse*
- Fossé de drainage / *Drainage ditch*
- Canal / *Canal*
- Plan d'eau / *Waterbody*

Végétation / *Vegetation*

- Milieu forestier / *Forest Environment*
- Milieux humide et hydrique / *Wetlands and Hydrous Environment*
- Non forestier

Empiètement du projet / *Project Encroachment*

- Empietement permanent / *Permanent encroachment*
- Empiètement temporaire / *Temporary encroachment*

Faune aviaire / *Avian fauna*

Observations / *Observations*

- Quiscale rouilleux (2016-2017, 2021) / *Rusty blackbird (2016-2017, 2021)*
- Nid de quiscale rouilleux (2016) / *Rusty blackbird nest (2016)*
- Moucherolle à côtés olive (2017, 2021) / *Olive-sided flycatcher (2017, 2021)*

Habitat potentiel de l'espèce / *Specie's potential habitat*

- Quiscale rouilleux / *Rusty blackbird* (871,3 ha)
- Moucherolle à côtés olive / *Olive-sided flycatcher* (1 185,9 ha)
- Paruline du Canada / *Canada warbler* (33,7 ha)

Infrastructure / *Infrastructure*

- Ligne de transport d'énergie électrique / *Electric power line*
- Route forestière / *Forestry Road*
- Chemin de gravier (mine) / *Gravel road (mine)*
- Route d'accès / *Access road*

OSISKO
MINIÈRE OSISKO

Projet minier Windfall - Étude d'impact sur l'environnement / *Windfall Mining Project - Environmental Impact Assessment*

Site minier Windfall, Eeyou Istchee Baie-James (Québec) / *Windfall Mining Site, Eeyou Istchee Baie-James (Quebec)*

Carte 7-5 / *Map 7-5*
Empiètement du projet sur l'habitat potentiel du quiscale rouilleux, du moucherolle à côtés olive et de la paruline du Canada /
Project Encroachment on Rusty Blackbird, Olive-Sided Flycatcher and Canada Warbler Potential Habitat

Sources :
CanVec+, 1/50 000, RNCan, 2014
MERN, AQréseau+, réseau routier, 2020

0 400 800 m

MTM, Fuseau 9 / *Zone 9*, NAD83

2023-03-23

Préparée par / Preparation : É. D'Astous
Dessinée par / Drawing : C. Thériault
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Table 7-19 List of species of vulnerable status observed in and around the biophysical environment study area

Species group	Species	Scientific name	Status[a]		
			LEMVQ[b]	COSEWIC[c]	SARA[d]
Birds of prey	Bald eagle	*Haliaeetus leucocephalus*	V	-	-
Land and forest birds	Common nighthawk	*Chordeiles minor*	LDTV	TH	SC
	Bank swallowe	*Riparia riparia*	-	TH	TH
	Olive-sided flycatcher	*Contopus cooperi*	LDTV	TH	SC
	Canada warbler	*Cardellina canadensis*	LDTV	TH	TH
	Rusty blackbird	*Euphagus carolinus*	LDTV	SC	SC

a Status: LDTV: likely to be designated threatened or vulnerable; SC: special concern; TH: threatened.
b Ministère des Forêts, de la Faune et des Parcs (MFFP, 2022b); List of threatened or vulnerable wildlife species in Quebec (LEMVQ).
c Committee on the Status of Endangered Wildlife in Canada (COSEWIC, 2021); List of species at risk in Canada.
d Government of Canada (Gouvernement du Canada, 2021). Species at Risk Act. List of species at risk.
Although bank swallows were not observed, they could use the borrow pits in the biophysical study area if the slopes were suitable for their settlement.

COMMON NIGHTHAWK

A specific inventory of common nighthawk (*Chordeiles minor*) was conducted in June 2016 and 2021. To do this, a standardized protocol was used (Knight, 2016; Knight et coll., 2019). Trips were conducted on clear evenings during the period of increased nighthawk activity around the full moon in June. Ten (10) stations were visited in 2016 and seven (7) in 2021.

A total of 20 sightings were reported in the summer of 2016 and three in the summer of 2017 (Map 7-4). In addition, nesting of the species was confirmed as young were observed in the study area in early August. In 2021, a total of 14 sightings were reported in June 2021.

BANK SWALLOW

For the bank swallow (*Riparia riparia*), a sand pit was visited in June 2021 to confirm the presence of cavities. The nesting potential of this site was also assessed during the visit.

The species has not been recorded in the study area. The nesting potential of the species in the study area is medium, since the watercourse banks are generally flat and the anthropogenic site visited (SA-01) is not suitable for the establishment of the species. However, the sand pit visited could become suitable depending on changes in the slope gradient (due to sand harvesting or natural erosion).

OLIVE-SIDED FLYCATCHER

Within the study area, a few stands correspond to breeding habitat for the olive-sided flycatcher. In 2016, it was spotted eight (8) times during wetland surveys, in addition to being observed opportunistically during other surveys (Map 7-5). In 2021, the species was recorded on 10 occasions. It is therefore very well established in the study area.

CANADA WARBLER

During the 2016 field inventories, a nesting singing male was observed in a patch of wet hardwood forest. This observation occurred outside the local biophysical study area. In contrast, in 2021, no individuals were detected during the surveys. It should be mentioned that nesting habitat for this species is not abundant in the study area.

BALD EAGLE

A helicopter survey was conducted in May 2016 with the goal of confirming the presence of nesting pairs in the study area. As mentioned above, an analysis was previously conducted to determine potential habitats to fly over for this species. Thus, only one area corresponds to these criteria and is located southeast of the study area, in the Lake Barry sector.

Four bald eagle reports were made in 2016 and 2017, all of which were of immature individuals. Because immature bald eagles do not have a defined nesting territory, it is quite possible that the three individuals observed in May, June, and July were the same individual. In addition, during other related surveys conducted in 2017, an immature individual was observed in June 2017 between Lake Croft and Windfall Lake. There were no reported sightings in 2021.

RUSTY BLACKBIRD

In 2016, 11 occurrences of rusty blackbird were reported from field inventories (Map 7-5). Two (2) nests were also found, one in a bog and the other in a pond.

During the 2021 inventories, rusty blackbirds were detected five (5) times, two (2) opportunistically in early May and three (3) times in June, only once during inventories conducted specifically for the species in wetlands.

7.4.2 IMPACT ON AVIFAUNA DURING THE CONSTRUCTION PHASE, AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the construction phase, the potential sources of impacts and resulting impacts **(in bold)** that may affect avifauna are the following:

— Organization of the site, stripping and clearing, surface preparation and access arrangement, construction of works and infrastructure, transportation and traffic, production and management of residual and hazardous materials.

These sources have the potential to produce the following impacts during the construction phase:

Habitat loss and fragmentation by:

— the activities involved in the organization of the site, stripping, and clearing that will result in habitat loss;

- dewatering of drifts and encroachment of watersheds may influence water volume; the time required for water renewal could be longer in some lakes and have an indirect impact on the habitats located along these water bodies.

Disturbance and risk of collision and mortality by:

- Mobile equipment transportation and traffic on the site;
- vibration and noise and light emissions during the construction of new infrastructure.

Alteration of habitat quality by:

- the accidental introduction of petroleum hydrocarbons, contaminants, or hazardous materials into surface waters and soil that will contaminate the habitat.

MITIGATION MEASURES

Common mitigation measures QUA01 to QUA04, QUA09, QUA11 to QUA21, NOR07, FA02, VEG01 to VEG04, PLA01, and PLA02 will be applied to reduce the impact of stripping and clearing on habitat loss and fragmentation. For impacts related to disturbance and the risk of collision and mortality, mitigation measures AIR01 to AIR04, NOR01 and NOR02, FAU02, FAU06, FAU08, FAU09, and NOR17 will be applied. Finally, mitigation measures QUA06 to QUA08 and QUA22 to QUA26 will reduce the project's impacts on spill risks.

Specific measure P26 will also be implemented for this component.

DETAILED RESIDUAL IMPACT DESCRIPTION

HABITAT LOSS AND FRAGMENTATION AND RISK OF DISTURBANCE, COLLISION, AND MORTALITY

During the construction phase (and throughout the life of the mine), considering the total footprint of the proposed infrastructure (134.81 ha of permanent encroachment and 1.66 ha of temporary encroachment), a loss of 85.98 ha of terrestrial habitat (22.69 ha of which is anthropogenic) and 50.49 ha of wetlands will be caused.

The work could affect one nesting indicated pair per waterfowl and other aquatic bird species observed (Table 7-20).

Table 7-20 Estimated number of indicated pairs of waterfowl and other aquatic birds that may be affected by the project

Group	Species	Density (IP/25 km²)	Number of IPs likely to be affected by the project
Waterfowl	Canada goose	1.0	0.05 (1)
	American black duck	4.3	0.23 (1)
	Ring-necked duck	2.5	0.14 (1)
	Common goldeneye	1.0	0.05 (1)
	Common merganser	1.0	0.05 (1)
	Hooded merganser	1.0	0.05 (1)
Other water bird	Bonaparte's gull	1.0	0.05 (1)
	Common loon	1.5	0.08 (1)
	Sandhill crane	1.5	0.08 (1)

Note: for the number of IPs likely to be affected by the project, the number in parentheses refers to the minimum number of IPs.

No lake is directly impacted by the project. According to modelling, the potential groundwater drawdown zone does not reach the surrounding lakes. However, Pond 1 is partially located in one of the two drawdown zones greater than 1 m. Since this pond receives the mining effluent from the project, no decrease is anticipated.

For the number of nesting pairs of birds of prey (excluding bald eagle, which is discussed below), five species were recorded and one nesting pair per species was estimated. Therefore, the project could impact a maximum of one nesting pair for the following species: Northern harrier, merlin, American kestrel, red-tailed hawk, and long-eared owl. The project will impact feeding habitat for all of these species (particularly open forest and wetland areas). Forest habitat used for nesting by red-tailed hawks, American kestrels, merlin, and short-eared owls will also be impacted.

For land birds, there is no exceptional habitat in the impacted area and all of the affected species are common on the regional scale. Inventories conducted in the summer of 2016 and 2021 resulted in 56 forest bird species identified using the limited radius count method. These species were distributed in three habitat types: mature, young, and regenerating. The number of nesting pairs likely to be affected by the project in these habitats is estimated at 295 (Table 7-21).

Table 7-21 Estimated number of indicated pairs of land birds that may be affected by the project

Habitat	Density (IP/ha)		Available habitat in the study area of the biophysical environment (ha)	Estimated number of indicated pairs (IP) in the biophysical environment study area	Surface area impacted (ha)	Number of IPs likely to be affected by the project		
	Medium	Standard deviation				Minimum	Medium	Maximum
Adult	3.34	1.05	253.52	846	4.57	10	15	20
Young	4.16	1.86	490.33	2,039	41.90	96	174	252
Regenerating	4.33	2.02	463.76	2,009	24.49	57	106	156
Total			**1,207.61**	**4,894**	**70.97**	**163**	**295**	**428**

Notes: Other impacted environments are shrub swamps (2.93 ha), open bogs (39.88 ha) and anthropogenic environments (22.69 ha).
Data collected in 2021 was used to estimate the number of IPs likely to be impacted by the project since it is the most recent data available.
Wooded bogs and tree swamps were classified as young environments since they hold bird communities representative of these environment types.
Forest environments with a 10-year age class, plantations, and disturbed forest environments were categorized as impacted environments that are regenerating.
The total area impacted is 70.97 ha (63.29 ha of forested areas and 7.68 ha of wooded bogs and tree swamps).

The estimated losses by infrastructure are presented in Table 7-22 and by species in Table 7-23. The main infrastructure areas that will impact avifauna during the construction period are the cleared areas for the buildings and the tailings storage facility. The land bird species that will be most impacted are white-throated sparrow, ruby-crowned kinglet, Nashville warbler, magnolia warbler, dark-eyed junco, and alder flycatcher.

Table 7-22 Estimated losses for each proposed infrastructure during the construction phase and by type of encroachment

Type of encroachment	Infrastructure	Adult		Young		Regenerating		Total	
		Area affected (ha)	Estimated loss (IP)	Area affected (ha)	Estimated loss (IP)	Area affected (ha)	Estimated loss (IP)	Area affected (ha)	Estimated loss (IP)
Permanent	Borrow pit	0.07	0.24	0.01	0.02	2.88	12.48	2.96	12.73
	Ponds	0.67	2.24	3.28	13.63	2.31	10.00	6.26	25.88
	Buildings	2.14	7.15	8.49	35.30	5.31	23.00	15.94	65.44
	Pipe	0.00	0.00	0.10	0.41	0.03	0.14	0.13	0.56
	Domestic effluent	0.01	0.02	0.01	0.06	0.01	0.03	0.03	0.11
	Enclosed encroachment between infrastructure	0.44	1.46	7.99	33.22	1.62	7.02	10.04	41.70
	Ditch	0.00	0.00	0.00	0.01	0.18	0.77	0.18	0.79
	Overburden stockpile	1.14	3.80	2.64	10.99	2.58	11.19	6.36	25.97
	Waste rock stockpile	0.00	0.00	0.05	0.20	3.16	13.68	3.20	13.88
	Tailings storage facility	0.00	0.00	15.11	62.85	5.09	22.07	20.20	84.91
	Portal	0.00	0.00	0.12	0.51		0.00	0.12	0.51
	Road	0.00	0.01	3.90	16.23	1.06	4.61	4.97	20.84
Temporary	Ponds	0.10	0.32	0.17	0.69	0.10	0.44	0.36	1.45
	Pipe	0.01	0.04	0.04	0.15	0.01	0.06	0.06	0.25
	Waste rock stockpile	0.00	0.00	0.01	0.03	0.14	0.60	0.15	0.63
Total		**4.57**	**15.27**	**41.90**	**174.28**	**24.49**	**106.09**	**70.97**	**295.65**

Table 7-23 Number of indicated pairs of birds affected by the project

Species	Adult					Young					Regenerating				
	Density (IP/ha)		Estimated loss			Density (IP/ha)		Estimated loss			Density (IP/ha)		Estimated loss		
	Medium	Standard deviation	Min.	Ave.	Max.	Medium	Standard deviation	Min.	Ave.	Max.	Medium	Standard deviation	Min.	Ave.	Max.
White-throated sparrow	0.62	0.42	0.93	2.85	4.77	1.02	0.79	9.52	42.68	75.84	1.30	0.83	11.36	31.78	52.19
Ruby-crowned kinglet	0.45	0.25	0.91	2.07	3.23	0.34	0.40	0.00	14.23	30.81	0.35	0.46	0.00	8.60	19.97
Nashville warbler	0.34	0.51	0.00	1.55	3.87	0.40	0.47	0.00	16.60	36.12	0.10	0.26	0.00	2.39	8.88
Magnolia warbler	0.23	0.31	0.00	1.04	2.45	0.28	0.40	0.00	11.86	28.62	0.29	0.44	0.00	7.17	18.04
Olive-sided flycatcher	0.11	0.25	0.00	0.52	1.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Alder flycatcher	0.11	0.25	0.00	0.52	1.68	0.17	0.27	0.00	7.11	18.57	0.27	0.47	0.00	6.69	18.18
American robin	0.11	0.25	0.00	0.52	1.68	0.17	0.38	0.00	7.11	23.12	0.20	0.27	0.00	4.78	11.48
Dark-eyed junco	0.11	0.25	0.00	0.52	1.68	0.11	0.24	0.00	4.74	14.74	0.38	0.40	0.00	9.32	19.17
Winter wren	0.11	0.25	0.00	0.52	1.68	0.06	0.18	0.00	2.37	9.87	0.04	0.15	0.00	0.96	4.53
Yellow-rumped warbler	0.11	0.25	0.00	0.52	1.68	0.23	0.40	0.00	9.48	26.06	0.12	0.23	0.00	2.87	8.58
American redstart	0.11	0.25	0.00	0.52	1.68	0.17	0.38	0.00	7.11	23.12	0.06	0.18	0.00	1.43	5.73
Common yellowthroat	0.11	0.25	0.00	0.52	1.68	0.11	0.36	0.00	4.74	19.74	0.25	0.47	0.00	6.21	17.68
Palm warbler	0.11	0.25	0.00	0.52	1.68	0.11	0.24	0.00	4.74	14.74	0.12	0.23	0.00	2.87	8.58
Golden-crowned kinglet	0.11	0.25	0.00	0.52	1.68	0.11	0.24	0.00	4.74	14.74	0.00	0.00	0.00	0.00	0.00
Swamp sparrow	0.11	0.25	0.00	0.52	1.68	0.06	0.18	0.00	2.37	9.87	0.04	0.15	0.00	0.96	4.53
Bay-breasted warbler	0.11	0.25	0.00	0.52	1.68	0.06	0.18	0.00	2.37	9.87	0.02	0.11	0.00	0.48	3.05
Boreal chickadee	0.11	0.25	0.00	0.52	1.68	0.00	0.00	0.00	0.00	0.00	0.02	0.11	0.00	0.48	3.05
Tree swallow	0.11	0.25	0.00	0.52	1.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Swainson’s thrush	0.06	0.13	0.00	0.26	0.84	0.17	0.38	0.00	7.11	23.12	0.16	0.26	0.00	3.82	10.13
Grey jay	0.06	0.13	0.00	0.26	0.84	0.00	0.00	0.00	0.00	0.00	0.04	0.21	0.00	0.96	6.10
Red-eyed vireo	0.00	0.00	0.00	0.00	0.00	0.11	0.24	0.00	4.74	14.74	0.12	0.28	0.00	2.87	9.68
Blue-headed vireo	0.00	0.00	0.00	0.00	0.00	0.06	0.18	0.00	2.37	9.87	0.06	0.18	0.00	1.43	5.73
Lincoln’s sparrow	0.00	0.00	0.00	0.00	0.00	0.11	0.24	0.00	4.74	14.74	0.08	0.25	0.00	1.91	8.02
Hermit thrush	0.00	0.00	0.00	0.00	0.00	0.06	0.18	0.00	2.37	9.87	0.10	0.22	0.00	2.39	7.72
Northern waterthrush	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.11	0.00	0.48	3.05

Species	Adult					Young					Regenerating				
	Density (IP/ha)		Estimated loss			Density (IP/ha)		Estimated loss			Density (IP/ha)		Estimated loss		
	Medium	Standard deviation	Min.	Ave.	Max.	Medium	Standard deviation	Min.	Ave.	Max.	Medium	Standard deviation	Min.	Ave.	Max.
Rusty blackbird	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Black-capped warbler	0.00	0.00	0.00	0.00	0.00	0.11	0.36	0.00	4.74	19.74	0.02	0.11	0.00	0.48	3.05
Northern flicker	0.00	0.00	0.00	0.00	0.00	0.08	0.19	0.00	3.56	11.56	0.00	0.00	0.00	0.00	0.00
Purple finch	0.00	0.00	0.00	0.00	0.00	0.06	0.18	0.00	2.37	9.87	0.00	0.00	0.00	0.00	0.00
Philadelphia vireo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.11	0.00	0.48	3.05
Cedar waxwing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.25	0.00	2.15	8.32
Mourning warbler	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.15	0.00	0.96	4.53
Common nighthawk	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.11	0.00	0.48	3.05
Warbler sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.11	0.00	0.48	3.05
Yellow-bellied flycatcher	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.05	0.00	0.24	1.53
Chestnut-sided warbler	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vireo sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**3.34**	**1.05**	**1.84**	**15.27**	**39.45**	**4.16**	**1.90**	**9.52**	**174.28**	**469.34**	**4.33**	**2.02**	**11.36**	**106.09**	**280.65**

SD: standard deviation; IP/ha: indicated pair per hectare

Note: The estimated losses presented in the “total” row were calculated based on mean densities and standard deviations. Therefore, this is not the sum of the losses per species.

For shorebirds, losses in open wetlands (open bogs) will affect an average of 67 nesting pairs (Table 7-24). The major losses will be at the tailings storage facility (20.94 ha; 35.07 IP) and the ponds (12.28 ha; 20.57 IP) (Table 7-25). Regionally, there are larger peatland complexes, which represent higher quality habitat for nesting shorebirds.

Table 7-24 Estimated losses (number of indicated pairs) for bird species recorded in open bogs

Species	Density (IP/ha)		Estimated number of IPs in the biophysical environment study area	Surface area impacted (ha)	Number of IPs likely to be affected by the project		
	Mean	Standard deviation			Min.	Ave.	Max.
Swamp sparrow	0.36	0.51	273.66	39.88	0.00	14.16	34.36
White-throated sparrow	0.27	0.26	205.27		0.18	10.62	21.06
Common yellowthroat	0.16	0.23	121.72		0.00	6.30	15.30
Rusty blackbird	0.14	0.31	105.70		0.00	5.47	17.70
Palm warbler	0.13	0.18	98.11		0.00	5.08	12.17
Dark-eyed junco	0.13	0.24	98.20		0.00	5.08	14.52
Grey jay	0.11	0.24	83.98		0.00	4.35	14.06
Boreal chickadee	0.07	0.15	52.85		0.00	2.73	8.85
Lincoln's sparrow	0.05	0.06	34.84		0.00	1.80	4.34
Alder flycatcher	0.05	0.09	38.77		0.00	2.01	5.47
Magnolia warbler	0.05	0.12	41.99		0.00	2.17	7.03
Ruby-crowned kinglet	0.05	0.09	38.77		0.00	2.01	5.47
Nashville warbler	0.04	0.09	30.93		0.00	1.60	5.18
Black-capped warbler	0.03	0.04	22.06		0.00	1.14	2.81
Hermit thrush	0.02	0.03	14.23		0.00	0.74	1.90
Fox sparrow	0.01	0.03	10.31		0.00	0.53	1.73
Cedar waxwing	0.01	0.02	7.84		0.00	0.41	1.31
Golden-crowned kinglet	0.01	0.02	7.84		0.00	0.41	1.31
Spotted sandpiper	0.01	0.01	3.92		0.00	0.20	0.66
Total	**1.68**	**1.00**	**1,290.97**		**0.18**	**66.79**	**175.23**

Note: The total estimated losses could not be evaluated since the standard deviation obtained is higher than the mean. The fact that only two wetlands were inventoried may explain this result.
Min.: Minimum, Ave. : Average, Max. : maximum.

Table 7-25 Estimated losses for each proposed infrastructure during the construction phase and by type of encroachment for open bogs

Type of encroachment	Infrastructure	Open peatland	
		Area affected (ha)	Estimated loss (IP)
Permanent	Pond	12.28	20.57
	Building	0.61	1.03
	Pipe	0.01	0.01
	Enclosed encroachment between infrastructure	0.91	1.53
	Ditch	0.12	0.19
	Waste rock stockpile	0.89	1.49
	Tailings storage facility	20.94	35.07
	Road	3.25	5.45
Temporary	Pond	0.78	1.31
	Waste rock stockpile	0.09	0.15
Total		**39.88**	**66.79**

As for species at risk, five species were inventoried during the nesting period: the bald eagle, the rusty blackbird, the olive-sided flycatcher, the common nighthawk, and the Canada warbler. In addition, other species could potentially use the study area, despite the fact that they have not been inventoried during the nesting period. This includes the bank swallow. The likely environmental impacts on this species are also discussed in this section.

BALD EAGLE

The impact on bald eagles is expected to be small. No direct impact is expected on the lakes in the study area. Moreover, the lakes located surrounding the infrastructure are small and therefore probably seldom used for feeding by the species. Furthermore, no disturbance of the nesting pair is anticipated due to the absence of identified nesting sites in the vicinity of the future facilities. Also, there are no existing potential habitats that will be impacted in the local study area of the biophysical environment.

RUSTY BLACKBIRD

The loss of potential habitat (bogs, ponds, and shrub swamps) is 44.43 ha (0.87 ha temporary loss and 43.56 ha permanent loss). Based on the density of nesting pairs present in the study area, it is estimated that 0 to 20 nesting pairs (average of 6 nesting pairs) could be affected by the project. An additional 826.90 ha of potential habitat are located within the biophysical study area.

OLIVE-SIDED FLYCATCHER

Preferred breeding habitat for the olive-sided flycatcher consists of forest edges near wetlands and open areas. A total of 48.55 ha of breeding habitat (1.08 ha of temporary loss and 47.47 ha of permanent loss) will be affected due to the new facilities. For this species, no density values could be assessed by standard inventory methods. However, since the olive-sided flycatcher's territory size would range from 10 ha to 20 ha (Altman and Sallabanks, 2020), between two and five breeding pairs could be impacted by the project. An additional 1,137.30 ha of potential habitat are located within the biophysical study area.

COMMON NIGHTHAWK

Preferred breeding habitat for the common nighthawk is regenerating, open spruce-lichen stands and anthropogenic environments. A total of 87.03 ha of breeding habitat (1.34 ha of temporary loss and 85.69 ha of permanent loss) will be affected due to the new facilities. For this species, no density values could be assessed by standard inventory methods. However, since the territory size varies between 10 and 30 ha, it is estimated that three to nine breeding pairs could be affected by the project. An additional 1,288.11 ha of potential habitat are located within the biophysical study area.

CANADA WARBLER

Preferred breeding habitat for Canada warblers is in moist mixedwood and deciduous stands and in coniferous forests with a developed shrub layer. A total of 9.60 ha of breeding habitat (<0.01 ha of temporary loss and 9.59 ha of permanent loss) will be affected due to the new facilities. Only one individual was detected during the surveys, outside the biophysical environment study area. No density values could be established. However, since the average home range size varies between 1 and 2 ha, it is estimated that five to ten breeding pairs could be affected by the project. An additional 24.08 ha of potential habitat is found in the biophysical study area, which is in the northern portion of its range.

BANK SWALLOW

Bank swallows establish colonies in both natural habitats (e.g., fine-grained cliffs) and artificial habitats (e.g., gravel pits, sand pits). No individuals were detected during the surveys. However, only one area could support the species if the slopes were suitable—the borrow pit.

DISTURBANCE OF POPULATIONS – RISK OF COLLISION AND MORTALITY

Indirect impacts caused by increased disturbance such as vibration, noise, light, and dust emissions are expected during the construction phase. In addition, collision and mortality risks related to the presence of infrastructure and traffic on the site are also possible.

The effect of noise has been shown in the literature to have a potential negative effect on avian wildlife (Ortega, 2012; McClure *et al*., 2013; Kunc and Schmidt, 2019; Senzaki *et al*., 2020). The threshold at which impacts could be felt is 40 dBA (Reijnen *et al*., 1997; Shannon *et al*., 2015). In fact, noise from infrastructure construction, site traffic, and refuelling and maintenance of mobile equipment could result in avoidance of certain noisy areas, changes in the reproductive success of certain species, and changes in interspecific communication. Human presence would also result in the avoidance of areas used by certain bird species. However, it should be noted that the noise caused by the project on the periphery of the mine site should be around the threshold for this wildlife group, especially since it will have to be limited to the noise criteria established in Directive 019 and according to the requirements of NI 98-01. Thus, noise disturbance to avifauna could extend to a maximum of 1.75 km centred on the sources of noise emissions for all scenarios studied. Few studies have been done on the impact of vibration on birds. However, Ferguson-Lee and Christie (2005) suggest that the upper limit is 10 kHz to 20 kHz and the lower limit is 50 kHz to 300 Hz. In some species of birds of prey, it would be between 1 kHz and 6 kHz (Yamazaki et al., 2004). The main source of vibration during the construction phase of the project will be surface blasting activities. It should be noted, however, that these activities will be carried out on a sporadic basis and will be concentrated in specific areas, such as for the construction of roads and ponds.

In the case of light disturbance, nighttime lighting could have an effect on migrating birds, attracting groups of birds to operations and diverting them from their migratory route. This may occur particularly during foggy conditions, resulting in a risk of mortality from collisions (Ogden, 1996). However, given the mitigation measures in place, the residual impact will be limited.

ACCIDENTAL INTRODUCTION OF PETROLEUM HYDROCARBONS, CONTAMINANTS, OR HAZARDOUS MATERIALS INTO THE ENVIRONMENT

As for the risk of accidental hydrocarbon spills, since they will be managed in accordance with the spill response plan and with numerous mitigation and control measures in place, the risk of a spill impacting the environment is very low; the spill will be contained and contaminated soils will be recovered quickly, as prescribed in the Emergency Response Plan (see Chapter 12). However, if there is a spill, the degree of contamination will depend on the nature of the contaminants and their concentrations.

RESIDUAL IMPACT ASSESSMENT

During the construction phase, the potential residual impacts on the avifauna component are related to activities that cause habitat loss (birds in general and species of special status), disturbance and risk of collision and mortality, and the risk of spills.

With respect to habitat loss for bird species in general, the intensity of residual impacts on avifauna is considered low. This assessment considers the reduction in the degree of disturbance through the project's mitigation measures as well as the application of and compliance with existing standards and regulations, primarily for clearing activities. The degree of disturbance will be low. In addition, the intensity of the impact reflects the medium ecosystem rating of the component due to the small area affected and the low species richness, and a low social rating (medium overall value). The spatial scope of the anticipated residual impacts is established as specific since they are likely to be felt over a small area, i.e., at the infrastructure level.

The duration of the impacts is considered to be long since they result from clearing activities that cause permanent loss. The probability of occurrence is considered high. Therefore, the residual impact on the avifauna component, birds in general, is defined as low.

With respect to species at risk, the intensity of residual impacts from potential habitat loss on five species (common nighthawk, olive-sided flycatcher, Canada warbler, bald eagle, and rusty blackbird) is rated as medium. As with other bird species, the degree of disturbance is low. The intensity of the effect reflects the high ecosystem rating of the component due to the importance of the species in terms of protection, which is a matter of consensus in the scientific community. In addition, their status as endangered species gives them a high ecosystem and socioeconomic value (high overall value). The spatial scope of the anticipated residual impacts is established as specific since they are likely to be felt over a small area, i.e., at the infrastructure level, and will affect only a few individuals. The duration of the impacts is considered to be long since they result from clearing activities that cause permanent loss. The probability of occurrence is considered high. Therefore, the residual impact on the avifauna component, species of special status, is defined as medium. Despite the significance of the residual impact for this component, it should be noted that the effect will be limited to the cleared area and that several replacement habitats are available in the surrounding area.

As for the residual impacts related to disturbance and the risk of collision and mortality, the intensity is considered low for birds in general and medium for species of special status. The degree of disturbance will be low. In fact, the effect does not significantly alter the inherent characteristics of the component, and so it will maintain its integrity. The spatial scope of the anticipated residual impacts is established as specific since they are likely to be felt over a small area, i.e., at the infrastructure level. The duration of the impacts is considered to be short as the impacts felt due to disturbance will be discontinuous. The probability of occurrence is considered high since the activities will inevitably cause some noise and therefore some disturbance, but this disturbance is applied to the probability of occurrence and not to the species itself. Therefore, the residual impact of disturbance on the avifauna component is defined as very low for birds in general and low for species of special status.

For potential residual impacts related to the risk of accidental spills of petroleum hydrocarbons into the environment, the intensity of these impacts on avifauna, birds in general, is judged to be low, and medium for species of special status. This assessment considers the reduction in the degree of disturbance to the component through the project's mitigation measures, as well as the application of and compliance with applicable standards and regulations, thereby making the degree of disturbance low. The spatial scope of the residual impacts is established as specific since the impacts are likely to be felt over a small area within the infrastructure zone. The duration of the impacts is considered to be short as they result from specific activities with a fixed duration in the construction schedule. The probability of occurrence is considered Low. Therefore, the residual impact on the avifauna component is defined as very low for birds in general and low for species of special status.

<table>
<tr><th colspan="3">Impact on avifauna during the construction phase</th></tr>
<tr><td>Nature</td><td>Negative</td><td rowspan="8">Significance:
Birds in general:
Loss of habitat – Low
Disturbance, risk of collision and mortality, and risk of accidental spills – Very low
Species of status:
Loss of habitat – Medium
Disturbance, risk of collision and mortality, risk of accidental spills – Low</td></tr>
<tr><td>Ecosystem value</td><td>Medium (birds in general), high (species of special status)</td></tr>
<tr><td>Socioeconomic value</td><td>Low (birds in general), high (species of special status)</td></tr>
<tr><td>Degree of disturbance</td><td>Low</td></tr>
<tr><td>Intensity</td><td>Low (birds in general), medium (species of special status)</td></tr>
<tr><td>Spatial scope</td><td>Specific</td></tr>
<tr><td>Duration</td><td>Long (habitat loss), short (disturbance, risk of collision and mortality, risk of accidental spills)</td></tr>
<tr><td>Probability of occurrence</td><td>High (habitat loss), medium (disturbance, risk of collision and mortality), low (risk of accidental spills)</td></tr>
</table>

7.4.3 IMPACT ON AVIFAUNA DURING THE OPERATIONS PHASE, AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the operations phase, the potential sources of impacts and resulting impacts (**in bold)** likely to affect avifauna are as follows:

— The presence and operation of new infrastructure, water use and management, transportation and traffic, residual and hazardous materials generation and management.

These sources may cause the following impacts during the operations phase:

Disturbance and risk of collision and mortality by:

— Mobile equipment transportation and traffic on the site;

— vibration and noise and light emissions from existing infrastructure and activities.

Alteration of habitat quality by:

— the accidental introduction of petroleum hydrocarbons, contaminants, or hazardous materials into surface waters and soil that will contaminate the habitat.

MITIGATION MEASURES

The mitigation measures listed for the construction phase will also be applied to mitigate impacts related to disturbance, the risk of collision and mortality, and the risk of spills. In addition, the common mitigation measure FAU07 will be implemented to reduce the risk of disturbance.

DETAILED RESIDUAL IMPACT DESCRIPTION

DISTURBANCE DUE TO THE PRESENCE OF INFRASTRUCTURE AND TRAFFIC, RISK OF COLLISION AND MORTALITY

The anticipated effect of the presence of the facilities and of mobile equipment traffic (disturbance and risk of collision and mortality) will be similar to what was assessed during the construction phase, although the intensity of the transportation activity will be less than in the construction phase. For noise-related disturbances, those that could affect avifauna (60 dBA and above) could extend to a maximum of 2 km centred on the sources of noise emissions for all the scenarios studied.

ACCIDENTAL INTRODUCTION OF PETROLEUM HYDROCARBONS, CONTAMINANTS, OR HAZARDOUS MATERIALS INTO THE ENVIRONMENT

As far as spill risks are concerned, they are the same as those anticipated during the construction phase.

RESIDUAL IMPACT ASSESSMENT

In the operations phase, the residual impacts are related to disturbance, the risk of collision and mortality, and the risk of accidental spills in the environment. Since the same mitigation measures as those applied during the construction phase will be in effect during the operations phase, the residual impacts will be the same. Therefore, the residual impact of disturbance and risk of collision and mortality on the avifauna component is defined as very low for birds in general and medium for species of special status. As for the risk of accidental spills, the residual impact is defined as very low for birds in general and low for species of special status.

<table>
<tr><th colspan="3">Impact on avifauna during the operations phase</th></tr>
<tr><td>Nature</td><td>Negative</td><td rowspan="8">Significance:
Birds in general:
Very low
Species of special status:
Disturbance, risk of collision and mortality - Medium
Risk of accidental spills - Low</td></tr>
<tr><td>Ecosystem value</td><td>Medium (birds in general), high (species of special status)</td></tr>
<tr><td>Socioeconomic value</td><td>Low (birds in general), high (species of special status)</td></tr>
<tr><td>Degree of disturbance</td><td>Low</td></tr>
<tr><td>Intensity</td><td>Low (birds in general), medium (species of special status)</td></tr>
<tr><td>Spatial scope</td><td>Specific</td></tr>
<tr><td>Duration</td><td>Short (risk of accidental spills), medium (disturbance, risk of collision and mortality)</td></tr>
<tr><td>Probability of occurrence</td><td>Low (risk of accidental hydrocarbon spills), high (disturbance, risk of collision and mortality)</td></tr>
</table>

7.4.4 IMPACT ON AVIFAUNA DURING THE CLOSURE PHASE, AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the closure phase, potential sources of impacts and resulting impacts (**in bold**) likely to affect avifauna are as follows:

— Final restoration, production and management of residual and hazardous materials.

These sources have the potential to produce the following impacts during the operations phase:

Habitat creation by:

— site rehabilitation.

Disturbance and risk of collision and mortality by:

— mobile equipment transportation and traffic for site rehabilitation.

Alteration of habitat quality by:

— the accidental introduction of petroleum hydrocarbons, contaminants, or hazardous materials into surface waters and soil that will contaminate the habitat.

MITIGATION MEASURES

In the closure phase, all mitigation measures listed for the construction and operations phases will be applied when they address the same impact sources.

DETAILED RESIDUAL IMPACT DESCRIPTION

DISTURBANCE DUE TO THE PRESENCE OF INFRASTRUCTURE AND TRAFFIC/RISK OF COLLISION AND MORTALITY.

Dismantling activities, including mobile equipment traffic, will cause disturbance and risk of collisions and mortality. The anticipated impacts are the same as in the construction and operations and maintenance phases.

ACCIDENTAL INTRODUCTION OF PETROLEUM HYDROCARBONS, CONTAMINANTS, OR HAZARDOUS MATERIALS INTO THE ENVIRONMENT

As far as spill risks are concerned, they are the same as those anticipated during the construction phase.

HABITAT RESTORATION

At the end of operations, habitats will be restored or recreated and will eventually be able to fulfill functional requirements for certain migratory bird species. In the short term, restored areas may be used by certain bird species, such as the common nighthawk, which may nest in areas with sparse vegetation.

RESIDUAL IMPACT ASSESSMENT

In the closure phase, the residual impacts are related to disturbance, the risk of collision and mortality, and the risk of accidental spills. The same mitigation measures as those applied during the construction and operations phases will be in effect during the closure phase. Thus, the anticipated residual impacts are the same for birds in general, i.e., very low. The significance of the residual impact of disturbance and the risk of collision and mortality as well as the risk of accidental spills on avifauna, species of special status, are considered low.

Once the closure phase is over and the rehabilitation work has been completed, a positive impact is expected due to habitat restoration. The extent is limited, with a long duration.

<table>
<tr><th colspan="3">Impact on avifauna during the closure phase</th></tr>
<tr><td>Nature</td><td>Negative/Positive</td><td rowspan="8">Significance:
Birds in general:
Very low
Habitat restoration – Positive impact
Species of special status:
Low
Habitat restoration – Positive impact</td></tr>
<tr><td>Ecosystem value</td><td>Medium (birds in general), high (species of special status)</td></tr>
<tr><td>Socioeconomic value</td><td>Low (birds in general), high (species of special status)</td></tr>
<tr><td>Degree of disturbance/enhancement</td><td>Low</td></tr>
<tr><td>Intensity</td><td>Low (birds in general), medium (species of special status)</td></tr>
<tr><td>Spatial scope</td><td>Specific</td></tr>
<tr><td>Duration</td><td>Short</td></tr>
<tr><td>Probability of occurrence</td><td>High (disturbance, risk of collision and mortality), low (risk of accidental spills)</td></tr>
</table>

7.5 LARGE MAMMALS

Important facts about large mammals

Existing conditions

The portrait established for large fauna is based on existing documentation and on a study completed in 2022 establishing the use of the territory for large fauna but mainly for woodland caribou (*Rangifer tarandus caribou*) and moose (*Alces alces*). Woodland caribou are a species of special status with an average population density of 1 to 2 individuals/100 km^2. Based on surveys conducted in the 50 km radius study area around the Windfall mine site, it is estimated to be 0.19 individuals/100 km^2, which is defined as a very low density. It should also be noted that the study area under consideration has undergone anthropogenic disturbance on approximately 74% of its surface (mainly via logging) resulting in a habitat considered unsuitable for this species.

As far as moose are concerned, the boreal region, where the project is located, is considered to be a poorly productive habitat in summer conditions and even more so in winter conditions. This is mainly due to the poor quality of the food available. In the specific moose inventory zone (100 km^2), an estimated density of 0.5 moose/10 km^2 has been determined, while territories further south have densities that can exceed 2 moose/10 km^2 (Bilodeau and Greaves, 2021).

The presence of grey wolves in the Windfall project area was confirmed during the inventories through the observation of numerous tracks and at least one carcass of a moose calf killed by a wolf pack. It should be noted, however, that no specimens were observed by the inventory teams.

Although no specific inventory has been conducted for black bears, their presence has been abundantly confirmed in the Windfall project area, through signs of presence and incidental sightings by individuals. These observations were made by wildlife experts, but also by Osisko employees and tallymen who confirmed an increase in the number of sightings since the start of activities at the Windfall site.

Potential Project Impacts

During the construction phase, impacts are associated with habitat loss and fragmentation/alteration of feeding sites, disturbance and risk of collision and mortality, and alteration of habitat quality (spills). No impacts to woodland caribou habitat are anticipated as the Windfall site area is not considered suitable habitat for the species. Nevertheless, considering the mitigation measures that will be implemented, the intensity of the residual impact on woodland caribou is considered medium for disturbance and alteration of the environment by potential spills. The spatial scope is specific and the duration short, with a low probability of occurrence. The significance of the impact on woodland caribou is therefore low. For moose, black bear, and grey wolf, the intensity of impact for all aspects considered is deemed low. The spatial scope will be specific and the duration will be short for disturbance/risk of collision and mortality and accidental spills, while it will be long for habitat loss/fragmentation. The probability of occurrence is low for the risk of spills and medium for disturbance/risk of collision and mortality, and habitat loss/fragmentation. The result is a residual impact of very low significance for the risk of spills, and low for disturbance/risk of collision and mortality, and habitat loss/fragmentation.

In the operations and closure phase, the impacts are associated with disturbance and the risk of collision and mortality, as well as the alteration of habitat quality (spills). The assessment parameters of the residual impact are the same for the woodland caribou and for the other species as in the construction phase. The significance of the residual impact will therefore be low for woodland caribou and very low for moose, black bear, and grey wolf.

A positive impact is expected, mainly for moose, black bear, and grey wolf habitat, during site closure and habitat rehabilitation. However, during the closure work, there remains a risk of spills, disturbance, and collision and mortality. The assessment parameters of the residual impact are the same for the woodland caribou and for the other species as in the construction phase. The significance of the residual impact will therefore be low for woodland caribou and very low for moose, black bear, and grey wolf.

7.5.1 CURRENT CONDITIONS

LARGE MAMMALS

A study was conducted in 2022 to determine the land use pattern of large mammals. The inventory focused on woodland caribou (*Rangifer tarandus caribou*) and moose (*Alces alces*) to address some of the concerns raised by the Cree community of Waswanipi. Black bear (*Ursus americanus*) and grey wolf (*Canis lupus*) data were also included in the study due to opportunistic sightings reported in 2016, 2017, and 2021.

Considering that the boreal caribou is a sensitive component of the natural environment that has a protected status at the federal and provincial levels, the study area specific to large fauna was mainly defined according to this species. It covers an area of 7,853 km^2, with a radius of 50 km from the centre of the proposed mine (Map 1 of the sectorial report, Appendix 7-5). According to the guidelines for the management of woodland caribou habitat (Équipe de rétablissement du caribou forestier du Québec, 2013a), a minimum area of 5,000 km^2 must be used to analyze the rate of disturbance of the habitat.

Various sources of information were used to determine the use of the study area by caribou and moose: a request for information from government organizations, a review of scientific articles and reports on the area’s mammals or on the biology of the species, discussions with tallymen, and an aerial survey.

Due to the limited information available on large wildlife in the study area defined for this study, an aerial survey for caribou and moose was conducted from March 19 to 22, 2018. It should be noted that the tallyman of trapline W25B participated in this inventory and that his knowledge on the location of large fauna was considered when conducting the flyovers. The area used for the aerial caribou survey covered approximately 1,500 km^2, or a 20 km square on either side of the proposed mine centre point. Within this zone, another 100 km^2 inventory zone, covering a square 5 km on either side of the mine site’s centre, was surveyed according to the technique applicable to moose.

The method used involves an exhaustive inventory of the territory. The inventory techniques were defined according to the two target species. The details of this study and the methodology used are presented in the sectorial report in Appendix 7-5.

WOODLAND AND MIGRATORY CARIBOU

According to the report of the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) which establishes the different designable units of caribou in Canada, Quebec is home to a significant proportion of Designable Unit 6 of the "boreal caribou" (COSEWIC, 2011). The distribution of this unit extends from Labrador to the Rocky Mountains and the Northwest Territories. In Quebec, the boreal caribou is also called "woodland caribou."[1] The status of woodland caribou is distinct from that of the Eastern Migratory caribou (Unit 4), which includes the George River and Leaf River populations. Of these two designable units, only boreal caribou are likely to occur in the study area defined for large fauna.

FEDERAL CONTEXT

The woodland caribou was listed as threatened in Canada under the Species at Risk Act in June 2003 (COSEWIC, 2002). Environment and Climate Change Canada (ECCC) has developed a recovery strategy, based on a probabilistic assessment of population self-sustainability. This approach assesses the ability of a woodland caribou population to maintain its range. To do this, three main indicators are used: population trend, population size, and level of range disturbance.

According to the ECCC approach, a population of woodland caribou has a probability of self-sustainability of 0.60 when 35% of the range is disturbed, which is considered a medium disturbance rate. However, it should be kept in mind that the 0.60 threshold is a minimum, as the probability that the population is not self-sustaining remains significant at 0.40. The revised probabilistic approach applied by ECCC (2011) further demonstrated that 70% of the variation in woodland caribou population recruitment is explained by a single variable, the rate of habitat disturbance (anthropogenic and natural disturbances) (Environment Canada 2008, 2011).

Three factors contribute to defining critical boreal caribou habitat (conservation unit) for each local population: habitat location, habitat surface area, and habitat type. Six conservation units have been designated for Quebec under the federal recovery strategy (Environment Canada, 2012). Three of these conservation units are considered non-self-sustaining, two are considered self-sustaining, and one is rated as having uncertain status.

The 5 km zone of influence around the mine is located 75 km south of conservation unit QC6. Most of the woodland caribou's range in Quebec is located in this conservation unit, which covers a total area of 621,562 km² (Table 7-26). As a result, the study area, 50 km from the mine's centre, defined for large fauna is entirely outside of critical habitat for boreal caribou, as defined in the Recovery Strategy for the Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada.

1 This name will be used later in the environmental impact assessment.

Table 7-26 Level of disturbance and probability of self-sustainability for the six conservation units used in the federal recovery strategy for woodland caribou in Quebec

Conservation unit or local population (Quebec and Labrador)	Area (km²)	Level of disturbance (%)		Undisturbed habitat (%)	Probability of self-sustainability Risk assessment
		Forest fires	Human activity		
QC1- Val-d'Or	3,469	0.2	65	35	Unlikely: NSS
QC2- Charlevoix	3,128	4	80	18	Very unlikely: NSS
QC3- Pipmuacan	1,377	11	60	32	Unlikely: NSS
QC4- Manouane	2,716	18	26	59	Fairly likely: NSS/SS
QC5- Manicouagan	11,341	3	36	63	Probable: SS
QC6- Rest of the occupied area	621,562	20	13	68	Probable: SS

Notes: NSS: not self-sustainable; NSS/SS: not self-sustainable or self-sustainable; SS: self-sustainable.
Overlapping fire and human disturbances are counted only once.
Buffer zones of 0.5 km are applied to disturbances caused by human activities.
The status of these units remained the same between the 2011, 2012, and 2020 Environment Canada assessments.
Sources: Environment Canada (2011 and 2012).

PROVINCIAL CONTEXT

The woodland caribou was designated vulnerable in Quebec in February 2005 under the Act respecting threatened and vulnerable species (Order in Council 75, 2005). As a result, Quebec has also developed a provincial recovery plan for woodland caribou, prepared by a team of specialists and organizations involved in the protection of the species (Équipe de rétablissement du caribou forestier) [Woodland caribou recovery team]. Two versions of this provincial woodland caribou recovery plan have been implemented to date, the first one for the period 2005-2012 and a second one tabled in May 2013 covering the period 2013-2023 (Équipe de rétablissement du caribou forestier du Québec, 2008, 2013a). Habitat management guidelines for woodland caribou also were first developed in 2010 and revised in 2013 (Équipe de rétablissement du caribou forestier du Québec 2010, 2013b).

In August 2020, the Quebec woodland caribou recovery team published the mid-term review of its woodland caribou recovery plan. This review covered the period from June 2013 to March 2018. This document highlights the important work of the recovery team, particularly through its various scientific studies and publications, as well as the progress or completion of 23 of the 30 actions of the recovery plan.

Finally, the Quebec government is currently in the process of finalizing a strategy for the management of woodland and mountain caribou that would be based on the establishment of territories where habitats will be preserved or restored and where forestry activities, in particular, will be controlled. These territories would cover about 5000 km^2 or more and would be maintained by large, lightly disturbed forest areas. At the time of finalizing this environmental impact assessment, no date had been set for the release of this strategy.

CREE CONTEXT

The James Bay and Northern Quebec Agreement (JBNQA), signed on November 11, 1975, solidified Cree rights and established regimes to protect these rights, such as the environmental and social protection regime under Section 22, and the hunting, fishing, and trapping regime under Section 24 (Cree Nation Government, 2015).

In addition, the traditional Eeyou hunting law, or *Eeyou Indoh-hoh Weeshou-Wehwun* (the Law), regulates harvesting activities (hunting and fishing) in Cree territory. According to this Law, each Cree community is associated with a number of hunting territories (*Indoh-hoh Istchee*), which must be managed by the *Kaanoowapmaakin* (or tallymen). In accordance with the Law, Tallymen have several responsibilities, including monitoring, supervising, and guiding the activities of the members of each Cree community, including the harvesting of wildlife on hunting grounds, to ensure that it remains available for future generations (Cree Trappers' Association, 2009).

Section 10 of the Law describes the specific rules for certain activities, including the hunting of large wildlife (moose, caribou, bear, porcupine, whale, and seal). According to section 10.3, tallymen may not deny any member of the community the right to hunt large wildlife for food or subsistence purposes, except for conservation or safety reasons. On the other hand, section 10.4 states that tallymen have the right to ban or restrict the harvesting of large wildlife species in a given hunting territory for reasons of wildlife conservation or management. However, in such a case, the tallyman must inform the community. Furthermore, the Cree-Québec Forestry Board (CQFB) is responsible for monitoring, analyzing, and assessing the implementation of the forestry provisions of the Agreement Concerning a New Relationship Between the Gouvernement du Québec and the Crees of Québec (ANRQC), or the Paix des Braves. Since October 2011, the CQFB has considered the recovery of woodland caribou as a strategic issue on which the parties must agree in order to address the status of the species in the context of forest management practised on the territory of the Agreement (CQFB, 2018). Thus, among the actions envisaged in its 2015-2020 Sustainable Development Action Plan, the CQFB intends to "contribute to the recovery of the woodland caribou and ensure a close follow-up."

DENSITY, DEMOGRAPHICS, AND USE OF THE TERRITORY

Woodland caribou live at very low densities, varying from one to two individuals/100 km² according to inventories conducted in the 1990s (Courtois, 2003). Between 2000 and 2010, the MELCCFP intensified its efforts in carrying out inventories of woodland caribou to harmonize forestry and other activities with the maintenance of this species. In inventories conducted during this period in its continuous range, nearly 3,000 caribou were counted over 190,234 km², for an average density of 1.5 caribou per 100 km² (Équipe de rétablissement du caribou forestier du Québec, 2013b).

Woodland caribou from the local Assinica population (herd), located within federal Conservation Unit QC-6 northeast of Lebel-sur-Quévillon, are the most likely to use the established large wildlife study area. It should be noted, however, that there may be interactions between individuals from this population and those from Témiscamie and Nottaway. However, it is important to bear in mind that the 5 km zone of influence around the mine is located 75 km south of the QC6 conservation unit and that the 50 km radius study area defined for large wildlife and centred on the Windfall project site is entirely outside critical boreal caribou habitat.

The report on the mid-term review of the Quebec woodland caribou recovery plan mentions six new inventories conducted between 2013 and 2017, one of which covered the territory of the Assinica herd (Équipe de rétablissement du caribou forestier du Québec, 2020). This inventory, conducted in 2013 by Brodeur et al. (2017), shows that the range of this population is estimated at 23,850 km^2. Thirty-eight groups of caribou were observed with a total of 509 individuals, for an estimated density of 2.4 woodland caribou/100 km^2. The observed population structure was 31.5% males, 53.2% females, and 15.3% calves. Based on the 16 active telemetry collars present during the survey, Brodeur et al. (2017) calculated a visibility rate of 87.5%, leading to a total population estimate of 580 caribou (corrected count).

Rudolph et al. (2012) concluded that this population, although part of federal Conservation Unit QC-6 that was deemed self-sustaining, should be considered non-self-sustaining. Decreased recruitment rate, decreased survival rate of adult females, and a disturbance rate above the threshold required for population persistence are the main elements that support this conclusion. The study by Brodeur et al. (2017) showed a ratio of 27.8 calves/100 females, which is below the theoretical value proposed by Environment Canada (2011) to ensure population self-sustainability. The probability of self-sustainability for this herd would therefore be medium with a potential of 65%. Brodeur et al. conclude that the point measure presented for recruitment suggests that the population in 2013 had some stability.

Following a request for information, the MELCCFP's Direction de la gestion de la faune du Nord-du-Québec office transmitted information concerning caribou inventories and telemetric monitoring for the study area defined for large wildlife, i.e., within a 50 km radius of the proposed mine centre. According to the information provided, six incidental sightings are listed in this area: four sightings were from before 2015 and two were reported between 2015 and 2018. Through telemetry, the locations of a woodland caribou were also recorded in the spring of 2011 in the northern limit of the area, at a distance of more than 35 km from the centre of the mine. It should be noted that the locations of collared caribou do not provide an exhaustive picture of the use of the territory by all caribou.

According to accounts from interviews with tallymen included in the large wildlife study area (traplines W25B, W24C, W25A, W24D, 17 and 19), Mr. Icebound (W25B) mentioned that historically there were no caribou in his trapline and that, to his recollection, his family never hunted caribou. The first sightings of caribou were on the east side of the marshes, about 20 years ago. He also mentioned that a caribou was observed near the mine site during the biological surveys and that his father used to see a few in this area. Finally, he noted that two caribou were reportedly observed by Bonterra employees at the borrow pit north of his camp and that three more were seen before Christmas 2018 between his camp and Lake Barry. According to Mr. Icebound, caribou prefer swampy and open areas and tend to move southward to take advantage of open areas created by logging. In 2022, the family of another tallyman mentioned having observed traces of caribou (4 or 5 individuals, including calves) on the outskirts of Lac Roméo. This family also expressed concern about the effect of the mine on the preservation of these caribou.

The aerial survey conducted in March 2018 by WSP over an area of 1,600 km located and classified three caribou, two males and one female, in the southern boundary of the surveyed area, at a distance of approximately 20 km from the centre of the mine site. The tallyman who was present during the overflight also mentioned that caribou sightings had been reported by community members in this area in the weeks preceding this survey. The 2018 results are consistent with a very low density of about 0.19 caribou per 100 km^2. No other signs of caribou presence were noted in the surveyed area. Even considering an observation rate of 85%, i.e., a correction factor of 15% (Courtois, 1991), the estimated number of individuals would be about four, with a density of 0.25 caribou per 100 km^2.

Observations from the 2018 inventory, coupled with current knowledge, indicate that woodland caribou have made very limited use of the large mammal inventory area over the past decade within approximately 50 km of the proposed mine.

HABITAT CONDITIONS

Several authors acknowledge that woodland caribou, in their habitat selection, have a preference for bogs, mature softwood stands with lichens, and other sites that are rich in lichens (Équipe de rétablissement du caribou forestier du Québec, 2013b). It is also known that it avoids recently disturbed environments (Moreau et al. 2012), although it will sometimes make do with regenerating stands from 6- to 40-year-old cuts or fires, particularly in the spring (Hins et al. 2009).

The current rate of habitat disturbance was assessed at the scale of the large wildlife study area (50 km peripheral to the mine centre), covering an area of 7,853 km² (Map 2 of the sectorial report, Appendix 7-5). A radius ranging from 5 km to 50 km was used to perceive the variation in disturbance rate at different scales (Table 7-27). For this simulation, the total disturbance footprint was determined from the combined effects of fires in the last 40 years and anthropogenic disturbances. A 500 m buffer zone was used to map anthropogenic elements. The extent of the buffer was determined based on Environment Canada's demonstration that the use of a 500 m buffer provided a better representation of the combined effects of predation and increased avoidance on boreal caribou population trends at the national scale (Environment Canada 2011).

Overall, anthropogenic elements disturb 74% of the large wildlife inventory area within 50 km. It should be noted that this area is subject to wood harvesting activities. Forest harvesting and the extensive network of logging roads are the main sources of human disturbance. The large wildlife study area also contains 317 land tenure rights, including 129 private cottage leases, 148 temporary shelter permits, 33 outfitting permits, four industrial permits, and one telecommunications tower permit. This use of the territory also contributes to the disturbance of woodland caribou. According to ecoforestry mapping (MFFP, 2018), natural disturbances are related to forest fires that have affected 9% of the land area. Of this proportion, 7% of fire areas overlap with areas already disturbed by anthropogenic elements.

Table 7-27 Analysis of the disturbance rate of woodland caribou habitat at a radius varying from 5 km to 50 km from the mine centre.

Distance from the centre of the mine (km)	Type of disturbance	Area (ha)	Disturbance (%)
5	Area of the zone	7,853	100%
	Anthropogenic	6,340	81%
	Natural	907	12%
	Natural and anthropogenic[1]	6,340	81%
10	Area of the zone	31,412	100%
	Anthropogenic	18,995	60%
	Natural	5,557	18%
	Natural and anthropogenic[1]	19,927	63%
20	Area of the zone	125,654	100%
	Anthropogenic	68,150	54%
	Natural	24,627	20%
	Natural and anthropogenic[1]	78,246	62%
30	Area of the zone	282,729	100%
	Anthropogenic	190,811	67%
	Natural	32,597	12%
	Natural and anthropogenic[1]	203,321	72%
40	Area of the zone	502,636	100%
	Anthropogenic	357,509	71%
	Natural	49,272	10%
	Natural and anthropogenic[1]	370,941	74%
50	Area of the zone	785,375	100%
	Anthropogenic	579,289	74%
	Natural	71,436	9%
	Natural and anthropogenic[1]	595,916	76%

[1] The "natural and anthropogenic" line does not represent the sum of natural and anthropogenic areas disturbed, but rather the total area impacted by both natural and anthropogenic disturbances. It should be noted that some parts of the territory may be simultaneously affected by both types of disturbance. For example, disturbances related to the presence of logging roads (anthropogenic) may be superimposed on forest fire disturbances (natural) (Map 2 - Woodland caribou habitat disturbance; Appendix 7-5).

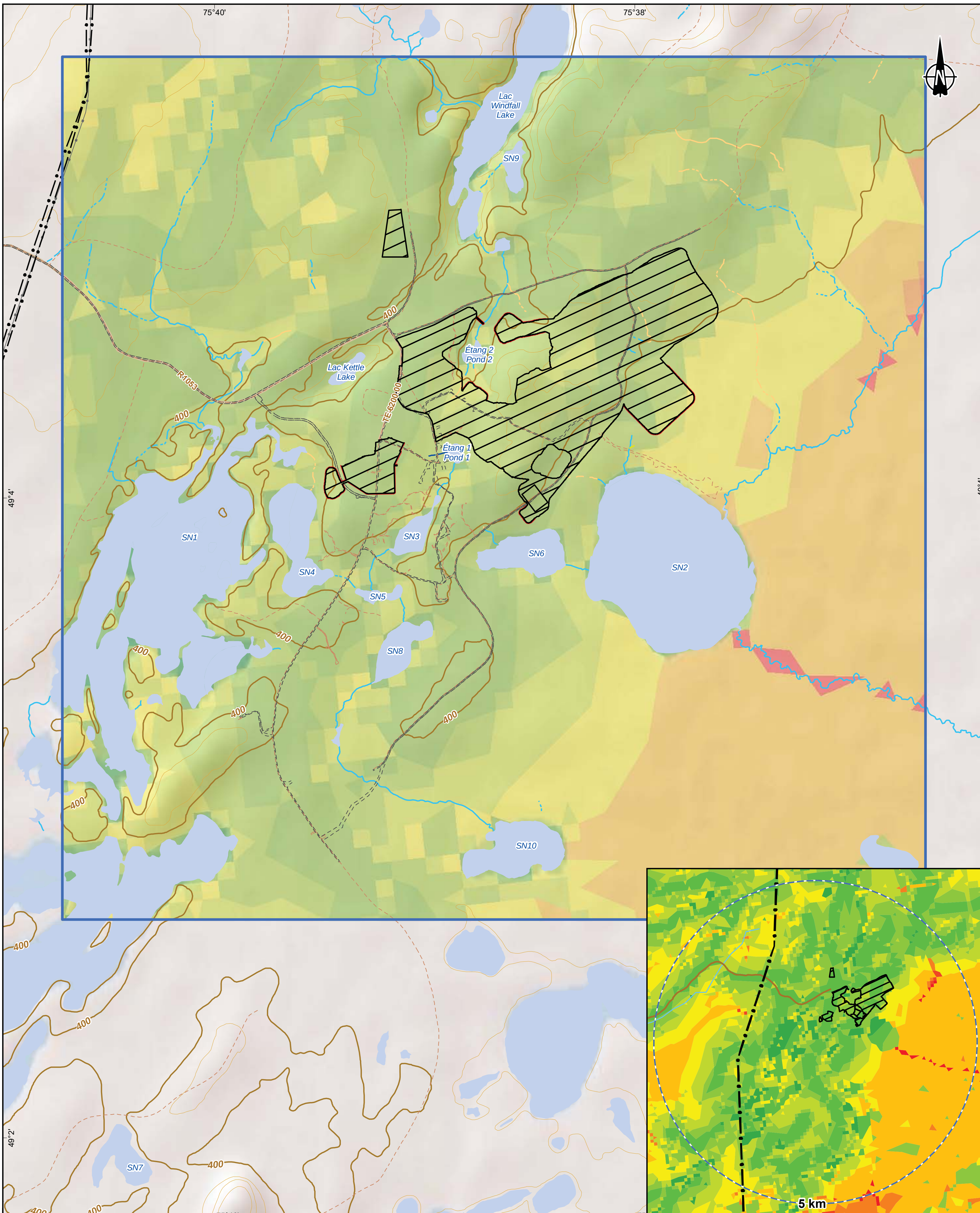
The area with the highest rate of disturbance (81%) by anthropogenic and natural elements within the large wildlife study area is located within 5 km of the centre of the mine. Fires have disturbed nearly 12% of this area, while anthropogenic elements generate about 81% of the disturbance. Within 10 km of the centre of the mine, 63% of the surface is disturbed. Fires cover about 18% of this area, while anthropogenic disturbances cover about 60%.

It is likely that areas disturbed by logging will have the capacity to regenerate and provide suitable conditions for woodland caribou in the future. During the aerial survey conducted in March 2018, it was found that a proportion of these cut areas were logged using a harvesting method that provides protection for high regeneration (CPHR). This method of harvesting accelerates the reconstitution of softwood stands, favouring habitat conditions for woodland caribou (photo 7-1).

Photo 7-1 Cutting with protection of high regeneration

The relative probability of occurrence of woodland caribou, according to the habitat selection model developed by Leblond et al. (2015), represents another index to assess the state of the environment in terms of habitat for woodland caribou. This index has been incorporated into the identification of priority areas for the creation of large protected areas for woodland caribou. This mathematical model, while incorporating several environmental characteristics, does not necessarily indicate the actual distribution of the species on the territory.

In the northern portion of the study area defined for large wildlife that was covered by the modelling, the relative probability of occurrence of woodland caribou is medium to low (Map 7-6). Of this total area, cells representing medium to low probability of occurrence account for over 80% of the area, or just under 4,000 km^2. Areas with the highest probability are generally represented by patches of residual forest. The available habitat within 50 km of the centre of the proposed mine site is, however, highly fragmented by logging areas and their access roads. On this point, ECCC states that for local populations to be self-sustaining, they must have access to continuous tracts of undisturbed habitat with the biophysical characteristics necessary to meet their life cycle needs (Environment Canada, 2012). The study area defined for large wildlife thus provides poor habitat conditions for woodland caribou.



Zone d'étude locale du milieu biophysique/ *Biophysical environment local study area*

Zone d'influence de la mine / *Mine impact area*

Hydrographie / *Hydrography*

- Cours d'eau permanent / *Permanent watercourse*
- Cours d'eau permanent partiellement souterrain / *Partially undeground permanent watercourse*
- Cours d'eau intermittent / *Intermittent watercourse*
- Cours d'eau intermittent partiellement souterrain / *Partially undeground intermittent watercourse*
- Cours d'eau souterrain / *Underground watercourse*
- Fossé de drainage / *Drainage ditch*
- Canal / *Canal*
- Plan d'eau / *Waterbody*

Infrastructure / *Infrastructure*

- Ligne de transport d'énergie électrique / *Electric power line*
- Route forestière / *Forest road*
- Chemin de gravier (mine) / *Gravel road (mine)*
- Route d'accès / *Access road*

Empiètement du projet / *Project Encroachment*

- Empiètement permanent / *Permanent encroachment*
- Empiètement temporaire / *Temporary encroachment*

Caribou forestier / *Woodland Caribou*

Probabilité relative d'occurrence / *Relative probability of occurrence*

- Faible / *Low*
- Élevée / *High*

OSISKO
MINIÈRE OSISKO

Projet minier Windfall - Étude d'impact sur l'environnement / *Windfall Mining Project - Environmental Impact Assessment*

Site minier Windfall, Eeyou Istchee Baie-James (Québec) / *Windfall Mining Site, Eeyou Istchee Baie-James (Quebec)*

Carte 7-6 / *Map 7-6*
Empiètement du projet sur la probabilité relative d'occurrence du caribou / *Project Encroachment on Caribou Relative Likelihood of Occurence*

Sources / Sources:
CanVec+, 1/50 000, RNCan, 2014
MERN, AQréseau+, réseau routier, 2020-03
MFFP, 2018
BDGA, 1/1 000 000, MRN Québec, 2012

0 225 450 m

MTM, Fuseau 9 / *Zone 9*, NAD83

2023-03-23

Préparée par / Preparation : É. D'Astous
Dessinée par / Drawing : C. Thériault
Vérifiée par / Verification : M.-H. Brisson
_201_11330_19_eimb_c7_6_161_PR_OCC_Caribou_230323.mxd

wsp

MOOSE

The low density of moose in Quebec's boreal region is due in large part to the low productivity of the habitat. The low availability and poor quality of food is most critical during the winter months.

Fire and logging, which are disruptors of plant dynamics, can increase the amount of available browse. Several years after a fire, regenerating burnt-over areas with a high proportion of deciduous tree or shrub species provide food-rich habitat (Courtois et al. 1996; Samson et al. 2002). The forest species sought by moose for feeding are white birch and willow in summer, and balsam fir in winter (Dussault et al., 2002; Samson et al., 2002; Dussault et al., 2004). Mixed and regenerating hardwood forests for food, interspersed with mature stands for shelter, provide suitable habitat for moose establishment. Mixedwoods, hardwoods and shrub swamps are minimally present in the study area defined for large wildlife. With respect to the calving period, the preferred habitats are the banks of lakes and streams, softwood stands, and hilltops.

The moose inventory area includes two traplines, W25A and W25B. According to the tallymen of these traplines, the area is rather swampy and is therefore not suitable for moose. However, some of the more densely wooded areas beyond the 5 km moose inventory zone boundary would be suitable for moose use and should be protected.

In 2018, tallymen and land users mentioned that moose hunting had become more difficult due to anthropogenic disturbances related to logging, mineral exploration activities, and increased traffic on the access road going to the Windfall project site. Following the numerous forest cutting operations, several years must pass before the territory becomes attractive again for moose. Furthermore, according to these users, there are no longer any moose along the access road (where they used to hunt) due to increased traffic and noise. These conditions make it more challenging to locate which areas the moose are heading towards. Some users mentioned that moose hunting was unsuccessful for the first time in 2017.

According to tallymen consulted in 2022, these findings of declining moose numbers in the area still applied. A tallyman also indicated that in 2017 and 2018, moose were occasionally seen along the road northeast of the site, but that they have not been seen there since. However, moose tracks were seen in 2022 on the access road to a mining exploration camp, a few kilometres south of the Windfall project. There was less human disturbance in this area, however, as this other mining company's exploration camp was temporarily closed.

The preservation of moose habitat is a concern for tallymen, since this species is an integral part of the traditional diet of Cree communities. Combined with other small game, moose allow some users of the territory to completely cover their meat needs in winter. With increased activity on the Windfall site near their hunting grounds, users are concerned that they will have to travel greater distances to hunt moose and support themselves.

The 2018 aerial survey identified 40 trail systems corresponding to moose wintering areas in the 1,600 km^2 area, including two in the 100 km^2 moose inventory area (Map 7-6). The effort to locate, count, and classify moose was concentrated in the 100 km^2 inventory area, where the moose inventory method was applied. In estimating density per 10 km^2, an observation rate of 80% was used to estimate the number of individuals in the moose inventory area. Outside this area, a reasonable effort was made to locate and count the moose.

In the moose-specific inventory area, a total of four individuals (three females and one calf) were observed in two wintering areas (moose yards), which corresponds to an estimated density of 0.5 moose/10 km^2. In the 1,600 km^2 caribou inventory area, 40 wintering areas were located and 13 moose were counted in seven of them, including six females and seven males. It should be noted that territories further south have densities that can exceed 2 moose/10 km^2 (Bilodeau and Greaves, 2021).

GREY WOLF

Although the grey wolf (*Canis lupus*) is more associated with furbearers than with large mammals, it is one of the main predators of moose and caribou. No wolves were observed during the inventories. However, tracks were observed on several occasions, covering almost the entire caribou inventory area of 1,600 km^2. Carcass remains of a young moose killed by a pack of wolves were also observed.

Anthropogenic disturbances related to forest cutting may promote the presence and facilitate the movement of wolves. Past work in Quebec shows that following a forestry cut, an increase in the abundance of food resources favourable to black bears and moose is noted. Increased moose numbers support the potential increase in densities of the grey wolf, a predator of woodland caribou. On the other hand, increasing the density of logging roads increases the efficiency of predators in patrolling a developed area in search of prey (St-Laurent et al. 2014). Wolf predation is predominantly centred on adult caribou, but appears to be low due to particularly effective avoidance strategies on the part of caribou.

BLACK BEAR

No specific black bear inventories were conducted in the study area defined for large wildlife. However, some were observed and signs of their presence were encountered during some of the inventories for other wildlife groups.

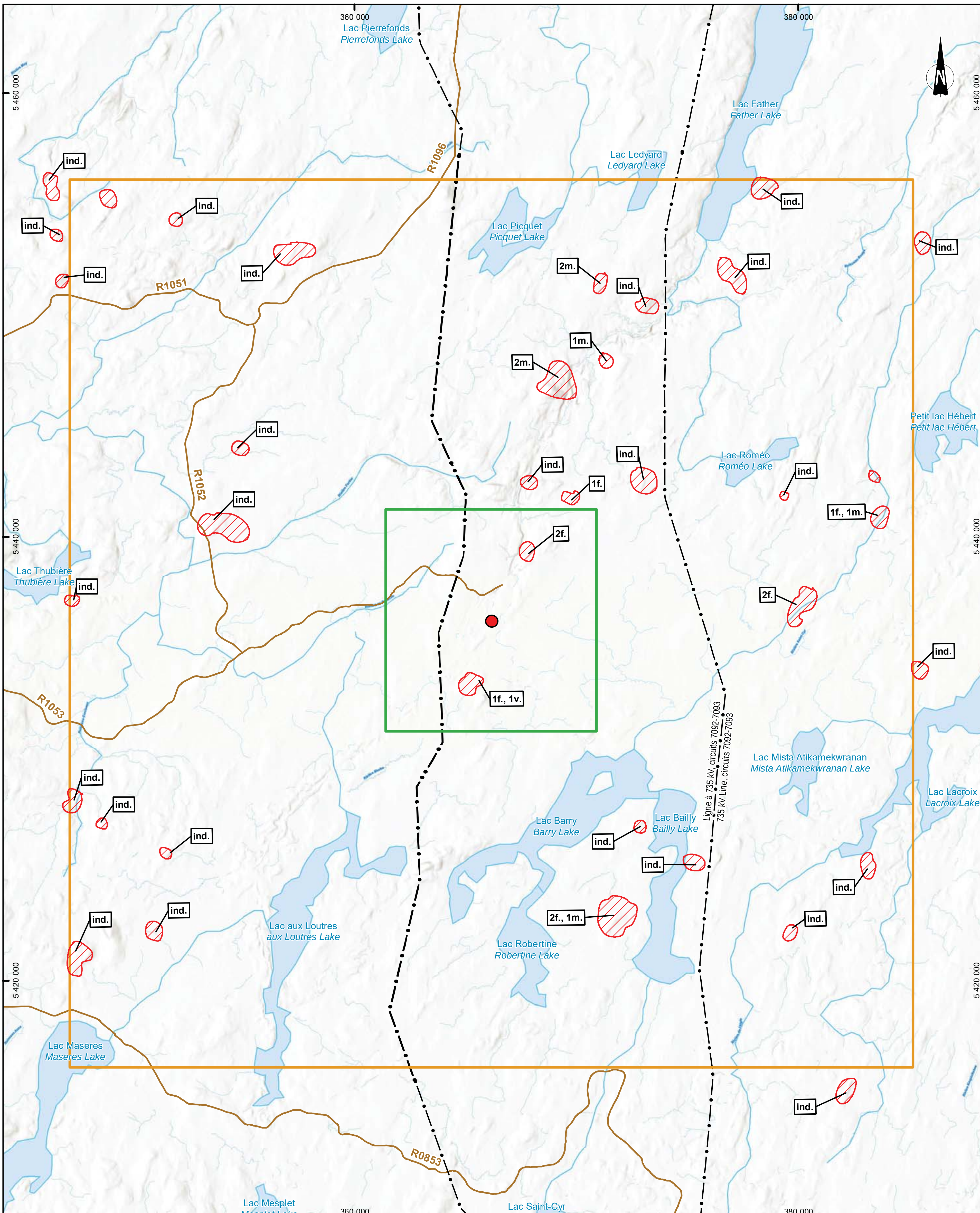
Bears are also major predators of caribou and moose calves. Strategies for avoiding caribou predators appear to be ineffective in the face of potentially high black bear densities. Bear predation on caribou calves is emerging as a central factor in the decline of the forest ecotype of caribou in eastern Canada (St-Laurent et al. 2014). According to this study, predation accounted for 71% of calf deaths and black bears were the predator in 83% of cases. Telemetric monitoring of females showed that anthropogenic disturbances (logging and forest roads) forced caribou to increase their movements and, consequently, the probability of encountering a predator. In addition, females that were more likely to visit areas of recent forestry cuts were more likely to lose their calves to predation by black bears.

In the fall, bears primarily use bare areas, areas where ericaceous plants predominate, recent burnt-over areas, and bogs devoid of lichens. In the spring, it also visits mixedwood and hardwood forests, hardwood and mixedwood shrublands, marshes, swamps, watercourses, and lakes (Tecsult Inc. 2005; CRRNTBJ, 2010).

Within the study area defined for large wildlife, food availability for black bears is determined in part by the occurrence of wetlands and environments disturbed by fire and logging. These are particularly important for the production of berries, which bears depend on for the accumulation of their fat reserves (Samson, 1996). A high proportion of the study area defined for large wildlife is disturbed by fire and logging, providing good habitat potential for the black bear.

Since Osisko resumed exploration activities, bears are frequently seen near the exploration camp and near the drilling areas. In 2022, there were four (4) bears living near the camp.

During the 2019 interview, occupants of trapline W25B stated that bears are typically hunted in the fall beginning in October, in part because of their more abundant fat supply. According to them, bears follow their own trails and normally stay near areas rich in blueberries. They also noticed a greater presence of bears in the summer of 2018, to the point that they were considered a problem.



Éléments du projet / *Project elements*

Site à l'étude / *Study site*

Zone d'inventaire de l'orignal / *Moose survey area* (95 km²)

Zone d'inventaire du caribou / *Caribou survey area* (1 520 km ²)

Orignal / *Moose*

Réseau de piste / *Trail network*

Observation directe
f. : femelle
m. : mâle
v. : veau
ind. : indéterminé

Hydrologie / *Hydrology*

Cours d'eau permanent / *Permanent water course*

Plan d'eau / *Water body*

Infrastructures / *Infrastructures*

Route / *Road*

Ligne de transport d'énergie / *Transmission line*

OSISKO
MINIÈRE OSISKO

Projet minier Windfall - Étude d'impact sur l'environnement / *Windfall Mining Project - Environmental Impact Assessment*

Site minier Windfall, Eeyou Istchee Baie-James (Québec) / *Windfall Mining Site, Eeyou Istchee Baie-James (Quebec)*

Carte 7-7 / *Map 7-7*
Occurence et indice d'occurence de l'orignal /
Moose Occurrence and Occurrence Index

Sources / Sources:
CanVec+, 1/50 000, RNCan, 2014
MERN, AQréseau+, réseau routier, 2020-03
MFFP, 2018
BDGA, 1/1 000 000, MRN Québec, 2012

0 1,75 3,5 km

MTM, Fuseau 9 / *Zone 9*, NAD83

2023-03-14

Préparée par / Preparation : M.-H. Brisson
Dessinée par / Drawing : V. Venne
Vérifiée par / Verification : M.-H. Brisson
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wsp

La précision des limites et les mesures montrées sur ce document ne doivent pas servir à des fins d'ingénierie ou de délimitation foncière. Aucune analyse foncière n'a été effectuée par un arpenteur-géomètre. / Boundary accuracy and measurements shown on this document are not to be used for engineering or land delineation purposes. No land analysis was carried out by a land surveyor.

7.5.2 IMPACTS ON LARGE WILDLIFE DURING THE CONSTRUCTION PHASE, AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the construction phase, the potential sources of impacts and resulting impacts **(in bold)** that may affect large wildlife are the following:

— Organization of the site, stripping and clearing, surface preparation and access arrangement, construction of works and infrastructure, transportation and traffic, production and management of residual and hazardous materials.

These sources have the potential to produce the following impacts during the construction phase:

Habitat loss and fragmentation, primarily for moose, by:

— activities related to the organization of the site, stripping, and clearing that will result in a loss of surface area and alterations in the nature of the existing moose habitats. It should be mentioned that since the area covered by the large wildlife study zone does not correspond to caribou habitat, no loss of habitat is anticipated for this species.

Disturbance and risk of collision and mortality by:

— Mobile equipment transportation and traffic on the site;

— vibration and noise and light emissions during the construction of new infrastructure.

Alteration of habitat quality by:

— the accidental introduction of petroleum hydrocarbons, contaminants, or hazardous materials into surface waters and soil that will contaminate the habitat.

MITIGATION MEASURES

Common mitigation measures QUA01 to QUA04, QUA08, QUA11 to QUA21, NOR07, VEG01 to VEG04, PLA01, and PLA02 will be applied to reduce the impact of stripping and clearing on habitat loss and fragmentation. For impacts related to disturbance and the risk of collision and mortality, mitigation measures AIR01 to AIR04, NOR01, FAU04 and FAU06, FAU09, and NOR03 will be applied. Finally, mitigation measures QUA06, QUA07, QUA22 to QUA26, as well as NOR04, NOR05, and NOR10 will reduce the project’s impacts on spill risks.

Specific measure P26 will also be implemented for this component.

DETAILED RESIDUAL IMPACT DESCRIPTION

HABITAT LOSS AND FRAGMENTATION

For the large fauna component, the project has been optimized to minimize impacts on terrestrial wildlife, including this wildlife group. However, clearing and grubbing as well as stripping and excavation will cause habitat loss, changes in habitat structure, and fragmentation.

WOODLAND CARIBOU

For woodland caribou, the inventories and consultations carried out with members of the Cree community occupying and using the Windfall project area have confirmed a very low presence of this species in the area. In fact, an inventory completed on a territory of 1,600 km^2 revealed only three caribou, which corresponds to a density of 0.10 caribou/100 km^2. Moreover, discussions with members of the Cree community have revealed sporadic and isolated sightings, particularly between the tallyman's camp on trapline W25B and Lake Barry, i.e., further south than the Windfall project site. Furthermore, the assessment of the quality of the habitat present within a 50 km radius of the Windfall project site shows that the habitat is not very suitable for supporting caribou populations. This information confirms the observations and surveys completed by provincial and federal agencies, which show that the main caribou populations occupy territories located over 80 km north of the Windfall project site. Given the absence of recognized caribou habitat in the area of the project site and the sporadic presence of a few individuals, no habitat loss was considered for woodland caribou.

MOOSE

According to inventories conducted for moose within the 100 km^2 (10,000 ha) inventory area dedicated to moose, a total of four moose were observed, including three adult females and one calf, for a relatively low density of 0.5 moose/10 km^2. This low density is explained, in part, by the low quality of the habitat in the inventory area relative to the preferences of this species. In addition, numerous forest fires and logging activities have resulted in the transformation and fragmentation of this habitat. It should be noted, however, that these disturbances could lead to an increase in the amount of browse available to moose with the gradual regeneration of these areas.

The main impact on moose is related to the clearing of areas required for the Windfall project, which will result in a permanent reduction in the area of natural environments of 112.33 ha, which represents approximately 1.1% of the area of the moose inventory zone. Of this area 39.3 ha is quality habitat, in the form of hardwood stands (18.8 ha) and mixedwood stands (20.5 ha). Regenerating stands (24.2 ha) and wetlands (49.5 ha) also provide good habitat for the species.

BLACK BEAR AND GREY WOLF

Clearing the areas required for the Windfall project site will have little impact on the availability of quality habitat (regenerating stands, wetlands, shrublands, etc.) for black bear and even less impact on the grey wolf. It is worth noting that an increased presence of black bears has been observed since the beginning of the work at the Windfall site. Although black bears generally prefer territories free of human presence, their opportunistic behaviour may lead them to visit work areas. Food odours, human feeding, and improperly stored food could attract bears, threaten worker safety, and require relocation or removal of problem bears near work areas.

As for the grey wolf, studies show that the opening and presence of access roads associated with forestry and mining activities would favour the wolf's hunting success by facilitating its movement on the territory.

DISTURBANCE DUE TO THE PRESENCE OF INFRASTRUCTURE AND TRAFFIC/RISK OF COLLISION AND MORTALITY

Indirect impacts due to increased disturbance such as noise, vibration, and dust emissions are expected during the construction phase. In addition, collision and mortality risks related to the presence of infrastructure and traffic on the construction site are also possible.

The effect of noise has been shown in the literature to have a potential negative effect on mammals (Shannon et al., 2015; Kunc and Schmidt, 2019, Mancera, 2017). The threshold at which impacts would be felt is 52 dBA. In fact, noise from infrastructure construction, site traffic, and refuelling and maintenance of mobile equipment could cause avoidance of certain noisy areas, changes in the reproductive success of certain species, and changes in interspecific communication. However, the noise caused by the project will not exceed this threshold beyond 700 m from the central point of the emission sources for all scenarios studied. The effect on the periphery of the project will therefore be low. The risk of collision and mortality is associated with the movement of mobile equipment.

ACCIDENTAL INTRODUCTION OF PETROLEUM HYDROCARBONS, CONTAMINANTS, OR HAZARDOUS MATERIALS INTO THE ENVIRONMENT

As for the risk of spills, they will be mainly associated with the refuelling and breakdown of mobile equipment. However, since spills will be managed in accordance with the spill response plan and given the numerous mitigation and control measures in place, the risk of a spill affecting surface water quality is very low; the spill will be contained and contaminated soils will be recovered quickly, as prescribed in the Emergency Response Plan (see Chapter 12). Finally, if there is a spill, the degree of contamination will depend on the nature of the contaminants and their concentrations.

RESIDUAL IMPACT ASSESSMENT

During the construction phase, the potential residual impacts on the large wildlife component are related to activities that cause habitat loss, disturbance, and the risk of spills.

VALUE OF THE LARGE WILDLIFE SPECIES CONSIDERED

The woodland caribou is a species of special status as it is considered vulnerable in Quebec and threatened federally. For this reason, its ecosystem value is considered high. In comparison, moose have a medium ecosystem value due to their low occurrence and importance to the Cree community. The black bear and grey wolf will have a low ecosystem value since there are no special concerns associated with them.

Similarly, woodland caribou will have high socioeconomic value because of the legal protection afforded it as a species of special status. Moose, black bear, and grey wolf will have medium socioeconomic value because of their interest to the Cree community.

Finally, woodland caribou is assigned a high value while moose, black bear, and grey wolf are assigned a medium value.

HABITAT LOSS AND FRAGMENTATION

The degree of disturbance associated with habitat loss and fragmentation due to clearing and stripping of work areas is considered low since a very small area is affected and the habitat present has already been significantly altered by past human and natural activities. This assessment considers the reduction in the degree of disturbance through the project's mitigation measures as well as the application of and compliance with existing standards and regulations, primarily for clearing activities.

For the moose, black bear, and grey wolf, which have a medium value and a low degree of disturbance, the intensity of the impact will be low.

The spatial scope of the anticipated residual impacts is established as specific since they are likely to be felt over a small area, i.e., at the infrastructure level. The duration of the impacts is considered to be long since they result from clearing activities that cause permanent loss. The probability of occurrence is considered high. Therefore, the residual impact on moose, black bear, and grey wolf is defined as low.

DISTURBANCE AND RISK OF COLLISION AND MORTALITY

With respect to disturbance and the risk of collision and mortality, the degree of disturbance is considered low for all species considered, resulting in a medium intensity for caribou and a low intensity for the other species. In fact, the impact does not significantly alter the inherent characteristics of the component, and so it will maintain its integrity. The spatial scope of the anticipated residual impacts is established as specific since they are likely to be felt over a small area, i.e., near the infrastructure. The duration of the impacts is considered to be short as the impacts felt due to disturbance will be discontinuous and within the construction period. The probability of occurrence is considered low for caribou, given its rarity in the work area, and medium for the other species considered, which are more prevalent and therefore more likely to be affected by the construction activities that will cause noise and disturbance. Consequently, the residual impact of disturbance will be low for caribou and very low for the other species.

RISK OF ACCIDENTAL INTRODUCTION OF PETROLEUM HYDROCARBONS, CONTAMINANTS, OR HAZARDOUS MATERIALS

The potential residual impacts on large fauna are related to the risk of accidental hydrocarbon spills in the environment. The intensity of residual impacts on large fauna is considered low. This assessment considers the reduction of the degree of disturbance to the component through all of the project's optimization and mitigation measures, as well as the application of and compliance with applicable standards and regulations. The spatial scope of the residual impacts is established as specific since the impacts are likely to be felt over a small area within the work zone. The duration of the impacts is considered to be short as they result from specific activities with a fixed duration in the construction schedule. The probability of occurrence is considered Low. Therefore, the residual impact on caribou is defined as low while it will be very low for the other species.

Impact on caribou during the construction phase		
Nature	Negative	Significance: Low
Ecosystem value	High	
Socioeconomic value	High	
Degree of disturbance	Low	
Intensity	Medium	
Spatial scope	Specific	
Duration	Short	
Probability of occurrence	Low	

Impact on moose, black bear, and grey wolf during the construction phase		
Nature	Negative	Significance: Risk of accidental spills and disturbance, risk of collision and mortality – Very low Loss of habitat – Low
Ecosystem value	Medium (moose) and low (black bear and grey wolf)	
Socioeconomic value	Medium	
Degree of disturbance	Low	
Intensity	Low	
Spatial scope	Specific	
Duration	Short (disturbance, risk of collision and mortality, and risk of accidental spills), long (habitat loss)	
Probability of occurrence	Low (risk of accidental spills), medium (disturbance, risk of collision and mortality) and high (habitat loss)	

7.5.3 IMPACTS ON LARGE FAUNA DURING THE OPERATIONS PHASE, AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the operations phase, the potential sources of impacts and resulting impacts (**in bold)** that may affect large fauna are the following:

— The presence and operation of new infrastructure, water use and management, transportation and traffic, residual and hazardous materials generation and management.

These sources may cause the following impacts during the operations phase:

Disturbance and risk of collision and mortality by:

— mobile equipment transportation and traffic on the site;

— vibration and noise and light emissions from existing infrastructure and activities.

Alteration of habitat quality by:

— the accidental introduction of petroleum hydrocarbons, contaminants, or hazardous materials into surface waters and soil that will contaminate the habitat.

MITIGATION MEASURES

The mitigation measures listed for the construction phase will also be applied to mitigate impacts related to disturbance, the risk of collision and mortality, and the risk of spills.

DETAILED RESIDUAL IMPACT DESCRIPTION

DISTURBANCE DUE TO THE PRESENCE OF INFRASTRUCTURE AND TRAFFIC/RISK OF COLLISION AND MORTALITY

The anticipated effect of the presence of the facilities and mobile equipment traffic (disturbance and risk of collision and mortality) will be similar to what was assessed during the construction phase, although slightly less due to the reduced number of mobile equipment. However, the duration would be medium. Noise levels will not exceed 50 dBA beyond a distance of 1 km centred on the noise sources for all scenarios studied.

ACCIDENTAL INTRODUCTION OF PETROLEUM HYDROCARBONS, CONTAMINANTS, OR HAZARDOUS MATERIALS INTO THE ENVIRONMENT

As far as spill risks are concerned, they are the same as those anticipated during the construction phase.

RESIDUAL IMPACT ASSESSMENT

During the operations phase, the residual impacts are disturbance, the risk of collision and mortality, and the risk of accidental spills. The related impacts are essentially the same as during the construction period. The significance of the residual impact of these two likely changes for caribou is considered low, while it will be very low for other species.

Impact on caribou during the operations phase		
Nature	Negative	Significance: Low
Ecosystem value	High	
Socioeconomic value	High	
Degree of disturbance	Low	
Intensity	Medium	
Spatial scope	Specific	
Duration	Short (risk of accidental spills), medium (disturbance, risk of collision and mortality)	
Probability of occurrence	Low	

Impact on moose, black bear, and grey wolf during the operations phase		
Nature	Negative	Significance: Very low
Ecosystem value	Medium (moose) and low (black bear and grey wolf)	
Socioeconomic value	Medium	
Degree of disturbance	Low	
Intensity	Low	
Spatial scope	Specific	
Duration	Short (risk of accidental spills), medium (disturbance, risk of collision and mortality)	
Probability of occurrence	Low (risk of accidental spills), medium (disturbance, risk of collision and mortality)	

7.5.4 IMPACTS ON LARGE MAMMALS DURING THE CLOSURE PHASE, AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the closure phase, potential sources of impacts and resulting impacts **(in bold)** likely to affect large fauna are as follows:

— Final restoration, production and management of residual and hazardous materials.

These sources have the potential to produce the following impacts during the operations phase:

Habitat creation by:

— site rehabilitation.

Disturbance and risk of collision and mortality by:

— mobile equipment transportation and traffic for site rehabilitation.

Alteration of habitat quality by:

— the accidental introduction of petroleum hydrocarbons, contaminants, or hazardous materials into surface waters and soil that will contaminate the habitat.

MITIGATION MEASURES

In the closure phase, all mitigation measures listed for the construction and operations phases will be applied when they address the same impact sources.

DETAILED RESIDUAL IMPACT DESCRIPTION

DISTURBANCE DUE TO THE PRESENCE OF INFRASTRUCTURE AND TRAFFIC/RISK OF COLLISION AND MORTALITY

Dismantling activities, movement of mobile equipment carrying materials, retired equipment, and the procurement of goods and services will result in disturbance and risk of collision and mortality. The anticipated impacts are the same as in the construction and operations phases.

ACCIDENTAL INTRODUCTION OF PETROLEUM HYDROCARBONS, CONTAMINANTS, OR HAZARDOUS MATERIALS INTO THE ENVIRONMENT

As far as spill risks are concerned, they are the same as those anticipated during the construction phase.

HABITAT RESTORATION

Following decommissioning, habitats will be restored or recreated and will be able to once again fulfill functional requirements for large mammals.

RESIDUAL IMPACT ASSESSMENT

In the closure phase, the residual impacts are the same as in the operations phase, i.e., disturbance and the risk of accidental spills. Therefore, the significance of the residual impact of these two likely changes for caribou is considered to be low, while it will be very low for other species.

Once the closure phase is over and the rehabilitation work has been completed, a positive impact is expected due to habitat restoration, mainly for moose, black bear, and grey wolf.

Impact on caribou during the closure phase		
Nature	Negative/Positive	Significance: Low Positive impact
Ecosystem value	High	
Socioeconomic value	High	
Degree of disturbance	Low	
Intensity	Medium	
Spatial scope	Specific	
Duration	Short	
Probability of occurrence	Low	

Impact on moose, black bear, and grey wolf during the closure phase		
Nature	Negative	Significance: Very low Positive impact
Ecosystem value	Medium (moose) and low (black bear and grey wolf)	
Socioeconomic value	Medium	
Degree of disturbance	Low	
Intensity	Low	
Spatial scope	Specific	
Duration	Short	
Probability of occurrence	Low (risk of accidental spills), medium (disturbance, risk of collision and mortality)	

7.6 MAMMALS – CHIROPTERANS

Important facts about chiropterans

Existing conditions

Although little data is available on the presence of chiropterans in the region, the geographical distributions show that six species are potentially present. Published data show a low number of recordings in the Nord-du-Québec region, and for only four species. The results of the acoustic inventories completed in 2016, 2017, and 2021 confirmed the presence of the same six species, as expected from their geographical distribution, namely the northern myotis, little brown bat, big brown bat, silver-haired bat, hoary bat, and red bat. Except for the big brown bat, all these species have a special status.

On the other hand, the inventories only identified potential maternity roosts without confirming their use by chiropterans. Similarly, no potential hibernacula were identified during the review of existing literature or field research.

Potential Project Impacts

During the construction phase, impacts are associated with habitat loss and fragmentation/alteration of feeding sites, disturbance and risk of collision and mortality, and alteration of habitat quality (spills). Given the mitigation measures that will be implemented, the intensity of the residual impact on chiropterans is considered medium for all anticipated impacts. The spatial scope will be specific and the duration will be short for disturbance/risk of collision and mortality and accidental spills, while it will be long for habitat loss/fragmentation. The probability of occurrence is low for the risk of spills and high for disturbance/risk of collision and mortality, and habitat loss/fragmentation. The result is a residual impact of low significance for the risk of spills, and medium for disturbance/risk of collision and mortality and habitat loss/fragmentation.

In the operations phase, the impacts are associated with disturbance and the risk of collision and mortality, as well as the alteration of habitat quality (spills). The intensity of the impact is judged to be medium and its spatial scope specific; the duration will be short (spills), as it will be felt at some point during the operations, and medium (disturbance and risk of collision and mortality), as the effect will be felt throughout the life of the mine. The probability of occurrence will be high (disturbance and risk of collision and mortality) to low (spills). The significance of the residual impact will be medium for disturbance/risk of collision and mortality, and low for the risk of spills.

During the closure phase, site rehabilitation should have a positive impact on the restoration of the habitat. However, during the closure work, there remains a risk of spills, disturbance, and collision and mortality, the intensity of which is perceived as medium. The spatial scope of these impacts will be specific. The duration is considered short since it is limited to the closure work. Finally, the probability of occurrence will be medium (disturbance/risk of collision and mortality) to low (spills). The result is a residual impact of medium significance (disturbance/collision and mortality) to low (spills).

7.6.1 CURRENT CONDITIONS

In Quebec, there are eight species of bats, five of which are considered resident since they remain in the province during the winter, and three of which are considered migratory since they spend the winter further south. It should be noted, however, that in Quebec, even resident species migrate during the fall, albeit over shorter distances than in the case of migratory species.

EXISTING LITERATURE

There are few data available to provide a relevant reference state for chiropterans in the region. According to the geographical distribution of bat species in Quebec (Jutras et coll., 2012), six species of chiropterans are potentially present in the region: three resident species—the little brown bat (*Myotis lucifugus*), the northern myotis (*M. septentrionalis*), and the big brown bat (*Eptesicus fuscus*); and three migratory species—the silver-haired bat (*Lasionycteris noctivagans*), the hoary bat (*Lasiurus cinereus*), and the red bat (*Lasiurus borealis*).

According to the latest report of the Réseau québécois d'inventaire acoustique de chauves-souris [Quebec network of acoustic bat inventories, or the Network], published in the CHIROPS newsletter (Jutras et Vasseur, 2011), the Nord-du-Québec region is one of the regions with the lowest number of recordings in the entire Network. It should be noted that these recordings were taken at Lac Bourbeau, approximately 140 km northeast of the study site. Between 2003 and 2009, the species recorded were hoary bat, bats of the genus *Myotis*, and big brown bat.

Since the local biophysical study area is located in the extreme south of the Nord-du-Québec region, the Network data collected in Abitibi, which is approximately 230 km southwest of the local biophysical study area, can also be considered, especially since the number of passages recorded there is greater than in Nord-du-Québec. In this region the species recorded in 2009 were the hoary bat, the big brown bat, the red bat, the silver-haired bat and bats of the genus *Myotis* (Jutras et Vasseur, 2011).

As for the CDPNQ database, no records of chiropterans were listed in 2017 within 15 km of the centre of the local study area of the biophysical environment (MFFP, 2017), and the same is true of the data available from the CDPNQ via the interactive map available online (Gouvernement du Québec, 2022).

In addition, the closest known critical habitat for chiropterans, the Rose Lake Mine hibernacula, is located approximately 90 km northwest of the local biophysical study area near Lac Madeleine (Brunet et Duhamel, 2003).

ACOUSTIC INVENTORIES OF CHIROPTERANS

Chiropteran inventories were conducted in 2016, 2017, and 2021 using the fixed acoustic inventory technique, which is based on the protocol developed by the Ministère des Ressources naturelles et de la Faune (MRNF) for bat inventories as part of wind power projects (MRNF, 2008). This methodology collects point-in-time information on chiropteran activity using automated inventory stations. Details of this study are presented in the sectorial report in Appendix 7-6.

Ten inventory stations were set up to document certain habitats favourable to the activities of the bat species potentially present, i.e., sites suitable for breeding, feeding, or resting, as well as potential travel or migration corridors (Map 7-3). These included:

— two stations in 2016, active during the late breeding season and the first half of the chiropteran migration period;

— three stations in 2017, active during the second half of the breeding season and during the migration period;

— five stations in 2021, active during the entire breeding and fall migration periods.

The inventoried habitats were characterized by the presence of two or more of the following:

— open environments;

— mature forest environments;

— watercourses and water bodies;

— wetlands.

These acoustic inventories confirmed the use of the local study area of the biophysical environment by the six bat species potentially present:

— bats of the genus *Myotis*, including:

  a the northern myotis (confirmed);

  b the little brown bat (confirmed).

— the big brown bat;

— the silver-haired bat;

— the hoary bat;

— the red bat.

Acoustic inventories also confirmed the importance of certain landscape components as chiropteran habitat elements, notably the combination of wetlands and water environments with mature forest stands and open environments, which provide resting, breeding, and feeding sites. The results also suggest the presence of a travel and migration corridor used by chiropterans, which would pass through Lac Croft and then continue further south through Windfall Lake, thus forming a chain of lakes and watercourses with a general north-south orientation.

SEARCH FOR CHIROPTERAN MATERNITY SITES

Several species of bats, such as the little brown bat and the northern bat, both listed as endangered under Schedule 1 of the Species at Risk Act (SARA), are likely to use buildings as resting or nursing (maternity) sites (Tremblay et Jutras, 2010). To confirm the presence of such sites in the Windfall project area, a search for potential chiropteran maternity sites was conducted during the 2021 season. Details of this study are presented in the sectorial report (Appendix 7-6).

In accordance with the bat colony validation protocol proposed by the Ministère des Forêts, de la Faune et des Parcs (*Protocole de validation d'une colonie de chauves-souris*) (MFFP, 2014), the assessment and validation activities for the potential presence of maternity colonies in the field took place between June 17 and July 7, 2021, i.e., during the birthing and nursing season.

No potential sites were observed at anthropogenic structures (buildings). Several potential sites were identified in natural structures (cavity trees and snags), but although the most promising ones were visually and acoustically checked in the evening, none were found to be used by chiropterans. However, this does not guarantee that sites for birthing and nursing of pups are not used in the local study area of the biophysical environment.

SEARCH FOR CHIROPTERAN HIBERNACULA

To assess the potential for chiropteran hibernacula in the local study area of the biophysical environment, a literature search was conducted in 2017. Particular attention was paid to former mine sites that could be found in the local biophysical study area, namely five worked deposits (Urban, Ritchot, Windfall Lake [Zone F], Duval, and Win-98-02) and one deposit with assessed tonnage (Winfdall Lake [Alto]), as well as the presence of underground workings that would have led to the creation of sites of interest for chiropterans. Various documentary sources were consulted, in particular the geomatics information system (SIGÉOM) (MERN, 2021). Details of this research are presented in the chiropteran sectorial report (Appendix 7-6).

No potential sites were identified in the review of available documents and information. Only the Windfall site ramp, built in 2007 and 2008 and flooded until 2017, could have been accessible to chiropterans, but has since been used for advanced exploration.

SPECIAL STATUS SPECIES

Of the resident species identified, the little brown bat and the northern myotis are considered endangered in Canada and are listed on Schedule 1 of SARA (Gouvernement du Canada, 2022a). The three species of migratory bats, namely the silver-haired, hoary, and red bats, are on the *List of wildlife species likely to be designated as threatened or vulnerable* of the MFFP (MFFP, 2021a; MFFP, 2021b; MFFP, 2021c).

Table 7-28 specifies the status of each of these species in Quebec and Canada, as well as their preferred habitat.

The little brown bat and the northern myotis have been considered endangered in Canada since 2014 due to the spread of white-nose syndrome (WNS), a whitish fungal infection causing significant declines in bat populations. This infection first appeared in the eastern United States in the winter of 2006-2007 and then spread rapidly to Quebec. It leads to significant mortality in chiropteran species, particularly cave-dwelling species. In addition, the Government of Quebec is currently in the process of assessing the status of 27 wildlife species and these two species could be granted threatened status under the Act respecting threatened or vulnerable species (chap. E-12.01) (Government of Quebec, 2022).

Table 7-28 List of chiropteran species of special status identified in the study area

Common name	Scientific name	Status in Quebec [a]	Status in Canada [a]	Preferred habitat
Little brown bat	*Myotis lucifugus*	–	ES	Occurs in a variety of habitats (riparian, forest, or anthropogenic). Uses anthropogenic or natural structures as resting or nursery sites. Hibernates in caves or old mine openings.
Northern long-eared myotis	*Myotis septentrionalis*	–	ES	Associated with the boreal forest. Uses anthropogenic or natural structures as resting or nursery sites. Hibernates in caves or old mine openings.
Silver-haired bat	*Lasionycteris noctivagans*	L	–	Occurs in large openings in mature forests with large diameter trees, urban landscapes, and habitats near watercourses and ponds. Uses natural structures as resting or nursery sites.
Hoary bat	*Lasiurus cinereus*	L	–	Lives in wooded and semi-wooded areas near clearings or water bodies. Uses trees as a resting place.
Red bat	*Lasiurus borealis*	L	–	Inhabits forests with large trees in stands with dense canopy cover, but openings in the understory. Uses trees or bushes as resting places.

a Status in Quebec as defined by the Act respecting threatened or vulnerable species: L: likely to be designated threatened or vulnerable.
b Status in Canada as defined in Schedule 1 of the Species at Risk Act: ES: endangered species.
Sources: (ECCC, 2018; ERCSQ, 2019; ERCSQ, 2021; MFFP, 2022; Gouvernement du Canada, 2022b; Owen et coll., 2003; Prescott et Richard, 2004; Tremblay et Jutras, 2010).

7.6.2 IMPACTS ON CHIROPTERANS DURING THE CONSTRUCTION PHASE, AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the construction phase, the potential sources of impacts and resulting impacts (**in bold**) that may affect chiropterans are the following:

— Organization of the site, stripping and clearing, surface preparation and access arrangement, construction of works and infrastructure, transportation and traffic, production and management of residual and hazardous materials.

These sources have the potential to produce the following impacts during the construction phase:

Habitat loss and fragmentation by:

— the activities involved in the organization of the site, stripping, and clearing that will result in habitat loss;
— dewatering of drifts and encroachment of watersheds may influence water volume; the time required for water renewal could be longer in some lakes and have an indirect impact on the habitats located along these water bodies.

Disturbance and risk of collision and mortality by:

— Mobile equipment transportation and traffic on the site;
— vibration and noise and light emissions during the construction of new infrastructure.

Alteration of habitat quality by:

— the accidental introduction of petroleum hydrocarbons, contaminants, or hazardous materials into surface waters and soil that will contaminate the habitat.

MITIGATION MEASURES

Common mitigation measures QUA01 to QUA04, QUA07, QUA10 to QUA20, NOR07, VEG01 to VEG04, FAU02 and FAU03, FAU05, PLA01, and PLA02 will be applied to reduce the impact of habitat loss and alteration on the component. For impacts related to disturbance and the risk of collision and mortality, mitigation measures AIR01 to AIR03, NOR01 to NOR03, FAU04, FAU06, FAU08, and FAU09 will be applied. Finally, mitigation measures QUA06, QUA07, QUA14 to QUA17, QUA21 to QUA26, NOR04 to NOR06, NOR 08, and NOR 10 will reduce the project's impacts on spill risks.

Specific measures P03, P04, and P26 will also be implemented.

RESIDUAL IMPACT DESCRIPTION

HABITAT LOSS AND FRAGMENTATION/LOSS OR ALTERATION OF FEEDING SITES

According to the *Recovery Strategy for the Little Brown Myotis, the Northern Myotis, and the Tri-colored Bat* (ECCC, 2018), habitat loss is one of the greatest threats to these species after white-nose syndrome (WNS). Most of the species potentially present are arboreal (Tremblay et Jutras, 2010): red and hoary bats use mainly arboreal roosts, while bats of the genus *Myotis* use arboreal structures, buildings, and rocky structures. (Tremblay et Jutras, 2010). The big brown bat uses buildings or rocky structures (Tremblay et Jutras, 2010), but also mature trees with cavities (woodpecker holes, crevices, etc.) (Willis et coll., 2006). Therefore, clearing and other work associated with the construction of the work and storage areas will cause a direct loss of roost sites for chiropterans and will contribute to changes in the microclimate of the immediate environment, which could also result in the loss of roost sites or decrease their quality. This loss of habitat could potentially be accompanied by mortality if arboreal chiropterans are present during clearing activities. With regard to forest environments likely to provide suitable chiropteran roosting sites, the project will result in the loss of 4.57 ha of mature tree stands (70 years and older)—that is, 4.46 ha of permanent encroachment and 0.11 ha of temporary encroachment—and 7.68 ha of wooded wetlands likely to be used by bats (tree swamps and wooded bogs), i.e., 7.59 ha of permanent encroachment and 0.08 ha of temporary encroachment.

The loss of wetlands and water environments will result in the loss of feeding sites for chiropterans. A total of 50.49 ha of wetlands will be affected by the project, 49.53 ha permanently and 0.96 ha temporarily. These environments are indeed key habitats to meet the feeding needs of chiropterans since they usually support large quantities of prey (Grindal et coll., 1999). For bats using these areas, the loss of these sites could imply increased displacement to alternate foraging sites.

It should be noted, however, that peatlands, which make up the bulk of the wetland area in the local study area of the biophysical environment, are generally not preferred feeding sites for chiropterans. In fact, free water is not always present and the acidity of the environment is not favourable to the production of high insect densities. The most favourable wetlands in terms of feeding sites for chiropterans (swamps, marshes, and ponds) represent only about 4% of the study area (100.61 ha). In total, 4.55 ha of these wetlands favourable to chiropterans will be permanently affected by the project (no temporary encroachment).

Some changes to the habitat structure could also have an effect on the use of the environment by chiropterans. However, it is more difficult to qualify and quantify this impact, since many factors come into play and their effect varies by species. For example, the fragmentation of forests can lead to the creation of linear landscape elements that will be used by certain chiropteran species (ECCC, 2018). In fact, when moving from one site to another, bats generally use linear forest structures to guide themselves (Grindal et Brigham, 1998; Henderson et Broders, 2008). Forest edges bordering areas that have been cut, as well as road rights-of-way and other linear features, are therefore potential corridors for their movements (ECCC, 2018), as well as potential feeding sites (ERCSQ, 2019). However, the impacts of habitat fragmentation appear to vary by species and by the nature and extent of the fragmentation itself (Ethier et Fahrig, 2011; Segers et Broders, 2014). It is nevertheless clear that alterations to the structure of the habitat could lead to changes in its use by bats.

DISTURBANCE OF POPULATIONS/RISK OF COLLISION AND MORTALITY

Activities that generate noise, vibration, and dust, such as earthmoving, construction, excavation, transportation, and traffic activities could cause disturbance to chiropteran populations.

Since chiropterans use echolocation, both in their movements and to locate and capture prey, the presence of anthropogenic noise could interfere with these activities. For "acoustic" predators such as bats, noise pollution is therefore likely to decrease hunting efficiency (Senzaki et al., 2016; Finch et al., 2020). The impact of this type of disturbance varies according to the species of chiropteran, each of which uses its own range of ultrasound frequencies (Bunkley et coll., 2015). Therefore, the frequency of noise generated by road traffic, which varies between 0 kHz and 50 kHz, but mostly between 1 kHz and 20 kHz, (Schaub et coll., 2008), will probably cause more disturbance to species using low frequencies, but will also affect other species in Quebec, since their minimum frequencies are generally between 35 kHz and 45 kHz. Among the species potentially present in the project area, those using low frequencies are the silver-haired, hoary, and big brown bats. At their roosts, the presence of noise could also affect chiropterans by disturbing their sleep. As a result, a decrease or disappearance of the quality of daytime roosts available for local chiropteran populations could be observed in the area surrounding the project site.

Similarly, vibrations generated by some activities near certain habitats, such as maternity colonies, could result in a reduction in reproductive success and cause bats to abandon some sites to find others (ECCC, 2018; McCracken, 2011). The inventories conducted did not confirm the presence of a chiropteran maternity site on the project site.

However, the presence of such a habitat in the local study area of the biophysical environment remains possible. In any case, the area close to the blasting activities was visited in the field and the impacts on more distant sites would gradually decrease the further away from the blasting.

The study area of the local biophysical environment has numerous snags, and several species of bats regularly change their summer roosts using a network of sites in the same area (ECCC, 2018; ERCSQ, 2019). It is therefore possible that the sites inspected were used by chiropterans at another time, or that areas containing several snags that are less suitable were used preferentially.

Moreover, as chiropterans are mainly nocturnal, they are especially likely to be disturbed by light pollution (Stone et coll., 2015). It would appear that the presence of artificial light would disrupt the movements of certain species of chiropterans (Stone et coll., 2009) and may direct them to suboptimal alternate flight paths. These alternate flight paths may require greater energy expenditures and may pose greater predation risks (Stone et coll., 2015). However, it is difficult to assess the actual effect as a result of the project, since the impact of a flight path change varies depending on the available habitats in the surrounding environment. In addition, some chiropteran species, including the big brown, hoary, and red bats and species of the genus *Myotis*, use artificial light sources for feeding under certain conditions as they tend to concentrate many flying insects (Rydell, 1992; Stone et coll., 2015) (Rydell and Racey 1995; Hickey et al. 1996). However, given the mitigation measures in place, the residual impact will be limited.

In summary, some sources of disturbance from mine activities (noise, vibration, and light pollution) may result in various impacts on chiropterans using the local study area of the biophysical environment. These can result in behavioural disruption in individual bats, particularly in relation to their movements and feeding, or in a reduction in the quality or even loss of certain habitats such as daytime roosts, maternity roosts, and feeding sites. However, positive impacts can result from certain sources of disturbance such as the creation of linear landscape elements during deforestation or the attractive effect of lights on insects.

Road traffic can also pose a risk to chiropterans by causing direct mortality due to collisions with mobile equipment (ECCC, 2018). The time of the season, the surrounding environment, and traffic density influence the number of collisions and deaths with mobile equipment. Low-flying species, such as the northern myotis and tri-colored bat, appear to be more vulnerable to the risk of mortality due to collision (Fensome and Mathews, 2016). This risk is also higher in juveniles than in adults, likely because young bats are less experienced and less skilled in flight (Fensome and Mathews, 2016). The height of the roadside tree canopy may also affect the risk of mortality due to collision. For example, little brown bats have been observed to cross roads at canopy height and when the canopy was low (<6 m), they crossed at a lower height and near mobile equipment (Russel et al., 2009).

ACCIDENTAL INTRODUCTION OF PETROLEUM HYDROCARBONS, CONTAMINANTS, OR HAZARDOUS MATERIALS INTO THE ENVIRONMENT (FEEDING SITES)

Accidental spills of hazardous materials, particularly from equipment maintenance activities or from traffic and breakdowns of mobile equipment, could, in some cases, have an indirect impact on chiropterans. In fact, the possible contamination of a watercourse, water body, or wetland could alter the survival or reproduction of the insects that chiropterans feed on. Certain contaminants could also accumulate in the tissues of insects and thus cause contamination in chiropterans. Moreover, insofar as bats use this type of environment for drinking, direct contamination of individuals is also possible (Clarke-Wood et coll., 2016; Korine et coll., 2015; Pilosof et coll., 2014).

However, since spills will be managed in accordance with the spill response plan and given the numerous mitigation and control measures in place, the risk of a spill affecting surface water quality is very low; the spill will be contained and contaminated soils will be recovered quickly, as prescribed in the Emergency Response Plan (see Chapter 12). Finally, if there is a spill, the degree of contamination will depend on the nature of the contaminants and their concentrations.

RESIDUAL IMPACT ASSESSMENT

The intensity of habitat loss was considered medium. The overall environmental value of the chiropteran component was considered high. On the one hand, its ecosystem value was considered high, since the conservation of most chiropteran species is a matter of consensus in the scientific community. Because WNS has already had a major impact on chiropteran populations, other threats, such as habitat loss, may result in significant impacts on residual populations (ECCC, 2018). On the other hand, its socioeconomic value is also considered high given the legal conservation status that most chiropteran species now enjoy. Given the activities resulting from the preparation, installation, and presence of the construction site and the work in the water environment, the degree of disturbance of this impact is low. Considering that the natural environments present on the site are of average quality for chiropterans (forest stands that are generally young or regenerating and relatively few wetlands of interest) and taking into account the planned rehabilitation activities, the loss of habitat will not compromise the integrity of local populations. Furthermore, by avoiding deforestation during the breeding season and considering that there is sufficient replacement habitat of similar quality in the region, the effect of this habitat loss should not be significant for chiropteran populations. Habitat loss is limited to small areas of the local study area of the biophysical environment; however, its spatial scope is specific. The duration is long since it will take many years following the end of mine operations for habitats to return to a similar quality. Finally, the probability of occurrence of this impact is high since the loss of habitat is unavoidable in order to complete the project. Therefore, the residual impact of habitat loss on the chiropteran component is considered to be medium.

Disturbances such as noise, light, and vibration from infrastructure installation, transportation, and traffic activities are considered to be of medium intensity (socioeconomic and ecosystem values are assessed as high and the degree of disturbance as low). In fact, these disturbances are reversible and, for many, are discontinuous over time.

Furthermore, the real impact of these disturbances is variable depending on the chiropteran species affected. Positive impacts may even result from some sources of disturbance, such as light sources that provide new feeding opportunities for some specie. As a result, the intensity of the impact is medium. The spatial scope is specific to the areas where the mine activities are carried out and in their immediate vicinity. The duration of this impact is medium since it will occur on a temporary, continuous, or discontinuous basis during the entire construction phase (less than 2 years). The probability of occurrence is high since these disturbances are inevitable given the nature of the activities. Thus, the residual impact of disturbances for the chiropteran component is considered medium.

As for the risk of hazardous material spills that could occur, particularly during equipment transportation activities, the intensity is considered to be medium (socioeconomic and ecosystem values are assessed as high and the degree of disturbance as low). In the event of an accidental spill despite the various mitigation measures in place, the probability that it would significantly affect local chiropteran populations is negligible. The spatial scope of this impact is specific. If a spill does occur, it will be confined to a small area due to the proposed mitigation measures. The duration of this impact was considered to be short since the impacts result from specific activities with a fixed duration in the construction schedule. Furthermore, this impact on chiropteran populations, or indirectly on the insect populations they could feed on, is not permanent (dilution, decantation, decontamination).

Finally, the probability of occurrence of a spill and contamination is low given the various prevention measures that will be applied during the project. Overall, the residual impact of the risks of spills on the chiropteran component is low.

Impact on chiropterans during the construction phase		
Nature	Negative	Significance: Habitat loss/disturbance, risk of collision and mortality – Medium Risk of accidental spills - Low
Ecosystem value	High	
Socioeconomic value	High	
Degree of disturbance	Low	
Intensity	Medium	
Spatial scope	Specific	
Duration	Long (habitat loss) Short (disturbance, risk of collision and mortality/risk of accidental spills)	
Probability of occurrence	High (habitat loss/disturbance, risk of collision and mortality) Low (risk of accidental spills)	

7.6.3 IMPACTS ON CHIROPTERANS DURING THE OPERATIONS PHASE, AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the operations phase, the potential sources of impacts and resulting impacts (**in bold)** likely to affect chiropterans, are the following:

— The presence and operation of new infrastructure, water use and management, transportation and traffic, and the production and management of residual and hazardous materials.

These sources may cause the following impacts during the operations phase:

Disturbance and risk of collision and mortality by:

— transportation and traffic of mobile equipment on the site;

— vibration and noise and light emissions from existing infrastructure and activities.

Alteration of habitat quality by:

— the accidental introduction of petroleum hydrocarbons, contaminants, or hazardous materials into surface waters and soil that will contaminate the habitat.

MITIGATION MEASURES

The mitigation measures listed for the construction phase will also be applied to mitigate impacts related to disturbance, the risk of collision and mortality, and the risk of spills during the operations phase of the project.

RESIDUAL IMPACT DESCRIPTION

DISTURBANCE OF POPULATIONS/RISK OF COLLISION AND MORTALITY

Most of the impacts are essentially the same as in the construction phase. Most of the habitat loss will have occurred during the construction phase, but the effect will continue into the operations phase.
Impacts related to disturbance (noise, light, vibration) will also be similar, as site activities during the operations phase will include the use and movement of mobile equipment, albeit to a lesser extent (reduced activity level compared to the construction phase). For this reason, it was not deemed necessary to describe in detail the impacts already discussed in the previous section. However, the duration of the impact will be medium since it will extend over the entire operations phase. Thus, the residual impact of disturbances for the chiropteran component is considered medium.

ACCIDENTAL INTRODUCTION OF PETROLEUM HYDROCARBONS, CONTAMINANTS, OR HAZARDOUS MATERIALS INTO THE ENVIRONMENT (FEEDING SITES)

As the anticipated effect is similar to what was assessed for the construction phase, it was not considered necessary to describe in detail the impacts already discussed in the previous section. Thus, the residual impact of the risk of spills on the chiropteran component is very low.

RESIDUAL IMPACT ASSESSMENT

The significance of the residual impacts of the risk of spills, as well as the disturbance and the risk of collision and mortality on the chiropteran component will be the same as during the construction period, i.e., low and medium respectively.

Impact on chiropterans during the operations phase		
Nature	Negative	Significance: Disturbance, risk of collision and mortality - Medium Risk of accidental spills – Low Habitat restoration – Positive impact
Ecosystem value	High	
Socioeconomic value	High	
Degree of disturbance	Low	
Intensity	Medium	
Spatial scope	Specific	
Duration	Medium (disturbance, risk of collision and mortality) Short (risk of accidental spills)	
Probability of occurrence	High (disturbance, risk of collision and mortality) Low (risk of accidental spills)	

7.6.4 IMPACTS ON CHIROPTERANS DURING THE CLOSURE PHASE, AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the closure phase, potential sources of impacts and resulting impacts (**in bold)** that may affect chiropterans are as follows:

— Final restoration, production and management of residual and hazardous materials.

These sources have the potential to produce the following impacts during the operations phase:

Habitat creation by:

— site rehabilitation.

Disturbance and risk of collision and mortality by:

— mobile equipment transportation and traffic for site rehabilitation.

Alteration of habitat quality by:

— the accidental introduction of petroleum hydrocarbons, contaminants, or hazardous materials into surface waters and soil that will contaminate the habitat.

MITIGATION MEASURES

During the closure phase, common and specific mitigation measures from the previous two phases will also be implemented if appropriate. Particular attention will be paid to the possible presence of chiropterans in buildings and other anthropogenic structures before their dismantling.

RESIDUAL IMPACT DESCRIPTION

RESTORATION OF HABITATS/TEMPORARY SHELTER OR USE AS MATERNITY SITES/USE OF THE SITE (FEEDING)/REDUCTION OF POPULATION DISTURBANCE

Since most of the chiropteran species potentially present prefer to use large trees as potential roosting or maternity sites, the rehabilitation of the study area will not result in the development of this type of habitat for many years. However, the open spaces that will be regenerated following the planting of trees may be used by species that hunt in this type of environment.

The buildings and other structures that will be dismantled are likely to be used as temporary shelters or as maternity roosts by the big brown bat or, to a lesser extent, bats of the genus *Myotis* (Tremblay et Jutras, 2010). Therefore, this infrastructure must be considered as a potential habitat for chiropterans.

Anticipated impacts for disturbance and the risk of collision and mortality, will be similar to those assessed during the construction and operations phases. However, use of the site by this component will likely be less than during the construction phase as individuals will have learned over the years to avoid sources of disturbance. The disturbance will gradually decrease during the closure phase and eventually cease at its conclusion.

ACCIDENTAL INTRODUCTION OF PETROLEUM HYDROCARBONS, CONTAMINANTS, OR HAZARDOUS MATERIALS INTO THE ENVIRONMENT

The anticipated impact will be similar to what was assessed in the construction and operations phases.

RESIDUAL IMPACT ASSESSMENT

In the closure phase, the negative residual impacts are related to disturbance and the risk of mortality (collision), as well as the risk of accidental spills. Since the same mitigation measures as those applied during the construction and operations phases will be in effect during the closure phase, the residual impacts are also of medium significance (disturbance and risk of collision and mortality) and low significance (risk of spills). However, these residual effects will be offset by the positive effects of site restoration.

Indeed, once the closure phase is over and the rehabilitation work has been completed, a positive impact is expected due to habitat restoration.

<table>
<tr><th colspan="3">Impact on chiropterans during the closure phase</th></tr>
<tr><td>Nature</td><td>Negative/Positive</td><td rowspan="8">Significance:

Disturbance and risk of collision and mortality - Medium

Risk of accidental spills – Low
Habitat creation – Positive impact</td></tr>
<tr><td>Ecosystem value</td><td>High</td></tr>
<tr><td>Socioeconomic value</td><td>High</td></tr>
<tr><td>Degree of disturbance/enhancement</td><td>Low</td></tr>
<tr><td>Intensity</td><td>Medium</td></tr>
<tr><td>Spatial scope</td><td>Specific</td></tr>
<tr><td>Duration</td><td>Short (disturbance and risk of collision and mortality/risk of accidental spills)</td></tr>
<tr><td>Probability of occurrence</td><td>High (disturbance and risk of collision and mortality)
Low (risk of accidental spills)</td></tr>
</table>

7.7 MAMMALS – OTHER SPECIES

Important facts about mammals – Other species

Existing conditions

Existing conditions for small mammals, furbearers, and small fauna were based on existing literature, as well as capture campaigns in 2016 and 2021 (small mammals) and opportunistic surveys in 2016, 2017, and 2021. For small mammals, the capture campaigns mainly targeted two species of special status, namely the southern bog lemming (*Synaptomys cooperi*) and the rock vole (*Microtus chrotorrhinus*). The results show the presence of seven species of vole, heather vole, mouse, and shrew, but not the two targeted species. For furbearing mammals and small fauna, the literature mentions the possible presence of 18 species (excluding small mammals and chiropterans), while chance observations have identified eight species: Canadian beaver (*Castor canadensis*), red squirrel (*Tamiasciurus hudsonicus*), snowshoe hare (*Lepus americanus*), grey wolf (*Canis lupus*), eastern chipmunk (*Tamias striatus*), moose (*Alces alces*), black bear (*Ursus americanus*), and muskrat (*Ondatra zibethicus*).

Potential Project Impacts

During the construction phase, impacts are associated with habitat loss and fragmentation/alteration of feeding sites, disturbance and risk of collision and mortality, and alteration of habitat quality (spills). Given the mitigation measures that will be implemented, the intensity of the residual impact on small mammals, furbearers and small fauna is considered low for all anticipated impacts. The spatial scope is specific for all impacts considered since it is restricted to the work areas. The duration will be short for disturbance/risk of collision and mortality and accidental spills, while it will be long for habitat loss/fragmentation. The probability of occurrence is low for the risk of spills and high for disturbance/risk of collision and mortality, and habitat loss/fragmentation. The result is a residual impact of very low significance for the risk of spills, and low for disturbance/risk of collision and mortality, and habitat loss/fragmentation.

In the operations phase, the impacts are associated with disturbance and the risk of collision and mortality, as well as the alteration of habitat quality (spills). The intensity of the impact is considered to be low and its spatial scope specific. Its duration will be medium for disturbance/risk of collision and mortality and short for the risk of spills. The probability of occurrence is high (disturbance and risk of collision and mortality) to low (spills), and the significance of the residual impact will therefore be low for disturbance/risk of collision and mortality and very low for the risk of spills.

During the closure phase, site rehabilitation should have a positive impact on the restoration of the habitat. However, during the closure work, there remains a risk of spills, disturbance, and collision and mortality, the intensity of which is perceived as low. The spatial scope of these impacts will be specific and the duration short since it is limited to the closure work. Finally, the probability of occurrence will be medium (disturbance and risk of collision and mortality) to low (spills). The significance of the residual impact will therefore be very low.

7.7.1 CURRENT CONDITIONS

A first capture campaign was conducted in 2016 in a larger study area, encompassing the study area of the second campaign held in 2021. Opportunistic sightings of various species of mammals were also reported in 2016, 2017, and 2021. The details of this study are presented in the sectorial report in Appendix 7-7. A summary of these details and the results obtained are also presented below.

EXISTING LITERATURE

According to the Atlas des micromammifères du Québec (Desrosiers et al., 2002) and all the available databases consulted (Canadensys, GBIF, etc.), 18 species of small mammals and 18 species of mammals (excluding small mammals and chiropterans) are likely to occur in the study area.

INVENTORY OF SMALL MAMMALS

A small mammal inventory targeting mainly the southern bog lemming (*Synaptomys cooperi*) and the rock vole (*Microtus chrotorrhinus*), two species likely to be designated as threatened or vulnerable in Quebec (MFFP, 2022b), was conducted in August 2016 and September 2021. Preferred habitat for both species is present in the local study area of the biophysical environment. The methodology used is based on the MELCCFP protocol (Jutras, 2005).

To carry out this work, eight (8) transects were laid out in the study area. Victor traps and pitfall traps were set up along the transects in habitats suitable for the two target species (peaty habitats, stands near streams and rocky slopes) so as to cover the limited study area. The field campaign took place in late summer 2016 and 2021 for a total of five (5) nights of capture per transect for both inventory years.

In 2016, each transect included 20 Victor traps and two pitfall traps set for a period of five consecutive days.
In 2021, each transect included 20 Victor traps and five (5) pitfall traps set for a period of five (5) consecutive days. The identification of small mammals was carried out using Lupien's (Lupien, 2001, 2002) identification keys, a dissection kit, and a binocular magnifying glass.

Capture success was used to evaluate the relative abundance of small mammals in each of the transects as well as for the three (3) habitat classes inventoried: peatland, forest environment, and Jack pine stand and regeneration. The effort and detailed results are presented in the sectorial report (Appendix 7-7).

A total of seven species were recorded in 2016 and 2021: southern red-backed vole (*Myodes gapperi*), meadow vole (*Microtus pennsylvanicus*), heather vole (*Phenacomys intermedius*) deer mouse (*Peromyscus maniculatus*), woodland jumping mouse (*Napaeozapus insignis*), cinereous shrew (*Sorex cinereus*), and smoky shrew (*Sorex fumeus*). These species have no special status.

FURBEARERS AND SMALL FAUNA

No specific inventory was conducted to identify other mammal species. However, species observed opportunistically during these inventories were documented and the potential for the presence of species of special status was described in detail.

According to the literature consulted, within a 100 km radius of the project, 18 species of mammals (excluding small mammals, chiropterans, and large fauna) are likely to occur in the biophysical environment study area (Table 7-29). Within the inventory areas, seven species of furbearers and small fauna were detected (WSP 2016, 2017, and 2021). These species are the Canadian beaver (*Castor canadensis*), red squirrel (*Tamiasciurus hudsonicus*), snowshoe hare (*Lepus americanus*), grey wolf (*Canis lupus*), eastern chipmunk (Tamias striatus), black bear (Ursus americanus), and muskrat (Ondatra zibethicus).

Table 7-29 List of species present in the inventory areas and likely to occur within a 100 km radius of the project

Species	Latin name	Inventory areas	Regional study area	
		WSP (2016, 2017, and 2021)	Scientific literature	Mining and industrial projects
Least weasel	*Mustela nivalis*	-	X[a,d]	X[e]
Canadian beaver	*Castor canadensis*	X	X[a,d]	X[f]
Coyote	*Canis latrans*	-	X[a,b,c,d]	-
Red squirrel	*Tamiasciurus hudsonicus*	X	X[a,b,c,d]	X[e,f]
Northern flying squirrel	*Glaucomys sabrinus*	-	X[a,b,c]	X[e]
Ermine	*Mustela erminea*	-	X[a,b,c]	X[e,f]
Snowshoe hare	*Lepus americanus*	X	X[a,c]	-
Grey wolf	*Canis lupus*	X	X[a,b,c,d]	X[f]
River otter	*Lutra canadensis*	-	X[a,c,d]	X[f]
Canadian lynx	*Lynx canadensis*	-	X[a,c,d]	X[f]
Bobcat	*Lynx rufus*	-	-	-
American marten	*Martes americana*	-	X[a,b,c,d]	X[f]
Groundhog	*Marmota monax*	-	X[a,c]	-
Striped skunk	*Mephitis mephitis*	-	X[a]	X[e]
Black bear	*Ursus americanus*	X	X[a,b,c,d]	X[f]
Fisher	*Martes pennanti*	-	X[a,d]	X[e,f]
American porcupine	*Erethizon dorsata*	-	X[a,c]	X[e]
Muskrat	*Ondatra zibethicus*	X	X[a,c,d]	X[f]
Raccoon	*Procyon lotor*	-	X[d]	-
Red fox	*Vulpes vulpes*	X	X[a,c,d]	X[f]
Eastern chipmunk	*Tamias striatus*	X	X[a,b,c]	-
American mink	*Neovison vison*	-	X[a,b,c,d]	X[f]

a. (Prescott et Richard, 2013)
b. (Canadensys, 2022)
c. (GBIF, 2022)
d. Data from the UGAF zone 31 (MFFP, 2022c)
e. (Genivar, 2011)
f. (MFFP, 2020)

SPECIES OF SPECIAL STATUS

Within the framework of the present study, among the species of furbearers, small fauna and small mammals likely to occur in the territory, based on the literature within a 100 km radius of the project, no species with a vulnerable status or listed on Schedule 1 of the SARA were detected.

7.7.2 IMPACT ON OTHER MAMMAL SPECIES DURING THE CONSTRUCTION PHASE, AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the construction phase potential sources of impacts and resulting impacts (**in bold)** likely to affect other mammal species are as follows:

— Organization of the site, stripping and clearing, surface preparation and access arrangement, construction of works and infrastructure, transportation and traffic, production and management of residual and hazardous materials.

These sources have the potential to produce the following impacts during the construction phase:

Habitat loss and fragmentation by:

— the activities involved in the organization of the site, stripping, and clearing that will result in habitat loss;
— Dewatering of drifts and encroachment of watersheds that could influence water volume; the time required for water renewal could be longer in some lakes and could therefore have an indirect impact on the habitats located along the edges of these water bodies.

Disturbance and risk of collision and mortality by:

— transportation and traffic of mobile equipment on the site;
— vibration and noise and light emissions during the construction of new infrastructure.

Alteration of habitat quality by:

— the accidental introduction of petroleum hydrocarbons, contaminants, or hazardous materials into surface waters and soil that will contaminate the habitat.

MITIGATION MEASURES

Common mitigation measures QUA01 to QUA04, QUA09, QUA11 to QUA21, NOR07, VEG01 to VEG04, PLA01, and PLA02 will be applied to reduce the impact of stripping and clearing on habitat loss and fragmentation. For impacts related to disturbance and the risk of collision and mortality, mitigation measures AIR01 to AIR04, NOR01 and NOR02, FAU06, FAU08, and FAU09 will be applied. Finally, mitigation measures QUA06 to QUA08 and QUA22 to QUA26 will reduce the project's impacts on spill risks.

Specific measure P26 will also be implemented for this component.

DETAILED RESIDUAL IMPACT DESCRIPTION

HABITAT LOSS AND FRAGMENTATION

For the mammal – other species component, the project has been optimized to minimize impacts on terrestrial wildlife, including this wildlife group. However, clearing and grubbing as well as stripping and excavation will cause habitat loss, changes in habitat structure, and fragmentation.

As mentioned previously, the inventories confirmed the presence of eight species of mammals in addition to the seven species of small mammals.

Considering the total footprint of the project that may be suitable for the establishment of the eight inventoried species, 136.47 ha of potential habitat will be affected by the project, of which 1.66 ha are temporary losses and 134.81 ha are permanent losses. Thus, the affected environments are the following: 63.29 ha of forest environment (1.88 ha of hardwood forest, 20.60 ha of mixedwood forest, 16.32 ha of softwood forest and 24.49 ha of regeneration and plantation environments), 50.49 ha of wetlands (1.62 ha of tree swamp, 2.93 ha of shrub swamp, 6.06 ha of wooded peatland and 39.88 ha of open peatland), and 22.69 ha of non-forest environments. However, it should be noted that several wetlands and terrestrial environments of interest are located on the periphery of the facilities and may be home to the same species as those identified during the inventories.

No lake is directly impacted by the project. According to modelling, the potential groundwater drawdown zone does not reach the surrounding lakes. However, Pond 1 is located in one of the two drawdown zones greater than 1 m. Since this pond receives the mining effluent from the project, no decrease is anticipated.

DISTURBANCE DUE TO THE PRESENCE OF INFRASTRUCTURE AND TRAFFIC/RISK OF COLLISION AND MORTALITY

Indirect impacts caused by increased disturbance such as vibration, noise, and dust emissions are expected during the construction phase. In addition, collision and mortality risks related to the presence of infrastructure and traffic on the construction site are also possible.

The effect of noise has been shown in the literature to have a potentially negative effect on mammals (Shannon et al., 2015; Kunc and Schmidt, 2019, Mancera, 2017). The threshold at which impacts would be felt is 52 dBA. In fact, noise from infrastructure construction, site traffic, and refuelling and maintenance of mobile equipment could cause avoidance of certain noisy areas, changes in the reproductive success of certain species, and changes in interspecific communication. However, the noise caused by the project will not exceed this threshold beyond 700 m from the central point of the emission sources for all scenarios studied. The effect on the periphery of the project will therefore be low. With respect to vibration, the main source during the construction phase will be caused by surface blasting activities. It should be noted, however, that these activities will be carried out on a sporadic basis and will be concentrated in specific areas, such as for the construction of roads and ponds. As far as collision and mortality risks are concerned, they are associated with the movement of mobile equipment.

ACCIDENTAL INTRODUCTION OF PETROLEUM HYDROCARBONS, CONTAMINANTS, OR HAZARDOUS MATERIALS INTO THE ENVIRONMENT

As for the risk of spills, they will be mainly associated with the refuelling and breakdown of mobile equipment. However, since spills will be managed in accordance with the spill response plan and given the numerous mitigation and control measures in place, the risk of a spill affecting surface water quality is very low; the spill will be contained and contaminated soils will be recovered quickly, as prescribed in the Emergency Response Plan (see Chapter 12). Finally, if there is a spill, the degree of contamination will depend on the nature of the contaminants and their concentrations.

RESIDUAL IMPACT ASSESSMENT

During the construction phase, the potential residual impacts on the mammal - other species component are related to activities that cause habitat loss, disturbance, and the risk of spills. It should be noted that no species of special status is present in the project's area of influence.

With respect to habitat loss, the intensity of residual impacts on herpetofauna is considered low. This assessment considers the reduction in the degree of disturbance through the project's mitigation measures as well as the application of and compliance with existing standards and regulations, primarily for clearing activities. However, the degree of disturbance from clearing activities is considered low. In addition, the intensity of the impact reflects the medium ecosystem rating of the component due to the small area affected and the low species richness, and the medium social rating due to the presence of fur-bearing animals (medium overall value). The spatial scope of the anticipated residual impacts is established as specific since they are likely to be felt over a small area, i.e., at the infrastructure level. The duration of the impacts is considered to be long since they result from clearing activities that cause permanent loss. The probability of occurrence is considered high. Therefore, the residual impact on the component mammals – other species is defined as low.

With regard to disturbance and the risk of collision and mortality, the intensity of the residual impacts is considered low. The degree of disturbance will be low. In fact, the impact does not significantly alter the inherent characteristics of the component, and so it will maintain its integrity. The spatial scope of the anticipated residual impacts is established as specific since they are likely to be felt over a small area, i.e., at the infrastructure level. The duration of the impacts is considered to be short as the impacts felt due to disturbance will be discontinuous and within the construction period. The probability of occurrence is considered high since the construction activities will inevitably cause some noise and therefore disturbance. Therefore, the residual impact of disturbance on the mammal – other species component is defined as low.

As for the potential residual impacts on mammals related to the risk of accidental oil spills in the environment, the intensity of residual impacts on mammals is considered low. This assessment considers the reduction of the degree of disturbance to the component through all of the project's optimization and mitigation measures, as well as the application of and compliance with applicable standards and regulations. The spatial scope of the residual impacts is established as specific since the impacts are likely to be felt over a small area within the work zone. The duration of the impacts is considered to be short as they result from specific activities with a fixed duration in the construction schedule. The probability of occurrence is considered Low. Therefore, the residual impact on the mammal component - other species is defined as very low.

Impact on mammals - other species during the construction phase		
Nature	Negative	Significance: Risk of accidental spills - Very low Disturbance, risk of collision and mortality, and habitat loss - Low
Ecosystem value	Low	
Socioeconomic value	Medium	
Degree of disturbance	Low	
Intensity	Low	
Spatial scope	Specific	
Duration	Short (disturbance, risk of collision and mortality, and risk of accidental spills), long (habitat loss)	
Probability of occurrence	Low (risk of accidental spills), high (habitat loss, disturbance, risk of collision and mortality)	

7.7.3 IMPACT ON OTHER MAMMAL SPECIES DURING OPERATIONS, AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the operations phase, the potential sources of impacts and resulting impacts (**in bold)** likely to affect other mammal species are as follows:

— The presence and operation of new infrastructure, water use and management, transportation and traffic, residual and hazardous materials generation and management.

These sources may cause the following impacts during the operations phase:

Disturbance and risk of collision and mortality by:

— transportation and traffic of mobile equipment on the site;

— vibration and noise and light emissions from existing infrastructure and activities.

Alteration of habitat quality by:

— the accidental introduction of petroleum hydrocarbons, contaminants, or hazardous materials into surface waters and soil that will contaminate the habitat.

MITIGATION MEASURES

The mitigation measures listed for the construction phase will also be applied to mitigate impacts related to disturbance, the risk of collision and mortality, and the risk of spills.

DETAILED RESIDUAL IMPACT DESCRIPTION

DISTURBANCE DUE TO THE PRESENCE OF INFRASTRUCTURE AND TRAFFIC/RISK OF COLLISION AND MORTALITY

The effect of the presence of the installations and the mobile equipment traffic (disturbance and risk of collision and mortality) will be similar to what was assessed during the construction phase, although slightly less due to the reduced number of mobile equipment. Noise levels will not exceed 50 dBA beyond a distance of 1 km centred on the noise sources for all scenarios studied.

ACCIDENTAL INTRODUCTION OF PETROLEUM HYDROCARBONS, CONTAMINANTS, OR HAZARDOUS MATERIALS INTO THE ENVIRONMENT

As far as spill risks are concerned, they are the same as those anticipated during the construction phase.

RESIDUAL IMPACT ASSESSMENT

During the operations phase, the residual impacts are disturbance, the risk of collision and mortality, and the risk of accidental spills. The related impacts are essentially the same as during the construction period. The residual impact on the mammalian component – other species is defined as very low for the risks of accidental spills and low for the disturbance and risk of collision and mortality.

<table>
<tr><th colspan="3">Impact on mammals - other species during the operations phase</th></tr>
<tr><td>Nature</td><td>Negative</td><td rowspan="8">Significance:

Risk of accidental spills - Very low

Disturbance, risk of collision and mortality - Low</td></tr>
<tr><td>Ecosystem value</td><td>Low</td></tr>
<tr><td>Socioeconomic value</td><td>Medium</td></tr>
<tr><td>Degree of disturbance</td><td>Low</td></tr>
<tr><td>Intensity</td><td>Low</td></tr>
<tr><td>Spatial scope</td><td>Specific</td></tr>
<tr><td>Duration</td><td>Short (risk of accidental spills), medium (disturbance, risk of collision and mortality)</td></tr>
<tr><td>Probability of occurrence</td><td>Low (risk of accidental spills), high (disturbance, risk of collision and mortality)</td></tr>
</table>

7.7.4 IMPACT ON OTHER MAMMAL SPECIES DURING THE CLOSURE PHASE, AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the closure phase, potential sources of impacts and resulting impacts (**in bold**) likely to affect other mammal species are as follows:

— Final restoration, production and management of residual and hazardous materials.

These sources have the potential to produce the following impacts during the operations phase:

Habitat creation by:

— site rehabilitation.

Disturbance and risk of collision and mortality by:

— mobile equipment transportation and traffic for site rehabilitation.

Alteration of habitat quality by:

— the accidental introduction of petroleum hydrocarbons, contaminants, or hazardous materials into surface waters and soil that will contaminate the habitat.

MITIGATION MEASURES

In the closure phase, all mitigation measures listed for the construction and operations phases will be applied when they address the same impact sources.

DETAILED RESIDUAL IMPACT DESCRIPTION

DISTURBANCE DUE TO THE PRESENCE OF INFRASTRUCTURE AND TRAFFIC/RISK OF COLLISION AND MORTALITY

Dismantling activities, movement of mobile equipment carrying materials, retired equipment, and the procurement of goods and services will result in disturbance and risk of collision and mortality. The anticipated impacts are the same as in the construction and operations phases.

ACCIDENTAL INTRODUCTION OF PETROLEUM HYDROCARBONS, CONTAMINANTS, OR HAZARDOUS MATERIALS INTO THE ENVIRONMENT

As far as spill risks are concerned, they are the same as those anticipated during the construction phase.

HABITAT RESTORATION

Following decommissioning, habitats will be restored or recreated and will be able to once again fulfill functional requirements for mammals.

RESIDUAL IMPACT ASSESSMENT

In the closure phase, the residual impacts are the same as those of the operations phase, i.e., disturbance, risk of collision and mortality and the risk of accidental spills. Therefore, given that the duration is estimated to be short in both cases, the significance of the residual impact of these two likely changes for mammals is considered very low.

Once the closure phase is over and the rehabilitation work has been completed, a positive impact is expected due to habitat restoration.

Impact on mammals - other species in the restoration phase		
Nature	Negative/Positive	Significance: Very low Habitat restoration – Positive impact
Ecosystem value	Low	
Socioeconomic value	Medium	
Degree of disturbance/enhancement	Low	
Intensity	Low	
Spatial scope	Specific	
Duration	Short	
Probability of occurrence	Low (risk of accidental spills), medium (disturbance, risk of collision and mortality)	

8 CURRENT CONDITIONS AND PROJECT IMPACTS ON THE SOCIAL ENVIRONMENT

This chapter describes the current conditions of the main components of the social environment affected by the Windfall project and the project's impacts on these components. The initial conditions represent the state of the sensitive components of the social environment before the beginning of the project (Chapter 5, Section 5.2). It should be noted that the development done and the infrastructure constructed in the exploration and post-exploration phases are considered to be part of the initial state. The work performed during these phases has already received the necessary authorizations and is therefore excluded from the scope of this project's environmental impact assessment process. On this basis, the impacts of the Windfall project are assessed on the future changes anticipated relative to this initial state, which includes the infrastructure already in place.

The impact assessment is also carried out in relation to the issues identified in Chapter 4 (Section 4.8). These issues reflect the concerns raised about the project by many of the stakeholders encountered to date, and the varying degrees of significance of the associated impacts. The main issues identified are as follows:

- preservation of the quality of the environment (First Nations and non-First Nations communities);
- preservation of biodiversity (First Nations communities);
- consideration of First Nations interests and concerns (First Nations communities);
- concentration of economic benefits at the local level (non-First Nations communities).

8.1 LAND PLANNING, DEVELOPMENT, AND TENURE

Highlights of land use planning and development

<u>Existing conditions</u>

The regional study area has over 723 km^2 of protected areas.

The local study area consists primarily of Category III public lands under the municipal jurisdiction of the Eeyou Istchee James Bay Regional Government (EIJBRG). It is almost uninhabited and is mainly used to harvest natural resources (forestry and mining) and, to a lesser extent, for vacationing and leisure activities. There is no structured wildlife territory, such as outfitting establishments with exclusive rights and controlled harvesting zones. The local study area is not subject to any public land use plan or regional land development plan. Likewise, no land use and development plan has been produced for the territory of the EIJBRG.

Potential impacts of the project

No impact is expected for the construction, operations, and closure phases since the use of the land where the project development is planned is compatible with the proposed activities (see Chapter 3).

8.1.1 CURRENT CONDITIONS

The regional study area (RSA) situates the project in its socioeconomic and geographic context (Map 8-1). It serves as a spatial framework for the description of the components of the social environment, some elements of which are found outside the limits of the local study area (LSA). The delineation of this area aims to document the demographic and economic characteristics of the non-First Nations communities and First Nations members concerned by the project. The description of these components also includes the development trends of these communities and the vocations that have been given to the territory. This allows adequate assessment of the project's impacts on the main ongoing or planned activities in the RSA.

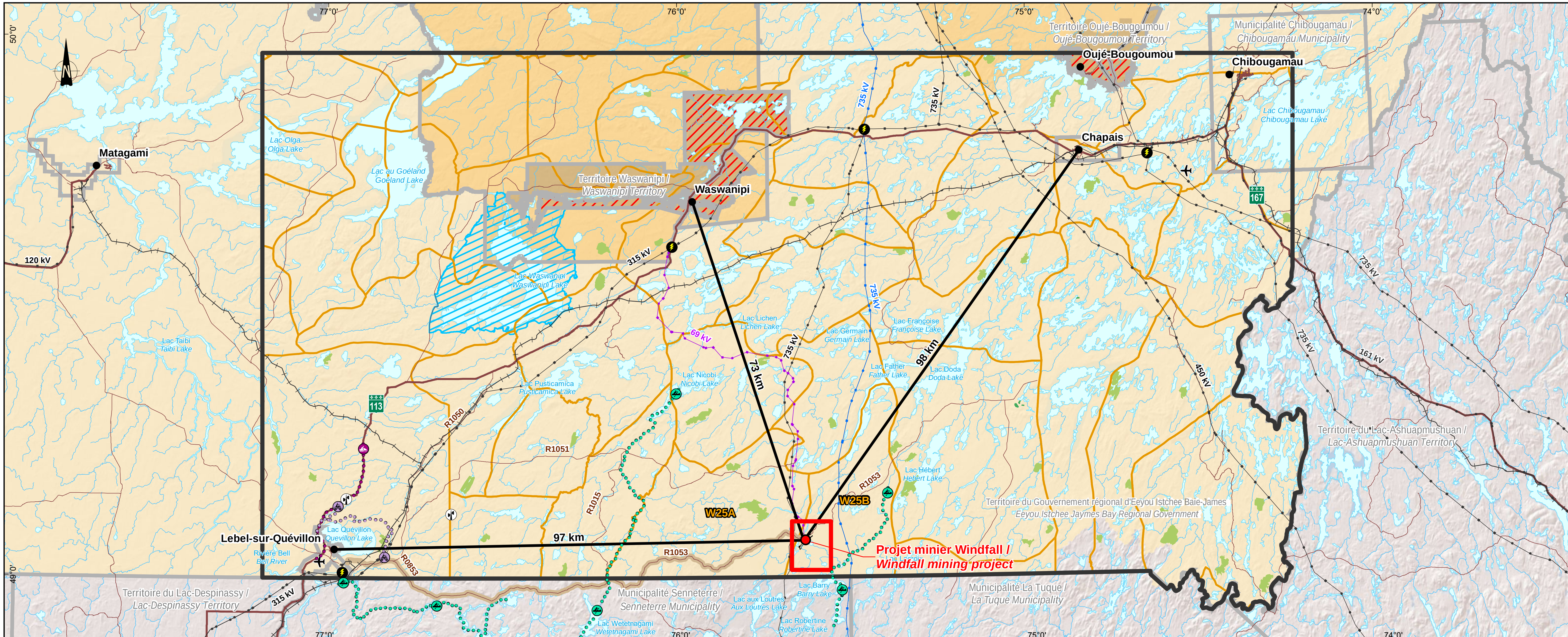
The RSA, which has an area of 22,763 km^2, is entirely located in the Nord-du-Québec administrative region. It includes the municipality of Lebel-sur-Quévillon to the west and the towns of Chibougamau and Chapais to the northeast. It also includes the Cree community of Waswanipi. The southern part of the study area encompasses a portion of forest road R1053 (R6000), and Roads R1050 (R1000) and R0853 (R5000), which serve as the main access to the projected mine from Lebel-sur-Quévillon (Map 8-1). It should be noted that the Lebel-sur-Quévillon airport is also included in the RSA.

The local study area (LSA) of the social environment, which has an area of 80 km^2 (8 km by 10 km), extends around the proposed mine site and has been delineated to encompass the land use and resource components likely to be impacted by the project (outfitting and private cottage leases) (Map 8-2). The LSA is entirely located in the Nord-du-Québec administrative region, known for its large natural expanses scattered with lakes and rivers and for its rich mineral deposits. In general, the Windfall project, located on Category III lands of the municipal jurisdiction of the Eeyou Istchee James Bay Regional Government (EIJBRG), is located about 73 km southwest of the Cree village of Waswanipi and at equidistant (about 98 km) from the towns of Chapais to the northeast and Lebel-sur-Quévillon to the west (Map 8-1).

The governance structure of the James Bay territory was modified in 2014 by the creation of a joint Cree and Jamesian regional government. Thus, under the Agreement Concerning a New Relationship Between the Gouvernement du Québec and the Crees of Québec, the Act establishing the Eeyou Istchee James Bay Regional Government (EIJBRG) was adopted and assented to. This announced the establishment of the EIJBRG on January 1, 2014, which replaces the Municipalité de Baie-James (MBJ) in its roles and functions. This regional government ensures the management of Category III lands, on which the Cree have exclusive trapping rights (with some exceptions in the south) and certain non-exclusive hunting and fishing rights.

In general, the responsibility for land use planning and resource management of Category III lands in the study area is shared between two principal agents: the Ministère des Ressources naturelles et des Forêts (MRNF) and the EIJBRG. This territory is located between the 49th and 55th parallels and also includes the treaty lands not included in the other land categories. Development bodies also participate in regional planning, particularly the Administration régionale Baie-James (ARBJ).

North of the 49th parallel, the territory is governed by the James Bay and Northern Quebec Agreement (JBNQA). The territorial regime established by the Agreement provides for the division of the territory into Category I, II, and III lands. Almost all of the RSA is found on Category III lands. On Category III lands, the First Nations have the exclusive right to harvest certain aquatic species and fur-bearing animals (Cree-Québec Forestry Board, 2018). They may establish any camp on these lands for hunting, fishing, and trapping purpose and, in this case, a Quebec government title is not required. On these lands, hunting and fishing are permitted both for First Nations and non-First Nations people.



Distance à vol d'oiseau / *Distance in a straight line*

Limites administratives / *Administration Boundaries*

Municipalité ou territoire équivalent (TE) / *Municipality or Equivalent Territory (ET)*

Territoire conventionné (CBJNQ) / *Territory under agreement (JBNQA)*

Terre de catégorie I / *Category I lands*

Terre de catégorie II / *Category II lands*

Terre de catégorie III / *Category III lands*

Projet / *Project*

Zone d'étude régionale / *Regional study area*

Zone d'étude locale du milieu humain / *Human local study area*

Occupation du territoire cri / *Cree Territory Occupation*

Terre réservée à la communauté crie / *Land reserved for the Cree community*

Terrain de trappage cri / *Cree trapline*

Infrastructures connexes / *Related Infrastructure*

Aéroport / *Airport*

Tour de télécommunication / *Communication tower*

Poste électrique d'Hydro-Québec / *Electrical substation*

Ligne de transport d'énergie électrique / *Electric power transmission line*

Deux lignes parallèles de transport d'énergie électrique / *Two parallel power transmission lines*

Ligne de transport d'énergie préliminaire projetée (en processus d'autorisation environnementale) / *Preliminary proposed power transmission line (ongoing environmental assessment application)*

Réseau routier / *Road network*

Route nationale / *National road*

Route régionale / *Regional road*

Route d'accès / *Access road*

Réseau ferroviaire / *Railway network*

Chemin de fer / *Railway*

Sentiers / *Trails*

Canotable / *Canoe*

Motoneige / *Snowmobile*

Quad / *Quad bike*

Aires protégées / *Protected area*

Réserve aquatique projetée / *Projected aquatic reserve*

Écosystème forestier exceptionnel / *Exceptional forest ecosystem*

Refuge biologique / *Biological refuge*

OSISKO
MINIÈRE OSISKO

Projet minier Windfall - Étude d'impact sur l'environnement / *Windfall Mining Project - Environmental Impact Assessment*

Site minier Windfall, Eeyou Istchee Baie-James (Québec) / *Windfall Mining Site, Eeyou Istchee Baie-James (Quebec)*

Carte 8-1 / *Map 8-1*

Zone d'étude régionale - principales composantes du milieu humain / *Regional Study Area - Main Components of the Social Environment*

Sources / *Sources:*
CanVec+, 1/50 000, RN Can, 2014
SDA, 1/20 000, MERN Québec, 2020
BDTA, 1/250 000, MRN Québec, 2002
BDGA, 1/5 000 000, MRN Québec, 2012
Contraintes et restrictions (GESTIM), MERN Québec, 5 décembre 2022
Google Earth, imagerie aérienne (identification des postes électriques), 2018
MELCCFP, Aires protégées, 2023-01

0 9 18 km

MTM, Fuseau 9 / Zone 9, NAD83

2023-02-24

Préparée par / *Preparation* : S. Paradis
Dessinée par / *Drawing* : J. Roy
Vérifiée par / *Verification* : M.-H. Brisson
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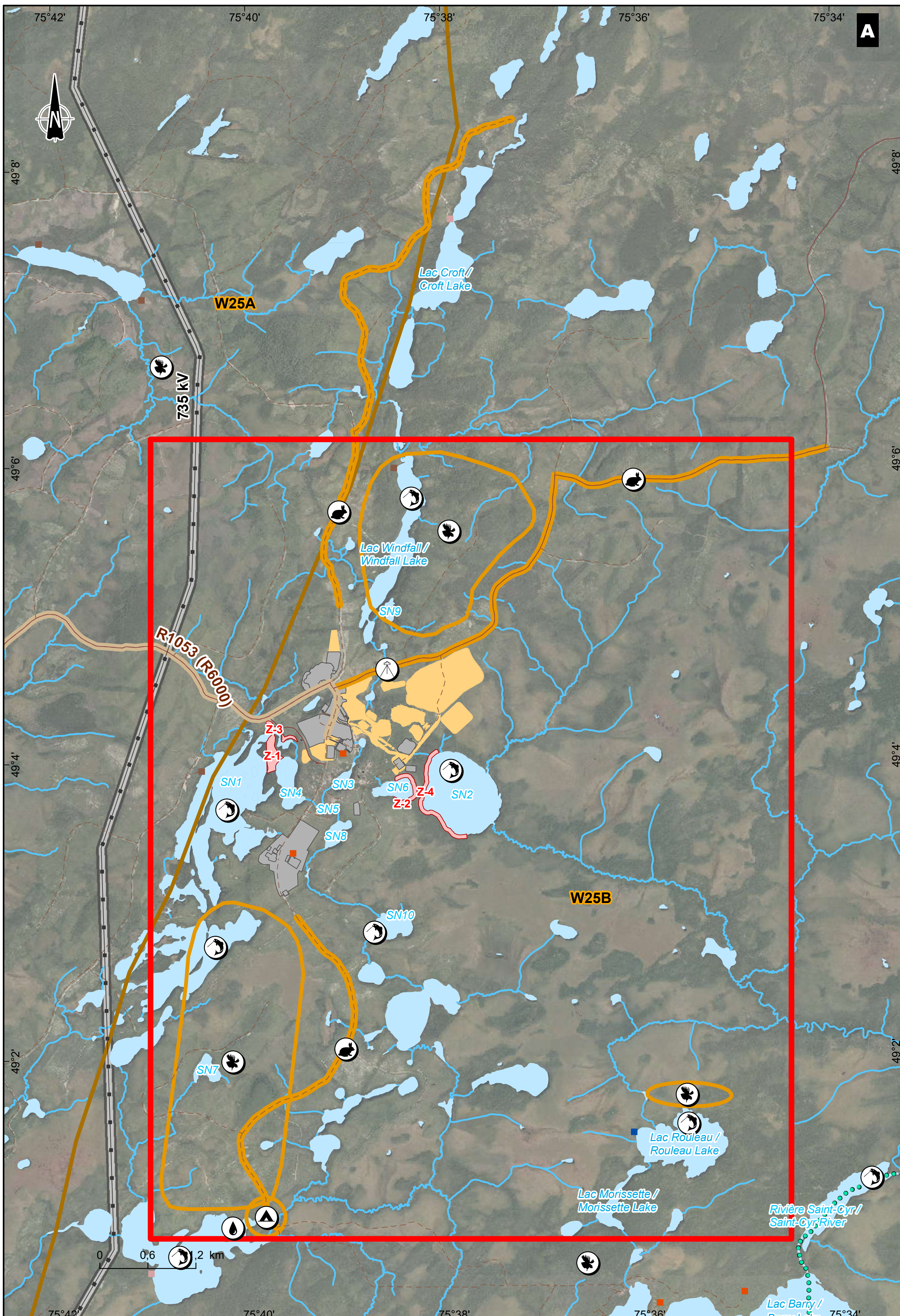
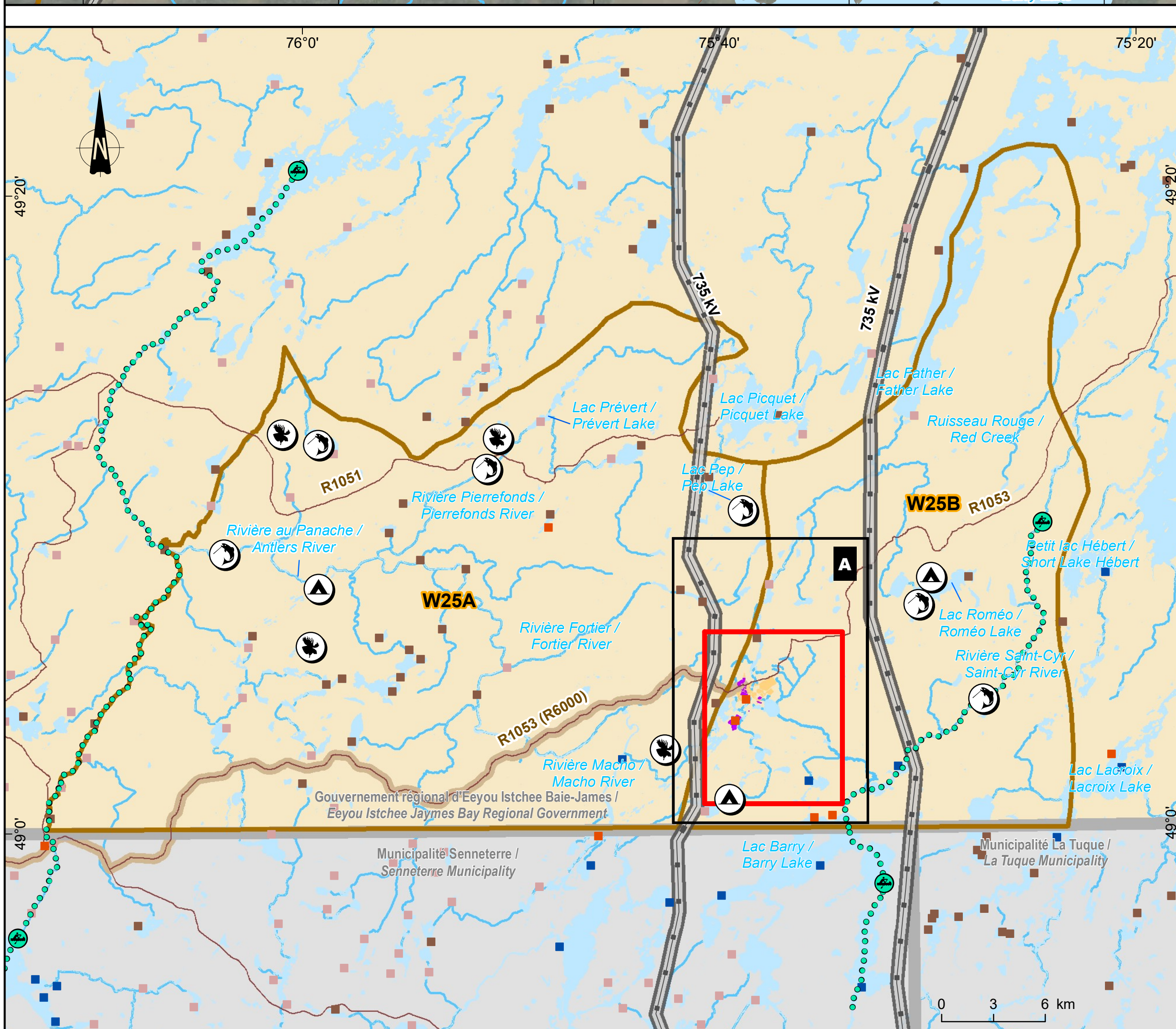




Limite administrative / *Administration Boundary*

Municipalité ou territoire équivalent (TE) / *Municipality or Equivalent Territory (ET)*

Terres de catégorie (CJBNQ) / *Category Lands (JBNQA)*

Terre de catégorie III / *Category III lands*

Projet / *Project*

Zone d'étude locale du milieu humain / *Human local study area*

Infrastructures existantes et/ou qui seront construites en 2023 / *Existing and/or new infrastructure to be built in 2023*

Infrastructures minières à l'étude / *Mining infrastructure under study*

Infrastructures connexes / *Related Infrastructures*

Ligne de transport d'énergie électrique / *Electric power transmission line*

Accès et déplacement des utilisateurs / *Access and travel paths for users*

Route régionale / *Regional road*

Route forestière / *Logging road*

Route d'accès / *Access road*

Hydrographie / *Hydrography*

Cours d'eau / *Watercourse*

Étendue d'eau / *Waterbody*

Utilisation traditionnelle du territoire par les Cris / *Cree land use*

Campement cri / *Cree Camp*

Caméra de suivi de la faune (initiative crie) / *Wildlife tracking camera (Cree Initiative)*

Zone d'habitat de l'orignal / *Moose habitat area*

Zone de pêche / *Fishing area*

Zone d'habitat du lièvre / *Hare habitat area*

Source d'eau pour usage domestique / *Water source for domestic use*

Zone valorisée pour la faune (la délimitation de ces zones est approximative pour fins de confidentialité) / *Wildlife valued area (the delimitation of these areas is approximate for confidentiality purposes)*

Terrain de trappage cri / *Cree trapline*

Archéologie / *Archeology*

Zone de potentiel archéologique identifiée en 2022 / *Area of archaeological potential identified in 2022*

Baux de villégiature / *Leisure leases*

Fins d'abri sommaire en forêt / *Temporary forest shelter*

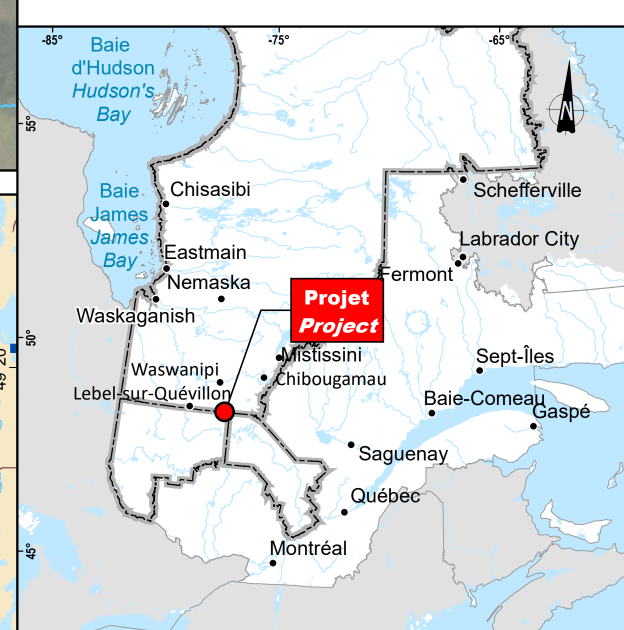
Fins d'hébergement dans une pourvoirie sans droits exclusifs / *For lodging at an outfitter without exclusive rights*

Fins de villégiature / *For leisure purposes*

Autres fins / *Other purposes*

Sentiers / *Trails*

Canotable / *Canoe*



OSISKO
MINIÈRE OSISKO

Projet minier Windfall - Étude d'impact sur l'environnement / *Windfall Mining Project - Environmental Impact Assessment*

Site minier Windfall, Eeyou Istchee Baie-James (Québec) / *Windfall Mining Site, Eeyou Istchee Baie-James (Quebec)*

Carte 8-2 / *Map 8-2*
Zone d'étude locale du milieu humain - Utilisation du territoire / *Social Environment Local Study Area - Land Use*

Sources / Sources:
CanVec+, 1/50 000, RN Can, 2014
SDA, 1/20 000, MERN Québec, 2020
BDTA, 1/250 000, MRN Québec, 2002
BDGA, 1/5 000 000, MRN Québec, 2012
Contraintes et restrictions (GESTIM), MERN Québec, 2022-12-05
GRHQ, Réseau hydrique, 2019-05
AQRéseau+, Réseau routier, 2022-09
MELCCFP, Inventaire écoforestier, 2011

0 0,6 1,2 km

MTM, Fuseau 9 / Zone 9, NAD83

2023-03-14

Préparée par / Preparation : S. Paradis
Dessinée par / Drawing : J. Roy
Vérifiée par / Verification : M.-H. Brisson
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MINISTÈRE DES RESSOURCES NATURELLES ET DES FORÊTS

The MRNF plays a management role with respect to Quebec's land and resources. To fulfil its development mandate, the MRNF uses an approach reconciling the concerns related to the planning of activities, the respect for the environment, and the collaboration with the partners and the communities concerned. The public land use plan [*Plan d'affectation du territoire public*] (PATP) and the regional public land development plan [*Plan régional de développement du territoire public*] (PRDTP) are two public land management and development tools used by the government.

The PATP defines the provincial government's directions concerning the use and protection of public land. It aims to guide the interventions of the various stakeholders on Quebec land by providing them with the necessary basis for integrated management of lands and resources, thus contributing to the sustainable development of public land and minimizing conflicts. The PRDTP, in collaboration with regional stakeholders, determines the principles and measures for harmonious use of public land.

No PATP and PRDTP has been produced for the Nord-du-Québec region.

It should be noted that the issuance of privatecottage leases has been administratively suspended throughout the Eeyou Istchee James Bay territory since the signing of the new governance agreement for this territory in 2012 (MRNF, personal communication, January 2023).

PROTECTED AREAS

Receiving assent in 2022, the Natural Heritage Conservation Act (NHCA) provides for measures to protect natural heritage and biodiversity. It provides a framework for the creation of aquatic reserves, biodiversity reserves, ecological reserves, and man-made landscapes, and the recognition of nature reserves on private land.

This Act is the main legislative tool by which Quebec implements its powers to honour its commitments in conservation of natural environments, particularly through the establishment of a network of protected areas representative of its biodiversity. (MELCCFP, 2022)

The RSA contains more than 723 km^2 of protected areas (Table 8-1), located especially around water bodies. These are mainly composed of biological refuges and there are also two exceptional forest ecosystems, the Forêt rare du Lac-Phooey and the Forêt rare du Lac-des-Vents. The RSA also includes the Réserve aquatique projetée du Lac-Waswanipi, a projected aquatic reserve (Map 8-1).

Table 8-1 Surface area of protected areas in the regional study area

Categories	Area (km^2)
Projected aquatic reserve	577.29
Exceptional forest ecosystem	0.75
Biological refuge	145.79
Total	**723.83**

The LSA does not contain any protected areas. It should also be noted that no protected areas are intersected by any of the project's main infrastructure, i.e., the mine site or the access road. In fact, of all the protected areas in the RSA, the closest is a biological refuge located just under 9 km from the projected camp.

2020-2023 NORTHERN ACTION PLAN

Located at the southern limit of the territory of application of the Société du Plan Nord, the Windfall project is nevertheless part of this great vision of the northern territory development. Various measures arising from the 2020-2023 Northern Action Plan (NAP 20-23) may influence the project, particularly to:

- continue support for the mining sector for the rehabilitation and improvement of multi-resource roads;
- optimize freight transportation;
- improve the capacity of the territory's suppliers to meet the needs of the mining and forestry sectors;
- implement a corporate social responsibility intervention plan specific to any project in the territory;
- support large companies in terms of social responsibility on the territory;
- support pilot projects to address the negative effects of commuting on women and families;
- support workforce training in northern communities;
- align workforce training with the needs of large projects in the territory;
- develop local expertise and entrepreneurship in the circular economy sector (Société du Plan Nord, 2020).

LA GRANDE ALLIANCE

La Grande Alliance is a memorandum of understanding for collaboration and consolidation of socioeconomic ties between the Cree Nation and Quebec government to connect, develop, and protect the territory.

Resulting from a long process of consultation with the Cree communities, La Grande Alliance particularly envisions:

- extension of the railway network to favour economic development and reduce the impacts of trucking;
- electrification of certain industrial projects;
- sharing of infrastructure in the territory;
- training of a local workforce;
- identification of new protected areas suitable for the connectivity of the territory's wildlife habitats.

It is anticipated that La Grande Alliance will extend over a 30-year term to ensure the predictability and stability of the economic and social development of the Eeyou Istchee James Bay territory and Quebec as a whole. Consistent with this infrastructure program, the Grevet (Lebel-sur-Quévillon)-Chapais rail line reactivation project could potentially have a positive influence on the Windfall project (Grand Council of the Crees, Eeyou Istchee, 2022).

EEYOU ISTCHEE JAMES BAY REGIONAL GOVERNMENT

As mentioned previously, the EIJBRG is responsible for the management of Category III lands, on which the Cree have exclusive trapping rights (with some exceptions in the south) and certain non-exclusive hunting and fishing rights. They are also beneficiaries of an environmental and social protection regime.

It should noted that no land use and development plan has been produced for the territory of the EIJBRG.

The EIJBRG, on the other hand, has established a zoning by-law that determines the authorized or prohibited uses of the zones defined in the zoning plan.

ZONING BY-LAW

According to the EIJBRG zoning by-law governing the territory in which the LSA is located, the future mine site is located in zone 49 (12)-32, a sector where the extractive industry is permitted (EIJBRG, 2022).

ADMINISTRATION RÉGIONALE BAIE-JAMES

Under the Agreement respecting the Regions and Rurality Fund – Component 2 (FRR-Component 2), the ARBJ must determine its annual intervention priorities for the periods extending from April 1, 2022, to March 31, 2023. The various courses of action revolve around three major themes:

— to support, economic development and diversification;
— to act to provide favourable living conditions and safe, stimulating living environments to improve the overall development, health, and welfare of the population;
— To establish, fund, and implement local and regional development sectorial agreements with government departments and bodies as well as partnership agreements with non-profit organizations (NPO).

Among the courses of action, some may directly or indirectly concern the Windfall project (ARBJ, 2022):

— To promote circular economy research and development activities.
— To support actions for integrated development of natural resources and land.
— To favour viable development of the territory and maximization of the benefits of harvesting natural resources.
— To optimize transportation of passengers and freight between the region’s communities and between these communities and neighbouring regions (multi-purpose access road, automated transportation, railway potential, etc.).
— To reduce the isolation of the Jamésie and its cities and towns, by positioning it as an innovative region in new technologies.
— To support the digital transformation of companies.
— To strengthen the attractiveness of James Bay to favour settlement of newcomers and retention of the population.
— To support businesses in accessing a qualified workforce in sufficient numbers to meet the needs of the labour market while promoting the recognition of prior learning and skills.

8.1.2 IMPACTS ON PLANNING, DEVELOPMENT, AND TENURE OF LANDS IN THE CONSTRUCTION, OPERATIONS, AND CLOSURE PHASES

No impact is anticipated on land use planning and development during the construction, operations, and closure phases. The Windfall project will obtain all the permits required in accordance with the land-use planning requirements.

8.2 FIRST NATIONS INTERESTS AND TREATY LANDS

Highlights pertaining to First Nations interests and treaty lands

Existing conditions

- Most of the regional study area is located on the treaty lands of the James Bay and Northern Québec Agreement (JBNQA).
- The regional study area also overlaps most of the traditional territory of the Cree First Nation of Waswanipi, as well as a portion of the territory of the Cree Nation of Oujé-Bougoumou.
- The Atikamekw of Opiticiwan and Anishnabe of Lac Simon communities are outside the regional study area, located to the southeast and west-southwest of the Windfall site, respectively.
- The regional study area overlaps Category III, II, and I lands of the JBNQA, while the local study area is restricted to Category III lands only.
- The local study area more specifically overlaps two traplines, W25B and W25A.
- The historical occupation of the Crees of Waswanipi mainly developed around the Hudson's Bay Company fur trading post.

Potential impacts

The potential sources of impact identified in the construction, operations, and closure phases will bring change to the First Nations interests and treaty lands component, as these activities will alter a portion of the land, where it will no longer be possible, or will be less interesting, to carry on Cree activities of interest, particularly hunting, fishing, trapping, and berry-picking. However, these activities are discussed under the First Nations traditional land use component in Section 8.6.

8.2.1 CURRENT CONDITIONS

The regional study area, considered for the socioeconomic impact assessment in the context of this document, also overlaps most of the traditional territory of the Cree First Nation of Waswanipi, as well as a portion of the territory of the Cree Nation of Ouje-Bougoumou. Indeed, it overlaps a total of 46 traplines, including 37 (out of 62) of the community of Waswanipi and 9 (out of 13) of the community of Oujé-Bougoumou.

On a larger scale, the local study area, primarily associated with the land use component of this impact assessment, more specifically overlaps two traplines of the community of Waswanipi, namely W25B and W25A. The current occupation and use of the territory by users are described in Section 8.6.

In addition to the Cree communities, there are reserve lands of the Atikamekw First Nation of Opitciwan about 70 km southeast as the crow flies (whose ancestral land claim is named Nitaskinan, encompassing the Gouin Reservoir) and the Algonquin Anishnabe First Nation of Lac Simon about 170 km as the crow flies west-southwest of the Windfall site, both located outside the regional study area. The Atikamekw Nation, of which the First Nation of Opitciwan is part, entered into negotiations with the Governments of Quebec and Canada to resolve its land claims. The claims of these two First Nations would overlap the Windfall site. No current use of the lands and wildlife resources was documented for these two communities in the local study area of the project. The details of their uses of the territory are presented in the sectorial study on archaeology (Appendix 8-1). The historical use of the territory was studied based on the data available and covers a much larger sector than that of the study areas for the project.

OCCUPATION BY THE CREES OF WASWANIPI

Waswanipi[1] is one of the nine First Nations of the Cree Nation present in Quebec, along with Mistissini, Oujé-Bougoumou, Nemaska, Whapmagoostui, Chisasibi, Wemindji, Eastmain, and Waskaganish.[2] Waswanipi is the most southern First Nation of Eeyou Istchee. Located at the junction of the Opawica, Chibougamau, and Waswanipi Rivers and along Road 113, Waswanipi is 45 km upstream of the site the Crees today call the Old Post (former Hudson's Bay Company trading post), also known in Cree as *Chiiwetaau*, which means "let us return there."

After originating in the Quebec subarctic regions in the second half of the 17th century, the fur trade benefited from the contribution of the Crees in terms of its configuration and development (Morantz, 2002a). This trade resulted in a mutually beneficial interdependence between Cree trappers and other Algonquin nations, as well as traders (Feit, 2000). In this sense, the practice of the leading economic activities, those now said to be traditional, namely hunting, fishing, and trapping, evolved dynamically. Their historical evolution is the result of a change of institutions, values, and cultural practices, according to a "continuity, and even a reinforcement or refinement" of the culture, instead of "a loss or an impoverishment of the culture" (Morantz, 2002b - TRANSLATION).

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1 The word "Waswanipi" is a transformation of the term wash-te-ou-nebi in iiyiyuu ayimuun (Cree language), which can be translated literally as "light on the water" or "reflection on the water," referring to traditional night fishing during which the Crees attract fish with torches (Wattez, 2020). On the Waswanipi Band Council website, it is specified that the term refers to "a time when fishermen travelled with torches fuelled with pine oil to harpoon fish in the spawning grounds at the mouth of the Waswanipi River" (Wattez, 2020).

2 Washaw Sibi was recognized as the tenth Cree Nation community at the 2003 Annual General Meeting of the Cree Nation (Cree Nation Government, 2003).

Under the presence of the federal government in Eeyou Istchee starting in the 1930s, occupancy was “bureaucratic” and “piecemeal” (Morantz, 2002c - TRANSLATION). The Crees demonstrated their adaptability, which took the form of conservation of “a degree of control—although diminished—over social and cultural institutions” (Morantz, 2002d - TRANSLATION). Between the 1950s and 1970, the Crees were still very engaged in the traditional way of life focused on trapping fur-bearing animals and subsistence hunting and fishing. This was also a period when they adapted to the growing development of mining and forestry activities, which announced the start of a period of more radical changes.

Development of the exploitation of natural resources, primarily mining and forestry, was rapid due to the expansion of the transportation network, particularly the railway connecting Senneterre to Chibougamau and Chibougamau to Saint-Félicien. Several mines were opened in the 1950s in four towns: Chibougamau, Chapais, Desmaraisville, and Matagami. Moreover, loggers transferred “about 500 woodcutters to pulp processing operations within 30 km of the Old Post” (Marshall, CRA and CFNW 1987 - TRANSLATION). These activities were followed by many other subsequent activities required in any new town, such as services and small businesses. The consequence was a mass migration of non-First Nations people from southern Quebec and Ontario, coming to work and live in the new towns and mining camps (Marshall, CRA and CFNW, 1987). In the 1950s, over 20,000 people migrated to the region to work in the mines of Chibougamau, Chapais, Desmaraisville and Matagami (La Rusic, 2006).

Beginning in 1950-1970, external actors, the Quebec Government, the companies exploiting natural resources (mining, forestry and hydroelectric) and the population settling in the territory, put unprecedented pressure on the Crees (Morantz, 2002; Feit, 2000 and 2004).

For the Crees of Waswanipi, the project of establishing a reserve, developed since the mid-1920s, represented in this context a way of maintaining sufficient control over their destiny (La Rusic, 2006). It was supposed to enable them to adapt to the colonization of their territory, already under way, and its inevitable future intensification (Wattez, 2020). An Indian reserve was formally established on February 13, 1961, by order (No. 242). On this basis, 620 acres on Waswanipi Island were transferred to the Crown as a housing and community infrastructure site, but no reserve or any other development ever emerged there (La Rusic, 2006). This led to the dispersion of the Crees of Waswanipi to various places in the region for about twenty years (1960-1980), beginning with the closure in 1963 of the Hudson’s Bay Company trading post on Waswanipi Island (Morantz, 2002). Following the consultation with families between 1971 and 1974 to determine the choice of a site (Wattez, 2020), the signing of the James Bay and Northern Quebec Agreement (JBNQA) on November 11, 1975, established the obligations and the legal foundations for the construction process of the reserve (Gull, 2011), inaugurated in 1976 in the banks of the Waswanipi River. The creation of the reserve gradually ended the dispersion of Cree families that had been under way for twenty years (1960-1980) and the sending of Cree children to Indian residential schools in Ontario and Quebec for over thirty years (CFNW, 202; Wattez, 2020).

TREATY LAND REGIME

Most of the regional study area (Map 8-1) is located on the treaty lands of the James Bay and Northern Quebec Agreement (JBNQA).

The legislative and legal context of the Nord-du-Québec region is framed by the JBNQA (1977) and the Agreement concerning a New Relationship between le Gouvernement du Québec and the Crees of Québec (Paix des Braves).

La Paix des Braves is a 50-year comprehensive political and economic agreement made between the Quebec Government and the Crees in February 2002. The principles of this agreement aim to develop a nation-to-nation relationship based on trust and mutual respect. Moreover, it intends to foster respect for the sustainable development principles and the Cree traditional way of life, as well as greater autonomy and better control by the Crees of their own development. It guarantees Cree participation in the forest, mining and hydroelectric development of the territory (Secrétariat aux affaires autochtones, 2011).

The land regime introduced by the JBNQA is a determining element for land use, a component addressed in Section 8.7. It provides for the division of the territory into Category I, II, and III lands.

Category I lands are reserved for the exclusive use of the Crees. They may be used for residential, community, commercial, industrial or other purposes. The Crees hold exclusive hunting, fishing and trapping rights on these lands.

Category II lands are contiguous to Category I lands and are part of the Quebec public domain. These are lands where the Cree have exclusive hunting, fishing, and trapping rights. As in the case of Category I lands, the Crees may exercise these rights at all times of the year and for all animal species, except those that are protected under federal or provincial legislation. For the purpose of these activities, they may establish any camp necessary for their practice without having to comply with the land lease provisions of the Act respecting the lands in the domain of the State. On Category I and II lands, the Crees hold exclusive rights to operate commercial fisheries and outfitting establishments (MRNF, 2010).

Since the formation of the EIJBRG, the Cree Nation Government has jurisdiction over Category II lands. Moreover, the new EIJBRG, composed of a representative of the Quebec government and an equal number of Cree and Jamesian representatives, has jurisdiction over Category III lands (EIJBRG, 2018).

Category III lands represent all treaty lands not included in Category I and II lands. On these lands, the Crees enjoy the exclusive right to trap fur-bearing animals and certain advantages in the area of outfitting without exclusive rights. They may establish any camp on these lands necessary for hunting, fishing and trapping and, in this case a Quebec government title is not required. Moreover, the Crees do not require a permit to engage in these activities and no limit is imposed on them for the number of catches. In addition, certain wildlife species are reserved for their hunting and fishing activities. They have the right to harvest fish species reserved for commercial fisheries. On these lands, hunting and fishing are permitted both for First Nations and non-First Nations people (EIJBRG, 2018).

As illustrated on the map of the social environment (Map 8-1), the regional study area overlaps Category III, II and I lands, while the local study area is restricted to Category III lands only.

8.2.2 IMPACTS ON FIRST NATIONS INTERESTS AND TREATY LANDS IN THE CONSTRUCTION, OPERATIONS, AND CLOSURE PHASES

The potential sources of impact identified in the construction phase (organization of the site; stripping and clearing; surface preparation and access arrangement; construction of works and infrastructure; transportation and traffic; production and management of residual and hazardous materials; workforce and procurement), operations (presence and operation of new infrastructure; water use and management; transportation and traffic; production and management of residual and hazardous materials; workforce and procurement), and closure (presence of the remnants of the site; final restoration; production and management of residual and hazardous materials; workforce and procurement) will introduce changes to the First Nations interests and treaty lands component, because these activities will alter a portion of the territory, where it will no longer be possible, or will be less interesting, to exercise rights, particularly hunting, fishing, trapping, and berry-picking rights. These rights are discussed under the First Nations traditional land use component in section 8.6.

8.3 POPULATION, ECONOMY, AND EMPLOYMENT

Highlights on population, economy and employment

Existing conditions

Cree communities of Eeyou Istchee

— In 2021, Waswanipi had 1,836 inhabitants. The community had a very young population (27.1% under the age of 15). In comparison, only 15.7% of the Quebec population was under the age of 15.

— In 2019, the pre-tax average income of Cree workers aged 25 to 64 ($49,318) was lower than that of Quebecers in the same category ($54,409).

— In 2021, the households of Waswanipi and the Cree communities of Eeyou Istchee mostly occupied band housing (80.8% and 71.5%, respectively).

— In 2016, the proportion of people with at least a high school diploma in the Cree communities of Eeyou Istchee (48.7%) was significantly lower than in the province (80.1%).

— The unemployment rates in the Cree communities (16.0%) and Waswanipi (19.6%) were more than twice as high as the provincial rate (7.2%) in 2016.

— The economic activities of the Cree communities of Eeyou Istchee are mainly related to the tertiary sector, but also partly to the primary sector. In 2016, the proportion of employment in the primary sector (6.9%) was three times higher than in Quebec (2.5%).

Jamesian municipalities

— In 2021, the municipality of Lebel-sur-Quévillon had 2,091 inhabitants, while the population of all Jamesian municipalities totalled 12,194 people.

— In 2021, the pre-tax average income of Jamesian workers aged 25 to 64 ($62,772) was higher than that of Quebec workers ($54,409).

- In 2021, the proportion of owner-occupied dwellings in Lebel-sur-Quévillon (84.1%) was far greater than that of Nord-du-Québec (35.6%) and Quebec (59.9%).
- In 2021, the proportion of the population with a trade school diploma (vocational training) in Lebel-sur-Quévillon (29.3%) was almost twice that of Quebec overall (15.8%). Meanwhile, the proportion of the population with at least a high school diploma was lower for Jamesian municipalities (75.4%) than for the province (81.8%).
- In 2021, the unemployment rate for Lebel-sur-Quévillon was at least twice as low (3.6%) as that of the province (7.6%).
- The economic structure of the Jamesian municipalities is largely dependent on the energy, mining, and forestry sectors. In 2021, the proportion of employment in the primary sector was much higher for Jamesian municipalities (10.6%) and for Lebel-sur-Quévillon (10.0%) than for the province (2.4%).

<u>Potential impacts of the project</u>

Cree communities of Eeyou Istchee and Jamesian municipalities

The expected impacts for the Cree communities and the Jamesian municipalities are positive for the construction, operations, and closure phases, but also negative for the closure phase.

In the construction phase, the positive impacts include job maintenance and creation, the economic benefits for regional businesses, and the increase in the qualifications and employability of the regional workforce. The increase in workers' incomes is added to the positive impacts in the operations phase.

Several enhancement measures will be implemented by Osisko, particularly to favour local hiring, the awarding of contracts to local businesses, and development of the skills of employees and the local workforce. However, due to the fly-in/fly-out or shuttle-based work arrangement and long rotating work schedules (15/13), some socioeconomic stakeholders have raised concerns about the reduction of benefits for Jamesian municipalities.

In the closure phase, the economic benefits resulting from the dismantling and restoration activities will have a positive effect. The loss of employment and wages in the post-restoration phase will have a negative impact, however. The significance of the impacts will greatly depend on the economic situation and the job market at time of the closure. The anticipated significance of this negative impact is low for the Cree communities of Eeyou Istchee and the Jamesian municipalities.

8.3.1 CURRENT CONDITIONS

Section 8.3 presents population, economic and employment data from the territory in which the Windfall project will take place. The study area for this component is regional so as to have a picture of the populations in the Eeyou Istchee James Bay Territory (Map 8-1). The main towns described are Lebel-sur-Quévillon, Waswanipi, Chapais and Chibougamau. For each theme, the data is presented separately for the Cree communities of Eeyou Istchee and for the Jamesian municipalities.

POPULATION DISTRIBUTION, TRENDS, AND AGE STRUCTURE

The Eeyou Istchee James Bay Territory includes the municipalities of Chibougamau, Chapais, Lebel-sur-Quévillon, and Matagami, as well as the nine Cree communities of the Nord-du-Québec region: Chisasibi, Eastmain, Waskaganish, Wemindji, Whapmagoostui, Mistissini, Nemaska, Oujé-Bougoumou, and Waswanipi.

In 2021, the population of the Nord-du-Québec region was 45,740, or 0.5% of the population of Quebec. (Table 8-2). The region ranked as the least populous in the province. In 2021, the Cree communities of Eeyou Istchee had 18,225 inhabitants, over one third (39.8%) of the region's population (Table 8-2), while the Jamesian municipalities had 12,194 inhabitants (Table 8-3) (Statistics Canada, 2022a).

CREE COMMUNITIES OF EEYOU ISTCHEE

The principal Cree community concerned by the project, Waswanipi, had a population of 1,836 in 2021 (Statistics Canada, 2022a). From 2011 to 2021, the rate of variation of its population was 3.3%, a rate far lower than that of the other communities of Eeyou Istchee (11.5%) (Table 8-2).

Table 8-2 Population trend of the Cree communities of Eeyou Istchee, 2011, 2016, 2021

Total population				
Territory	2011	2016	2021	Variation 2011-2021 (%)
Waswanipi	1,777	1,759	1,836	3.3
Cree communities of Eeyou Istchee[a]	16,350	17,183	18,225	11.5
Nord-du-Québec	42,579	44,561	45,740	7.4
Quebec	7,903,001	8,164,631	8,501,833	7.6

a The data for the Cree communities of Eeyou Istchee were calculated based on the data of the nine Cree villages: Chisasibi, Eastmain, Waskaganish, Wemindji, Whapmagoostui, Mistissini, Nemaska, Oujé-Bougoumou, and Waswanipi.

Sources: Statistics Canada, 2017, 2022a.

According to the Institut de la statistique du Québec (ISQ, 2021a, 2022d, 2022e, 2022f), the population of Waswanipi is expected to increase by 14.1% between 2026 and 2041, a slightly lower growth rate than that of the communities of Eeyou Istchee (17.9%), but at least twice as high as that of Quebec (6.0%) (Table 8-3).

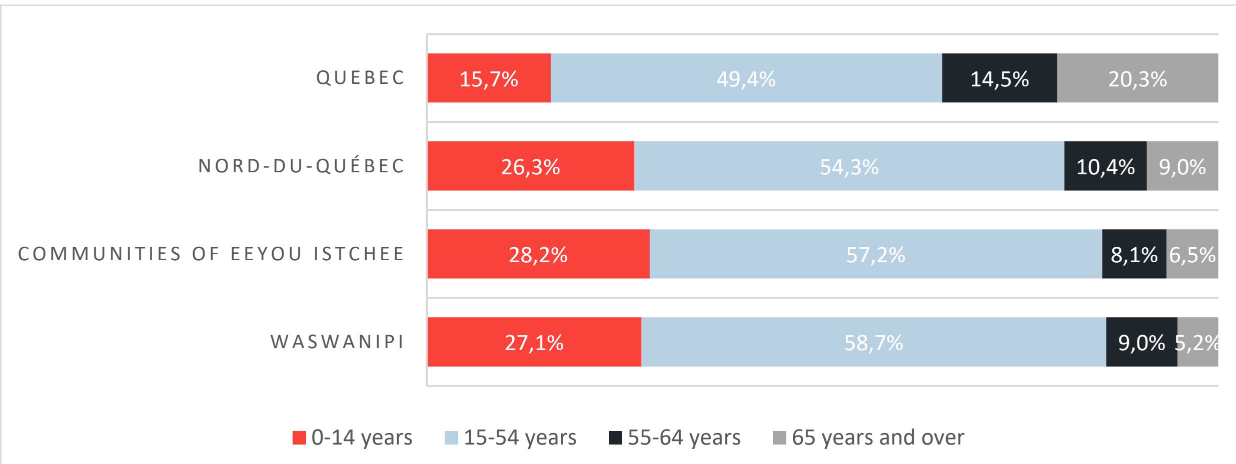
Table 8-3 Demographic outlook for the Cree communities of Eeyou Istchee, 2026-2041

Territory	2026	2031	2036	2041	Variation 2026-2041 (%)
Waswanipi	1,904	1,990	2,078	2,173	14.1
Cree communities of Eeyou Istchee	20,077	21,359	22,555	23,667	17.9
Nord-du-Québec	48,662	50,454	52,171	53,839	10.6
Quebec	8,952,555	9,167,487	9,341,994	9,489,377	6.0

Sources: ISQ, 2021a, 2022d, 2022e, 2022f.

The population of the Cree communities of Eeyou Istchee, like that of Nord-du-Québec, is particularly young compared to that of Quebec as a whole. In 2021, the proportion of youth aged between 0 and 14 in Cree communities (28.2%) was significantly higher than for the province (15.7%) (Figure 8-1). This trend was also observed for Waswanipi (27.1%). The 15-54 age group also represented more than half the population of the Cree communities (57.2%) and Waswanipi (58.7%). On the other hand, there were twice as few people aged 55 and over in the communities of Eeyou Istchee (14.6%) than in Quebec as a whole (34.8%).

Figure 8-1 Population distribution by age group of the Cree communities of Eeyou Istchee, 2021



Sources: ISQ, 2022b, 2022c.
Notes: The 2021 data is provisional.

JAMESIAN MUNICIPALITIES

Among Jamesian municipalities, the town of Chibougamau has the largest population in the region, with 7,233 inhabitants. The municipality of Lebel-sur-Quévillon ranks second, with a population of 2,091 in 2021. Also in 2021, the town of Chapais had 1,468 inhabitants (Statistics Canada, 2022a).

Contrary to the Cree communities of Eeyou Istchee (11.5%) and Quebec (7.6%) (Table 8-2), the Jamesian municipalities as a whole and Lebel-sur-Quévillon experienced a population decrease between 2011 and 2021 (-5.0% and -3.1% respectively) (Table 8-4).

Table 8-4 Population trend of the Jamesian municipalities, 2011, 2016, 2021

Total population				
Territory	**2011**	**2016**	**2021**	**Variation 2011-2021 (%)**
Lebel-sur-Quévillon (V)	2,159	2,187	2,091	-3.1
Chapais (V)	1,610	1,499	1,468	-8.8
Chibougamau (V)	7,541	7,504	7,233	-4.1
Jamesian municipalities[a]	12,836	12,643	12,194	-5.0
Nord-du-Québec	42,579	44,561	45,740	7.4
Quebec	7,903,001	8,164,631	8,501,833	7.6

a The data for the Jamesian municipalities was calculated based on the data for the municipalities of Lebel-sur-Quévillon, Chapais, Chibougamau and Matagami.

Sources: Statistics Canada, 2017, 2022a.

According to the Institut de la Statistique du Québec (ISQ, 2021a, 2022d, 2022e, 2022f), the populations of the Jamesian municipalities and Lebel-sur-Quévillon should continue their demographic decline until 2041, while the populations of Nord-du-Québec and Quebec will resume their growth (Table 8-5). From 2026 to 2041, the populations of Jamésie and Lebel-sur-Quévillon should decrease by 5.7% and 10.8%, respectively, while those of Nord-du-Québec and the province could increase by 10.6% and 6.0%.

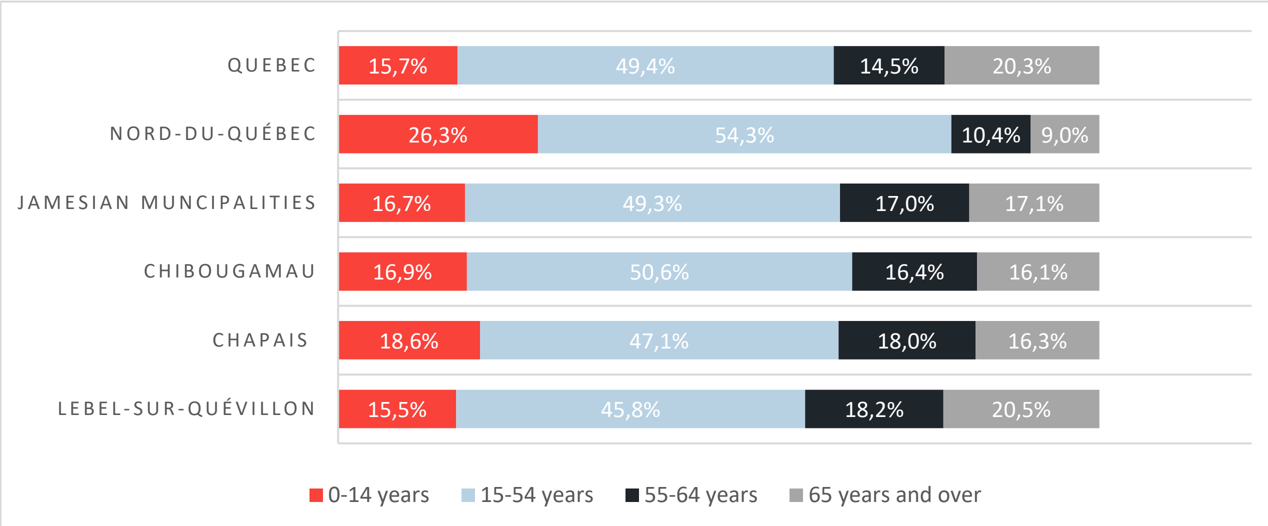
Table 8-5 Demographic outlook of the Jamesian municipalities, 2026-2041

Territory	2026	2031	2036	2041	Variation 2026-2041 (%)
Lebel-sur-Quévillon (V)	1,995	1,911	1,840	1,780	-10.8
Chapais (V)	1,489	1,445	1,421	1,394	-6.4
Chibougamau (V)	7,190	7,029	6,899	6,789	-5.6
Jamesian municipalities	13,036	12,724	12,477	12,294	-5.7
Nord-du-Québec	48,662	50,454	52,171	53,839	10.6
Quebec	8,952,555	9,167,487	9,341,994	9,489,377	6.0

Sources: ISQ, 2021a, 2022d, 2022e, 2022f.

Conversely to the communities of Eeyou Istchee, the Jamesian and Lebel-sur-Quévillon age structure was similar to that of the province in 2021. However, in Lebel-sur-Quévillon, the proportion of the population aged between 15 and 54 (45.8%) was slightly lower than that of Jamésie (49.3%) and Quebec (49.4%) (Figure 8-2). For this same town, people aged 55 and over (38.7%) accounted for more than one third of the population, slightly higher than for Jamésie (34.1%) and Quebec (34.8%).

Figure 8-2 Population distribution of the Jamesian municipalities by age group, 2021



Sources: ISQ, 2022b, 2022c.
Notes: The 2021 data is provisional.

Concerning migration, as in the past 20 years, the interregional migration balance for Nord-du-Québec was negative for 2020-2021, with the departure of 205 individuals. However, this loss was slightly lower than for 2019-2020 (-287 individuals) (ISQ, 2022g). For 2020-2021, the first top three destination regions for outbound individuals were Abitibi-Témiscamingue (19.1%), Saguenay-Lac-Saint-Jean (17.7%) and Montréal (14.1%) (ISQ, 2022h). The proportion of people leaving the region was greater for the Jamesian municipalities (-1.22%) than for the Cree communities of Eeyou Istchee (-0.01%) (ISQ, 2022g).

INCOME

CREE COMMUNITIES OF EEYOU ISTCHEE

HOUSEHOLD INCOME

In 2021, the average number of people per household in Waswanipi (3.6) was higher than the regional (3.1) and Quebec (2.2) averages. The median after-tax household income for this community ($102,000) was almost $40,000 higher than that of Quebec households ($63,200) in 2020. The median income of this community's households was also nearly $20,000 higher than that of Nord-du-Québec households (Statistics Canada, 2022a).

WORKERS' INCOME AND DISPOSABLE INCOME PER INHABITANT

In 2019, 5,594 workers were between the ages of 25 and 64 in the Cree communities of Eeyou Istchee (ISQ, 2022i). For this territory, the pre-tax average income of workers aged 25 to 64 ($49,318) and the disposable income per inhabitant ($29,042) were lower than those of Quebecers in these same categories ($54,409 and $30,591, respectively) (ISQ, 2022j and 2022k).

LOW-INCOME FAMILIES

According to the 2019 data available from the ISQ, the proportion of families with an income below the low-income cutoff was three times greater for the Cree communities of Eeyou Istchee (27.1%) than for Quebec (9.3%) (Table 8-6). The median after-tax income of low-income families was $25,540 for couple families and $20,920 for one-parent families. The median income of low-income couple families was therefore greater than that of this same type of family in Quebec ($23,750). For low-income one-parent families, the median income was lower than that of the province.

Table 8-6 Low-income family numbers, rate, and median annual after-tax income in the Cree communities of Eeyou Istchee, 2019

Territory	Number of low-income families	Rate of low-income families (%)	Median after-tax income of low-income families ($)	
			Couple families	One-parent families
Cree communities of Eeyou Istchee	1,180	27.1	25,540	20,920
Nord-du-Québec	2,100	18.4	26,790	21,710
Quebec	214,080	9.3	23,750	22,470

Note: Data for Waswanipi is unavailable.
Sources: ISQ, 2022l, 2022m, 2022n, 2022o, 2022p, 2022q.

INCOME SECURITY PROGRAM FOR CREE HUNTERS AND TRAPPERS (ISP)

In 1976, the JBNQA allowed the establishment of the Income Security Program for Cree Hunters and Trappers (ISP), which aims to encourage them to continue their traditional hunting, fishing or trapping activities by guaranteeing an income to the participants. The average amount of benefits paid per family unit for all Cree communities in 2020-2021 was $19,341, an amount similar to that of 2019-2020 ($19,608). In 2020-2021, the average benefit per family unit in Waswanipi ($22,875) was the highest in the Cree communities after Whapmagoostui ($23,435). In Waswanipi, 266 people (193 adults and 76 children, or 133 family units) were registered in the ISP in 2020-2021 (CHESB, 2022).

JAMESIAN MUNICIPALITIES

HOUSEHOLD INCOME

The average number of people per household in Lebel-sur-Quévillon, Chapais, and Chibougamau was the same as that of Quebec in 2021, at 2.2 individuals per household. Nord-du-Québec households were bigger with an average of 3.1 members (Statistics Canada, 2022a).

In 2020, the median after-tax household income in Lebel-sur-Quévillon ($75,500) was lower than that of Nord-du-Québec ($85,500), but more than $10,000 higher than that of Quebec households ($63,200). In Chapais and Chibougamau, the median after-tax household income was $68,500 and $72,000, respectively (Statistics Canada, 2022a).

WORKERS' INCOME AND DISPOSABLE INCOME PER INHABITANT

In 2019, there were 6,211 Jamesian workers aged 25 to 64 (ISQ, 2022i). The pre-tax average income of Jamesian workers aged 25 to 64 ($62,772) was higher than that of Quebec workers ($54,409). Also, the disposable income per inhabitant in Jamésie ($32,664) was higher than that of Quebec inhabitants ($30,591) (ISQ, 2022j).

LOW-INCOME FAMILIES

According to the 2019 data available from the ISQ, the proportion of families with an income below the low-income cutoff was twice as low for the Jamesian municipalities (27.1%) than for Quebec (9.3%) (Table 8-7).

In Jamésie, the median after-tax income of low-income couple families ($24,400) was slightly higher than that of the same type of family in Quebec ($23,750). On the other hand, the median after-tax annual income of low-income one-parent families ($22,050) was slightly lower than that of Quebec ($22,470).

Table 8-7 Low income family numbers, rates, and median annual after-tax income in the Jamesian municipalities, 2019

Territory	Number of low-income families	Rate of low-income families (%)	Median after-tax income of low-income families ($)	
			Couple families	One-parent families
Jamesian municipalities	190	4.8	24,200	22,050
Nord-du-Québec	2,100	18.4	26,790	21,710
Quebec	214,080	9.3	23,750	22,470

Note: The data for Lebel-sur-Quévillon, Chapais and Chibougamau is unavailable.
Sources: ISQ, 2022l, 2022m, 2022n, 2022o, 2022p, 2022q.

HOUSING

CREE COMMUNITIES OF EEYOU ISTCHEE

In 2021, the occupancy rate of Waswanipi private housing[3] was 79.7%, slightly lower than that of the Cree communities of Eeyou Istchee (83.0%) (Table 8-8). Compared to that of the Cree communities, the occupancy rate of Quebec private housing (92.6%) was nearly 10% higher. The occupancy rate of a private dwelling has remained relatively stable in Waswanipi since 2016 (79.2%) (Statistics Canada, 2017).

The vast majority of households of Waswanipi and the Cree communities of Eeyou Istchee occupied "band" housing in 2021, i.e., dwellings belonging to the First Nation located in the community (respectively 80.8% and 71.5%).

3 According to Statistics Canada, a private dwelling is considered private if it has a private entrance. This private entrance may be from outside the building or from a common hall, lobby, vestibule or stairway inside the building (Statistics Canada, 2022a).

Despite the stability of the occupancy rate of all private dwellings, a critical need of over 2,000 affordable housing units was identified in 2021 for the Cree communities of Eeyou Istchee. To meet these needs, the Canada Mortgage and Housing Corporation (CMHC) announced an investment of $17.4 M for the construction of 55 modular homes within the nine Cree communities. Of this number, five homes must be constructed in Waswanipi (CMHC, 2021).

Table 8-8 Size of households and mode and rate of occupancy of dwellings in the Cree communities of Eeyou Istchee, 2021

Territory	Proportion of the number of private households according to the mode of occupancy of their dwelling (%)			Occupancy rate of private dwellings[c, d] (%)
	Owner	Tenant	Dwelling provided by the local government, the First Nation, or the Indian Band	
Waswanipi[a]	11.5	7.7	80.8	79.7
Cree communities of Eeyou Istchee[b]	13.8	14.6	71.5	83.0
Nord-du-Québec	35.6	44.4	19.9	83.9
Quebec	59.9	39.9	0.2	92.6

Note: Due to rounding, proportions do not always add up to 100%.
a The Waswanipi data for the 2021 population census should be used prudently. It has been revised for the occupancy rate of private dwellings, but not for the other housing-related aspects.
b The data for the Cree communities of Eeyou Istchee were calculated based on the data of the nine Cree villages: Chisasibi, Eastmain, Waskaganish, Wemindji, Whapmagoostui, Mistissini, Nemaska, Oujé-Bougoumou, and Waswanipi.
c The occupancy rate of private dwellings was calculated based on the following data: private dwellings occupied by usual residents/total private dwellings.
d The vacancy rate of rental housing presented by the CMHC is unavailable for municipalities of fewer than 2500 inhabitants. The occupancy rate of private dwellings thus does not reflect the situation regarding the availability of rental housing.
Sources: Statistics Canada, 2022a, 2022b.

JAMESIAN MUNICIPALITIES

The occupancy rate of private dwellings in Lebel-sur-Quévillon was 81.1% in 2021, a rate lower than that of the Jamesian municipalities (87.5%) and Quebec (92.6%) (Table 8-9). It should be noted that between 2016 and 2021, the occupancy rate of private dwellings in Lebel-sur-Quévillon varied very little (-0.3%), while it increased slightly in Quebec (1.1%) (Statistics Canada, 2017).

In 2021, the proportion of owner-occupied dwellings in Lebel-sur-Quévillon (84.1%) was more than double that of Nord-du-Québec (35.6%). In comparison, this proportion was 59.9% in Quebec.

According to a study conducted by the Groupe de Ressources Techniques de l'Abitibi-Témiscamingue-Ungava (GRTATU), the rental housing vacancy rate in Lebel-sur-Quévillon was around 0% in 2021 (ARBJ, 2021). To counter this shortage, the Quebec government granted $1.8 M of financial support to the Comité 5000 organization to purchase and renovate residential properties. Therefore, 18 rental dwellings are expected to be offered to newcomers (Radio-Canada, 2022).

Table 8-9 Size of households and mode and rate of occupancy of dwellings in the Jamesian municipalities, 2021

Territory	Proportion of the number of private households according to the mode of occupancy of their dwelling			Occupancy rate of private dwellings[bc] (%)
	Owner	Tenant	Dwelling provided by the local government, the First Nation, or the Indian Band	
Lebel-sur-Quévillon (V)	84.1	15.9	0.0	81.1
Chapais (V)	76.2	23.8	0.0	91.1
Chibougamau (V)	70.1	29.9	0.0	89.7
Jamesian municipalities[a]	74.2	25.8	0.0	87.5
Nord-du-Québec	35.6	44.4	19.9	83.9
Quebec	59.9	39.9	0.2	92.6

Note: Due to rounding, proportions do not always add up to 100%.
a The data for the Jamesian municipalities was calculated based on the data for the municipalities of Lebel-sur-Quévillon, Chapais, Chibougamau and Matagami.
b The occupancy rate of private dwellings was calculated based on the following data: private dwellings occupied by usual residents/total private dwellings.
c The vacancy rate of rental housing presented by the CMHC is unavailable for municipalities of fewer than 2500 inhabitants. The occupancy rate of private dwellings thus does not reflect the situation regarding the availability of rental housing.
Source: Statistics Canada, 2022a

EDUCATION AND TRAINING

CREE COMMUNITIES OF EEYOU ISTCHEE

In 2016, over half the population aged 15 and over in the community of Waswanipi (54.5%) had at least a high school diploma (Table 8-10). This proportion was similar for Nord-du-Québec (55.2%), and slightly lower for the Cree communities of Eeyou Istchee (48.7%). A significant difference was, however, observed between the graduation rate of the Cree communities of Eeyou Istchee and that of the province (80.1%).

In 2016, participation in college and university studies was twice as low for Waswanipi (22.6%) and the Cree communities (21.9%) than for Quebec (41.7%). On the other hand, the proportion of people with a diploma from a trade school (vocational training) was higher in Waswanipi (21.3%) than in Nord-du-Québec (18.6%) and in the province as a whole (16.9%).

Table 8-10 Highest level of education attained by the population aged 15 and over, Cree communities of Eeyou Istchee, 2016 and 2021

Territory	Level of education (%)											
	No certificate, diploma, or degree		High school diploma or certificate of equivalence		Apprenticeship or trade school certificate or diploma		Certificate or diploma from a college, CEGEP, or other non-university institution		University certificate or diploma lower than the bachelor level		University certificate, diploma or degree at the bachelor level or higher	
	2016	2021	2016	2021	2016	2021	2016	2021	2016	2021	2016	2021
Waswanipi[a]	46.4	N.A.[c]	10.6	N.A.	21.3	N.A.	15.7	N.A.	2.6	N.A.	4.3	N.A.
Cree communities of Eeyou Istchee[b]	51.3	N.A.	11.4	N.A.	15.4	N.A.	13.1	N.A.	2.4	N.A.	6.4	N.A.
Nord-du-Québec	44.6	44.0	14.8	18.7	18.6	14.6	12.1	13.0	2.4	2.3	7.3	7.4
Quebec	19.9	18.2	21.5	21.4	16.9	15.8	17.6	17.4	3.6	3.7	20.5	23.5

Note: Totals may not add up to 100% due to rounding.
a Revised education data from the 2021 population census are not available for Waswanipi. The data published by Statistics Canada are not presented in this table as they are not revised to reflect the total population and are therefore not representative.
b The data for the Cree communities of Eeyou Istchee were calculated based on the data of the nine Cree villages: Chisasibi, Eastmain, Waskaganish, Wemindji, Whapmagoostui, Mistissini, Nemaska, Oujé-Bougoumou, and Waswanipi. The compilation of the data is not presented for 2021 since the data available for the community of Waswanipi is not representative.
c N.A. : not available
Sources: Statistics Canada, 2017a, 2022a.

JAMESIAN MUNICIPALITIES

In 2021, the proportion of the population holding at least a high school diploma in Lebel-sur-Quévillon (80.4%) was similar to that of Quebec (81.8%), while it was slightly lower for the Jamesian municipalities (75.4%) (Table 8-11). The level of education of the population of Lebel-sur-Quévillon was significantly higher than that of Nord-du-Québec, where the proportion of graduates was 56.0%. On the other hand, only 13.6% of the Jamesian population aged 15 and over had a university degree, or half the rate for the Quebec population (27.2%). The proportion of the population with a trade school diploma (vocational training) in Lebel-sur-Quévillon (29.3%) was almost twice that of Quebec overall (15.8%).

Table 8-11 Highest level of education attained by the population aged 15 and over, Jamesian municipalities, 2016 and 2021

Territory	Level of education (%)											
	No certificate, diploma or degree		High school diploma or equivalent		Apprenticeship or trade school certificate or diploma		Certificate or diploma from a college, CEGEP, or other non-university institution		University certificate or diploma lower than the bachelor level		University certificate, diploma or degree at the bachelor level or higher	
	2016	2021	2016	2021	2016	2021	2016	2021	2016	2021	2016	2021
Lebel-sur-Quévillon (V)	26.1	19.8	17.9	19.5	28.6	29.3	16.0	21.0	2.8	2.0	8.1	8.6
Chapais (V)	33.3	35.8	15.2	18.1	32.1	31.0	12.3	11.9	1.2	1.3	5.8	2.7
Chibougamau (V)	25.5	23.3	18.1	18.0	24.1	24.0	18.0	18.8	3.5	3.5	10.8	12.5
Jamesian municipalities[a]	26.3	24.6	17.8	18.5	26.8	25.6	16.6	17.7	3.1	3.0	9.3	10.6
Nord-du-Québec	44.6	44.0	14.8	18.7	18.6	14.6	12.1	13.0	2.4	2.3	7.3	7.4
Quebec	19.9	18.2	21.5	21.4	16.9	15.8	17.6	17.4	3.6	3.7	20.5	23.5

Notes: Totals may not add up to 100% due to rounding
a The data for the Jamesian municipalities were calculated based on the data for the municipalities of Lebel-sur-Quévillon, Chapais, Chibougamau and Matagami.
Sources: Statistics Canada, 2017a, 2022a.

VOCATIONAL TRAINING

The Centre de formation professionnelle de la Baie-James (CFPBJ) offers a variety of training programs, particularly in the mining sector (CFPBJ, 2022). On the other hand, in 2016, the Centre de service scolaire de la Baie-James inaugurated a brand new ore process plant-school in Chibougamau. This plant-school provides practical and theoretical training leading to the Diploma of Vocational Studies in Ore Processing Machine Operation, but also participates in the recognition of prior learning and skills and in the continuing education of workers in the mining industry (CSBJ, 2016). Practical training is also offered at the Windfall site.

In Waswanipi, the Cree School Board (CSB) offers training programs at the Sabtuan Regional Vocational Training Centre (SRVTC) in a variety of fields complementary to the mining industry, such as welding and fitting, worksite machinery operation and mechanics, surveying and professional cooking (CSB, 2022 and personal communication, 2022). The programs range between 900 and 1,800 hours per year and are mainly oriented to the practical component. The premises have recent equipment and material; practice areas are also developed outside so that the students can apply the concepts learned. The teachers are all bilingual (French and English) and adapt according to the language needs of their cohorts. Before the COVID-19 pandemic, the classes accommodated between 10 and 14 students. The cohorts have been less numerous in the past few years.

Most programs include internships of at least 120 hours. Currently, the internship programs are provided mainly for the Stornoway or Newmont mining companies. According to the stakeholder interviewed, about 80% of the internships are working well with employers in the region. He believes this is due to the supportive work environment (personal communication, 2022).

Finally, the SRVTC offers its clients the possibility of residential accommodation in Waswanipi. Among the 50 rooms available, some can accommodate the student’s nuclear family (up to two children).

Osisko has also recently offered a workforce training initiative through a partnership with the Comité sectoriel de main-d'oeuvre de l'industrie des mines (CSMO Mines - Sectoral workforce committee for the mining industry) and the Cree community of Waswanipi. This program on mining essentials, known as L'Essentiel des mines, is an employment preparation program for the Crees. The objective is to teach the job skills required to obtain a job in the mining sector.

Parallel to this, Apatisiiwin Skills Development (ASD) is an institution based in Mistissini that aims to guide job seekers in their integration into the labour market. Employment counsellors are present in all Cree communities.

LABOUR MARKET

In 2021, the participation rate (63.1%) and the employment rate (58.5%) of Nord-du-Québec were a little lower than those of Quebec (respectively 64.1% and 59.3%) (Statistics Canada, 2022). The unemployment rate for the region (7.3%) was similar to that of the province (7.6%).

CREE COMMUNITIES OF EEYOU ISTCHEE

In 2016, the participation rate of the Cree communities of Eeyou Istchee (65.3%) was slightly higher than that of Québec (64.1%) (Table 8-12). On the other hand, the participation rate of the community of Waswanipi (63.0%) was lower than that of the province. This rate was also higher for men (65.3%) than for women (61.1%) (Statistics Canada, 2017a).

Also in 2016, as in the case of the Nord-du-Québec trend, the unemployment rates in the Cree communities (16.0%) and Waswanipi (19.6%) were more than twice as high as the provincial rate (7.2%). In Waswanipi, the unemployment rate for men (25.3%) was twice as high as for women (11.6%) (Statistics Canada, 2017a). The employment rates in the Cree communities (54.9%) and Waswanipi (50.6%) were both lower than that of Quebec (59,5%).

Table 8-12 Main labour market indicators, Cree communities of Eeyou Istchee, 2016 and 2021

Territory	Participation rate[c] (%)		Unemployment rate[d] (%)		Employment rate[e] (%)	
	2016	2021	2016	2021	2016	2021
Waswanipi[a]	63.0	N.A.[f]	19.6	N.A.	50.6	N.A.
Cree communities of Eeyou Istchee[b]	65.3	N.A.	16.0	N.A.	54.9	N.A.
Nord-du-Québec	68.1	63.1	13.0	7.3	59.3	58.5
Quebec	64.1	64.1	7.2	7.6	59.5	59.3

a The revised workforce participation data of the 2021 population census are unavailable for Waswanipi. The data published by Statistics Canada are not presented in this table, given that it is not revised to reflect the total population and is therefore not representative.
b The data for the Cree communities of Eeyou Istchee were calculated based on the data of the nine Cree villages: Chisasibi, Eastmain, Waskaganish, Wemindji, Whapmagoostui, Mistissini, Nemaska, Oujé-Bougoumou, and Waswanipi. The compilation of the data is not presented for 2021, given that the data available for the community of Waswanipi is not representative.
c The participation rate is the proportion of labour force relative to the population 15 years and older.
d The unemployment rate represents the proportion of unemployed people in the labour force.
e The employment rate refers to the number of people employed relative to the population aged 15 and over.
f N.A. : not available
Sources: Statistics Canada 2017a, 2022a.

JAMESIAN MUNICIPALITIES

In 2021, the participation rate of the Jamesian municipalities was 66.8%, a higher rate than that of Quebec (64.1%) (Table 8-13). In Lebel-sur-Quévillon, the participation rate (63.8%) was lower than those of the Jamesian municipalities and the province. For this same municipality, the workforce participation rate for women (57.8%) was at least 10% lower than for men (66.6%) (Statistics Canada, 2022). The employment rate of the Jamesian municipalities (64.2%) and Lebel-sur-Quévillon (61.8%) was higher than that of Quebec (59.3%). Between 2016 and 2021, the workforce participation and employment rates both increased in Lebel-sur-Quévillon (respectively 1.3% and 9.7%).

In 2021, the unemployment rates for the Jamesian municipalities (4.0%) and Lebel-sur-Quévillon (3.6%) were roughly half that of the province (7.6%). This rate was also lower for women (2.1%) than for men (4.0%) in the municipality. It should be noted that the unemployment rate of Lebel-sur-Quévillon and the Jamesian municipalities greatly diminished between 2016 and 2021 (respectively 13.0% and 4.1%).

Table 8-13 Main labour market indicators, Jamesian municipalities, 2016 and 2021

Territory	Participation rate[b] (%)		Unemployment rate[c] (%)		Employment rate[d] (%)	
	2016	2021	2016	2021	2016	2021
Lebel-sur-Quévillon (V)	62.5	63.8	16.6	3.6	52.1	61.8
Chapais (V)	65.6	63.7	7.5	5.6	60.7	60.6
Chibougamau (V)	72.1	69.2	6.9	3.7	67.1	66.7
Jamesian municipalities[a]	69.6	66.8	8.1	4.0	64.0	64.2
Nord-du-Québec	68.1	63.1	13.0	7.3	59.3	58.5
Quebec	64.1	64.1	7.2	7.6	59.5	59.3

a The data for the Jamesian municipalities was calculated based on the municipalities of Lebel-sur-Quévillon, Chapais, Chibougamau and Matagami.
b The participation rate represents the proportion of the labour force relative to the population aged 15 and over.
c The unemployment rate represents the proportion of unemployed people relative to the labour force.
d The employment rate refers to the number of people employed relative to the population aged 15 and over.
Sources: Statistics Canada 2017a, 2022a

SKILLED WORKFORCE

In 2019, the Nord-du-Québec region had 7,595 jobs in the mining industry (Comité sectoriel de main-d'œuvre de l'industrie des mines. CSMO Mines, 2020). Over half of these jobs (52.3%) were dedicated to mining operations.

According to the CSMO Mines (2020) estimate of workforce needs for 2019-2023, 46.6% of the positions to be filled in the mining industry are located in Nord-du-Québec. It is also estimated that 64.4% of the positions to be filled usually required a Diploma of Vocational Studies. For the 2019-2023 period, the greatest needs for Nord-du-Québec are for workers who have vocational training, with about 340 positions to be filled for skilled heavy machinery operators, 226 positions for long hole drillers, conventional miners, and truck and scooptram drivers, 205 positions for heavy machinery mechanics, 144 positions for diamond drillers, and 100 positions for diamond driller's helpers. Apart from the positions requiring vocational training, the greatest needs in the region are for university-educated geologists (100 positions) followed by daily workers (91 positions) and labourers (87 positions), which do not require specific training. At the college level, the workforce needs are greater for geological technicians (60 positions) (CSMO Mines, 2020).

Moreover, for the 15 types of jobs most practised in the mining sector, a study conducted for the Ministère de l'Éducation et de l'Enseignement supérieur (MEES) had estimated that the following seven (7) types of jobs would have a workforce shortage in Nord-du-Québec in 2021: mine and quarrying supervisor, geological and mineralogy technician, mining engineer, millwright and industrial mechanic, transport truck driver, heavy equipment mechanic, and welder (Groupe DDM, 2018). The other most practised occupations were judged to be in equilibrium, that is, with supply meeting demand.

By 2025, the Ministère du Travail, de l'Emploi et de la Solidarité sociale (MTESS, 2022) estimates that there will be a workforce shortage in Nord-du-Québec for geology and mineral processing technicians, heavy equipment mechanics, and heavy equipment operators. The occupations of metal processing labourers, machine operators in mineral and metal processing, underground production and development miners, and mining and quarrying supervisors, will be in equilibrium.

More specifically in Jamésie, according to the Enquête sur les besoins de main-d'œuvre et de formation auprès des entreprises de la Jamésie (Survey of workforce and training needs of Jamésie companies) (BIP Recherche, 2021), about 47% of the jobs are low-skilled or unskilled and thus do not require any diploma or only a high school diploma. One of the challenges perceived by companies, however, is the recruitment of a qualified workforce.

CSMO Mines (2020) considers that the use of workers currently under-represented in the industry, particularly First Nations workers, could make it possible to meet some of the labour needs in the mining sector.

As mentioned in the previous sections, the proportion of people who have a Diploma of Vocational Studies was higher for the Cree community of Waswanipi in 2016, compared to that of Quebec (respectively 21.3% and 16.9%). Approximately 250 members of the Waswanipi community had a vocational diploma at the time, and the skilled workforce, i.e., the population with vocational, college, or university training, consisted of 515 individuals. In 2016, the skilled labour pool for all Cree communities totalled 4,375 individuals (Statistics Canada, 2017). It should also be noted that the unemployment rate was higher for the community of Waswanipi (19.6%) than for Quebec (7.2%) in 2016.

In 2021, the proportion of the population of the municipality of Lebel-sur-Quévillon and of all the Jamesian municipalities with vocational training was also higher than that of the province (respectively 29.3%, 24% and 15.8%). There were 510 people in Lebel-sur-Quévillon and 2,515 people in the Jamesian municipalities who had vocational training. The skilled labour pool in the Jamesian municipalities consisted of 5,595 people in 2021 (Statistics Canada, 2022). The unemployment rate of the Jamesian municipalities (4%) was lower than that of the province (7.6%).

Osisko estimates that about half of the workforce required for the Windfall project will be unskilled and will come from the region and the neighbouring regions. The details of the jobs forecast are presented in Section 3.10 of Chapter 3.

ECONOMY AND ECONOMIC STRUCTURE

REGIONAL ECONOMY

In 2019, the gross domestic product (GDP) of the Nord-du-Québec region was $5 B, representing 1.2% of the GDP of Quebec as a whole ($426.3 B). Relative to the 2016 GDP ($3.9 B), the regional GDP showed a growth of 27.2%, exceeding the growth reported for Quebec as a whole (15.7%) for the same period (ISQ, 2021b). According to the Desjardins economic forecasts (2022), a slowing of nominal GDP growth is anticipated in 2023 for Nord-du-Québec, as in the rest of the province.

The Nord-du-Québec economy is strongly influenced by the mineral resource extraction sector, which accounted for 42.9% of this region's GDP in 2019 (ISQ, 2021c). In that same year, Nord-du-Québec was the region with the greatest share (44.5%) of Quebec's total mining investment (ISQ, 2021d). In 2019, Nord-du-Québec had 4,048 jobs (person-years) associated with the mining sector, 21.4% of the province's mining jobs. The region thus had the greatest proportion of mining jobs among all the administrative regions of Quebec (ISQ, 2021d).

ECONOMIC STRUCTURE

CREE COMMUNITIES OF EEYOU ISTCHEE

In 2016,[4] the economic activities of the Cree communities of Eeyou Istchee were mainly related to the tertiary sector, where 83.0% of the experienced labour force[5] held jobs (Statistics Canada, 2017a). The Cree communities therefore held a greater proportion of jobs in this sector than the Nord-du-Québec region (79%) and Quebec (79.6%). As in the case of the region, the economy of the Cree communities was also based on the primary sector because the proportion of employment (6.9%) in that sector was three times greater than in Quebec (2.5%).

The economic structure in Waswanipi was also mostly related to the tertiary and primary sectors in 2016. Although the vast majority of the jobs belong to the tertiary sector (83.9%), the gap between Waswanipi and the province was accentuated for the proportion of jobs in the primary sector (10.2% and 2.5%, respectively). However, Waswanipi showed a higher proportion of jobs in the forest industry since 85.7% of jobs belonged to the agriculture, forestry, fishing and hunting category, while only 14.3% of the primary sector jobs were in the mining, quarrying and oil and gas extraction category. Thus, 1.5% of all Waswanipi jobs were in the mining, quarrying and oil and gas extraction category, compared to 0.5% of the jobs in Quebec as a whole (Statistics Canada, 2017a).

4 The revised industrial sector data of the 2021 population census is unavailable for Waswanipi. The data published by Statistics Canada is not presented given that it is not revised to reflect the total population and is therefore not representative. For the same reason, the compilation of data for the Cree communities of Eeyou Istchee is not presented for 2021.

5 According to Statistics Canada (2017a), the experienced labour force refers to individuals aged 15 years and over who were employed during the week preceding the census, as well as the unemployed who had last worked in either 2015 or 2016.

Several businesses are listed in Waswanipi, notably in the service, construction, excavation, concreting and crushing, food, tourism, transportation, forestry, janitorial, and housekeeping sectors (Cree First Nation of Waswanipi, n.d.). Among them, in particular, are the following companies:

- Kevin Blacksmith Transport
- MJS Transport
- G4 Drilling (joint venture)
- Major-Cooper Apiitsiiwin
- Construction Cooper/Gilbert (joint venture)
- Janitorial Cleaning Laundry Services (J.C.L.S.)
- Waswanipi Sibi Construction
- Eenou Eyou Construction
- Waswanipi Eenouch Construction
- Eeyou Eenou Cabinets/Katapatuk Renos
- Chiisek Willie Company
- Eenou Welding/SM’s Tire and Welding Reg’d
- Terry’s Plastering and Painting
- Amisk Excavation
- Miyuukaa-Fournier et fils (joint venture)
- Miyuukaa-Orbit-Garant (joint venture)
- Miyuukaa-CMAC-Thyssen (joint venture)
- Miyuukaa-Gestion ADC (joint venture)
- Miyuukaa-Harnois (joint venture)
- Washwanu-Desfor (joint venture)

Waswanipi also has the Waswanipi Development Corporation, which governs the two corporations, Miyuukaa Corporation and Mishtuk Corporation.

JAMESIAN MUNICIPALITIES

The economic structure of the Jamesian municipalities is largely dependent on the energy, mining, and forestry sectors. In 2021, the share of employment in the primary sector was even greater for the Jamesian municipalities (10.6%) than for Nord-du-Québec (7.1%) (Statistics Canada, 2022). On the other hand, 8.4% of all jobs in the Jamesian municipalities were in the mining, quarrying and oil and gas extraction category. Although most jobs in Jamésie were in the tertiary sector (66.1%), the proportion was lower than that of Quebec (79.7%).

In 2021, the municipality of Lebel-sur-Quévillon had a proportion of jobs in the primary sector (10.0%) similar to that of the Jamesian municipalities (10.6%) (Statistics Canada, 2022). Most of the jobs in the primary sector in Lebel-sur-Quévillon were in the mining, quarrying, and oil and gas extraction category (63.6%). This category thus included 6.3% of the total employment of the municipality, compared to 2.4% of jobs in the province. Compared to Quebec as a whole, Lebel-sur-Quévillon showed a much lower proportion of employment in the tertiary sector (respectively 79.7% and 64.3%).

Lebel-sur-Quévillon is a one-industry town founded in the 1960s following the establishment of a pulp mill operated by Domtar (Centre régional de santé et des services sociaux de la Baie-James, 2002). The closure of this mill in 2008 had triggered a major economic slowdown and the departure of nearly 1,000 residents. Over the past few years, however, the situation has improved with the development of new mining projects and the revival of the pulp mill by Chantiers Chibougamau (Deshaies, 2018). The pulp produced by the Nordic Kraft pulp mill is used, in particular, to manufacture toilet paper and recyclable and compostable food packaging. According to Chantiers Chibougamau:

> "The operation of this mill, revived in 2020 after more than 15 years of inactivity, plays a key role in adding value to sawmill by-products—wood chips and bark—for stabilization of the entire Quebec timber sector." (Chantiers Chibougamau, 2022 - TRANSLATION).

About 160 businesses are identified in Lebel-sur-Quévillon, particularly in the food sector, health and social services, various services and businesses, passenger transportation, materials and minerals, excavation, concreting, construction,forestry, mining, telecommunications, industrial equipment manufacturing and repair and mechanical sectors, etc. (Lebel-sur-Quévillon, n. d.). Several companies therefore operate in sectors related to the mining industry and construction. Among them, in particular, are the following companies:

- Béton Fortin Inc.
- Blais et Langlois Inc.
- De Champlain Isolation
- Excavation Éric Bisson & Fille
- Excavation et débroussaillage S. Rioux
- Hydrau-Mécanic
- Mécanique générale GMS Inc.
- MP Renaud-Vation inc.
- Nivelage forestiers L. b. Inc.
- Entreprises Forestières Amtech/Groupe Desfor
- ALS Minéral
- Transport F.M.F. Inc.
- Transport JSV
- Énergie Électrique du Nord Inc.
- Bélanger Électrique

The complete list of Lebel-sur-Quévillon businesses is available on the municipality's website: https://www.lsq.quebec/fr/loisirs-et-culture/repertoire-economique.html.

ECONOMIC VITALITY INDEX[6] OF THE TERRITORIES

The localities with the highest vitality indices are mostly located in the major centres, in the vicinity of Québec City, Montréal, and Gatineau. However, the Nord-du-Québec localities are well positioned compared to the other remote regions. In 2018, 75% of the region's localities were situated in the first and second quintiles. No locality in Nord-du-Québec was situated in the fifth quintile (ISQ, 2021e).

The economic vitality index is very high in several Cree and Inuit communities, particularly due to their population's significant growth. In 2018, Waswanipi had a relatively low economic vitality index (-0.72), compared to that of the communities of Eeyou Istchee (5.04), and was situated in the third quintile. However, its index had improved compared to 2016 (-1.24) (ISQ, 2021e).

In 2018, Lebel-sur-Quévillon ranked in the second quintile for the territories, with an economic vitality index of 3.23, a decrease of one quintile compared to 2016. Chapais was also situated in the second quintile in 2018, with a slightly higher index (5.71), while Chibougamau ranked in the first quintile (7.85). Jamésie maintained its position in the second quintile (ISQ, 2021e).

DEVELOPMENT PROJECTS

Several mining companies are developing exploration and mining projects in the territory of Eeyou Istchee James Bay. In particular, Bonterra Resources plans to restart the Barry open-pit gold mine, just over 10 km southwest of the Windfall project. In the same area, the company is also developing the Gladiator project, a gold mining project about 8 km south-southeast of the Windfall site. The ore extracted from these two projects will be sent to the process plant of the Bachelor site, 3.5 km east of Desmaraisville. The project to increase the processing rate of the Bachelor complex is currently in the environmental assessment process (Bonterra Resources, 2022).

It should also be noted that Osisko holds 100% of two other gold projects currently in the exploration stage, the Quévillon project and the Urban Barry project. The Quévillon project is composed of 2,815 individual claims covering an area of 150,163 hectares. It can be subdivided into two blocks of claims; the central block surrounds the municipality of Lebel-sur-Quévillon and contains the Osborne-Bell deposit; the northeast block is separated into three sectors and extends from the village of Miquelon to the community of Waswanipi. The Quévillon project is located on the boundary between the territory of Eeyou Istchee James Bay and the Abitibi-Témiscamingue administrative region. The Urban Barry project is located 100 km east of the municipality of Lebel-sur-Quévillon. The Urban-Barry property is composed of 1,916 map-designated claims covering an area of about 1,000 km².

6 The economic vitality index allows measuring, at a regular frequency, of the economic vitality of the territories, based on variants that each represent a dimension of vitality, namely the labour market (rate of workers), the standard of living (total median income of individuals) and the demographic dynamics (mean annual growth rate of the population over five years). A locality with a negative index may signify a lag in economic vitality compared to most Quebec localities of 40 or more inhabitants. The first quintile includes the localities with greater economic vitality, while the fifth quintile includes those with the lowest indices (ISQ, 2021e).

Some mining projects are also in development in the Chibougamau sector. Doré Copper Mining has three copper and gold mining projects: the Corner Bay project 55 km south of Chibougamau, the Joe Mann project 60 km south of Chibougamau, and the Devlin project 18 km south of Chibougamau. The Corner Bay and Devlin projects are beginning the feasibility study process, while the Joe Mann project is in advanced exploration (Doré Copper Mining, 2022). Also in the vicinity of Chibougamau, two iron-vanadium mining projects are in development, the BlackRock project of BlackRock Metals and the Mont Sorcier project of Voyager Metals (MERN, 2022). The BlackRock project, located about 30 km southeast of Chibougamau, has completed the environmental assessment process (COMEX, 2022). The Mont Sorcier project, currently in the planning and design process, is located 18 km east of Chibougamau (Voyager Metals Inc., n.d.). Finally, Yorbeau Resources Inc. is developing the Scott project 20 km west of Chibougamau to mine zinc (Yorbeau Resources Inc., n.d.).

Parallel to the Windfall project, the Miyuukaa Corporation plans to build a 69-kilovolt (kV) power transmission line approximately 85 km long (Kuikahaacheu Transmission Line) between the Hydro-Québec Waswanipi substation, located on Road 113, and a new substation that will be named Windfall. The project also includes the construction of two new transformer substations, one adjacent to the existing Waswanipi facilities and the other near the Windfall project land occupancy lease. The project is currently in the environmental authorization process.

8.3.2 IMPACTS ON THE POPULATION, THE ECONOMY, AND EMPLOYMENT IN THE CONSTRUCTION PHASE AND MITIGATION MEASURES

CREE COMMUNITIES OF EEYOU ISTCHEE AND JAMESIAN MUNICIPALITIES

SOURCES OF POTENTIAL IMPACTS

During the construction phase, the source of potential impact and the resulting impacts (**in bold**) likely to affect the population, the economy, and employment in the Eeyou Istchee James Bay territory are as follows:

— Workforce and procurement

This source has the potential to result in the following impacts during the construction phase:

— **Maintenance and creation of jobs**

— **Economic benefits for local and regional businesses**

— **Increase in the qualifications and employability of the Cree and regional workforce**

MITIGATION MEASURES

Common mitigation measures POP01 and POP02 will be applied to enhance the positive impacts of maintenance and creation of jobs. They are presented in Appendix 5-2, in the Population, economy and employment section. During the construction phase, the following specific mitigation measures will also be implemented:

— In accordance with the existing hiring policy, when their qualifications are equal, favour women as well as local and First Nations people in the hiring process. In order, give priority to people from the Cree First Nation of Waswanipi, people from the other Cree communities of Eeyou Istchee, people from Northern Quebec, people from Abitibi-Témiscamingue, people from Quebec, and people from Canada..

— Continue to ensure the visibility of job opportunities in the local community through participation in various local and regional initiatives (e.g., career days).

— Continue to encourage local purchasing and the involvement of local suppliers of goods and services in supply chain opportunities, applying the existing Responsible Procurement Policy.

— Encourage the development of local businesses aligned with Osisko's needs, particularly First Nations-owned businesses, as set out in the Responsible Procurement Policy.

— Maintain collaboration with local training institutes to develop training programs adapted to the mining industry and the regional context.

— Continue to develop specific and transferable employee skills by supporting professional development activities that are aligned with employees' roles and Osisko's needs, as outlined in the Professional Development Policy.

— Participate in the implementation of a business opportunities, training, and employment committee governed by the upcoming Impact and Benefit Agreement (IBA) with the Cree First Nation of Waswanipi and the Cree Nation Government.

— Continue to hold regular information sessions with local contractors from the Cree community of Waswanipi to inform them of upcoming service needs related to mining operations.

DETAILED DESCRIPTION OF RESIDUAL IMPACTS

MAINTENANCE AND CREATION OF JOBS

The expenses relating to the construction of the mine will contribute to the maintenance and creation of jobs. The work should normally extend over a period of about 18 months. At the height of the construction period, a maximum of 1,100 workers will be required. The construction activities will also allow maintenance of Osisko's current jobs (191 in 2022). It is estimated that the construction phase will allow 2,800 full-time equivalent (FTE) jobs to be supported in the Abitibi-Témiscamingue and Nord-du-Québec regions, including 682 FTE jobs for the Nord-du-Québec region (Aviseo Conseil, 2023; Appendix 1-1).

Osisko has been promoting the hiring of local workforce since 2015, particularly from the community of Waswanipi and other Cree communities, and from the Jamesian municipalities. In 2021, 17% of the Windfall project's employees came from the Cree communities of Eeyou Istchee and 6% came from the Jamesian municipalities (Osisko, 2022).

Osisko will continue to implement several measures to encourage local hiring, including by following its existing Hiring Policy. The shuttles serving Waswanipi, Lebel-sur-Quévillon, Chapais and Chibougamau will continue to facilitate transportation and will continue to be an employment incentive for workers in the region. The continued hiring of a local workforce may continue, in this sense, to generate positive benefits for the labour market in several municipalities and communities of the region. The Osisko Hiring Policy specifies that recruitment of local and regional workers must be favoured. In the case of jobs where specializations are required and where regional workforce availability is more limited, Osisko retains the flexibility to go to the provincial and national level. However, its priority remains the hiring of local and regional resources.

ECONOMIC BENEFITS FOR LOCAL AND REGIONAL BUSINESSES

Construction activities will increase the local demand for goods and services and will generate more significant economic benefits for the region. The services required for several stages of mine construction will create new business opportunities for Cree, local, and regional businesses.

A total of $789 M will be invested for the construction phase of the Windfall project. Aviseo Conseil (2023) conducted an analysis of the economic benefits of the Windfall project. The summary document containing the methodology and the details of certain information is found in Appendix 1-1. The capital expenditures of the construction phase of the Windfall mine site should generate $295 M for the Quebec GDP during the construction phase. The Abitibi-Témiscamingue and Nord-du-Québec regions will be the major beneficiaries as it is estimated that 53% of value added ($305.7 M) will be generated in these regions. These investments will also allow generation of tax revenue, $65.3 million for the Quebec government and $42.6 million for the Canadian government.

The importance of the economic benefits for the region's municipalities was mentioned on several occasions during meetings with the socioeconomic stakeholders of Lebel-sur-Quévillon, Chapais and Chibougamau, and with the local entrepreneurs of Waswanipi. Certain stakeholders also raised concerns regarding the equitable distribution of the project's benefits within the region. For example, the Cree entrepreneurs want the project to generate business opportunities both for the economic development corporations affiliated with the Band Council and for emerging and existing small businesses. Several enhancement measures with the objective of favouring local procurement and contracting to local businesses are already implemented by Osisko under its Responsible Procurement Policy. Osisko will continue to favour the integration of local supplies into its supply chain and encourage the development of local businesses aligned with the project's needs. The mining company will also participate in the implementation of committees on business opportunities, training, and employment governed by the potential Impact and Benefit Agreement (IBA) with the Cree First Nation of Waswanipi and the Cree Nation Government.

Concerns were also raised regarding the possible reduction of the economic benefits for the local municipalities due to the rotating work schedules and shuttling of the workers, which will result in a majority of workers only passing through Lebel-sur-Quévillon. The stakeholders interviewed fear that the benefits for local businesses will be smaller due to this work mode. Discussions are in progress through the Osisko Lebel-sur-Quévillon Cooperation Committee to see what measures could be established to maximize the benefits in this community.

INCREASE IN THE QUALIFICATIONS AND EMPLOYABILITY OF THE CREE AND REGIONAL WORKFORCE

During the construction phase, the local workers hired for the project may take advantage of this experience to acquire or consolidate their professional skills, in addition to benefiting from training offered by Osisko. The new aptitudes acquired through experience and specific training will thus contribute to the increase in worker qualification and employability. The Waswanipi contractors particularly mentioned that they wish to acquire more knowledge related to the mining sector and develop skills complementary to their field of expertise in order to meet the project's needs.

Osisko will implement several measures to further increase the qualifications and employability of the regional workforce. In addition to the measures favouring local hiring and visibility, Osisko will continue to encourage the development of its employees' skills by supporting the training initiatives relevant to the jobs, in accordance with its Professional Development Policy. The mining company already collaborates with the local training institutes to develop training and programs adapted to the mining industry.

RESIDUAL IMPACT ASSESSMENT

CREE COMMUNITIES OF EEYOU ISTCHEE AND JAMESIAN MUNICIPALITIES

The project's residual impacts on the population, economy, and employment for the Cree communities of Eeyou Istchee and the Jamesian municipalities in the construction phase are positive, because the project will provide economic benefits, business opportunities, and local jobs, in addition to increasing the qualifications and employability of the contractors and employees who will go to work on the site.

The socioeconomic value for this component is considered medium. Indeed, it is of great interest in terms of improvement and socioeconomic benefits. However, certain Jamesian stakeholders mentioned that they believed that the benefits for their municipality would be limited, considering the fact that the workers will come from all over the province and that the project will not induce new workers to settle in the municipalities near the project. It should be noted that, for safety reasons, Osisko does not allow employees to travel to or from the site by their own means, due to the remoteness of the site, the duration of the trip, and the duration of the shifts, and because the roads used to get to the site are logging roads.

The spatial scope is regional because the effects will be felt by several municipalities and communities in the territory of Eeyou Istchee James Bay. The duration is short, because the construction period will last less than two years.

Impact on the population, the economy, and employment in the construction phase		
Nature	Positive	Positive impact
Ecosystem value	Not applicable	
Socioeconomic value	Medium	
Degree of disturbance	Not applicable	
Intensity	Not applicable	
Spatial scope	Regional	
Duration	Short	
Probability of occurrence	Not applicable	

8.3.3 IMPACTS ON THE POPULATION, THE ECONOMY, AND EMPLOYMENT IN THE OPERATIONS PHASE, AND MITIGATION MEASURES

CREE COMMUNITIES OF EEYOU ISTCHEE AND JAMESIAN MUNICIPALITIES

SOURCES OF POTENTIAL IMPACTS

During the operations phase, the source of potential impact and the resulting impacts (**in bold**) likely to affect the population, the economy, and employment in the Eeyou Istchee James Bay territory are as follows:

— Workforce and procurement

This source has the potential to result in the following impacts during the operations phase:

— **Maintenance and creation of jobs**

— **Economic benefits for local and regional businesses**

— **Increase in the qualifications and employability of the Cree and regional workforce**

— **Increase income for in workers**

MITIGATION MEASURES

Common mitigation measures POP01 and POP02 will be applied to enhance the positive impacts of maintenance and creation of jobs (Appendix 5-2). During the operations phase, the following specific mitigation measures will also be implemented:

— In accordance with the existing hiring policy, when their qualifications are equal, favour women as well as local and First Nations people in the hiring process. In order, give priority to people from the Cree First Nation of Waswanipi, people from the other Cree communities of Eeyou Istchee, people from Northern Quebec, people from Abitibi-Témiscamingue, people from Quebec, and people from Canada.

— Continue to ensure the visibility of job opportunities in the local community through participation in various local and regional initiatives (e.g., career days).

— Continue to encourage local purchasing and the involvement of local suppliers of goods and services in supply chain opportunities, applying the existing Responsible Procurement Policy.

— Encourage the development of local businesses aligned with Osisko's needs, particularly First Nations-owned businesses, as set out in the Responsible Procurement Policy.

— Maintain collaboration with local training institutes to develop training programs adapted to the mining industry and the regional context.

— Continue to develop specific and transferable employee skills by supporting professional development activities that are aligned with employees' roles and Osisko's needs, as outlined in the Professional Development Policy.

- Participate in the implementation of a business opportunities, training, and employment committee governed by the upcoming Impact and Benefit Agreement (IBA) with the Cree First Nation of Waswanipi and the Cree Nation Government.
- Continue to hold regular information sessions with local contractors from the Cree community of Waswanipi to inform them of upcoming service needs related to mining operations.

DETAILED DESCRIPTION OF RESIDUAL IMPACT

MAINTENANCE AND CREATION OF JOBS

For the operations phase, an average of 635 employees per year will be necessary to ensure the operations on the mine site. The mine's life is estimated at about 10 years. It is forecast that an annual average of 1,017 direct and indirect jobs will result from the 2025-2035 operations period. It is also estimated that an annual average of 70 indirect jobs will be supported in Nord-du-Québec by the expenditures serving to operate the mine. Over the entire period, the expenditures of the mining operations alone will allow a total of 12,203 jobs to be supported on the Quebec scale, including 7,621 in the Abitibi-Témiscamingue and Nord-du-Québec regions and 4,582 in the rest of Quebec. The enhancement measures favouring local hiring will continue to apply, which should have a positive effect on the labour market of the municipalities and communities of Eeyou Istchee James Bay.

Considering the high participation rate (66.8%) and employment rate (64.2%), as well as the low unemployment rate (4.0%) in the Jamesian municipalities, job creation could also have a negative effect on workforce availability at the regional level.

Concerning the Cree communities of Eeyou Istchee, because the participation rate (60.7%) and the employment rate (56%) are lower than those of the Nord-du-Québec region, job creation should not generate pressure on workforce availability.

During meetings with Cree and non-Cree socioeconomic stakeholders, concerns were raised regarding competition that will be created for jobs, particularly for small and medium enterprises that cannot compete with the conditions offered by the mining company. The project's beneficial effects on job creation in the region will thus be somewhat mitigated by this secondary effect.

During the operations period, regular updates will also be provided on the mine's life.

ECONOMIC BENEFITS FOR LOCAL AND REGIONAL BUSINESSES

During the operations period, the expenditures and economic benefits will be generated by the increase in demand for local goods and services. Considering the mine's life, the operations activities could generate interesting business opportunities for existing businesses, but also for new businesses, particularly for maintenance and repair services or for equipment leasing. It is estimated that the mine's operations will contribute $1,783 M to the Quebec GDP, including $1,083 M in the form of wages and benefits. Of this amount, $1,155 M will be generated directly in the Abitibi-Témiscamingue and Nord-du-Québec regions, namely 65% of value creation.

The expenditures related to operations activities should total $2,134 M for mining operations and $588 M for site maintenance capital, totalling $2,722 M over 10 years. The Abitibi-Témiscamingue and Nord-du-Québec regions will be able to count on an average economic contribution of $96.2 M per year. Of this amount, the Nord-du-Québec region will be able to count on an economic contribution of $85.4 M, including 92% from direct effects. The indirect effects will mainly benefit the Abitibi-Témiscamingue region, which has a large number of suppliers.

The enhancement measures implemented during the construction period will continue to favour contracting to local businesses, maximizing the regional benefits. This should have a positive impact on regional Cree and non-Cree businesses.

During operations, the operating expenditures will contribute to tax benefits of $711.5 M to the Quebec government. The Government of Canada will be able to collect gross tax revenues of $332.8 M. Apart from the tax revenues for the Governments of Quebec and Canada, Osisko will disburse $68.7 M in property and school taxes, for an average annual amount of $5.9 M (Aviseo Conseil, 2023).

INCREASE IN THE QUALIFICATIONS AND EMPLOYABILITY OF THE CREE AND REGIONAL WORKFORCE

As in the construction phase, the local workers hired during the operations period of the mine will be able to improve their work skills and professional qualifications due to the experience acquired and the continuing education offered in the workplace. This will help increase the employability of the local workforce.

The job prospects at the mine, combined with those of other mining projects under development in the region, could also be a source of motivation for some young people to pursue studies or acquire training related to the mining sector.

Osisko will continue to apply measures favouring local hiring and visibility of jobs in the local communities, and the development of its employees' skills. It should be noted that Osisko is already undertaking specific efforts for the training of First Nations workers. Specifically, Osisko has established an on-the-job training program on mining essentials, L'Essentiel des Mines, which teaches essential and job readiness (non-technical) skills that the mining industry considers necessary for industry jobs. The first cohort of the program was carried out from June to August 2022 and included eight individuals from Waswanipi. Among these individuals, Osisko proceeded to hire one graduate through the Minopro Cree agency, who holds a position with the Environment Department. In addition to supporting the development of specific skills, Osisko will also encourage the acquisition of transferable skills (e.g., leadership, time management, communication, etc.). The mining company already collaborates with the local training institutes to develop training and programs adapted to the mining industry. Certain initiatives are already in place, particularly with the CFPBJ for the Diploma of Vocational Studies (DVS), in Ore Extraction. The program's practical training is offered at the Windfall site, among others. At Osisko's request, the CFPBJ is also evaluating the possibility of opening a cohort specifically for the Crees and a female cohort in this same DVS.

INCREASE INCOME FOR WORKERS

The workers who will obtain a job at the mine are likely to see their income increase. The increase in income may have positive effects on the living conditions of employees and their families. Direct jobs will have an average salary approaching $110,000 and indirect jobs, $72,000. In comparison, in 2021, the average salary was $62,772 for Jamesian workers aged 25 to 64, $49,318 for Cree workers of Eeyou Istchee, and $61,000 for Abitibi-Témiscamingue workers. Thus, the jobs supported by the Windfall mining project resulting from the expenditures of the mining operations will benefit from average salaries up to 125% higher than those of these two regions.

The increase in income of local employees could also generate benefits for stores and businesses in the region. The increase in salaries generally contributes to the increase in workers' spending. It is estimated that spending on consumption of goods and services by workers related to the Windfall mining project will support 1,205 FTE jobs in Quebec, including 397 in the Abitibi-Témiscamingue and Nord-du-Québec regions. Because the induced jobs are supported by the workers' demand for goods and services, these jobs will be located mainly in nearby businesses and services.

In addition to supporting induced jobs, the activities at Windfall will generate an induced value added of nearly $121 million for Quebec, including over $33 million in the Abitibi-Témiscamingue and Nord-du-Québec regions. However, as in the construction phase, these benefits could instead be dispersed throughout the province due to the shuttle-based work mode. It should be noted that preliminary estimates indicate that approximately half of the employees coming to the site will use fly-in/fly-out (FIFO) because they will be located outside the region, while the other half will be shuttled by bus because they will come from within the region or neighbouring regions. The local hiring measures will contribute to ensure benefits in the region.

On the other hand, the increase in wages could fuel the phenomenon of competition among the region's businesses for the attraction and retention of labour. The attraction of good working conditions could lead to a displacement of the workforce. Some small and medium enterprises will thus experience more difficulties attracting and recruiting employees because they cannot offer conditions of employment similar to those of the project.

The increase in wages nonetheless should generate more positive than negative effects.

RESIDUAL IMPACT ASSESSMENT

CREE COMMUNITIES OF EEYOU ISTCHEE AND JAMESIAN MUNICIPALITIES

The project's residual impacts on the population, the economy, and employment for the Cree communities and the Jamesian municipalities in the operations phase are positive, because the project will continue to generate economic benefits, business opportunities, and local jobs, in addition to increasing the qualifications, employability, and income of the contractors and employees who will go to work on the site.

The socioeconomic value for this component is medium. The spatial scope is regional as the workers will come from several Cree communities and municipalities in the region and the benefits will also affect businesses in various communities and municipalities. The duration is medium given that the effects will be produced during the operations period of the Windfall project.

Impact on the population, the economy, and employment in the operations phase		
Nature	Positive	Positive impact
Ecosystem value	Not applicable	
Socioeconomic value	Medium	
Degree of disturbance	Not applicable	
Intensity	Not applicable	
Spatial scope	Regional	
Duration	Medium	
Probability of occurrence	Not applicable	

8.3.4 *IMPACTS ON THE POPULATION, THE ECONOMY, AND EMPLOYMENT IN THE CLOSURE PHASE, AND MITIGATION MEASURES*

CREE COMMUNITIES OF EEYOU ISTCHEE AND JAMESIAN MUNICIPALITIES

SOURCES OF POTENTIAL IMPACTS

During the closure phase, the source of potential impact and the resulting impacts (**in bold)** likely to affect the population, the economy, and employment in the Eeyou Istchee James Bay territory are as follows:

— Workforce and procurement

This source has the potential to result in the following impacts during the closure phase:

— **Reduction of employment and income**

— **Economic benefits for local and regional businesses**

MITIGATION MEASURES

During the closure phase, common mitigation measures POP02 and POP03 will be applied to mitigate the impacts in relation to the losses of employment and income (Appendix 5-2). The following specific mitigation measures will also be implemented:

— Prioritize the reassignment of local employees to mine closure activities.

— In accordance with the existing hiring policy, when their qualifications are equal, favour women as well as local and First Nations people in the hiring process. In order, give priority to people from the Cree First Nation of Waswanipi, people from the other Cree communities of Eeyou Istchee, people from Northern Quebec, people from Abitibi-Témiscamingue, people from Quebec, and people from Canada.

— Continue to encourage local purchasing and the involvement of local suppliers of goods and services in supply chain opportunities, applying the existing Responsible Procurement Policy.

— Continue to hold regular information sessions with local contractors from the Cree community of Waswanipi to inform them of upcoming service needs related to mining operations.

DETAILED DESCRIPTION OF RESIDUAL IMPACT

REDUCTION OF EMPLOYMENT AND INCOME

At the beginning of the closure phase, namely during the post-operations phase, jobs will still be required for the closure, rehabilitation, and restoration of the site. The restoration work is estimated at $3.3 M in the Osisko feasibility study (BBA Inc. *et al*., 2023). The dismantling of the infrastructure and most of the restoration work will be done over a period of less than two years. However, the water treatment plant (WTP) will be conserved and water treatment will continue as long as pumping of the mine water and restoration work on the waste rock stockpile have not been completed. Subsequently, only environmental follow-up will continue in the post-restoration period for at least 10 years (minimum of eight samplings per year). The workforce needs will thus diminish gradually from the end of operations to the post-restoration period, which may have a negative effect on the regional labour market. The job losses for local workers will also result in a loss of income.

The significance of the effect of these job losses will largely depend on the state of the labour market and the economic situation of the region at that time. This situation particularly depends on the phenomenon of the boom and bust economy. The mining industry, like many primary sector activities, is a cyclical industry due to the variation in prices of basic products, such as gold, which is induced by the global fluctuation of supply and demand (Mining Industry Human Resources Council, 2019). Thus, the more the price of basic materials increases, the more mining activity intensifies, and the more the region benefits from the economic impacts and job creation. Conversely, the reduction of the price of ore may lead to the closure of mines or the stoppage of development of mining projects, and thus lead to a decline of employment and economic benefits.

The economic activities of the Nord-du-Québec region are more largely based on the primary sector compared to the rest of the province. The boom and bust cycles of the mining industry may have more notable effects, in this sense, on the economy and labour market of the territory of Eeyou Istchee James Bay. However, it is difficult to predict what the cycle and the economic context will be at that end of the Windfall project's activities.

To prepare the employees and their families for a transition, Osisko will inform the local communities in advance of the projected date of the mine closure.

To mitigate the effects of job losses, Osisko will institute a mechanism allowing repositioning of the workforce and support measures for the employees during the transition to the mine closure. In addition, while employees will have acquired skills and knowledge specific to the mining industry, Osisko will also have fostered the acquisition of transferable skills that can be used in other sectors. Reassignment to another job after mine closure should thus be facilitated. Whenever possible, the mining company will prefer reassignment of local employees to closure activities and will continue to favour local hiring as needed.

Although negative effects will be felt for the workers and the labour market in the region, these effects will be mitigated due to the dispersion of jobs in the region and the province.

ECONOMIC BENEFITS FOR LOCAL AND REGIONAL BUSINESSES

In the closure phase, more specifically during the post-operations period, the infrastructure dismantling, rehabilitation, and restoration activities will require hiring subcontractors for a period of less than two years. However, the activities in the post-restoration period will diminish compared to the operations phase because only environmental follow-ups will be required, which will result in a reduction of the demand for goods and services. This decrease in demand will affect the businesses that worked there. Osisko will favour contracting to local businesses.

The expenditures for training activities (included in the construction expenditures) total $83.3 M. They will thus be lower than for the construction and operations phases, but still considerable.

To mitigate the effects of the decrease in contracts and the reduction of economic benefits for Cree and non-Cree regional businesses, Osisko will keep the local actors informed of the projected date of the mine closure.

RESIDUAL IMPACT ASSESSMENT

CREE COMMUNITIES OF EEYOU ISTCHEE AND JAMESIAN MUNICIPALITIES

The residual impacts of the project on the population, the economy and employment for the Cree communities and the Jamesian municipalities in the closure phase are positive in part, because the infrastructure dismantling, rehabilitation and restoration activities will generate positive effects on the population, the economy and employment during the post-operations phase, which will last less than two years.

In the post-restoration phase, only environmental follow-ups will be required. During this phase, the impacts will instead be negative given the job losses and the reduction of economic benefits. The socioeconomic value for this component is medium. The degree of disturbance is low for the reduction of employment and income given the proportion of workers coming from the Cree communities and the Jamesian municipalities. However, the application of the mitigation measures mitigates the assessment. The intensity thus is low for this impact. The spatial scope of the impact is regional because several communities and municipalities in the region may be affected. The duration of the impact is short. The probability of occurrence is medium because the effect will greatly depend on the economic situation and the job market at the time of closure. The significance of the negative impact thus is low for the reduction of employment and income.

<table>
<tr><th colspan="3">Impact on the population, the economy and employment in the closure phase</th></tr>
<tr><td>Nature</td><td>Positive/Negative</td><td rowspan="8">Significance:
Economic benefits - Positive impact
Reduction of employment - Low (-)</td></tr>
<tr><td>Ecosystem value</td><td>Not applicable</td></tr>
<tr><td>Socioeconomic value</td><td>Medium</td></tr>
<tr><td>Degree of disturbance</td><td>Low (reduction of employment)</td></tr>
<tr><td>Intensity</td><td>Low (reduction of employment)</td></tr>
<tr><td>Spatial scope</td><td>Regional</td></tr>
<tr><td>Duration</td><td>Short</td></tr>
<tr><td>Probability of occurrence</td><td>Medium (reduction of employment)</td></tr>
</table>

8.4 QUALITY OF LIFE AND WELL-BEING

Highlights on the quality of life and well-being

Existing conditions

Cree communities of Eeyou Istchee

- Over the past few decades, First Nations have shifted from a diet based on natural resources to a mixed diet or one based more on commercial products. These dietary changes affect the health status of First Nations populations by contributing to the emergence of chronic diseases such as obesity, diabetes, and cardiovascular disease.
- In 2015, the smoking rate in the territory of Eeyou Istchee was twice as high as in Quebec. While the Cree population consumed alcohol less regularly than Quebecers (29% compared to 55%), the proportion of Crees with excessive consumption was three times higher than that of Quebecers.
- The Cree of Eeyou Istchee have a much stronger sense of belonging to their community than elsewhere in Quebec.
- The culture and identity of the Cree of Eeyou Istchee have been affected by the development of major projects in the territory over the past 50 years. Increased efforts to raise awareness must be made to prevent the erosion of culture among youth and to ensure the preservation of language, knowledge, traditions, and skills of elders.
- The harvesting, preparation, and consumption of traditional foods are also central to the Cree identity. However, many difficulties in accessing the land contribute to a decrease in this supply.
- The Cree Board of Health and Social Services of James Bay is the organization responsible for the management of health and social services for the nine (9) Cree communities of Eeyou Istchee. A Community Miyupimaatisiiun Centre (CMC) offering a variety of services in general medicine, home care, dentistry, social services, and paramedical services is present in each community, including Waswanipi.

Jamesian municipalities

- In 2014-2015, the proportion of Jamesians considered as regular or casual smokers was higher than that of Quebecers in general (23.9% and 19.5%, respectively). However, the proportion of individuals with abusive alcohol consumption in Jamésie (17.3%) was lower than that of the province (20.2%).
- As in the Cree communities, the sense of belonging to the community is also significantly stronger among Jamesians than among Quebecers.
- The Centre régional de santé et de services sociaux de la Baie-James, the health and social services centre for the region, serves all James Bay municipalities. Health and social services in Lebel-sur-Quévillon are provided by the Centre de santé Lebel, which offers a wide range of services, such as physiotherapy, social and psychological intervention, family planning, substance abuse intervention, etc.

Potential impacts of the project

Cree communities of Eeyou Istchee and Jamesian municipalities

Considering the project's location, some Cree land users (mainly the tallymen of traplines W25B and W25A and their families) and a few Jamesians will see their quality of life and well-being altered.

The main negative impacts for the construction phase are alteration of the quality of life and well-being of vacationers and land users, the concerns relating to the health risks for these actors, the decreased sense of safety for users of the access road, the risk of tension between the First Nations and non-First Nations workers, and the sense of loss and undermining of Cree cultural identity. In addition to these effects, another negative effect is likely to be added in the operations phase due to the prolonged absences of the workers, i.e., alteration of the workers' psychological well-being and the difficulties in maintaining work-family balance.

The main concerns raised by the vacationers and land users encountered concern the potential loss of tranquility, the deterioration of air quality, and the potential contamination of water and fish. Osisko will implement several mitigation measures to limit the noise nuisances, vibrations, dust, and night brightness. Considering that a very limited number of vacationers, land users, and workers will be able to feel the impacts and considering the mitigation measures implemented by Osisko (communications, Cree cultural awareness, and road safety mechanisms), the significance of the impacts for the Jamesians will be very low for all phases of the project. However, it is considered very low to low for the Cree land users in the operations and closure phases.

8.4.1 CURRENT CONDITIONS

DEFINITIONS OF QUALITY OF LIFE, HEALTH, AND WELL-BEING

Over the past few decades, several indices and initiatives, including a variety of indicators, were developed to measure the quality of life and well-being of populations. For example, the Better Life Initiative of the Organization of Economic Cooperation and Development (OECD) uses 11 indicators to measure current well-being: health, knowledge and skills, environmental quality, subjective well-being, personal safety, work-life balance, social connections, civic engagement, income and wealth, housing, work, and quality of employment (OECD, 2020). Statistics Canada has defined 20 key indicators, divided into the following six areas: life satisfaction and sense of meaning and purpose, prosperity, health, society, environment, and good governance (Statistics Canada, 2022c).

Several definitions and indicators are also used for health. According to the World Health Organization (WHO), health is defined as "a state of complete physical, mental, and social well-being, and not merely the absence of disease or infirmity" (WHO, 2022). This vision of health associates the concept of well-being with the balance between individuals and their environment. The interaction of individuals with their environment, made up of a set of dimensions, would thus contribute to their health. These dimensions, also called "determinants of health," include the community, the neighbourhood, the family and school environment, the physical environment, lifestyle, and health services (INSPQ, 2014).

For the Crees, the vision of this "complete state of well-being,",called *miyupimaatisiiun,* goes beyond the determinants of health. *Miyupimaatisiiun*, which presents a holistic vision of health, is said to result from the balance between social, economic, and environmental factors. The vision of health in Cree communities is therefore based on maintenance of interpersonal relationships and social cohesion, and on the relationship with nature, which particularly includes traditional food and the practice of traditional activities (INSPQ, 2014).

Regarding these multiple approaches on quality of life and well-being, the following sections present certain components that may be potentially influenced by the project. It should be noted that several quality of life indicators have already been addressed in Chapters 6, 7, and 8 (Physical Environment, Environmental Quality, Knowledge and Skills, Income, Work, etc.).

LIFESTYLE

CREE COMMUNITIES OF EEYOU ISTCHEE

Traditional food largely contributes to the maintenance of a healthy lifestyle in the Cree communities. In addition to having high nutritional values (nutrients, essential fatty acids), traditional food involves the practice of a physical activity to harvest resources.

Over the past few decades, diet has changed greatly in the First Nations communities of Quebec. According to the INSPQ (2015), the First Nations and Inuit of Quebec have shifted from a diet based on natural resources to a mixed diet or one based more on commercial products. In 2013, a decrease in traditional food consumption was already observed among youth in the Cree communities of Eeyou Istchee. According to Bobet (2013), the majority of Crees aged 40 and over (57%) had consumed traditional foods in the previous 24 hours, while only 28% of adults aged 18 to 39 years and 16% of Crees aged under 18 had consumed such foods. These dietary changes affect the health status of First Nations populations by contributing to the emergence of chronic diseases such as obesity, diabetes, and cardiovascular disease (INSPQ, 2015).

Lifestyle habits that can affect health include smoking and alcohol consumption. In 2015, the smoking rate in the territory of Eeyou Istchee was 43%, a rate about twice as high as in Quebec. On the other hand, regular alcohol consumption was lower for the inhabitants of Eeyou Istchee (29%) than for those of the province (55%). Although fewer people in Eeyou Istchee reported regular consumption, excessive consumption was three times higher than for the province (57% and 19% respectively) (CBHSSJB, 2020).

JAMESIAN MUNICIPALITIES

The latest Quebec population health survey was conducted in 2014-2015. This survey included a lifestyle profile in each health region. It should be noted that the Nunavik health region was excluded, as well as people residing on Indian reserves (ISQ, 2016).

According to this survey, 41.6% of the population aged 15 and over in the Nord-du-Québec health region had been sedentary during the four weeks preceding the survey. Regarding tobacco use, 17.8% of the Jamesians aged 15 and over were considered regular smokers, while 6.1% were considered casual smokers. The combined proportion of regular and casual smokers in January (23.9%) was slightly higher than that of Quebec (19.5%) (ISQ, 2016). On the other hand, in 2014, the proportion of Jamesians aged 12 and over who reported abusive alcohol consumption (17.3%) was lower than that of Quebec (20.2%) (Statistics Canada, 2017b).

SENSE OF BELONGING TO THE LOCAL COMMUNITY

CREE COMMUNITIES OF EEYOU ISTCHEE

According to the research, the sense of belonging to the community is related to well-being and physical and mental health (Schellenberg, 2004). This concept refers, in particular, to the social attachment of individuals, which influences involvement in communities (Statistics Canada, 2016).

Data on the sense of belonging to the community are scarce for the territory of Eeyou Istchee James Bay. In 2003, the results of the Cree Health Survey showed, however, that the sense of belonging in Cree communities was much stronger than elsewhere in Quebec. Eighty-two percent of the Cree population in Eeyou Istchee reported a "strong" or "very strong" sense of belonging to the community, compared to only 56 percent of Quebecers. This trend among the Crees was observed as much among youth as among elders (CBHSSJB and INSPQ, 2008).

JAMESIAN MUNICIPALITIES

In 2011-2012, a greater proportion of Jamesians than Quebecers (83% and 57% respectively) declared they had a "very strong" or "relatively strong" sense of belonging (Diop and MC Nicoll, 2015). In general, youth in the region considered that they had high social support within their family (CRSSSBJ, 2017).

TRADITIONAL WAY OF LIFE

The Cree culture and identity formed thousands of years ago around relationships with the land and the community. The development of major projects over the past 50 years and the rapid changes to a contemporary lifestyle affected the culture and identity of the Crees of Eeyou Istchee. Faced with the projected development of the territory, particularly by the Plan Nord, the Grand Council of the Crees (GCC) published its "Cree Vision of Plan Nord," which reiterates the importance of respect for Cree traditions and culture in any new development project (GCC, 2011).

The mass arrival of non-First Nations workers, according to the GCC, may affect the preservation of the Cree cultural identity. It believes that increased efforts to raise awareness must be made in this context. One of the GCC's priorities is to prevent the erosion of culture among youth and to ensure preservation of the language, knowledge, traditions, and skills of elders (GCC, 2011).

Traditional foods are also central to the Cree identity. In addition to affecting health, a change in the First Nations diet may disrupt the maintenance of cultural and identity values. The various activities related to harvesting (hunting, fishing, berry-picking), preparation, and transformation of traditional foods are deeply rooted in First Nations culture. They are often a source of renewal, an opportunity to tighten relationships, and a preferred time for knowledge transfer. For the Crees of Eeyou Istchee, *miyupimaatisiiun* is intrinsically related to the hunting, fishing, and berry-picking activities that contribute to the maintenance of a traditional diet (INSPQ, 2015).

While access to the land is a central factor in traditional food consumption, this access may nonetheless present many difficulties. The geographic location of certain communities, the loss of access to the land resulting from development projects, the costs associated with equipment, the lack of knowledge, interest, or time, the remoteness of the camps, the scarcity of certain species, the alteration of migration routes, and the impoverishment of certain communities are all factors that may hinder the practice of traditional hunting, fishing and berry-picking activities (INSPQ, 2015).

HEALTH SERVICES AND SOCIAL SERVICES

The Nord-du Québec administrative region encompasses three health regions (Nord-du-Québec, Terres-cries-de-la-Baie-James, and Nunavik), each of which has its own health and social services organization (ministère de la Santé et des Services sociaux [MSSS], 2022). Two organizations covering the health regions of Nord-du-Québec and Terres-Cries-de-la-Baie-James are relevant in the context of this study, namely the Cree Board of Health and Social Services of James Bay (CBHSSJB) and the Centre régional de santé et de services sociaux de la Baie-James (CRSSSBJ).

THE CREE BOARD OF HEALTH AND SOCIAL SERVICES OF JAMES BAY

Founded in 1978, the CBHSSJB is the body responsible for management of health and social services for Health Region 18, Terres-Cries-de-la-Baie-James, which includes the nine Cree communities of Eeyou Istchee. The CBHSSJB manages a Community *Miyupimaatissiun* Centre (CMC) in each of the Cree communities of Eeyou Istchee. Various services are offered by the CMCs, particularly in general medicine, home care, dentistry, social services, and paramedical services (CBHSSJB, 2022a).

In addition to the CMCs, the CBHSSJB coordinates the Chisasibi Regional Hospital, three group homes for youth at risk, a regional public health service, and a program planning unit. It also maintains liaison, interpretation, and transportation services for patients in Chibougamau, Val-d'Or, and Montréal, which allows it to ensure a connection between the communities and second- and third-line services (CBHSSJB, 2022a).

Specific services are also offered by the CBHSSJB to the inhabitants residing or working outside the communities. For example, a medication kit program was instituted for Cree beneficiaries visiting their hunting camp. The CBHSSJB also collaborated with certain industries on the coordination of care for Cree workers in work camps, and on prevention and management of emergencies (INSPQ, 2014).

The CMC of Waswanipi offers varied services, such as emergency medical services, general medical services for babies and children (*Awash*), youth (*Uschiniichisuu*), and adults (*Chishaayiyuu*), a dental clinic, a pharmacy, home care, and social services (youth protection and mental health). The CBHSSJB also coordinates a Multi-Service Day Centre and the Robin's Nest women's shelter (CBHSSJB, 2022b).

THE CENTRE RÉGIONAL DE SANTÉ ET DE SERVICES SOCIAUX DE LA BAIE-JAMES

The CRSSSBJ was founded in 1996 with the merger of five health and social service institutions in the Nord-du-Québec health region. Having also integrated the Régie régionale de la santé et des services sociaux du Nord-du-Québec in 1999, it is the only institution that included the responsibilities of an Health and Social Services Agency (HSSA) in its mission at the time.

The CRSSSBJ covers a territory of 350,000 km^2. The main Jamesian municipalities served are Chapais, Chibougamau, Lebel-sur-Quévillon, Matagami, and Baie-James, which includes the localities of Radisson, Valcanton, and Villebois (CRSSSBJ, n.d.).

Health and social services in Lebel-sur-Quévillon are delivered by the Centre de santé Lebel. The Centre offers general and specialized care. It also provides emergency services and acts as a walk-in clinic. The facility also serves as a trauma centre. In addition, it includes a local community service centre (CLSC) and long-term care facilities. In 2022, the Centre had nine beds, including five for long-term care. That year, 71 employees worked at the Centre and six general practitioners were on duty. The Centre de santé Lebel offers a wide range of services, such as physiotherapy, social and psychological intervention, family planning, and addiction services (CRSSSBJ, 2022).

WORKER TRANSPORTATION BY SHUTTLE

Fly-in, fly-out (FIFO) and shuttle bus services are frequently used today to transport workers of projects in remote regions. They are suited to the generally long-term work rotations at work camps that are usually at isolated sites. Shuttle transportation and long work rotations imply that the workers must be absent from their place of residence for prolonged periods. There are several work schedule variations but the most common are 7-7 (seven days of work, seven days off), 14-14, 21-21, or 21-7 (Regroupement des femmes de la Côte-Nord and Université Laval Research Chair on Northern Sustainable Development, n.d.).

Several active mines in the Nord-du-Québec region use FIFO, particularly the Newmont Éléonore mine and the Stornoway Diamonds Renard mine in the territory of Eeyou Istchee James Bay.

Most Osisko employees will work on schedules of 15 days of work followed by 13 days of rest during the operations period (Chapter 3, Section 3.10). Charter flights will be used to transport the employees living in southern Quebec (Québec, Montréal, and Bagotville). About half the workers will use FIFO during the operations phase, while the other half will use bus transportation because they live in the region or in neighbouring Abitibi-Témiscamingue region.

As mentioned in Chapter 4 (Section 4.1), Osisko subsidizes a research study by the CBHSSJB on the effects of shuttling on workers, their families, and Cree communities, especially women. The report summarizing the study's conclusions is expected in the spring of 2023.

8.4.2 IMPACTS ON THE QUALITY OF LIFE AND WELL-BEING IN THE CONSTRUCTION PHASE AND MITIGATION MEASURES

CREE COMMUNITIES OF EEYOU ISTCHEE AND JAMESIAN MUNICIPALITIES

SOURCES OF POTENTIAL IMPACTS

During the construction phase, the sources of potential impacts and the resulting impacts (**in bold**) likely to have an impact on the quality of life and well-being of the population of the Eeyou Istchee James Bay territory are as follows:

— Organization of the site, stripping and clearing, surface preparation and access arrangement, construction of works and infrastructure, transportation and traffic, production and management of residual and hazardous materials, as well as workforce and procurement.

These sources have the potential to result in the following impacts during the construction phase:

— **Alteration of the quality of life and well-being of vacationers and land users, including the increased loss of tranquility for the users of traplines W25B and W25A.**

— **Concerns of vacationers and land users about human health risks.**

— **Decreased sense of safety of users of the main access roads R1050 (R1000), R0853 (R5000), and R1053 (R6000).**

— **Risk of tension between First Nations and non-First Nations workers (difficulty of integration into the work environment).**

— **Sense of loss and undermining of Cree cultural identity.**

— **Increase in demand for health services and social services.**

Concerning this last potential impact, the influx of workers and the accident risks inherent to construction work could put pressure on the health and social services offered near the project site, particularly at Centre de santé Lebel. However, considering the fact that a health clinic is already in place at the Windfall project camp, that nurses with an expanded role are present, and that Osisko offers its employees and their immediate families virtual care on request, the residual impact on the increased demand for health services and social services is considered nil. Moreover, according to a representative of Centre de santé Lebel interviewed in the course of the consultations for the Windfall project in the fall of 2022, an increase in the demand for care would not create significant pressure on the health services offered in Lebel-sur-Quévillon in the current context.

MITIGATION MEASURES

Common mitigation measures AIR01, AIR02, AIR03, and NOR01 for dust, NOR02 for the sound environment, FAU08 and 09 for the light environment, as well as FAU04 and POP01, VIE01 to 04, UTT01 to 03 for quality of life and well-being will be applied to minimize the project's impacts on the quality of life and well-being of vacationers, land users, and workers. They are presented in Appendix 5-2.

During the construction phase, the following specific mitigation measures will also be implemented:

- Continue to inform the public about the progress of the project, upcoming major work, environmental impacts and preventive measures to mitigate them, as well as the safety measures in place.
- Continue to raise awareness of all non-First Nations workers and contractors on Cree culture and traditional practices during the orientation meetings and subsequent training activities for supervisors.
- Continue to host cultural activities to foster cross-cultural exchange and a respectful work culture.
- Continue to raise workers awareness of the various forms of harassment and implement mechanisms for handling complaints. Ensure the application of the Workplace Harassment Policy and take appropriate corrective action when a complaint is substantiated.
- Continue to assist land users near the Windfall site with road safety issues.
- Build a recreation centre accessible to all workers and a Cree cultural site with a teepee for First Nations workers to gather and practice traditional activities such as cooking, crafting, and storytelling.
- Establish a new Environmental Monitoring Committee, (the terms of which will be specified in the IBA) to discuss and determine solutions to the issues that may arise during the mine's phases.
- Continue the psychosocial support program to help Cree and non-Cree workers balance work and family life.

DETAILED DESCRIPTION OF RESIDUAL IMPACT

ALTERATION OF THE QUALITY OF LIFE AND WELL-BEING OF VACATIONERS AND LAND USERS

The impacts on land use by the Crees, particularly by the tallymen of traplines W25B and W25A, are described and assessed in Section 8.6, and may be closely linked to certain impacts associated with quality of life and well-being.

During the construction phase, the various development activities of the site and construction of the infrastructure may result in emission of noise, vibrations, dust, and atmospheric contaminants, as well as light sources. This is likely to disturb the tranquility and quality of life of the vacationers and land users near the site and the access road. Two private cottage leases are located in the local study area of the social environment, the nearest of which is located about 1.4 km (on the shores of SN1 Lake) and the other at nearly 2 km (on the shores of Windfall Lake) from the mine site. An outfitting establishment with non-exclusive rights in the LSA lies about 5.4 km from the site, on the shores of Lac Rouleau.

Despite the compliance of the sound levels with the applicable standards and the mitigation measures implemented (Section 6.4; Appendix 6-3), the noise from the machinery used for construction of the accesses and the infrastructure is likely to be perceptible by the vacationers and the land users located near the Windfall site, more specifically by the non-First Nations family owning a cabin on the shore of SN1 Lake. Given that they use their cabin or temporary shelter for recreational purposes (hunting, fishing, and berry-picking), but also to benefit from nature and tranquility, their experience and quality of life during their stay may be altered. The preliminary results of noise modelling were presented and there were no concerns raised in this regard. The loss of tranquility and the alteration of the experience in nature are a concern for certain land users. On the other hand, according to the owner of the cabin of the outfitting establishment with non-exclusive rights on the shore of Lac Rouleau, several clients mentioned they were disturbed by noise and vibrations caused by the exploration activities carried on by other mining companies on the periphery of its various rental cabins located outside the LSA. This owner estimates that these disturbances have led to a reduction in traffic and revenue over the past few years. It should be noted that vacationing families and outfitter clients are only present sporadically for a few weeks in a year and at different periods. Considering the remoteness of the private cottage leases in the territory, compliance with the applicable noise levels, and the sporadic presence of vacationers and clients of the outfitting establishment, the anticipated effects of noise nuisances on their quality of life and well-being have little significance. The outfitter is affected more specifically by the other mining exploration activities carried out near their facility.

Concurrently, the mine construction activities may result in an increased loss of tranquility for the users of trapline W25B, who have permanently inhabited the area near the site (6 km away) since 2016. The tranquility typically offered by this site is an integral part of their traditional way of life.

Blasting activities will also be required for the development of the surfaces to allow the construction of certain infrastructure, namely for the process plant and the neighbouring area (including the projected site of the crushed ore silo), the access road leading from the Lynx portal to the water treatment plant, and Pond C1. The projected duration of this rock blasting work is slightly over four months (126 days). The vibrations will conform to the criterion of 12.7 mm/sec of Directive 019 of the MELCCFP. Due to the remoteness of the First Nations and non-First Nations camps, it is unlikely that the vibrations felt will cause significant inconveniences for vacationers and land users.

Site preparation and the construction of the access roads and infrastructure will require the installation and use of additional light sources. To this effect, one of the Cree families of trapline W25B who has a camp 10.8 km northeast of the current site indicated that they can see lights and are afraid that this impact will be amplified with the construction of the mine. On the other hand, the measures provided for in this section and in Section 8.9 that will minimize the impacts on the landscape, particularly preservation of forest cover, should mitigate the potential effects of night brightness for the vacationers on the periphery of the site.

CONCERNS OF VACATIONERS AND LAND USERS ABOUT HUMAN HEALTH RISKS

Concerns were raised by First Nations and non-First Nations stakeholders concerning the risks of contamination of the neighbouring lakes and watercourses, deterioration of air quality, and potential contamination of natural resources harvested and consumed in the course of recreational or traditional activities (hunting, fishing, berry-picking).

During the construction phase, surface preparation, access arrangement, and infrastructure construction activities, as well as the increase in transportation and traffic, will generate dust and will thus have an effect on air quality (see Section 6.2; Appendix 6-1). Alteration of air quality is associated with possible effects on human health, which is a source of concern for vacationers and land users near the site. In all cases, these air quality criteria are determined with the objective of protecting human health.

All of the mitigation practices and measures implemented by Osisko to prevent dispersion of contaminants and dust emissions in the environment will help mitigate this risk. Moreover, given that the area surrounding the project site and the nearby cabins are used sporadically by vacationers, the potential effects on their health are rather low. However, it should be noted that, unlike the vacationers, the tallyman of trapline W25B and members of his family have inhabited the area permanently since 2016, which nuances the probability of occurrence since the probability of ingesting contaminants in the environment is greater. However, since their camp is located 6 km southwest of the Windfall site and air quality mitigation measures will be applied, the probability of occurrence is considered equal.

Nonetheless, it is possible that concerns will persist if the vacationers and the land users have a poor understanding of the mine's activities, environmental management, and preventive measures. Osisko will continue to maintain open communication channels and inform the public on the project's progress, the anticipated impacts, and the measures implemented to mitigate them so as to foster a clear understanding of the project.

DECREASED SENSE OF SAFETY FOR USERS OF THE MAIN ACCESS ROADS R1050 (R1000), R0853 (R5000), AND R1053 (R6000).

The users of the access road are both non-First Nations and First Nations users of the territory. More specifically, they are mainly holders of private cottage leases, the tallymen of traplines W25B and W25A, their family members, and other visiting friends and relatives, as well as other industrial users (forestry companies, mining exploration companies, etc.).

During the construction period, transportation and traffic on the main access road from Lebel-sur-Quévillon (Road R1050 (R1000) to kilometre 12, Road R0853 (R5000) to kilometre 66, and road R1053 (R6000) to kilometre 112 - Windfall) may increase. For the entire duration of the construction phase (18 months), about 3,200 trips will be required to transport materials. Data on the current traffic to the Windfall site (arrivals recorded at the gatehouse in the summer of 2022) are presented in Section 8.7.1.

This increase in traffic is likely to result in a reduced sense of safety for users of the access road and an increased risk of accidents, mainly for users of traplines W25B and W25A, who use this road more frequently than the other users mentioned above. Concerns have already been raised by local contractors regarding safety on the main access road due to increased traffic.

Mitigation measures will be implemented to make workers, subcontractors, and transporters aware of the need to respect the traffic rules on the main access road, as well as the Osisko Forest Road Access Procedure. Appropriate signage is already used, particularly for speed limits, and traffic is only permitted between 6 a.m. and 6 p.m. on the main access road. However, it should be noted that traffic hours may be extended in exceptional situations (e.g., weather-related flight delays) as provided for in the Procedure. During the construction phase, the range of hours allowed for traffic will also be extended during periods of longer sunlight, as in the summer. The users of the access road could feel the effects of this traffic. However, it should be mentioned that the increase in traffic on the roads also depends on other businesses in the area, which could also experience an increase in their activities, and this traffic could vary over time.

On the other hand, it should also be considered that Osisko's presence can increase the feeling of safety for users since the mine grades and clears snow from the road, which ensures a good quality road surface. It also sees to roadside brush clearing to ensure better visibility. It is mandatory for Osisko contractors and employees to report their progress on the roads using an FM radio. Their presence makes it possible to assist other users who may be in trouble or to call for help. This positive impact was mentioned by First Nations users in interviews conducted in the fall of 2022. In addition, at the meeting held in Lebel-sur-Quévillon on January 31, 2022, non-First Nations users of the road mentioned that since the arrival of Osisko, the road had never been in such good condition. They believed that the access was safer than before because of the frequency with which the road was maintained.

POTENTIAL FOR TENSION BETWEEN FIRST NATIONS AND NON-FIRST NATIONS WORKERS

During the construction period, employment and contracting opportunities for contractors will intensify relations between First Nations and non-First Nations workers. In some contexts, cultural differences and misunderstandings about these differences can become sources of tension, especially among workers in close proximity for an extended period. Prejudices may thus emerge within the two groups. Cree stakeholders encountered during the 2022 consultation activities raised racism in the workplace as a major concern. Some stakeholders working or having worked at the Windfall site mentioned that this issue was real, despite the efforts of the mine to raise awareness of cultural diversity.

Although the jobs and contracts for the construction period will be shorter than those for the operations phase, they will still be spread out over approximately 18 months. Prolonged contact between First Nations and non-First Nations workers and contractors may increase the risk of deteriorating relationships, but it can also create opportunities for bonding, living together, and social cohesion.

Several studies have shown that intercultural exchange activities and cultural awareness promote the development of more harmonious interethnic relations, in addition to helping to break down prejudice (Roquet, 2008). Osisko will therefore develop mechanisms to raise awareness of Cree culture during orientation sessions and will promote the holding of cultural activities. The Liaison Officer, a position held by a Cree worker, has already been proposing activities to share Cree culture for the past few years, which have notably contributed to the deconstruction of certain prejudices according to the officer.

SENSE OF LOSS AND UNDERMINING OF CREE CULTURAL IDENTITY

The sense of loss and undermining of Cree cultural identity is one of the project's anticipated impacts on quality of life. Use of the territory for traditional purposes evokes more than a mode of subsistence for the Crees. It gives them an identity and reflects a deep sense of belonging to the territory. It is the place where collective and individual memories, important events, births and deaths, legends and beliefs are recorded. In this regard, land preparation and infrastructure construction may affect some Cree community members and contribute to a sense of gradual loss of their traditional way of life and cultural identity. However, it should be noted that Osisko is undertaking efforts to harmonize the coexistence of operations and the traditional Cree way of life. Certain initiatives that have been put in place could even facilitate the practice of traditional activities and thus contribute to the maintenance of the Cree cultural identity. For example, supplying water or fuel to the tallyman of W25B, as well as regular maintenance of the access roads 12 months a year, are Osisko initiatives that can help him move around the territory.

Osisko also offers Cree employees the opportunity, whenever possible, to take time off during the goose hunting season if it does not compromise project operations. This period has great meaning for the Crees in terms of culture and identity. At the same time, rotating work schedules also allow some workers to have several consecutive days to engage in their traditional activities during their break periods, as opposed to more conventional work schedules such as 5/2 (five days on followed by two days off).

RESIDUAL IMPACT ASSESSMENT

CREE COMMUNITIES OF EEYOU ISTCHEE

The socioeconomic value of the quality of life and well-being of Cree land users is medium since the component has a definite social or cultural value, but without legal protection. The degree of disturbance is considered low (W25A users) to medium (W25B users) for the increased loss of tranquility of the users of the territory, particularly tallymen and their families, because with the mitigation measures that will be put in place, the residual effects will reduce the quality of their experience on the territory, without compromising its integrity. The changes caused at the beginning of the project may also have a greater effect on the users of the territory who will have to adapt to this new environment. The intensity of the impact is therefore low to medium for the main users of the territory. The other impacts identified have a low degree of disturbance and a low intensity since they will be affected in a barely perceptible way. The spatial scope of the anticipated impacts on the quality of life and well-being will be specific to a few users of the territory in the vicinity of the site, as well as to a small number of Cree workers. However, since the users of the access road could also be affected, the spatial scope is also local. The construction phase will be short (18 months). The probability of occurrence is medium for alteration of the quality of life of Cree users, for the risk of tension between the First Nations and non-First Nations workers, and for the sense of loss and undermining of Cree cultural identity, since it is possible that an impact will occur, without being certain of it. The probability of occurrence for the reduction of the sense of safety for the users of the access road and for concerns of risks to human health due to nuisances is low because the impacts are likely to occur only in case of an accident or accidental spill and there are road safety measures implemented. At the same time, the maintenance of roads by Osisko, which represents a positive impact, also mitigates the probability of occurrence for the impact of a decreased sense of security. The significance is therefore very low to low for the alteration of quality of life and very low for the other impacts.

Impact on quality of life and well-being during the construction phase – Eeyou Istchee		
Nature	Negative	Significance: Alteration of quality of life - Very low to low Other impacts - Very low
Ecosystem value	Not applicable	
Socioeconomic value	Medium	
Degree of disturbance	Low to medium (alteration of quality of life) and low (other impacts)	
Intensity	Low to medium (alteration of quality of life) and low (other impacts)	
Spatial scope	Specific (other impacts) to local (sense of safety on the road)	
Duration	Short	
Probability of occurrence	Low (risks for health, sense of safety on the road) to medium (alteration of quality of life, risk of tension, cultural identity)	

JAMESIAN MUNICIPALITIES

The socioeconomic value of the quality of life and well-being of the vacationers and the land users is medium because this component is socially valued. The degree of disturbance is considered low for alteration of quality of life and well-being of the vacationers and land users because, due to the mitigation measures that will be implemented, the residual effects will alter the quality of the experience in a barely perceptible way. Vacationers with leases near the project site who are likely to experience effects are present only sporadically, a few weeks per year. The intensity of the impact is therefore low. The other impacts also have a low degree of disturbance and a low intensity since their effects will be barely perceptible. The spatial scope of the anticipated impacts on the quality of life and well-being will be mostly specific because they will be limited to some vacationers and land users in the vicinity of the site, and to a limited number of workers. However, given that the users of the access road could be affected, the spatial scope is also local. The construction phase will be short (18 months). The probability of occurrence is medium for the alteration of quality of life of vacationers and for the risk of tension between the First Nations and non-First Nations workers since it is possible that there will be an impact. The probability of occurrence for human health risk concerns and for the possible decrease in the sense of safety of users of the main access road from Lebel-sur-Quévillon is low, as impacts are only likely to occur in the event of an accident or accidental spill. The significance is therefore very low for the overall impacts on the quality of life and well-being of Jamesians during the construction phase.

Impacts on the quality of life and well-being in the construction phase – Jamésie		
Nature	Negative	Significance: Very low
Ecosystem value	Not applicable	
Socioeconomic value	Medium	
Degree of disturbance	Low	
Intensity	Low	
Spatial scope	Specific (other impacts) to local (sense of safety on the road)	
Duration	Short	
Probability of occurrence	Low (risks for human health, sense of safety on the road) to medium (alteration of quality of life, risk of tension)	

8.4.3 IMPACTS ON THE QUALITY OF LIFE AND WELL-BEING IN THE OPERATIONS PHASE, AND MITIGATION MEASURES

CREE COMMUNITIES OF EEYOU ISTCHEE AND JAMESIAN MUNICIPALITIES

SOURCES OF POTENTIAL IMPACTS

During the operations phase, the sources of potential impacts and the resulting impacts (**in bold**) likely to have an impact on the quality of life and well-being of the population of the Eeyou Istchee James Bay territory are the following:

— The presence and operation of new infrastructure, water use and management, transportation and traffic, production and management of waste and hazardous materials, and workforce and procurement.

These sources have the potential to result in the following impacts during the operations phase:

— **Alteration of the quality of life and well-being of vacationers and land users, including the increased loss of tranquillity for the users of traplines W25B and W25A.**

— **Concerns of vacationers and land users about human health risks.**

— **Decreased sense of safety for users of the main access roads R1050 (R1000), R0853 (R5000), and R1053 (R6000).**

— **Risk of tension between First Nations and non-First Nations workers (difficulty of integration into the work environment).**

— **Alteration of the psychological and social well-being of workers and difficulties in balancing work and family life.**

— **Sense of loss and undermining of Cree cultural identity.**

MITIGATION MEASURES

Common mitigation measures AIR01, AIR02, AIR03 and NOR01 for dust, NOR02 for sound environment, FAU08 and 09 for light environment, FAU04 and POP01, VIE01 to 04, UTT01 to 03, for quality of life and well-being, will be applied to minimize the project's impacts on the quality of life and well-being of vacationers, land users, and workers. They are presented in Appendix 5-2. During the operations phase, the following specific mitigation measures will also be implemented:

— Continue to inform the public about the progress of the project, upcoming major work, environmental impacts and preventive measures to mitigate them, as well as the safety measures in place.

— Continue to raise awareness of all non-First Nations workers and bcontractors on Cree culture and traditional practices during the orientation meeting and subsequent training activities for the supervisors.

— Continue to host cultural activities to foster cross-cultural exchange and a respectful work culture.

- Continue to raise workers' awareness of the various forms of harassment and implement mechanisms for handling complaints. Ensure the application of the Workplace Harassment Policy and take appropriate corrective action when a complaint is substantiated.
- Continue to assist land users near the Windfall site with road safety issues.
- Establish a new Environmental Monitoring Committee, (the terms of which will be specified in the IBA) to discuss and determine solutions to the issues that may arise during the mine's phases.
- Continue the psychosocial support program to help Cree and non-Cree workers balance work and family life.
- Ensure that reliable means of communication are available at the work camp to let workers communicate with their families.

DETAILED DESCRIPTION OF RESIDUAL IMPACT

ALTERATION OF THE QUALITY OF LIFE AND WELL-BEING OF VACATIONERS AND LAND USERS

Several inconveniences will continue in the operations phase due to the presence and operation of new infrastructure, as well as transportation and traffic.

Noise will mainly be generated by the ore handling and crushing activities, and by the management of waste rock and tailings (Section 6.4; Appendix 6-3). With a noise contribution of 28 dBA or less, at least 6 dBA lower than the current ambient noise, the new mine site would not contribute to an increase in the study area's ambient noise. Underground blasting will be performed an average of twice a day during mine operations, at 6:30 a.m. and 6:30 p.m. Blasting work will also be required on the surface during the operations phase for construction of a water retention pond (Pond D1). The projected duration of this work is 28 days. According to the noise and vibration study (Section 6.4; Appendix 6-3), the vibrations sensed will remain lower than the criterion of 12.7 mm/sec of Directive 019. The project thus will continue to respect the standards in force for noise and vibrations.

As during the construction period, the effects of night brightness will be mitigated by the mitigation measures in place. All the mitigation measures instituted during the construction phase will be maintained to minimize the effects of loss of tranquility and alteration of the quality of life of the vacationers and land users. The existing communication methods, as well as the complaint and comments system, will allow assessment of the effectiveness of the measures and permit the necessary adjustments.

CONCERNS OF VACATIONERS AND LAND USERS ABOUT HUMAN HEALTH RISKS

During the operations phase, the presence and operation of new infrastructure, water use and management, transportation and traffic, and production and management of residual and hazardous materials may generate concerns relating to the risks of contamination of the natural environment and the potential effects on human health. The main concerns named are in relation to water and air quality, as well as potential contamination of the natural resources harvested and consumed in the course of recreational and traditional activities (hunting, fishing, berry-picking).

The mine water and domestic water management and treatment systems on the project site were developed to comply with the effluent water quality standards and criteria, and to meet the environmental discharge objectives of the MELCCFP (Section 6.7). However, water contamination potential is a concern for the land users who fish and consume fish on the watercourses and bodies of water near the site.

Although the traffic and associated dust emissions decrease in the operations phase, the presence of a waste rock stockpile and the tailings storage facility (filtered tailings) will contribute to the increase in dust emissions due to wind erosion. The applicable air quality standards will continue to be respected (Section 6.2; Appendix 6-1).

The prevention and mitigation measures implemented by Osisko during the construction phase will be maintained and will allow minimization of the effects on the natural environment and the ambient air and, and at the same time, on the risks to human health. The communication mechanisms in place will also make it possible to continue to communicate information on the mine’s activities, but also to gather the concerns of tallymen, cottagers and land users. The potential effects on the vacationers’ health remain low.

DECREASED SENSE OF SAFETY FOR USERS OF THE MAIN ACCESS ROADS R1050 (R1000), R0853 (R5000), AND R1053 (R6000).

During the operations phase, traffic on the main access road from Lebel-sur-Quévillon (Road R1050 (R1000) to kilometre 12, Road R0853 (R5000) to kilometre 66, and Road R1053 (R6000) to kilometre 112 - Windfall) will be lower than for the construction phase. Approximately 783 trips per year will be required to transport plant inputs and fuel for the duration of the mine operations. Osisko will continue to raise awareness among workers, subcontractors, and transporters of the need to respect the traffic rules, its Forestry Road Access Procedure, and the speed limits in effect. The possible decrease in the sense of safety may persist for some users of the access road. However, it should be noted that night traffic will not be authorized by Osisko, except in exceptional situations (e.g., delayed flights due to weather conditions), as provided for in the Procedure.

As mentioned for the construction phase, Osisko’s maintenance of the road and the possibility of assistance may increase the users’ sense of safety.

RISK OF TENSION BETWEEN FIRST NATIONS AND NON-FIRST NATIONS WORKERS

As in the construction period, the employment and contract opportunities during the operations phase will intensify the relations between the First Nations and non-First Nations workers. Given that the jobs will be much more long-term, it is possible that there will be more tension relating to cultural differences despite the mitigation measures implemented. Osisko will continue to raise the awareness of the Cree culture among its workers, to promote exchange through cultural activities, and to ensure the application of its Workplace Harassment Policy.

ALTERATION OF THE PSYCHOLOGICAL WELL-BEING OF WORKERS AND DIFFICULTIES IN BALANCING WORK AND FAMILY LIFE

Some studies on projects in Nord-du-Québec have already highlighted the difficulties in balancing work and family caused by the prolonged absence of workers with long-term rotating work schedules (Roquet, 2008). Some socioeconomic stakeholders also raised concerns about the psychosocial impacts of this type of non-standard work schedule, particularly the effects on families. Cree education and training stakeholders also raised concerns about drug and alcohol use problems that might be pronounced due to the higher wages and long rest periods after intensive work periods (15/13).

While there are some advantages to rotating schedules, such as higher incomes and longer leaves, the social problems associated with them are also increasingly documented (Regroupement des femmes de la Côte-Nord and Université Laval Research Chair on Northern Sustainable Development, n.d.). Several studies on the subject show that commuting and rotating schedules can affect the psychological well-being of workers. The main effects identified concern increased fatigue, the difficulty maintaining interpersonal relationships, the lack of important family moments, the constant adaptation of workers and families, the pressure on spouses, the risks of anxiety and depression, and the greater consumption of alcohol during the rest periods (Brouillette et al., 2022; INSPQ, 2018). In short, although some workers feel the negative effects of commuting and of rotating schedules, others derive benefits. Indeed, some Cree contractors consulted were of the opinion that a mining work environment provides supervision that offers a healthy lifestyle, which can be beneficial for people who tend to be more vulnerable.

To minimize the potential effects of shuttling and rotating schedules on the workers and their families, Osisko will offer reliable means of communication that will allow workers to remain in contact with their families and be reachable in case of a family emergency. Finally, facilities that favour social activities will also be set up at the work camp to encourage the creation and maintenance of harmonious relations in the workplace. Considering these measures and the relatively short work rotations (in comparison with 21-21 and 21-7), the residual effects on the workers and their families should be limited.

Furthermore, it should be noted that Osisko made a financial contribution to the Cree Board of Health's study on the evaluation of the psychosocial effects of rotating work schedules on Cree workers in some of the territory's mining companies. In the course of this study, a Cree interviewer visited the Windfall site in November 2022 to survey some Cree employees on their experience and thus identify concrete solutions to reduce the negative effects and improve the positive effects of rotation work schedules.

SENSE OF LOSS AND UNDERMINING OF CREE CULTURAL IDENTITY

The sense of loss and undermining of Cree cultural identity is one of the project's anticipated impacts on the quality of life. The use of the territory for traditional purposes evokes more than a mode of subsistence for the Crees. It confers on them an identity and reflects a deep sense of belonging to the territory. This is the place where collective and individual memories, important events, births and deaths, legends and beliefs are recorded. In this regard, operation of the mine over a period of about 10 years could affect some Cree community members and contribute to a sense of gradual loss of their traditional way of life and cultural identity. It should be noted, however, that Osisko offers Cree employees the opportunity, where possible, to take time off during the goose hunting season, if this does not compromise project operations. This period has a very important meaning in terms of culture and identity for the Crees. At the same time, rotating work schedules also allow some workers to have consecutive days to practise their traditional activities during their downtime as opposed to more traditional work schedules such as 5/2.

RESIDUAL IMPACT ASSESSMENT

CREE COMMUNITIES OF EEYOU ISTCHEE

The socioeconomic value of the quality of life and well-being component is medium. The degree of disturbance for the overall anticipated impacts in the operations phase is low with a low intensity. The spatial scope is specific for most impacts, which are felt by a few workers and land users near the site, whereas the reduction of the sense of safety of the users of the access road has effects at the local level. The impacts on the quality of life and well-being that are likely to occur during the operations phase are for the medium term. The probability of occurrence is low for the concerns relating to the risks for human health, for the reduction of the sense of safety for the users of the access road, and for the sense of loss and undermining of Cree cultural identity . Given that traffic will be lighter than in the construction period and that the mitigation measures will have been tested, the probability of occurrence of the possible reduction in the sense of safety for the users of the access road will arise only in the case of an accident. The probability of occurrence remains medium for the alteration of the quality of life and well-being of the tallymen and the land users, as well as for the risk of tension between First Nations and non-First Nations workers. It is also medium for the possible alteration of the workers' psychological well-being and the possible difficulties of work-family balance, given that the effects could occur for certain workers. The significance for all the residual impacts is therefore very low.

Impacts on the quality of life and well-being in the operations phase – Eeyou Istchee		
Nature	Negative	Significance: Very low
Ecosystem value	Not applicable	
Socioeconomic value	Medium	
Degree of disturbance	Low	
Intensity	Low	
Spatial scope	Specific (other impacts) to local (sense of safety on the road)	
Duration	Medium	
Probability of occurrence	Low (risks for health, sense of safety on the road) to medium (alteration of quality of life, risk of tension, work-family balance)	

JAMESIAN MUNICIPALITIES

The socioeconomic value of the quality of life and well-being component is medium. The degree of disturbance for the overall anticipated impacts is low with a low intensity. The spatial scope is still specific for most impacts, which are limited to a few workers, vacationers, and land users near the site, except for the reduction of the sense of safety for the users of the access road, which has effects at the local level. The impacts on the quality of life and well-being that are likely to occur during the operations phase are for the medium term. The probability of occurrence is low for the concerns relating to the risks for human health, and for the possible reduction of the sense of safety for the users of the access road, because impacts will occur only in the case of accidents. The probability of occurrence remains medium for the alteration of the quality of life and well-being of the vacationers and the land users, as well as for the risk of tension between First Nations and non-First Nations workers. It is also medium for the possible alteration of the workers' psychological well-being and the possible difficulties of work-family balance, considering that the effects could occur for certain workers. The significance is therefore very low for the impacts of this component.

Impact on the quality of life and well-being in the operations phase – Jamésie		
Nature	Negative	Significance: Very low
Ecosystem value	Not applicable	
Socioeconomic value	Medium	
Degree of disturbance	Low	
Intensity	Low	
Spatial scope	Specific (other impacts) to local (sense of safety on the road)	
Duration	Medium	
Probability of occurrence	Low (risks for health, sense of safety on the road) to medium (alteration of quality of life, risk of tension, work-family balance)	

8.4.4 IMPACTS ON THE QUALITY OF LIFE AND WELL-BEING IN THE CLOSURE PHASE, AND MITIGATION MEASURES

CREE COMMUNITIES OF EEYOU ISTCHEE AND JAMESIAN MUNICIPALITIES

During the closure phase, the sources of potential impacts and the resulting impacts (**in bold**) likely to have an impact on the quality of life and well-being of the population of the Eeyou Istchee James Bay territory are the following:

— The presence of the remnants of the site, the final restoration, and the production and management of residual and hazardous materials.

These sources have the potential to result in the following impact during the closure phase:

— **Concerns of vacationers and land users about human health risks.**

MITIGATION MEASURES

Common mitigation measures POP02, VIE01 to 04, and UTT03 for quality of life and well-being will be applied to minimize the project's impacts on the quality of life and well-being of the tallymen, vacationers, and land users. They are presented in Appendix 5--2. During the closure phase, the following specific mitigation measures will also be implemented:

- Continue to inform the public about the progress of the project, upcoming major work, environmental impacts and preventive measures to mitigate them, as well as the safety measures in place.
- Establish a new Environmental Monitoring Committee, (the terms of which will be specified in the IBA) to discuss and determine solutions to the issues that may arise during the mine's phases.

DETAILED DESCRIPTION OF RESIDUAL IMPACT

As in the construction and operations phases, the risk of contamination of the natural environment during the closure phase is likely to raise concerns about the effects on human health. In particular, concerns were raised regarding the sustainability of the geomembrane of the tailings storage facility. As mentioned previously, some vacationers and land users near the mine site are concerned about water quality and the fish they consume, and consequently about the potential impact on their health in case of contamination.

To mitigate these concerns, Osisko will pursue its dialogue with the public, maintain open communications with the vacationers, and maintain a complaint resolution system. The mining company will communicate, in particular, on the measures in place to prevent potential contamination of the natural environment, and on the environmental monitoring done. These mitigation measures, the restoration plan, and the financial guarantee required by the Mining Act and its regulations (see Section 1.5) should mitigate the concerns of the vacationers and the land users regarding the risks arising from potential contamination of the natural environment.

RESIDUAL IMPACT ASSESSMENT

CREE COMMUNITIES OF EEYOU ISTCHEE

The socioeconomic value of the quality of life and well-being component is medium. The degree of disturbance in the closure phase is low because the possible perception of potential contamination of the environment by the land users who consume natural resources (wildlife and plant life) on a daily basis is mitigated by the common mitigation measures implemented to monitor the quality of the environment (air and water). The intensity is also low. The spatial scope is specific because the main users affected will be the tallymen of traplines W25B and W25A and their family members. The duration is long given that environmental monitoring will continue for at least 10 years after closure. The probability of occurrence is considered low because an impact would occur only in the case of an accident. The significance of the impact is therefore very low.

Impact on the quality of life and well-being in the closure phase – Eeyou Istchee		
Nature	Negative	Significance: Very low
Ecosystem value	Not applicable	
Socioeconomic value	Medium	
Degree of disturbance	Low	
Intensity	Low	
Spatial scope	Specific	
Duration	Long	
Probability of occurrence	Low	

JAMESIAN MUNICIPALITIES

The socioeconomic value of the quality of life and well-being component is medium in the closure phase. The degree of disturbance is low given that the effects of potential contamination would be almost imperceptible for the vacationers and the land users, who consume natural resources (wildlife and plant life) sporadically. The intensity is also low. The spatial scope is specific because only a few individuals might be affected. The duration is long given that environmental monitoring will continue for at least 10 years after closure. The probability of occurrence is low because an impact would occur only in the case of an accident. The significance of the impact is therefore very low.

Impacts on the quality of life and well-being in the closure phase – Jamésie		
Nature	Negative	Significance: Very low
Ecosystem value	Not applicable	
Socioeconomic value	Medium	
Degree of disturbance	Low	
Intensity	Low	
Spatial scope	Specific	
Duration	Long	
Probability of occurrence	Low	

8.5 USE OF THE TERRITORY AND ITS NATURAL RESOURCES

Highlights regarding use of the territory and its natural resources

Existing conditions

The local study area is part of Quebec Hunting Zone 16. It is also part of Fur-bearing Animal Management Unit (UGAF) 31.

Wildlife harvesting activities, such as hunting, sport fishing, and blueberry picking, take place in the local study area. In addition to the wildlife harvesting activities that are practised there, there are also vacationing, recreational, forestry, and mining activities.

Only three public land use leases are found in the local study area, including two private cottage leases, the closest of which is located approximately 1.4 km from the mine site and the other about 2 km away. The local study area also includes a lease for lodging purposes at an outfitter without exclusive rights located southwest of the project, approximately 5.4 km from the Windfall mine site.

Potential impacts of the project

Due to the projected location of the facilities, the impact on the use of territory and its natural resources in the construction phase is considered very low to low. No impacts in addition to the impact during construction is anticipated on land and resource use for the project's operations and closure phases.

8.5.1 CURRENT CONDITIONS

HUNTING, TRAPPING, SPORT FISHING, AND BERRY-PICKING

The LSA is part of Quebec Hunting Zone 16. In 2021, a total of 399 moose and 103 bears were killed in Zone 16 (MFFP, 2022). It should be noted that all the public lands of the LSA are used by most of the private cottage lease holders for hunting and fishing (Map 8-2).

The LSA is part of Fur-bearing Animal Management Unit (UGAF) 31. It should be noted that this unit is part of the beaver reserves and lands of James Bay, northern Quebec, and northeastern Quebec. In these zones located north of the 49th parallel, trapping is reserved exclusively for people (First Nations) covered by the Regulation respecting beaver reserves and the Act respecting hunting and fishing rights in the James Bay and northern Québec territories (MFFP, 2018a). Table 8-14 presents the statistics on gross fur sales per species during the 2020-2021 season for UGAF 31. The most commonly harvested species (in bold in table 8-14) during this period were beaver, marten, red fox, and fisher (MFFP, 2021).

Table 8-14 Fur sales from UGAF 31, 2020-2021 season

Species	Number of furs
Beaver	**29**
Marten	**44**
Mink	1
Muskrat	3
Canada lynx	5
Red fox	**14**
Fisher	**13**
Otter	5
Black bear	7
Coyote	1
Raccoon	5
Bobcat	1

Source: MFFP, 2021.

Among the private cottage lease holders contacted as part of a public land use survey for the Windfall project's environmental impact assessment, the species hunted were primarily moose, bear, and hare. Most hunt and fish around their cabin or camp.

Quebec has 29 sport fishing zones. The LSA is found in Zone 16 (MFFP, 2017d). According to the survey of land users conducted as part of this study (see Chapter 4 for more details), the main species fished are pike and walleye. In addition to fishing and hunting activities, the land users also pick blueberries.

MINING ACTIVITIES

The LSA contains 286 mining claims, all held by the Osisko mining company. Various mining facilities are currently located on the Windfall project site (see Chapter 3 for more details). Initially constructed to accommodate about forty people in 2007, the exploration camp's capacity has grown to 300 people since 2017. The camp includes rooms, a kitchen, a dining room, an infirmary, a gym, offices, as well as drinking water supply and sanitary wastewater management facilities.

On the camp site, there are also core shacks, waste management facilities (including a composting unit) as well as workshops and warehouses (containers and canvas domes).

The mine site currently consists of a portal and a 1,450 m ramp, an overburden stockpile, a lined ore and waste rock stockpile with a collection ditch for ore and waste rock, sedimentation and polishing ponds, a waste treatment unit with geotubes, offices, sanitary facilities including showers and locker rooms, a garage, warehouses, and fuel tanks. The site also contains a helicopter landing pad, petroleum product tanks, and storage and maintenance areas for drills. To proceed with bulk sampling, other infrastructure will be added to the site in 2023. For this purpose, it should be noted that Ponds A and D may be built, as well as the polishing pond (P). The first phase of improvement of the water treatment unit and the expansion of the waste rock stockpile should also be carried out in 2023.

As part of the project under study, Osisko generally plans to retain and reuse the main existing surface infrastructure, i.e., the portal and the stockpile. The other infrastructure will be relocated, particularly the generator set, or eventually dismantled. The current workers' camp will meet the housing needs during construction of the new permanent camp and will also serve Osisko exploration teams, who will continue the exploration activities on the sector's other claims.

FOREST MANAGEMENT PLANNING

Since the adoption in April 2013 of the Sustainable Forest Development Act (SFDA), several changes have been made in the management of forest resources and land. The Act aims to establish sustainable forest management through the implementation of ecosystem-based management and to ensure integrated and regionalized management of resources and the territory. To achieve its objectives in terms of management quality, the former Ministère des Forêts, de la Faune et des Parcs[7] (MFFP) adopted its sustainable forest management strategy (SADF), with the following main challenges:

— ensure forest management and development that reflect the interests, values, and needs of the Quebec population and the communities;
— implement forest management that guarantees the sustainability of the ecosystems;
— establish an abundant forest environment generating diversified resources;
— encourage diversified, competitive, and innovative wood products industries and forestry operations;
— rely on forests and the forestry sector to contribute to the fight against climate change and to adapt to it;
— guarantee sustainable, structured, and transparent forest management.

This strategy provides for integration of local ecological issues into the integrated forest management plan (PAFI). The PAFI includes two types of integrated forest management plans, tactical (PAFIT) and operational (PAFIO) (MFFP, 2015).

Unlike the PAFIT, which is subject to public consultation every five years when new tactical plans are developed, the PAFIO, which is dynamic in nature and continually updated, is subject to annual public consultation to gather the concerns of forest users, including mining companies, about any changes or additions. This plan presents the operational planning for the management of the region's forest resources. More specifically, it identifies potential modified or added intervention sectors as well as the potential location of roads and other infrastructures to be built or improved.

Whether for the PAFIT or the PAFIO, public consultation has the following goals:

— promote a better public understanding of the management of Quebec's public forests and, more specifically, of forest management planning;
— enable the population to express their views on the proposed forest management plans and integrate, when possible, the concerns, values and needs expressed;
— reconcile the diverse concerns of the many users of forest resources and land;
— harmonize forest management with the values and needs of the population;
— enable the Minister to make the best possible decisions under the circumstances.

7 Following the appointment of the new Conseil des ministres in November 2022, the forest sector is now under the responsibility of the Ministère des Ressources naturelles et des Forêts (MRNF) while the wildlife and parks sector is under the responsibility of the Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs (MELCCFP).

On the other hand, the Local Integrated Land and Resource Management Panel (TLGIRT) is a privileged platform ensuring the consideration of the concerns and interests of the individuals or organizations concerned by the planned forest management activities. It constitutes a place of dialogue between the stakeholders of a given territory, while the role of manager remains a governmental responsibility.

PROFILE OF MANAGEMENT UNIT (MU) 087-62

Only one Management Unit (MU) is intersected by the local study area, namely MU 087-62. Composed in part of the former common areas 026-20 (6%), 083-87 north (47%), and 084-20 (3%), the total area of this MU is 467,622 ha. Nonetheless, once the protected areas, the bodies of water and the unproductive forest zones are subtracted, the area dedicated to forest management is 282,513 ha. Nearly all of the territory of MU 087-62, on public lands, is found within the Nord-du-Québec region and the territory of Eeyou Istchee, except for a small parcel located south of the 49th parallel in the Abitibi-Témiscamingue region. MU 087-62 is located east of the Town of Lebel-sur-Quévillon, south of the community of Waswanipi and southeast of the municipalities of Miquelon and Desmaraisville. In particular, this territory is crossed by logging road R-0653, and by other secondary logging roads (MFFP, 2020).

FORESTRY RIGHTS OF MU 087-62

The timber supply guarantees (GA) and the permits to harvest timber to supply wood processing plants (PRAU) are the main forestry rights granted in the Management Units. The GA grants its holder the right to annually purchase a volume of wood from State-owned forest lands in one or more administrative regions to supply the wood processing plant for which the guarantee is granted. The PRAU give its holder permission to harvest a volume of timber on lands in the domain of the State.

Concerning the forest rights issued in MU 087-62, there are two GA holders, Produits forestiers Résolu (Comtois) and Barette-Chapais ltée (MFFP, 2020). In the winter of 2022 and spring of 2023, the Barette-Chapais forestry company plans to carry out some cutting south of the project site. There are no plans for further forestry work in the short to medium term in the LSA (Personal communication, 2022).

PUBLIC LAND USE LEASE OWNERS

Management of the rights to use public land for various purposes is the responsibility of the Quebec Government, which administers this function through the MRNF. As of October 2022, there were two private cottage leases issued by MERN in the LSA. This type of lease grants the leasing of land in the domain of the State to an individual for the purpose of constructing a cabin or temporary shelter or engaging in personal activities (MERN, 2004). These lands usually have an area of 4,000 m^2. The LSA also includes a non-exclusive outfitting lease for Berthelot Lake Lodge Inc. Unlike an exclusive outfitting operation, a non-exclusive outfitting operation does not have exclusive rights to harvest wildlife in a given area. Its clients hunt and fish on public lands where they can meet other hunters and fishers.

The land users who have a private cottage lease in the LSA mainly use the area for hunting, fishing, and berry-picking activities. On the other hand, for many, their cabin or camp is also used as a vacation spot to enjoy nature and the tranquility of the area.

Depending on their habits, some leaseholders visit their land only one to four weeks a year for hunting or fishing trips, while other users who have cabins along the road and outside the local study area go there more often—every month or every weekend, and during their vacations. According to the survey conducted among land users, they rarely visit their cabins during the winter season.

Concerning motorized sports, the owners of public land use leases travel on the territory by snowmobile or quad (ATV) on private trails.

According to the Fédération québécoise du canot et du kayak (FQCK), there are no canoe routes in the LSA, but there are three in the RSA. These are the Cuvillier, Wetetnagami, and Saint-Cyr rivers (FQCK, 2005).

8.5.2 IMPACTS ON USE OF THE TERRITOIRY AND ITS NATURAL RESOURCES IN THE CONSTRUCTION PHASE AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the construction phase, the sources of potential impacts and the resulting impacts (**in bold**) likely to have an impact on the use of the territory and its natural resources are as follows:

- Organization of the site, stripping and clearing, surface preparation and access arrangement, construction of works and infrastructure, transportation and traffic, production and management of residual and hazardous materials, as well as workforce and procurement,

These sources have the potential to result in the following impacts during the construction phase:

Occasional alteration in the practice of some wildlife harvesting activities through:

- noise, dust and vibrations, particularly caused by clearing, machinery traffic, and blasting.

Potential increase in hunting and fishing pressures through:

- the presence of workers who might wish to engage in sport fishing or sport hunting near the mine site outside working hours.

It should be noted that the assessment of the project's impacts on the health and quality of life of vacationers and land users is addressed in Section 8.5.

MITIGATION MEASURES

Common mitigation measures for dust AIR01, AIR02 and AIR09, the sound environment NOR02 and NOR03, soil, surface water, and sediment quality QUA01 to 27, land use planning, development, and tenure PLA01 and PLA02, quality of life VIE01, and hunting and recreational fishing UTT03 will be applied to minimize the project's impact on the use of the territory and its natural resources. They are presented in Appendix 5-2. During the construction phase, the following specific mitigation measures will also be implemented:

- Continue to inform the public about the progress of the project, upcoming major work, environmental impacts and preventive measures to mitigate them, as well as the safety measures in place.
- Continue discussions with the leaseholder around SN1 Lake.

DETAILED DESCRIPTION OF RESIDUAL IMPACT

OCCASIONAL ALTERATION IN THE PRACTICE OF SOME WILDLIFE HARVESTING ACTIVITIES.

The inventories and interviews conducted in 2018 and 2022 show that the local study area (LSA) is visited for wildlife harvesting activities. In this regard, discussions with the leaseholders show that the area is visited for moose and bear hunting. Noise, dust, and vibrations caused by clearing, machinery traffic, and blasting, could disturb certain wildlife species of interest that are present near the new infrastructure sites, causing them to move to quieter area. Hunters and land users will therefore have to modify their practices and also move to other areas. However, the overall harvesting potential will not be affected because game will move to the periphery of the work areas and resource availability will remain the same. The area of influence of these nuisances will be limited. It should be noted that the land users have made adjustments to their practices since the advanced exploration activities on the site have already resulted in the displacement of large wildlife.

Sport fishing is a popular wildlife harvesting activity practised by land users in the LSA's water bodies. However, access to certain water bodies is difficult, particularly due to the lack of access roads and the topography of the area. At the request of land users, Osisko has agreed to leave an access road outside the secure areas of the mine site that will allow access to SN2 Lake.

POTENTIAL INCREASE IN HUNTING AND FISHING PRESSURE DUE TO WORKER PRESENCE:

During the construction phase, workers may wish to engage in sport fishing or hunting near the mine site outside working hours. However, Osisko already prohibits and will continue to prohibit sport hunting and fishing activities by its workers to avoid creating conflict with the local population.

RESIDUAL IMPACT ASSESSMENT

The impact on the practice of certain wildlife harvesting activities is negative. The socioeconomic value of the practice of these activities is medium because this component is valued by land users. The degree of disturbance of the component would be low because the construction activities will have the effect of displacing certain wildlife harvesting sites and activities, but without compromising their practice. The intensity of the impact is medium and its spatial scope is local because only the land users on and near new infrastructure sites will be affected. The impact will be of short duration with a medium probability of occurrence of disturbances caused by the construction work for users who visit the territory around the work areas. It will be of medium duration and high occurrence for those who visit areas that will accommodate the permanent infrastructure. The significance of the project's residual impact in the construction phase on certain wildlife harvesting activities is considered medium.

The risk of increased fishing and hunting pressure in the vicinity of the mine site is nil given the implementation of the measure to prohibit this type of activity for workers who will be housed there. Consequently, the assessment of this impact is not required.

Impacts on use of the territory and its natural resources in the construction phase		
Nature	Negative	Significance: Very low to low
Ecosystem value	Not applicable	
Socioeconomic value	Medium	
Degree of disturbance	Low	
Intensity	Low	
Spatial scope	Local	
Duration	Short to medium	
Probability of occurrence	Medium to high	

8.5.3 IMPACTS ON USE OF THE TERRITORY AND ITS NATURAL RESOURCES IN THE OPERATIONS PHASE, AND MITIGATION MEASURES

No additional impacts other than the impact during construction is anticipated on land and resource use during the project's operations phase.

8.5.4 IMPACTS ON USE OF THE TERRITORY AND ITS NATURAL RESOURCES IN THE CLOSURE PHASE, AND MITIGATION MEASURES

No impact on use of the territory and its natural resources is anticipated during the closure phase. After closure, the rehabilitation and restoration work will have restored the natural character of the sites under study and adapted them to the surrounding environment.

8.6 FIRST NATIONS TRADITIONAL LAND USE

8.6.1 CURRENT CONDITIONS

Highlights pertaining to First Nation traditional land use

Existing conditions

- The traditional territory of Waswanipi is composed of 63 traplines. The local study area intersects two traplines, a significant portion of trapline W25B and a portion of trapline W25A.
- The land is predominantly used for hunting, fishing, trapping, and berry-picking activities.
- The users of traplines W25B and W25A talked about their specific use in consultations conducted in July 2018 and October 2022.

Potential impacts of the project

The expected impacts on Cree land users in the construction and operations phases are negative, but both positive and negative in the closure phase.

The negative effects include the disturbance of traditional activities in the local study area (hunting, fishing, trapping, berry-picking), loss of some traditional activity sites (W25B and W25A) where the mine infrastructure will be located, the perceived or actual alteration in the quality of available food resources due to the loss or deterioration of wildlife habitat (e.g., potential contamination of fish in lakes and watercourses downstream of the effluent discharge point), alteration of cultural practice and traditional experience on the land, and the adaptation by Cree land users to the presence of the mine.

The significance of the residual impact is considered low to medium in the construction phase and medium in the operations phase.

In the closure phase, the effect on the temporary disturbance of traditional activities during the closure work is very low. On the other hand, reuse and reappropriation of the mine site for traditional purposes constitutes a positive effect.

There are nine Cree communities in the Eeyou Istchee James Bay territory. Since the creation of beaver reserves in the 1930s, the Cree territory has been divided into traplines. Each trapline is under the responsibility of a tallyman, who is responsible for deciding each year which resources to harvest and which areas to preserve to ensure the renewal of the species harvested.

The traditional territory of the community of Waswanipi, near the project site, is composed of 63 traplines (Map 8-1). The LSA straddles two traplines; most of the LSA area is part of trapline W25B and a small portion is located on trapline W25A, as illustrated on Map 8-2 (LSA).

In general, the use of traplines is dominated by hunting, fishing, trapping, and berry-picking activities by land users. However, more precise information regarding the traditional use of each trapline was collected in July 2018 and October 2022 during interviews conducted with the main land users concerned. The information provided was validated through follow-up interviews in January and February 2023.

TRAPLINE W25B

GENERAL USE

It should be noted that the portion of the W25B trapline encroached upon by the LSA is about 12.9% of its total area (556 km²), and 0.38% if only the footprint of the existing and proposed project infrastructure is included.

During interviews conducted in 2018, the main users of W25B trapline indicated that they spent most of their time at their camp located 6 km southwest of the Windfall site, within the boundaries of the LSA, all year long. This includes three isolated camps. Their former camp was located north of their trapline, outside the LSA, on the shore of Father Lake, but since access to the camp was difficult, they replaced it with their current camp because the road was now open year round by Osisko. However, the former camp, only accessible by boat, is still used by their family members in the fall and spring.

In 2022, the tallyman and his wife stated that they have lived in their camp permanently since 2016 and that their family members visit them seasonally or sporadically, primarily but not only in the fall during moose hunting season and in the spring during goose hunting season. Some of their family members work at the Windfall site and therefore regularly stay at the camp.

There is also another camp on W25B trapline, 10.8 km northeast of the mine site and outside the LSA, belonging to another family of land users. Its owner stayed there occasionally in 2018, especially at the beginning of the summer season, notably for forestry contracts. In 2022, the family interviewed indicated that they have been using their trapline more in recent years. The main user stays there mainly in the summer for fishing in Roméo Lake, but also in the fall for moose hunting. He indicated that he sometimes goes there in the winter, but that ice fishing has been very occasional or not practised in recent years.

A marten monitoring project (Waswanipi Wapistan Project), coordinated by one of the users of trapline W25B and members of the community of Waswanipi, has been in progress since 2018 in the project area. Its objective is to study the impacts of forest, mining, and hydroelectric development on the habitat and habits of marten, primarily, but the study also includes other species. The project study area covers a large area that includes a portion of the local study area. One of the surveillance cameras used for this project is installed in the LSA near the projected infrastructure. It is shown on Map 8-2.

HUNTING, FISHING, AND TRAPPING

The tallyman and his family engage in their traditional activities throughout the trapline assigned to them, but mainly in its central and southern parts. The northern portion of the trapline is less used due to forestry activities.

Before there were mining exploration activities in the area, the father of the current tallyman fished and trapped near the Windfall site. This is no longer the case. He also fished at SN2 Lake east of the project site, within the watersheds studied in the context of the project. As part of the ichthyofauna studies conducted by Osisko in 2018, seven species of fish[8] were identified, which encouraged the tallyman to fish there. In October 2022, he indicated that his son fishes there regularly, primarily during the summer season.

Hunting activities, trapping (hare, partridge, bear, marten, and occasional moose) are also carried on along the access road to the mine site and on the roads running northward (on both sides of Windfall Lake), and the road located south of the existing exploration camp. However, the members of the W25B family do not hunt along the bypass road, which is located too close to the Windfall site facilities and could pose a risk to workers according to the tallyman. He indicated that he has seen almost no moose in the area since 2019 and, as a result, he has to travel further to hunt.

The area located 5 km south and southeast of the project, near Barry Lake, is used for goose and moose hunting, as well as pole and line fishing for walleye.

Moreover, the tallyman indicated that he traps beaver along Road R1053 (R6000) east and west of the mine site. It should be noted that a decrease in the beaver population has been noted since the forestry activities, according to the tallyman. He also traps marten near the Bonterra exploration camp for fur, which he sometimes sells when he accumulates enough.

Finally, the tallyman indicated in 2018 that he engaged in trout fishing activities in the northeastern part of the trapline outside the watersheds studied in the context of the project, primarily in the summer.

Ice fishing used to take place regularly, but not so much in the last decade or so.

BERRY PICKING

The main user of W25B used to pick blueberries around the project site. As it is becoming less attractive to pick in this area, she is moving further west to the edge of W25A trapline to pick. The members of the other family of trapline W25B also pick blueberries, which is part of the traditional diet, outside the LSA every year. It should be noted that the local study area has a large number of wild blueberry plants (velvetleaf and highbush blueberry), plant species with favourable habitat in the area, particularly due to the pervasive acidic soils, coniferous forest edges, and openings. The disturbances associated with logging or fire contribute even more to the reproduction of this species.

ACCESS AND TRAVEL

The tallyman's main camp is accessible via the main road, R1053 (R6000). There are also several forest accesses on the trapline, which can also be used by vehicle.

The land users use the power line rights of way near their camp, west of Windfall Lake, to travel by snowmobile or quad (ATV) in the area. They also use the line crossing the centre of the trapline from north to south by snowmobile in winter, in order to reach the camp north of the trapline and Father Lake for hunting purposes.

8 White sucker, lake cisco, lake whitefish, northern pike, yellow perch, walleye, and fallfish. The details of this inventory are presented in Chapter 7.

Motorboats are used for fishing and hunting in the Barry Lake area. They can travel fairly far on this lake and the river when the water level is high, when the ice melts.

CONSUMPTION OF TRADITIONAL FOOD

Because they live on the trapline, the W25B users consume plenty of traditional foods. During the summer period, they eat less of it, because this is not a hunting or fishing season, but they eat more fish (mainly walleye) than game. In winter, they consume more beaver, hare, moose, partridge, and bobcat. However, they preserve a little meat (such as moose) for the summer. They do not buy meat at the store in the winter, unlike in the summer. Before living permanently on the trapline, they bought meat at the grocery store almost every two weeks.

When the family gathers at the camp, they eat only traditional food. All the traditional food they eat comes from their W25B trapline.

They buy drinking water in Lebel-sur-Quévillon. For other domestic uses, water can be drawn at the mine sites (Osisko or Bonterra). For this purpose, Osisko is offering the tallyman and his family to fill water jugs. There are also other sources of supply on the trapline, such as the nearby lake on the southwest side of their camp, and other lakes outside the LSA.

In the past few years, the tallyman’s wife has occasionally cooked traditional dishes for the Cree workers at Osisko. She mainly cooks hare stew, doughnuts, and bannock at their request.

VALUED ZONES

The tallyman identified two valued zones in the local study area for moose hunting. The first is located in the Windfall Lake area north of the projected mine site. This is a valued zone because it is wooded, while the rest of the trapline is mostly swampy. In addition, another valued zone for moose is located south of the exploration camp near the tallyman’s camp.

Moreover, outside the LSA, there is a former burial site near the Barry Lake camp, and a burial site on the shore of Father Lake.

FUTURE USE OF THE TRAPLINE

During the 2018 and 2022 interviews, the W25B land users feared that it will no longer be possible to hunt of their trapline, particularly in the LSA sector, because of the strict health and safety rules that could be imposed by Osisko. However, this is not the mining company’s intention. The tallyman hopes that he will be able to leave a territory rich in traditional resources to future generations after the closure and restoration of the mine site. The youngest family members (son and nephew) like to hunt and are learning enthusiastically from the tallyman and his wife, according to the information reported in October 2022.

All the activities are moving east over time, due to the intensification of activities at the Windfall site, but they have not yet planned to build another camp for now.

TRAPLINE W25A

GENERAL USE

The main camp, 11 km north of the access road and 25 km west-northwest of the Windfall site, is located outside the LSA. It has seven camps. It is used sporadically in all seasons, but regularly by family members. The tallyman does not live there permanently. He stays there with his family mainly during traditional activities, such as moose hunting (moose break) in the fall and the goose hunting (goose break) in the spring. The second generation of the family visits the territory more regularly.

It should be noted that the portion of trapline W25A encroached upon by the local study area is about 1% of its total area (864 km²).

HUNTING, FISHING, AND TRAPPING

The main activity zones are found at the centre of the trapline, along Road R1053 (R6000) and north of trapline W25A. The users hunt, fish, and trap in this zone. They mostly hunt moose and fish mainly for walleye with poles, but also for pike. They do not do much ice fishing and they do not fish with nets.

The tallyman's father used to net for walleye in a lake near their camp, but today's users don't use nets because there is less water and it is harder to get around on the water. They even have to portage in some places that used to be navigable two decades ago.

This is not only a preferred location for hunting moose. One of the family members traps beaver for meat along Road R1053 (R6000) because he says the resource is plentiful there. He can usually trap up to 20 beavers a year.

No goose hunting was mentioned in the local study area. Canada geese are hunted in the spring in two zones (in the swamp and near a lake), located in the northeast sector of the trapline.

The users indicated in the October 2022 interview that they had to travel more to hunt moose, because its habitat has changed since the disturbances due to development of the territory.

BERRY PICKING

No berry picking activity was reported by the users of trapline W25A. It should be noted, however, that the topic was not specifically addressed in the 2018 and 2022 interviews.

ACCESS AND TRAVEL

The users mostly access the hunting zones of trapline W25A via the existing roads. In the past, the R1053 (R6000) road was used to bypass the trapline to reach its southern portion, but since the construction of the access road from the north in the 1980s, they have been using it because it is shorter. The Panache River is sometimes used as a waterway during the summer. Because of the need to portage some of the shallower areas, users prefer land access by truck, quad (ATV), and snowmobile.

CONSUMPTION OF TRADITIONAL FOOD

Users consume more traditional foods than other types of food. A family member mentioned that he can eat moose every day, if he can harvest enough. However, in recent years, they have seen almost no moose. They also eat beaver occasionally.

They obtain their drinking water supply by collecting spring water from the well they have dug near their camp.

VALUED ZONES

During the 2018 and 2022 interviews, the tallyman indicated he wanted to protect a sector east of his trapline, at the boundary with trapline W25B, but outside the LSA, southwest of the project site. This sector is valued because it is suitable for moose habitat due to its topography and dense vegetation.

A family burial site is also located near the main camp (outside the LSA).

FUTURE USE OF THE TRAPLINE

The tallyman of trapline W25A indicated he wanted to protect the land as much as possible so that his descendants can practise traditional activities. He wants to be able to keep the portions intact, but is worried about the many development activities in the sector.

8.6.2 IMPACTS ON FIRST NATION TRADITIONAL LAND USE IN THE CONSTRUCTION PHASE, AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the construction phase, the sources of potential impacts and the resulting impacts (**in bold**) likely to have an impact on First Nation traditional land use are as follows:

— Organization of the site, stripping and clearing, surface preparation and access arrangement, construction of works and infrastructure, transportation and traffic, as well as production and management of residual and hazardous materials.

These sources have the potential to result in the following impacts during the construction phase:

— **Disturbance of traditional activities in the local study area (hunting, fishing, trapping, berry-picking), which includes:**
  — Alteration of the use of the territory by Cree users of traplines W25B and W25A.
  — Alteration of the quantity of food resources available due to the change generated to the wildlife and plant habitat.
  — Alteration of cultural practice and the traditional experience in the territory.

MITIGATION MEASURES

Common mitigation measures relating to traditional land use UTT01 to 03, as well as the nuisance reduction measures AIR01 to 03, and 09, NOR01 to 03, FAU08 and 09, the measures for wildlife and habitat FAU01 to 09, vegetation and wetlands VEG01 to 04 and NOR16, and the measures relating to quality of life VIE01 to 03 will be applied to reduce as much as possible the negative impacts of the project on traditional land use by the tallymen concerned and their families. The following specific mitigation measures will also be implemented:

- Establish a new Environmental Monitoring Committee, (the terms of which will be specified in the IBA) to discuss and determine solutions to the issues that may arise during the mine's phases.
- Build a recreation centre accessible to all workers and a Cree cultural site with a teepee for First Nations workers to gather and practice traditional activities such as cooking, crafting, and storytelling.[9]

DETAILED DESCRIPTION OF RESIDUAL IMPACT

Traditional activities (hunting, fishing, trapping, berry-picking) of Cree users in the LSA could be disturbed or altered during the construction phase, despite the application of common and specific mitigation measures. In fact, it is important to remember that according to the consultations carried out with land users in 2018 and 2022, animal and plant species are harvested within the LSA, particularly moose, hare, and blueberries. Hunting and fishing activities could be affected by the species concerned moving away from or temporarily avoiding the sector, particularly during the clearing and operations of borrow pits. It should also be noted that the land users have already had to modify their practices in the sector and have adapted them to the presence of infrastructure associated with the work and exploration activities. The residual impact on blueberry picking in the LSA will be less significant than on hunting and fishing, due to the presence of other picking areas also suitable for the practice of this activity on trapline W25B and in the LSA.

Traffic on the road network, noise, vibrations, and activities related to construction of the mine, such as blasting, for example, could disturb certain wildlife species of interest, such as moose and hare, present near the mine site and the road infrastructure, resulting in their displacement to quieter sectors. Thus, the Cree land users, primarily those of traplines W25B and W25A, might have to move and alter their practices. It should be noted that the projected duration of this rock blasting work is slightly over four months (126 days). The vibrations will conform to the criterion of 12.7 mm/sec of MELCCFP D019.

9 This mitigation measure is already initiated by Osisko and under discussion with the tallyman of trapline W25B.

RESIDUAL IMPACT ASSESSMENT

It should be noted that all of the existing and proposed infrastructure encroachments are located on trapline W25B. Indeed, the existing and projected infrastructure of the mine site will have the effect of removing an area of about 2.1 km^2 from trapline W25B, which has a total area of 556 km^2, corresponding to a proportion of 0.38%. Although 1% of the area of trapline W25A is intersected in the LSA, there is no encroachment on this trapline by existing or projected infrastructure.

The application of mitigation measures will minimize the negative impacts on traditional land use in the construction phase. The socioeconomic value of the traditional use of the territory is medium since the Cree cultural and social identity of the users concerned is of significant importance, but not legally protected.

The sector hosting the proposed infrastructures has already been partially abandoned by land users even before the construction phase, which tempers the assessment of the degree of disturbance and the probability of occurrence.

The degree of disturbance thus is considered high for the users of trapline W25B because of the portion of the land encroached on by the project's footprint and its associated disturbances. This has a direct impact on the quantity of food resources available and forces them to alter their travel. However, the degree of disturbance is medium for the users of trapline W25A because the disturbances associated with Road R1053 (R6000) will be less condensed temporally and spatially, and due to their sporadic use of the land. The spatial scope of the anticipated residual effects is considered specific because the effects are likely to be only felt by the Cree land users who visit the LSA, namely the families of traplines W25B and W25A. The duration is short because the impact will occur during the construction phase, which is less than two years (18 months).

The probability of occurrence is considered medium for both traplines W25B and W25A since the impact could occur. However, the wildlife and the land users have already abandoned the sector, so it is not assured that additional changes will occur. The overall significance of the impact on land use is therefore considered low to medium in the construction phase.

Impacts on First Nation traditional land use in the construction phase		
Nature	Negative	Significance: Low to medium
Ecosystem value	Not applicable	
Socioeconomic value	Medium	
Degree of disturbance	Medium to high	
Intensity	Medium to high	
Spatial scope	Specific	
Duration	Short	
Probability of occurrence	Medium	

8.6.3 IMPACTS ON FIRST NATION TRADITIONAL LAND USE IN THE OPERATIONS PHASE, AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the operations phase, the sources of potential impacts and the resulting impacts (**in bold**) likely to have an impact on First Nation traditional land use are as follows:

— The presence and operation of new infrastructure, water use and management, transportation and traffic, and the production and management of residual and hazardous materials

These sources have the potential to result in the following impacts during the operations phase:

— **Disruption of traditional activities in the local study area (hunting, fishing, trapping, berry-picking), which includes:**
  — Alteration of use of the territory by the Cree users of traplines W25B and W25A because they are adjacent to the infrastructure planned for the 10 years of operations of the mine.
  — Perceived or actual alteration in the quality of available food resources due to loss or degradation of wildlife habitat (e.g., potential contamination of fish in lakes and watercourses downstream of the effluent discharge point).
  — Alteration of cultural practice and the traditional experience in the territory.

— **Adaptation by Cree land users due to the presence of the mine.**

MITIGATION MEASURES

Common mitigation measures relating to traditional land use UTT01 to 03, as well as the nuisance reduction measures AIR01 to 03, AIR09, NOR01 to 03, NOR13, FAU08 and 09, the measures for wildlife and habitat FAU01 to 09, vegetation and wetlands VEG01 to 04 and NOR6, and the measures relating to quality of life VIE01 to 03 will be applied to minimize the project's impacts on traditional land use by the tallymen concerned and their families in the operations phase. The following specific mitigation measures will also be implemented:

— Establish a new Environmental Monitoring Committee, (the terms of which will be specified in the IBA) to discuss and determine solutions to the issues that may arise during the mine's phases .

DETAILED DESCRIPTION OF RESIDUAL IMPACT

Mine operations will result in disturbance of traditional activities in the LSA, particularly due to the close proximity of land surrounding the proposed mine infrastructure that is used for traditional activities such as blueberry picking, moose hunting, hare trapping, and fishing.

It should be noted that, with the development of the project's infrastructure, users of this territory have indicated that they consider to move their activities elsewhere on trapline W25B, particularly to the east-northeast, for at least the next decade. This change alters cultural practices and the traditional experience in general in the territory.

At the same time, users of the two aforementioned traplines will have to adapt to the presence of the mine and its daily operations, although the adaptation process has already begun with the start of exploration activities in 2015.

Moreover, as mentioned during the 2018 and 2022 consultation activities, the users' perception of the quality of wildlife resources harvested for consumption on the land near the mine could be affected, leading to their loss of interest in this portion of their trapline. This is particularly the case for fish caught downstream from the discharge point of the future mine effluent. Currently, the users do not fish in the watershed of the site effluent.

RESIDUAL IMPACT ASSESSMENT

It should be noted that the area hosting the proposed infrastructure has already been partially abandoned by users even before the construction phase, which will temper the assessment of the degree of disturbance and the probability of occurrence. The application of mitigation measures will help minimize negative impacts on traditional land use during the operations phase. The socioeconomic value of the traditional use of the territory is medium since the Cree cultural and social identity of the users concerned is of significant importance, but not legally protected. The degree of disturbance is medium for the users of the two traplines because it leads to a reduction of the quality of the experience in the territory for a 10-year period, but without compromising its integrity. The intensity therefore is medium.

The spatial scope of the anticipated residual effects is considered specific because they are likely to be only felt by the Cree land users who visit the local study area, namely the families of traplines W25B and W25A. The duration is medium because the impact will be felt continuously throughout the life of the mine, which is currently estimated at 10 years. The probability of impact occurrence is medium because impacts could occur but are not assured. The overall significance of the impact on land use in the operations phase is therefore considered medium.

Impacts on First Nation traditional land use in the operations phase		
Nature	Negative	Significance: Medium
Ecosystem value	Not applicable	
Socioeconomic value	Medium	
Degree of disturbance	Medium	
Intensity	Medium	
Spatial scope	Specific	
Duration	Medium	
Probability of occurrence	Medium	

8.6.4 IMPACTS ON FIRST NATION TRADITIONAL LAND USE IN THE CLOSURE PHASE, AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the closure phase, the sources of potential impacts and the resulting impacts (**in bold**) likely to have an impact on First Nation traditional land use are as follows:

— The presence of the remnants of the site, production and management of residual and hazardous material, and final restoration.

These sources have the potential to result in the following impacts during the closure phase:

— **Temporary disturbance of traditional activities during closure work.**

— **Reuse and reappropriation of the mine site for traditional purposes.**

MITIGATION MEASURES

Common mitigation measures relating to traditional land use UTT01 to 03, as well as the nuisance reduction measures AIR01 to AIR09, NOR01 to 03, NOR13, FAU08 and 09, the measures for wildlife and habitat FAU01 to 09, vegetation and wetlands VEG01 to 04 and NOR16, and the measures relating to quality of life VIE01 to 03, will be applied to maximize the reduction of the project's impact on traditional land use by the tallymen concerned and their families in the closure phase. The following specific mitigation or enhancement measures will also be implemented:

— Establish a new Environmental Monitoring Committee (the terms of which will be specified in the IBA) to discuss and determine solutions to the issues that may arise during the mine's phases.

— Work with the W25B and W25A tallymen to rehabilitate, restore, and revegetate the site and return it to its natural state.

DETAILED DESCRIPTION OF RESIDUAL IMPACT

The activities associated with closure of the mine will have similar but less intense effects over a shorter period than those generated by the construction phase and the operations and maintenance phases. The activities of the Cree users on traplines W25B and W25A, included in the local study area, could be disturbed temporarily by the activities related to closure of the mine and road traffic. Thus, moose hunting, in particular, could be affected. Common mitigation measures applied will limit these negative effects.

On the other hand, the rehabilitation and final restoration of the site will allow a portion of the area affected by the mine to be reused and reappropriated for traditional activities, which constitutes a positive effect. Also, whenever possible, certain facilities (building, parking, etc.) could be left in place, at the request of the tallymen of traplines W25B and W25A. After closure, the rehabilitation and restoration work will have the effect of restoring the natural character of the sites under study, adapted to the surrounding environment.

RESIDUAL IMPACT ASSESSMENT

The application of the mitigation measures will minimize the negative impact on traditional land use in the closure phase. The socioeconomic value of traditional use of the territory is medium since the Cree cultural and social identity of the users concerned is of significant importance, but not legally protected. The nature is negative for this effect, but also positive since the effect felt will fade as the mine site is reused and reappropriated for traditional purposes. The spatial scope of the anticipated residual effects is considered specific because they are likely to be only felt by the Cree land users who visit the local study area, namely the families of traplines W25B and W25A. The duration of the temporary disturbance of traditional activities is short for the closure period because the dismantling work will last less than two years (one year). The degree of disturbance is low because the users of the traplines concerned will probably have abandoned a portion of their territory and will have adapted their traditional activities throughout the years of operation of the mine. The probability of occurrence is medium since the impact could occur on the component, but it is not assured. The significance of the negative residual impact is considered very low.

<table>
<tr><th colspan="3">Impacts on First Nation traditional land use in the closure phase</th></tr>
<tr><td>Nature</td><td>Positive/Negative</td><td rowspan="8">Significance:
Reuse and reappropriation of the site - Positive impact
Temporary disturbance of traditional activities during closure work - Very low (-).</td></tr>
<tr><td>Ecosystem value</td><td>Not applicable</td></tr>
<tr><td>Socioeconomic value</td><td>Medium</td></tr>
<tr><td>Degree of disturbance</td><td>Low</td></tr>
<tr><td>Intensity</td><td>Low</td></tr>
<tr><td>Spatial scope</td><td>Specific</td></tr>
<tr><td>Duration</td><td>Short</td></tr>
<tr><td>Probability of occurrence</td><td>Medium</td></tr>
</table>

8.7 INFRASTRUCTURE

Highlights regarding infrastructure

Existing conditions

- The regional study area is crossed by Quebec Road 113 and a railway and contains six power transmission lines.
- Two airports are found in the regional study area. The first is municipal and is located in Lebel-sur-Quévillon; the second is under the management of the Ministère des Transports du Québec and is located between Chapais and Chibougamau.
- The existing logging roads R1050 (R1000), R0853 (R5000), and R1053 (R6000) will serve as access roads for the mine.
- The local study area is mostly composed of the area where the current and projected mine infrastructure is found.

Potential impacts of the project

The volume of traffic on the access road between the mine site and the urban area of Lebel-sur-Quévillon will increase due to the movement of workers and the transportation of supplies. Vehicles will not be required to drive through the city. However, this increase should not be felt by other users of the access road.

In short, although the socioeconomic value and intensity of the impact are of medium significance, the residual impact remains low.

8.7.1 CURRENT CONDITIONS

ROAD INFRASTRUCTURE

Quebec Road 113 crosses the western part of the regional study area (Map 8-1). Toward the northeast, it connects Lebel-sur-Quévillon to Road 167, passing through Waswanipi. The northern end of Road 113 (at the junction of Road 167) is located about ten kilometres south of Chibougamau. South of the RSA, Road 113 intercepts Road 397, which runs to Val-d'Or, and passes through Senneterre in Abitibi-Témiscamingue up to Road 117 in Saguenay–Lac-Saint-Jean. Finally, the RSA is criss-crossed by numerous logging roads. The existing logging roads R1050 (R1000), R0853 (R5000), and R1053 (R6000), which connect Lebel-sur-Quévillon to the Windfall project site, will serve as the main access roads for the mine for approximately 115 kilometres.

The roads used are in forest areas and are under the responsibility of the MRNF; however, road maintenance is the responsibility of paying users. In this context, the roads are maintained most of the time by the forest companies operating the areas they serve. In general, in the absence of forest activity, the roads are maintained less and sometimes left to deteriorate. In recent years, in 2018 and 2020, Osisko mandated its consultant to carry out inspections on the main access road, and in 2022, the consultant carried out a final inspection. During the last inspection, the consultant was able to note a positive trend in the condition of the road since Osisko took over its maintenance, as the forest companies had only done minimum maintenance. The road no longer requires repair, and except for the wing walls of the Wetetnagami bridge, only regular maintenance is foreseen. It should also be noted that the road will not be used for intensive transportation of ore, but only for the construction and operation of the site.

Osisko has also done some work on the R1053 (R6000):

- clearing 5 m on each side of the road;
- maintenance of traffic signals and signs;
- repair of the bridge deck at km 63;
- replacement of culverts;
- spreading of over 30 tonnes of gravel to maintain the road surface.

In addition to the forest industry using the roads, there are also hunting camp entrances adjacent to the road. According to the survey of land users conducted for this study (see Chapter 4 for more details), despite the fact that the forestry companies no longer maintain them, the roads are plowed in winter and are very well maintained by Osisko Mining. It should also be noted that Osisko is currently grading the roads frequently and as needed to ensure safe roads for all users at all times.

CURRENT TRAFFIC FLOW

During a traffic study conducted in 2018, traffic counts were performed in the field to determine the current traffic flows on the section of access road connecting Lebel-sur-Quévillon to the Windfall project. The traffic count was conducted at the junction of Roads R1050 (R1000) and R0853 (R5000) (km 12), i.e., at the entrance of the logging roads that will serve as the access road to the mine site.

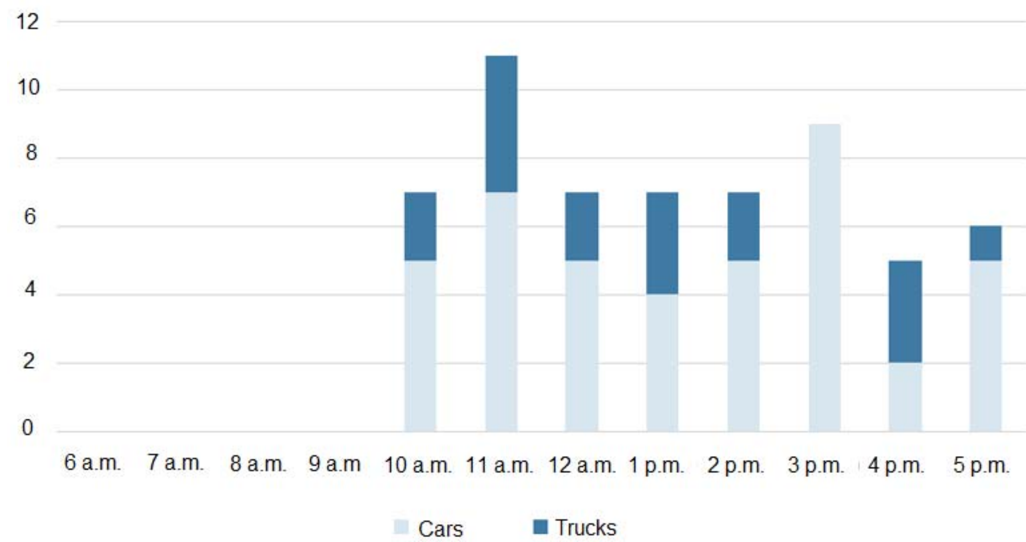
Photo 8-1 Area where the count was conducted – Road 0853 (R5000) (at km 15)

The counts were conducted in the spring of 2018, the busiest period on the logging roads in the area,[10] on a weekday, during a period of 12 consecutive hours, from 6 a.m. to 6 p.m. (Photo 8-1).

The surveys show that the current traffic flows on the section of Road 0853 (R5000) connecting the Windfall project to the town of Lebel-sur-Quévillon are fairly low and spread out between 9:30 a.m. and 6:00 p.m., reaching a maximum hourly volume of 11 vehicles, including four trucks at midday.

10 Source: Produit forestier résolu (Usine Comtois), 2050, route N805, Lebel-sur-Quévillon (Québec) J0Y 1X0. MTMDET, Bureau de la coordination du Nord-du-Québec.

Figure 8-3 Current traffic flows on Road 0853 (R5000)



AVERAGE ENTRY/EXIT AT THE WINDFALL MINE SITE GATEHOUSE.

According to information collected at the mine site gatehouse, between June and August 2022, there was an average of about 176 arrivals per week. The highest volume in a week was 230 arrivals, while the lowest volume was around 140 arrivals.

Other interesting facts: more than half (67%) of the vehicles registered at the gatehouse were light vehicles (pickups and minivans), while the remaining 33% were heavy vehicles (flatbeds, buses, tank trucks).

RAILWAY INFRASTRUCTURE

A Canadian National (CN) railroad, or more specifically the Canadian National Railway Company (CNRC), crosses the western part of the RSA, east of Quévillon Lake (Map 8-1). To the northwest, the railway runs a few kilometres south of Matagami and, in the south, it reaches the CN railway network and the municipality of Senneterre (CN, 2022).

AIRPORT INFRASTRUCTURE

A municipal airport is located approximately 4 km southwest of the centre of Lebel-sur-Quévillon in the RSA (Map 8-1). It is administered by the municipality. It offers air transportation services five days a week and on call on weekends (Ville de Lebel-sur-Quévillon, 2022).

To ensure the development of the airport area over the next few years, as traffic is expected to increase, the municipal government commissioned a consulting firm specializing in air transportation to develop a master development plan for the airport that would take into account its immediate needs while also considering its long-term development. The firm first proceeded with an assessment of the economic context, and then conducted a consultation process with the users to determine their needs at the airport and their potential impacts on both air and ground operations (OCTAN, 2022). In 2022, the airport parking lot was expanded to accommodate the growing number of Osisko users as it is the pick-up point for employees travelling by their own means.

In 2019, Lebel-sur-Quévillon announced its intention to develop a regular air service for its residents. In general, the flights come weekly from Québec and Saint-Hubert. They essentially transport mine and paper mill workers. The airport is also used for medical evacuations (MedEvacs), by the Société de protection des forêts contre le feu (SOPFEU), and by helicopters (Radio-Canada, 2019).

It should be noted that Windfall mine workers from southern Quebec will continue to transit through the Lebel-sur-Quévillon airport and then access the mine by road via shuttle buses.

The RSA also has access to the Chibougamau-Chapais Airport, which is located on Road 113 midway between the towns of Chibougamau and Chapais, and is approximately 20 kilometres from Chibougamau. Founded in 1982, this government airport is under the responsibility of Transport Québec. Equipped with adequate and functional infrastructure, an air terminal, a parking lot, and a refuelling stop for private seaplanes, the airport plays a central economic role in the Jamésie region (Développement Chibougamau, 2015).

ENERGY INFRASTRUCTURE

Currently, six power transmission lines operated by Hydro-Québec cross the regional study area (Map 8-1).

Eventually, the Windfall project's power distribution grid will connect to the 69 kV/13.8 kV transformer station, a network of towers and distribution cables (both overhead and underground). 13.8 kV/600 V power substations, 600 V distribution panels, and 120/240 V transformers and service panels.

8.7.2 IMPACTS ON INFRASTRUCTURE IN THE CONSTRUCTION PHASE AND MITIGATION MEASURES

During the construction phase, the source of potential impacts and the resulting impacts (**in bold**) likely to have an impact on infrastructure are as follows:

— Transportation and traffic.

This source have the potential to result in the following impacts during the construction phase:

— **Potential for traffic disruptions on the main access road.**

— **Premature deterioration of roads due to increased heavy truck traffic and transportation.**

— **Increased demand for airport services.**

MITIGATION MEASURES

The common mitigation measures relating to the speed limit AIR02, VIE02, the risk of collision with large mammals FAU04, and dialogue with the population VIE02, as well as the measures concerning cleaning of public roads INF01, which concern infrastructure, will be applied to minimize the project's impacts in these areas. They are presented in Appendix 5-2. During the construction phase, the following specific mitigation measures will also be implemented:

- Continue to inform the public about the progress of the project, upcoming major work, environmental impacts and preventive measures to mitigate them, as well as the safety measures in place.

DESCRIPTION OF RESIDUAL IMPACT

POTENTIAL FOR TRAFFIC DISTURBANCE ON THE MAIN ACCESS ROAD

It is not anticipated that the project will generate a high level of trucking. The project nonetheless will generate a certain traffic volume between the site and the urban zone of Lebel-sur-Quévillon. This traffic will mainly be related to trips by workers and to supply of the site. Most workers will work on a rotating schedule of 15 days on site and 13 days off site, while a minority will work on a rotating schedule of 8 days on site and 6 days off site. Currently, every Thursday, charter flights bring workers from Saint-Hubert, Quebec City, and Bagotville to Lebel-sur-Quévillon Airport. The same day, a worker bus also makes a trip from Rouyn-Noranda, passing through Val-d'Or and Senneterre to Lebel-sur-Quévillon. Moreover, on Thursdays, a second worker bus makes the trip from Chibougamau, passing through Chapais and Waswanipi bound for Lebel-sur-Quévillon. Workers arriving by charter planes and the two buses are transported from Lebel-sur-Quévillon by bus to the Windfall mine site. Other buses transport various employees and contractors to the mine site, every day from Monday to Thursday. The transportation details are not yet known for the construction phase but the current practices will be maintained, probably with a greater number of trips because there will be 1,100 workers on the project (in two sequences).

For the construction phase, the number of trips is estimated at 3,200. It should be noted that this estimate does not include transportation of workers and is only for travel associated with materials and various inputs. Traffic from the project will add to the volume of vehicles already on the access road, but is not expected to have a significant impact on users. In addition, Osisko's current trips will be replaced, so additional demand must be analyzed.

PREMATURE DETERIORATION OF ROADS DUE TO INCREASED HEAVY TRUCK TRAFFIC AND TRANSPORTATION

Osisko's access and traffic flow strategy promotes the use of existing roads that it is maintaining. The territory in which the project is integrated is criss-crossed by a network of logging roads, including the main logging roads R1050 (R1000), R0853 (R5000), and R1053 (R6000), which connect Lebel-sur-Quévillon to the Windfall project site. Many secondary logging roads are attached to these main logging roads and allow land users to reach their facilities. However, certain road sections could require repair work.

INCREASED DEMAND FOR AIRPORT SERVICES

Because the governance model of Lebel-sur-Quévillon Airport is based on the user-pay principle, the local airport administration imposes aeronautical fees on airlines that use the facilities. A mine project, such as Windfall, will generate increased demand for airport services and should result in increased revenues for the city.

RESIDUAL IMPACT ASSESSMENT

The nature of the anticipated impact is negative, specifically concerning the nuisances associated with transportation during the construction and operations phase, but positive concerning the benefits for Lebel-sur-Quévillon Airport, and consequently for the municipality. The socioeconomic value of the infrastructure is medium, because the access road will be the only major land transportation route between Lebel-sur-Quévillon and the mine project. The degree of disturbance is considered low, which will result in an impact of medium intensity. The spatial scope of the impact will be local since the road traffic related to the project should be limited to the territory of Lebel-sur-Quévillon for the activities generating the most traffic (trips by workers and supply of the site). The impact will be felt over a short period of time, i.e., the few years that construction will last. The probability of occurrence of the impact is high, considering that it is certain that the project will require transportation. The significance of the residual impact is therefore very low.

Impacts on infrastructure in the construction phase		
Nature	Positive/Negative	Significance: Very low
Ecosystem value	Not applicable	
Socioeconomic value	Medium	
Degree of disturbance	Low	
Intensity	Medium	
Spatial scope	Local	
Duration	Short	
Probability of occurrence	High	

8.7.3 IMPACTS ON INFRASTRUCTURE IN THE OPERATIONS PHASE AND MITIGATION MEASURES

No additional impacts other than those during construction are anticipated on infrastructure during the project's operations phase.

8.7.4 IMPACTS ON INFRASTRUCTURE IN THE CLOSURE PHASE AND MITIGATION MEASURES

No impact on the infrastructure is anticipated during the closure phase. After closure, the rehabilitation and restoration work will have restored the natural character of the sites under study and adapted them to the surrounding environment. Following the end of the mine's activities and the post-operation period, the Windfall project will generate very little traffic on the main access road and thus will have no more impact on the potential of traffic disturbance and deterioration of the road.

8.8 HERITAGE AND ARCHAEOLOGY

Highlights on heritage and archaeology

Existing conditions

- An initial study was conducted in 2007 to assess the archaeological potential on the western portion of the Windfall project site. Following the recommendations of this study, an archaeological inventory was conducted in 2017-2018. No archaeological material was found in the inventory zone.
- An archaeological potential assessment study was conducted in 2022. This study covered the eastern section of the project site, encompassing SN2 Lake and the proposed site of the tailings storage facility.
- Four zones of archaeological potential were identified. Two zones with archaeological potential are located north of SN1 Lake, and the other two zones are found respectively on the eastern shore of SN6 Lake and western shore of SN2 Lake.
- The identified zones with archaeological potential would have been appropriate for early First Nations occupation due to the flat topography, good drainage, and proximity to a water body. These zones have moderate archaeological potential.

Potential impacts of the project

The various construction work could uncover archaeological or historical remains on the Windfall project site. However, this probability is low, considering that no infrastructure is currently projected in the identified zones with potential and that mitigation measures will be implemented by Osisko to limit the risks of alteration of the archaeological remains. The significance of the residual impact in the construction phase is considered low. No impact is anticipated during the operations and closure phases.

8.8.1 CURRENT CONDITIONS

The local study area of the social environment does not contain any heritage site or building registered in the Répertoire du patrimoine culturel du Québec of the Ministère de la Culture et des Communications (MCC, 2013).

An initial study was conducted in 2007 to assess the archaeological potential on the western portion of the Windfall project site (Arkéos, 2022; Appendix 8-1). Following the recommendations of this study, an archaeological inventory with manual probing and visual inspection (1,028 borings) was conducted in 2017-2018. No archaeological material was found in the inventory zone. Two members of the Waswanipi Cree community participated in this inventory to incorporate traditional knowledge into the research. During the 2022 consultative activities, the Cree users of traplines W25B and W25A confirmed that, to their knowledge, there were no artifacts or archaeological sites on their traplines. They did, however, mention some cultural and burial sites outside the LSA, particularly on the shore of Father Lake.

An archaeological potential assessment study was conducted in 2022 to cover the eastern portion of the Windfall project (Arkéos, 2022; Appendix 8-1). The study area, which extends over an area of 5.14 km^2, includes the projected location of the tailing storage facility, as well as SN2 Lake, both of which are located in the eastern portion of the site.

According to this study, the initial population south of James Bay dated back around 5000 years BP. The territory of the study area was free of ice and water in this period and evidently habitable. The south portion of Eeyou Istchee territory is still unknown archaeologically. About forty archaeological sites are inventoried in the region, but none is found near the study area. The two least distant sites are found about 13 km south of the Windfall site, on the shores of the Saint-Cyr River. These two prehistoric First Nations sites were discovered in the late 1970s during the inventory work for the construction of power transmission lines.

The analysis of the data collected during the study allowed identification of four zones with archaeological potential in the study area (Map 8-2). Zone 1 extends from the northeast shore of SN1 Lake to the northwest shore of SN4 Lake. In the same area, Zone 3 is located north of SN1 Lake, near CE12 Lake. Farther east, Zone 2 is on the eastern shore of SN6 Lake, while Zone 4 covers the western shore of SN2 Lake. The study area seems to have been a suitable place to accommodate Algonquin seasonal winter camps during the post-colonial period. Also, the identified areas of potential would have been favourable for early First Nations occupation due to the flat topography, good drainage, and proximity to a water body. These zones have moderate archaeological potential. There is no projected infrastructure in these zones with potential.

It should be noted that there is little archaeological evidence of early First Nations occupation in the study area, but this is mainly due to the limited archaeological knowledge in the southern part of James Bay. The identified areas of potential could still reveal traces of ancient occupation. Other than these areas, the rest of the study area has no archaeological potential due to the numerous wetlands and poor drainage. The low number of zones with potential is also associated with the fact that the project site is located at the head of watersheds.

8.8.2 *IMPACTS ON HERITAGE AND ARCHAEOLOGY IN THE CONSTRUCTION PHASE, AND MITIGATION MEASURES*

SOURCES OF POTENTIAL IMPACTS

During the construction phase, the sources of potential impacts and the resulting impacts (**in bold**) likely to have an impact on heritage and archaeology are as follows:

— Organization of the construction site, stripping and clearing, surface preparation and access arrangement, and construction of works and infrastructure.

These sources have the potential to result in the following impacts during the construction phase:

— **Uncovering or altering any archaeological or historical remains**

MITIGATION MEASURES

The common mitigation measures ARC01 to 04 will be applied to minimize the project's impacts on heritage and archaeology in the construction phase. They are presented in Appendix 5-2.

DETAILED DESCRIPTION OF RESIDUAL IMPACT

UNCOVERING OR ALTERING ANY ARCHAEOLOGICAL OR HISTORICAL REMAINS

It should be remembered that according to the complementary study carried out in 2022, four zones of moderate archaeological potential were identified in the study area.

The various work involved in organizing the site, preparing and laying out the surfaces, as well as the construction of works and infrastructure, may uncover archaeological or historical remains on the Windfall project site. However, this probability is low given that no infrastructure is currently planned in the identified zones with potential. Based on the recommendations of the study of archaeological potential, Osisko will implement several measures to limit the risk of alteration of potential archaeological remains. First, in the event of alteration of the right of way of the projected infrastructure and of the construction work that would affect the zones with archaeological potential that have not been inventoried, an archaeological inventory will be carried out before the construction phase by means of manual probes spaced 10 m apart within these zones. In case of discovery of an important archaeological site, two options will be considered, either to proceed with a complementary inventory or to conduct a targeted dig that will allow sampling of the site before its destruction by the work. On the other hand, if archaeological remains are discovered outside the potential zones during the performance of the work, the work will be stopped pending assessment by an archaeologist and the regional office of the Ministère de la Culture et des Communications will be contacted.

RESIDUAL IMPACT ASSESSMENT

The socioeconomic value of heritage and archaeology is high considering its importance for specialists and First Nations communities, and the legal or regulatory protective measures applicable to this component. The degree of disturbance is considered low due to the mitigation measures that will be implemented to limit the risks of alteration of the remains in case of discovery. The intensity therefore is medium. The spatial scope is specific because only the site's potential archaeological remains will be affected. The duration is short, because the construction period will last less than two years, i.e., 18 months. The probability is low considering that there is no planned infrastructure in the identified potential areas. The significance of the impact is low.

Impact on heritage and archaeology in the construction phase		
Nature	Negative	Significance: Low
Ecosystem value	Not applicable	
Socioeconomic value	High	
Degree of disturbance	Low	
Intensity	Medium	
Spatial scope	Specific	
Duration	Short	
Probability of occurrence	Low	

8.8.3 IMPACTS ON HERITAGE AND ARCHAEOLOGY IN THE OPERATIONS PHASE AND MITIGATION MEASURES

No impact on heritage and archaeology is expected during the operations phase. In fact, in the operations phase, the project's footprint will not extend beyond the one that will have been established during the construction work. However, Osisko will remain attentive to the potential discovery of any evidence of archaeological interest.

8.8.4 IMPACTS ON HERITAGE AND ARCHAEOLOGY IN THE CLOSURE PHASE AND MITIGATION MEASURES

No impact on heritage and archaeology is expected during the closure phase. However, Osisko will remain attentive to the potential discovery of any evidence of archaeological interest.

8.9 LANDSCAPE

Highlights regarding the landscape

Existing conditions

The landscape study identified four landscape units in the study area: Windfall Lake (LAC-1), Macho River (RIV-1), Saint-Cyr River (RIV-2), and Panache and Fortier River. The results of the sensitivity analysis show a higher sensitivity of the Windfall Lake and Macho River landscape units due to the presence of cabins, their recreational use, and higher potential visibility. Visual considerations include preserving views from cabins and other recreational sites, protecting existing landforms and forest cover, and revegetating disturbed sites that could provide visual access to the Windfall mining project.

Potential impacts of the project

During the construction phase, the infrastructure likely to alter the landscape components and fields of vision associated with landscape unit LAC-1 is the expansion of the borrow pit and the construction of the mining camp complex near road R1053 (R6000). The construction of the new plant and the expansion of the waste rock stockpile, the overburden stockpile, and the ponds will alter the components and fields of vision of the RIV-1 landscape unit, while the tailings storage facility, a second overburden stockpile, and ponds are the main infrastructure that will alter the landscape of the RIV-2 unit. Landscape unit RIV-3 is not assessed, given that it has no anticipated impact on the landscape and on the integrity of the fields of vision of its observers. The significance of the residual impact is considered medium to low for these three units in the construction period.

During the operations phase, the views directly provided from the cabin located northwest of Windfall Lake (LAC-1) will not be affected by the mining project, but limited views of the tailings storage facility could be offered directly from the lake, when its height will exceed the existing forest cover. The progressive restoration measures for the tailings storage facility will allow reduction of this visual impact. In landscape unit RIV-1, the views offered directly from the cabin and the First Nations camp will not be affected by the new infrastructure due to the topography and the existing forest cover. The expansion of the waste rock stockpile could be visible for observers travelling on SN1 Lake when its height will exceed that of the forest cover. It is unlikely that the new infrastructure will be visible from Rouleau Lake (RIV-2), but view corridors may exist for recreational users from the more open sectors (peatlands, marsh, logging site, etc.).

All of the site restoration measures planned during the closure phase will restore the natural character of the landscape. The residual impact during closure is considered positive for the landscapes of Windfall Lake, the Macho and Saint-Cyr Rivers, and their associated fields of vision.

8.9.1 CURRENT CONDITIONS

STUDY AREA

To describe and analyze the effects of the Windfall project on the landscape, the spatial boundaries chosen are based on the local study area of the social environment (Map 8-2). This zone also considers the components of the landscape and the fields of vision of the observers likely to be affected by the mining project.

METHODOLOGY

The approach proposed in the context of the study of the visual environment conforms to the classical approaches of analyzing the landscape, developed in the context of the environmental assessment of mining infrastructure projects, while being adapted to the particularities of the study area, and the nature and scale of the project.

The first stage of the approach is to validate the study area, prepare an inventory protocol, and collect the necessary data for the landscape study. The second activity aims to produce the landscape inventory as such by describing the regional landscape and the landscape units specific to the study area. The delineation of the landscape units and their description are based on satellite images, orthophotos, and topographic maps and are completed with data from studies on the social and biophysical environments conducted as part of the environmental impact assessment. The inventory serves, in particular, to identify the sight lines and the strategic observation sites, the different types of observers, and the landscape sites of interest.

To do this, a field visit was conducted to obtain a photographic inventory of the landscape of the study area. The characterization of landscape is completed by an analysis of the planning documents pertaining to the aspects of landscape protection and development by the various local and regional actors (land use and development plan, urban plan, tourism association, etc.).

The results of the landscape analysis are illustrated on a landscape map (Map 8-3).

The final activity is to analyze the sensitivity of each of the landscape units to the introduction of new infrastructure. The degree of sensitivity is analyzed according to the criteria of visual accessibility (degree of visibility), level of visual interest (attraction, discordance) and the value attached to the landscape by the population (recreational site, territory of aesthetic interest, observation site, etc.). The detailed analysis makes it possible to identify the most sensitive landscape components of the study area, to measure the relative importance of the visual issues that may be raised by the project, and to target the most important aspects that must be considered to ensure the harmonization and landscape integration of the mining project components.

REGIONAL LANDSCAPE

The regional study area is located within the Mistassini Highlands and James Bay Natural Province (Li and Ducruc, 1999) and is part of the Saint-Cyr Lake regional landscape unit (Robitaille and Saucier, 1998). It is characterized by a gently rolling plain with very gently sloping hillsides (less than 400 m), eskers, and vast peatlands dominated by spruce-moss stands. It is part of the Opawica River watershed and contains many watercourses, lakes, and wetlands, which are mostly oriented on a southwest and northeast axis. This natural landscape is sparsely populated and mainly used for hunting, fishing, and vacationing. The entire study area is on public land. Road 113 is the main access road from which many logging roads lead.

LOCAL LANDSCAPE

The landscape inventory of the social environment study area delineated homogeneous landscape units that are distinguished by their particular composition of landforms, forest cover, land use, and the types of views they provide to observers. Each of the landscape units was assessed according to the following criteria:

- **Visual accessibility**, determined by the specific composition of the landscape (relief, hydrography, vegetation, land use), the identification and importance of the types of observers who perceive the landscape unit, the degree of openness of the fields of vision (open, screened, closed), and the capacity of the landscape components to absorb or insert a new infrastructure.
- **Visual attraction**, determined by the intrinsic value of the landscape, its special character, its general ambiance, the harmony of its components, the dynamism and diversity of its landscape composition, special vistas and views, the interest in landscape viewing activities, elements of visual discordance and degradation, and elements of viewer orientation.
- **Value or enhancement**, represented by the cultural, symbolic, and historical significance of the landscape and its special elements, amenity developments, legal protections, tourist visitation, observer preferences, and the vocation of the landscape.

A more precise analysis of the study area allowed the determination of four landscape units, distinguished from each other by their special composition and their degree of sensitivity to the mining project.

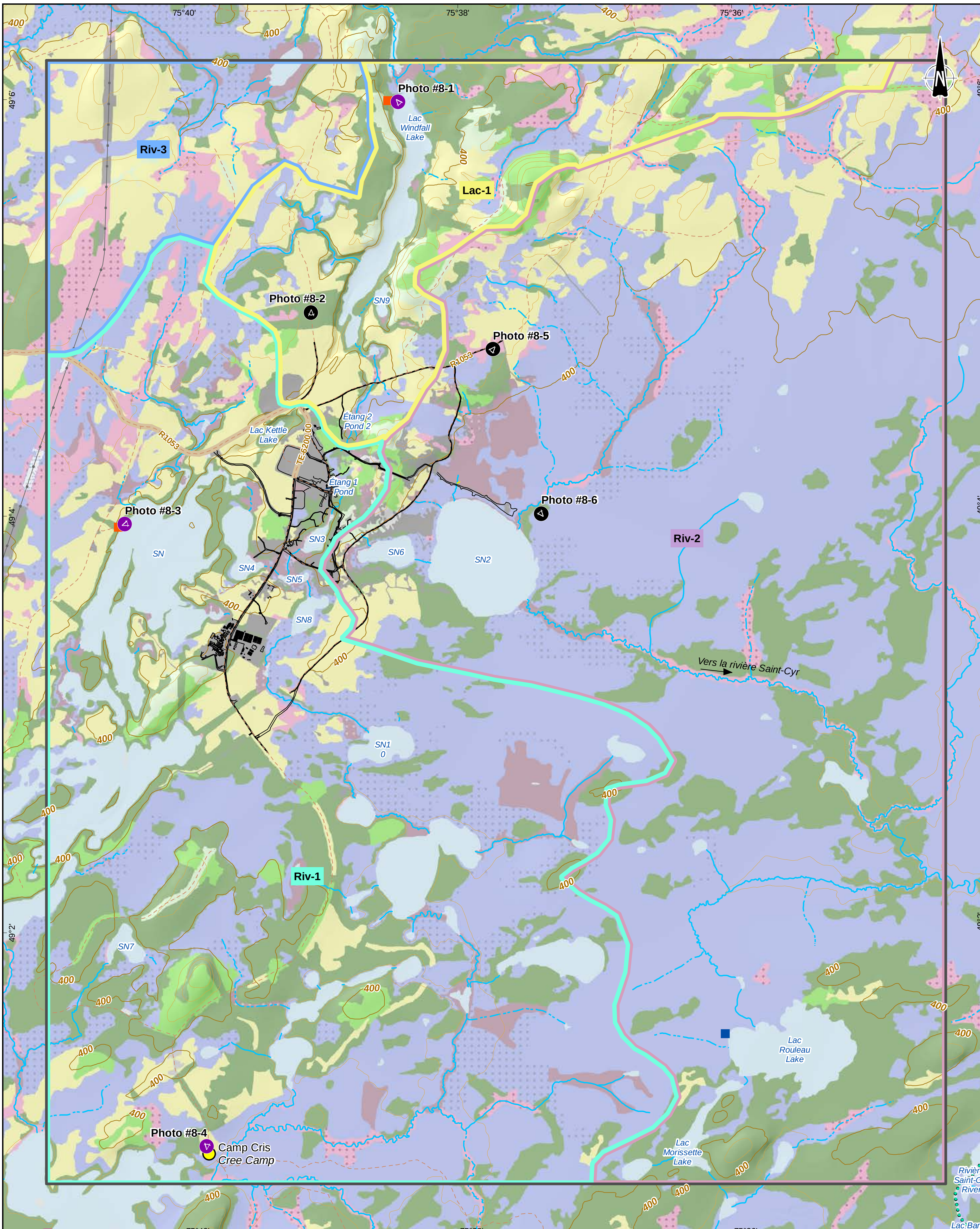
These landscape units are as follows:

- Windfall Lake landscape (LAC-1);
- Macho River landscape (RIV-1);
- Saint-Cyr River landscape (RIV-2);
- Panache and Fortier Rivers landscape (RIV-3).

The inventory of landscape components allowed identification of the observers located in each of these landscape units, i.e., fixed observers (vacationers, workers) and mobile observers (roads, recreational trails). The description of the landscape components and the fields of vision of its observers is presented below for each landscape unit.

The analysis is completed by the identification of the visual issues for each landscape unit and the fields of vision of their observers. The visual issues are determined according to the level of attraction, accessibility, value, and their level of sensitivity to implementation of the project.

The results of the landscape inventory were mapped on Map 8-3.



Zone d'étude du milieu humain / *Human environment study*

Topographie / *Topography*

Courbe de niveau maîtresse (m) / *Master contour line*

Courbe de niveau secondaire (m) / *Secondary contour line*

Hydrographie / *Hydrography*

Cours d'eau permanent / *Permanent*

Cours d'eau intermittent / *Intermittent*

Fossé de drainage / *Drainage ditch*

Canal / *Canal*

Végétation / *Vegetation*

Milieux naturels ouverts / *Opened natural*

Tourbière ombrotrophe ouverte / *Open bog*

Tourbière minérotrophe ouverte / *Open fen*

Marais / *Marsh*

Milieux naturels fermés / *Closed natural environments*

Marécage arbustif / *Shrub swamp*

Marécage arborescent / *Treed swamp*

Tourbière minérotrophe boisée / *Treed fen*

Tourbière ombrotrophe boisée / *Treed bog*

Régénération / *Regeneration*

Feuillu / *Broadleaved tree*

Mixte / *Mixed tree*

Résineux / *Resinous tree*

Autres milieux / *Other environment*

Gravière / *Gravel pit*

Anthropique / *Anthropogenic*

Infrastructure / *Infrastructure*

Ligne de transport d'énergie électrique / *Electric power*

Route forestière / *Forest road*

Route d'accès / *Access road*

Infrastructure minière existante / *Existing mining*

Utilisation du territoire / *Land use*

Bail de villégiature / *Vacation lease*

Fins d'abri sommaire en forêt / *Temporary forest*

Fins d'hébergement dans une pourvoirie sans droits exclusifs / *For lodging at an outfitter without exclusive rights*

Fins de villégiature / *For vacationing*

Camp existant / *Existing camp*

Unité de paysage / *Landscape unit*

Paysage de la rivière Macho / *Macho River*

Paysage de la rivière Saint-Cyr / *Saint-Cyr River*

Paysage des rivières Panache et Fortier / *Panache and Fortier River landscape*

Paysage du lac Windfall / *Windfall Lake*

Point de vue (photo) / *Point of view*

Photo-simulation / *Photo-simulation*

OSISKO
MINIÈRE OSISKO

Projet minier Windfall - Étude d'impact sur l'environnement / *Windfall Mining Project - Environmental Impact Assessment*

Site minier Windfall, Eeyou Istchee Baie-James (Québec) / *Windfall Mining Site, Eeyou Istchee Baie-James (Quebec)*

Carte 8-3 / *Map 8-3*
Paysage / *Landscape*

Sources :
CanVec+, 1/50 000, RNCan, 2014
MERN, AQréseau+, réseau routier, 2020

0 350 700 m

MTM, Fuseau 9 / *Zone 9*, NAD83

2023-01-25

Préparée par / Preparation : L. Giroux
Dessinée par / Drawing : C. Thériault
Vérifiée par / Verification : M.-H. Brisson
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WINDFALL LAKE LANDSCAPE (LAC-1)

LANDSCAPE COMPONENTS AND FIELDS OF VISION

Landscape unit LAC-1 is located north of the mining project and includes Windfall Lake and its tributaries. This lake has an elongated shape oriented on a north-south axis. It is embedded in hills covered by mixedwood-hardwood forests that can reach heights of 450 m. Some wetlands are present in the hollows of the hills. This landscape unit has a natural and intimate character that has not suffered disturbances except for traces of former logging sites and mining infrastructure to the south. This natural environment is accessible from main road R1053 (R6000) located on the west side of Windfall Lake and by another logging road to the south.

The observers are few in number and limited to the users of these roads and the occupants of a cabin north of Windfall Lake. This vacationing site is sought for its tranquility and for hunting and fishing activities. The views from the cabin are mainly oriented to the eastern shore of the lake due to its elongated shape. The field of vision is deep and open in the southwest axis for observers navigating on the lake. The field of vision of the users taking the roads is mostly framed by the existing forest cover.

LANDSCAPE SENSITIVITY AND VISUAL ISSUES

Landscape unit LAC-1 has moderate sensitivity due to its recreational use and the minimally disturbed natural and intimate character of the Windfall Lake landscape. However, visual accessibility is considered low due to the small number of observers and the forest cover present around the lake and the roads. The quality of the observers' views and the preservation of the forest cover around the lake and the roads are the main issues in this landscape unit.

The potential visibility of the mining project from the cabin is considered low to nil (Photo 8-1), but the risk could increase for observers positioned directly on the lake, whose view is oriented toward the highest infrastructure. Views are also possible from the road sections closest to the infrastructure (Photo 8-2).

Photo 8-2 View from the shores of Windfall Lake on the right of the cabin (Landscape Unit LAC-1).

Photo 8-3 View from a logging road (Landscape Unit LAC-1).

MACHO RIVER LANDSCAPE (RIV-1)

LANDSCAPE COMPONENTS AND FIELDS OF VISION

The Macho River landscape unit (RIV-1) contains the largest bodies of water in the study area, including SN1 Lake and a vast network of wetlands and watercourses. Large areas of peatlands and mixedwood forests occupy the southern half of this landscape unit. Its terrain is primarily flat to undulating, but it contains a series of small hills around SN1 Lake and south of the study area. Road R1053 (R6000) is the main road allowing access north of where other logging roads begin. This natural landscape contains several industrial disturbances around SN1 Lake and the presence of a power transmission line section near the road to the west. The exploration camp and the mining infrastructure of advanced exploration are also visible in some places. The regenerating forest cover around the lake is evidence of the presence of former logging sites in this sector.

The quantity of observers is low and limited to a family staying a few weeks a year at the cabin located on the shore of SN1 Lake, the Cree camp occupied permanently by the tallyman and his family, and users taking road R1053 (R6000) and the other logging roads. Broad views of the lake and the neighbouring landscape are provided from these camps with a background enclosed by the hills and the existing forest. Like Windfall Lake, this lake landscape is appreciated as a vacation spot and for hunting and fishing activities. Located on an unnamed lake south of the unit, the Cree camp of tallyman W25B is also among the potential observers. The hilly terrain, the forest cover, and the forested peatlands around this lake enclose the field of vision of its fixed and moving observers. Views of the lakes are also available from the power transmission line.

LANDSCAPE SENSITIVITY AND VISUAL ISSUES

The level of sensitivity of the Macho River landscape unit (RIV-1) is higher due to the presence of two camps on the shores of the lakes. Depending on the location of the cabins, the presence of hills, and the forest cover around these lakes, the potential visibility of the mine site is considered low to nil and higher for the cabin located on the western shore of SN1 Lake (Photos 8-3 to 8-4). Views of the mine site’s highest infrastructure can be had directly from SN1 Lake. The preservation of the existing forest cover, the revegetation of the sites already present, and the configuration and progressive restoration of the tailings storage facility are measures that will allow a more harmonious integration of the projected mining infrastructure in the natural landscape.

Photo 8-4 View from west shore of SN1 Lake at the cabin (Landscape Unit RIV1).

Photo 8-5 View from the logging road at the First Nations camp (Landscape Unit RIV-1).

SAINT-CYR RIVER LANDSCAPE (RIV-2);

LANDSCAPE COMPONENTS AND FIELDS OF VISION

The Saint-Cyr River landscape unit occupies the largest area of the study area. It is almost entirely covered with peatlands located on both sides of the tributaries of the Saint-Cyr River. SN2 Lake and Rouleau Lake are the main bodies of water. Its terrain is slightly more hilly in the northern part of the unit and around Rouleau Lake to the south. The main disturbances of this natural landscape are found around SN2 Lake and logging road R1053 (R6000), and are related to former logging sites and mining activities.

An outfitting establishment is present to the south and includes a private cottage lease located on the shores of Rouleau Lake. The clientele visiting this outfitting establishment and the users taking the logging road to the north are the main observers of this landscape (Photo 8-5). These observers also travel in the other sectors by quad and snowmobile. Apart from the views of Rouleau Lake, the field of vision of this recreational clientele varies according to the visual openings and the wooded screens offered throughout this peatland landscape (Photo 8-6).

LANDSCAPE SENSITIVITY AND VISUAL ISSUES

The Saint-Cyr River landscape unit has low to moderate sensitivity to the mining project. The levels of visual attraction and use attributed to this landscape are considered moderate due to the quality and integrity of the natural peatland landscapes and the recreational use in this sector. However, the small number of observers and the density of the forest cover reduce its visual accessibility. The potential visibility of the mining project remains limited from the outfitting establishment and Rouleau Lake due to the distance, the forested peatlands, and the topography.

Photo 8-6 View from the logging road (Landscape Unit RIV2).

Photo 8-7 View from a peatland (Landscape Unit RIV-2).

PANACHE AND FORTIER RIVERS LANDSCAPE UNIT (RIV-3).

LANDSCAPE COMPONENTS AND FIELDS OF VISION

Landscape unit RIV-3 is located northwest of the study area. It is small in area and contains a hilly landscape that accommodates wetland and small watercourses associated with the Panache and Fortier Rivers. The power transmission line visible above the hills is the main disturbance of this natural landscape. The observers are limited to the occasional recreational clientele visiting this sector and the users of Road R1053 (R6000).

LANDSCAPE SENSITIVITY AND VISUAL ISSUES

The level of sensitivity is considered low to moderate in this landscape unit due to its natural components being already disturbed in part by the passage of the power line and by the low visual accessibility (few observers, wooded screens). The potential visibility of the mine site from this landscape unit is considered almost nil due to the wooded hills that serve as a visual screen in this area. No visual issue in relation to the mining project is therefore anticipated in this area.

SUMMARY

The results of the sensitivity analysis show a higher sensitivity of the Windfall Lake and Macho River landscape units to the expansion of the mining project due to the presence of two lakeside cabins and a Cree camp, its recreational use, and higher visibility potential. Visual considerations include preserving views from cabins and other recreational sites, protecting existing landforms and forest cover around the mine site, and revegetation of the disturbed sites that could have visual openings.

8.9.2 IMPACTS ON THE LANDSCAPE IN THE CONSTRUCTION PHASE AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the construction phase, the sources of potential impacts and the resulting impacts (**in bold**) likely to have an impact on the landscape are as follows:

- The organization of the construction site, stripping and clearing, preparation of surfaces, development of accesses, construction of works and infrastructure, and transportation and traffic.

These sources have the potential to result in the following impact during the construction phase:

- **Alteration of the components of landscape units LAC-1, RIV-1, and RIV-2 and associated fields of vision**

It should be noted that landscape unit RIV-3 was not assessed as there are no anticipated impacts on the landscape and on the integrity of the visual fields of its observers.

MITIGATION MEASURES

The common mitigation measures for protection of soil, vegetation, and watercourses QUA01, QUA04, QUA08, QUA17, QUA18, VEG01, VEG04, NOR16, PLA01, PAY01 will be applied to reduce the impacts on the landscape and the associated fields of vision.

The following specific mitigation measures will also be applied:

— To the extent possible, preserve the forest cover along the road and revegetate bare areas with native vegetation once the work is completed.

DETAILED DESCRIPTION OF RESIDUAL IMPACT

ALTERATION OF THE COMPONENTS OF LANDSCAPE UNIT LAC-1 AND THE ASSOCIATED FIELDS OF VISION

During the construction phase, certain infrastructure is likely to alter the landscape and fields of vision associated with landscape unit LAC-1, particularly the expansion of the borrow pit and the mining camp complex located in this unit near Road R-1053 (R6000).

The development of this infrastructure could lead to the disappearance of part of the forest landscape and the existing wetlands in this sector over an approximate area of 16.6 ha.

The infrastructure present in the other landscape units and the most likely to alter the view of the observers of the LAC-1 unit is the new process plant.

The preservation of the forest cover around the borrow pit, the process plant, and the mining camp complex will contribute to limit this impact.

It should be noted that the views directly from the cabin located northeast of Windfall Lake will not be affected by the mining project during the construction period due to its location and the particular configuration of the lake.

ALTERATION OF THE COMPONENTS OF LANDSCAPE UNIT RIV-1 AND ASSOCIATED FIELDS OF VISION

In the construction phase, certain infrastructure is likely to alter the landscape and fields of vision of landscape unit RIV-1, particularly the new process plant, the overburden stockpile, and the ponds located in this unit and the tailings storage facility located in unit RIV-2.

The development of this infrastructure will lead to the disappearance of part of the forest landscape and the existing wetlands over an approximate area of 23.3 ha.

However, the views from the cabin located west of SN1 Lake will not be affected by the new mining infrastructure due to its location and the forest cover around the lake. This will also not be visible from the Cree camp due to its remoteness (about 6 km) and the presence of wooded hills.

ALTERATION OF THE COMPONENTS OF LANDSCAPE UNIT RIV-2 AND ASSOCIATED FIELDS OF VISION

During the construction phase, certain infrastructure is likely to alter the landscape and fields of vision associated with landscape unit RIV-2, particularly the tailings storage facility, the overburden stockpile, and the ponds. The new process plant and the camp complex is the other infrastructure most likely to be visible from this unit.

The development of this infrastructure will lead to the disappearance of part of the forest landscape and the existing wetlands over an area of 73.8 ha.

However, no visual impact was anticipated by the construction of this new mining infrastructure from Rouleau ALke and the outfitting establishment due to the distance (about 5.5 km) and the presence of small wooded hills throughout the peatlands.

RESIDUAL IMPACT ASSESSMENT

Only the landscape units disturbed in the construction phase are assessed in this analysis, i.e., units LAC-1, RIV-1, and RIV-2. It should be noted that the residual impact of landscape unit RIV-3 was not assessed as there is no anticipated impact on the landscape and on the integrity of visual fields for its observers.

Given the mitigation measures that will be implemented for the work in the construction phase, the nature of the impact on the quality of the landscape is considered negative because the new mining infrastructure will disturb part of the natural components of landscape units LAC-1, RIV-1, and RIV-2. The socioeconomic value assigned to these three landscape units is considered medium. Even though these units provide a certain economic, social, and cultural value due to their recreational use (cabins, outfitter, hunting, fishing, landscape observation, etc.), they are only visited by a limited proportion of observers and do not have legal protection. Moreover, part of the landscape is already disturbed by exploitation of resources and the presence of mining infrastructure already in place.

The degree of disturbance is considered low for landscape units RIV-1, RIV-2, and LAC-1 given the area of the infrastructure found there.

The intensity of the anticipated impact is determined by considering the degree of disturbance of each landscape unit and their socioeconomic value. The intensity of the impact is considered low because the degree of disturbance of the new infrastructure in the three landscape units is low and their socioeconomic value is medium.

The duration of the impact of the construction period will be short (less than 2 years, i.e., 18 months) and its probability of occurrence is high. The spatial scope is specific because the work will only be seen from specific locations and by a small number of observers.

Based on these various criteria, the significance of the residual impact is considered low for the three units.

Impacts on the landscape in the construction phase (LAC-1, RIV-1, RIV-2)		
Nature	Negative	Significance: Low
Ecosystem value	Not applicable	
Socioeconomic value	Medium	
Degree of disturbance	Low	
Intensity	Low	
Spatial scope	Specific	
Duration	Short	
Probability of occurrence	High	

8.9.3 IMPACTS ON THE LANDSCAPE IN THE OPERATIONS PHASE AND MITIGATION MEASURES

SOURCES OF POTENTIAL IMPACTS

During the operations phase, the sources of potential impacts and the resulting impacts **(in bold)** likely to affect the landscape are as follows:

— The presence and operation of new infrastructure as well as transportation and traffic

These sources have the potential to result in the following impacts during the operations phase:

— **Alteration of the components of landscape units LAC-1, RIV-1, and RIV-2 and associated fields of vision**

MITIGATION MEASURES

The same common and specific mitigation measures called for in the construction phase will be applied during the operations phase when work involving the same impact sources will occur.

DESCRIPTION OF RESIDUAL IMPACT

ALTERATION OF THE COMPONENTS OF LANDSCAPE UNIT LAC-1 AND ASSOCIATED FIELDS OF VISION

In the operations phase, certain infrastructure is likely to alter the landscape and fields of vision associated with landscape unit LAC-1, particularly the presence of the borrow pit, the process plant, and the mining camp complex located in this unit, near Road R-1053 (R6000).

The infrastructure present in the other landscape units and the most likely to alter the view of the observers of unit LAC-1 is the tailings storage facility and the other accumulation areas.

Limited views of the tailings storage facility could also be had directly from Windfall Lake and the logging roads. It should be noted that the views directly from the cabin located northeast of Windfall Lake will not be affected by the mining project due to its location and the particular configuration of the lake (Photo 8-1).

The preservation of the forest cover around the borrow pit, the plant, and the mining camp complex will contribute to limit this impact. Similarly, the progressive vegetation restoration measures will allow reduction of the visual impact from this landscape unit.

ALTERATION OF THE COMPONENTS OF LANDSCAPE UNIT RIV-1 AND ASSOCIATED FIELDS OF VISION

In the operations phase, certain infrastructure is likely to alter the landscape and the fields of vision of landscape unit RIV-1, particularly the presence of the new process plant, the progressive expansion of the waste rock and overburden stockpiles, and the tailings storage facility.

More specifically, the waste rock stockpile will be visible to the owners of the cabin at SN1 Lake when the height will exceed the existing dense forest cover on the shores of the lake around 2029. Thus, the views from the cabin located west of SN1 Lake will be slightly affected by the new mining infrastructure due to its location (Photo 8-3). The presence of the forest cover will reduce the view.

The projected infrastructure will not be visible either from the camp due to the distance (about 6 km) or the wooded hills in the background (Photo 8-4).

Progressive revegetation of the tailings storage facility is the primary measure that will reduce the visual impact from this landscape unit.

ALTERATION OF THE COMPONENTS OF LANDSCAPE UNIT RIV-2 AND ASSOCIATED FIELDS OF VISION

During the operations phase, certain infrastructure is likely to alter the landscape and fields of vision associated with landscape unit RIV-2, particularly the tailings storage facility and the overburden stockpile. The expansion of the waste rock stockpile, the presence of the new process plant, and the camp complex are the most likely to be visible from this unit.

It is unlikely that this infrastructure will be visible from Rouleau Lake given the presence of wooded hills between the lake and the mine infrastructure. However, the recreational clientele visiting this natural environment could have access to views from the more open areas of the peatland landscape.

The progressive vegetation restoration measures of the tailings storage facility will reduce the visual impact from this landscape unit.

RESIDUAL IMPACT ASSESSMENT

Given the mitigation measures that will be implemented for the work in the operations phase, the nature of the impact on the quality of the landscape is considered negative because the new mining infrastructure will disturb part of the natural components of landscape units LAC-1, RIV-1, and RIV-2. The degree of disturbance is considered low for landscape units RIV-1, RIV-2, and LAC-1 when considering the area of the infrastructure found there.

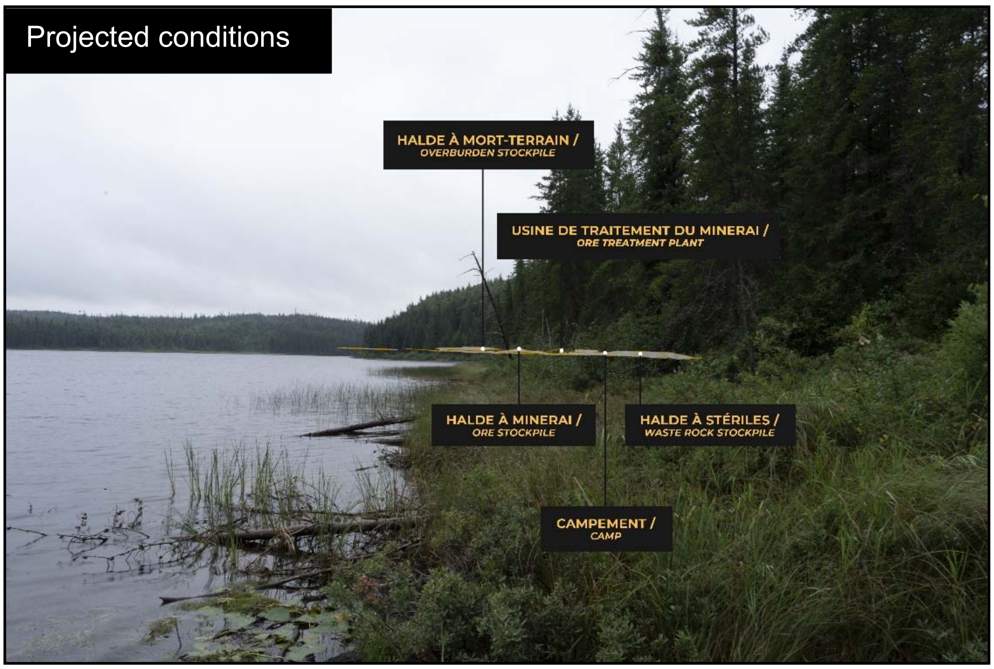


Photo 8-2 View from the shores of Windfall Lake at the cabin (Landscape Unit LAC-1).

Photo 8-4 View from the western shore of Lake SN1 at the cabin (Landscape Unit RIV-1).

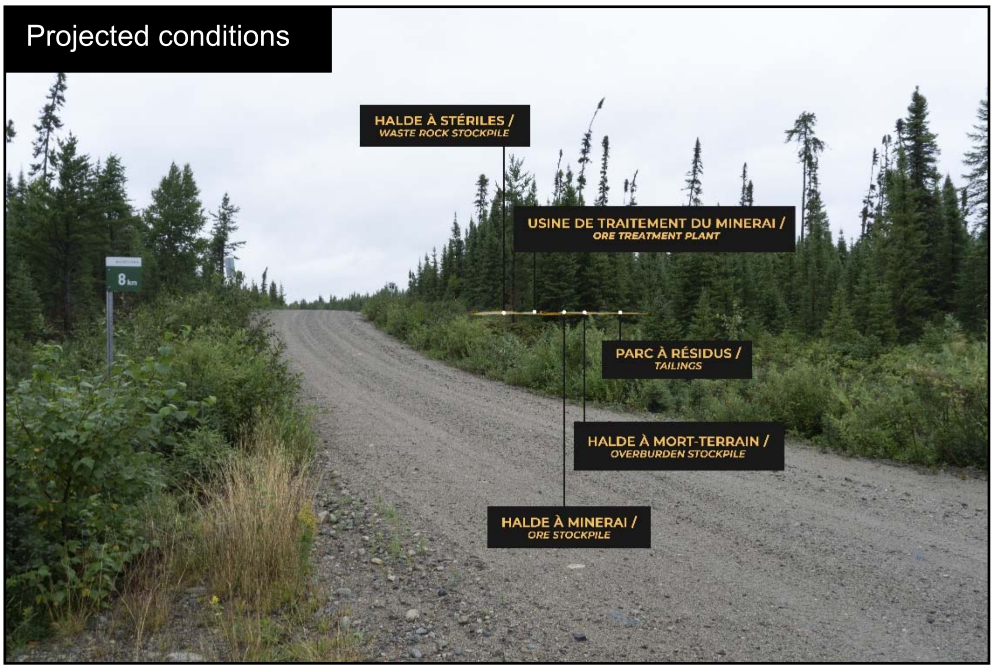


Photo 8-5 View from the logging road at the First Nations camp (Landscape Unit RIV 1).

The intensity of the anticipated impact is determined by considering the degree of disturbance of each landscape unit and their socioeconomic value. The intensity of the impact is considered low because the degree of disturbance of the new infrastructure in the three landscape units is low and their socioeconomic value is medium.

The duration of the impact of the operations period will be medium, and its probability of occurrence is high. The spatial scope is specific because the work will only be seen from specific locations and by a small number of observers. Based on these various criteria, the significance of the residual impact is considered low for the three units.

Impacts on the landscape in the operations phase (LAC-1, RIV-1, RIV-2)		
Nature	Negative	Importance: Low
Ecosystem value	Not applicable	
Socioeconomic value	Medium	
Degree of disturbance	Low	
Intensity	Low	
Spatial scope	Specific	
Duration	Medium	
Probability of occurrence	High	

8.9.4 *IMPACTS ON THE LANDSCAPE IN THE CLOSURE PHASE AND MITIGATION MEASURES*

SOURCES OF POTENTIAL IMPACTS

During the closure phase, the sources of potential impacts and the resulting impacts **(in bold)** likely to have an impact on the landscape are as follows:

— The presence of the remnants of the site and the final restoration;

These sources have the potential to result in the following impact during the closure phase:

— **Alteration of the components of landscape units LAC-1, RIV-1, and RIV-2 and associated fields of vision.**

MITIGATION MEASURES

The same common mitigation measures called for in the construction and operations phases will be applied during the closure phase when the work involves the same potential impact sources. Moreover, common mitigation measures QUA20 and PLA02 will be applied to complete the restoration of the site.

DESCRIPTION OF RESIDUAL IMPACT

ALTERATION OF THE COMPONENTS OF LANDSCAPE UNITS LAC-1, RIV-1, AND RIV-2 AND ASSOCIATED FIELDS OF VISION

During the closure phase, certain activities are likely to alter the landscape and the fields of vision of landscape units LAC-1, RIV-1, and RIV-2, particularly the presence of the remnants of the site and the final restoration work.

During the dismantling of the facilities, the anticipated impacts will be of the same nature as during the construction phase, but reduced since there will be no new construction. The same common mitigation measures may be applied.

During final restoration, which will take approximately two years, the residual surfaces of the tailings storage facility, waste rock stockpile, overburden stockpile, and borrow pits will be revegetated, thereby gradually restoring the natural character of the landscape.

Moreover, once the various buildings of the plant and the camp have been dismantled and the sedimentation ponds have been completely rehabilitated, all residual surfaces and access roads will be returned to the natural state.

The impact of the closure phase on the quality of the landscape will be positive since the restoration work will be carried out in accordance with the specific rehabilitation program of the site with the aim of restoring its natural appearance.

RESIDUAL IMPACT ASSESSMENT

The nature of the anticipated impact is negative when specifically considering the site closure work, but positive when considering the site rehabilitation. Overall, the impact is considered to be positive.

The various common and specific mitigation measures will allow the new infrastructure to be visually integrated into the natural landscape, particularly through the progressive restoration of the vegetation cover. The spatial scope is specific because the visual impact of the future mining infrastructure work will be visible only from very specific locations and by a small number of observers.

The duration of the impact will be short during the closure activities. The duration will be short or long depending on the type of measures implemented by the restoration plan to ensure restoration of the site in the long term.

Impacts on the landscape in the closure phase (LAC-1, RIV-1, RIV-2)		
Nature	Negative/Positive	Positive impact
Ecosystem value	Not applicable	
Socioeconomic value	Medium	
Degree of improvement	Not applicable	
Intensity	Not applicable	
Spatial scope	Specific	
Duration	Short/Long	
Probability of occurrence	Not applicable	

9 CLIMATE CHANGE RESILIENCE

Climate change highlights

Future trends in climate hazards that may impact the project

The general increase in temperatures will result in longer summers. Not only will the summers be longer, but they will also be hotter. However, heat waves will continue to be an exceptional phenomenon. The number of potential fire spread days will increase. Due to anticipated climate change, potential evapotranspiration rates will increase, but the maximum annual number of consecutive days without precipitation is expected to remain stable in the near term. This suggests that soil drought events will remain occasional and infrequent. Due to the general increase in temperatures, the annual number of freeze-thaw cycles is projected to decrease; however, freeze-thaw cycles during the winter months will increase. Although winter temperatures are on the rise, the Windfall site area will continue to experience waves of extreme cold. The increase in the amount of winter precipitation and the trend of average winter temperatures to get closer to the freezing point suggest that freezing rain events will be more frequent and intense, rain-on-snow events will be more numerous, and snowstorms will be less frequent but more intense. There will be an increasing trend in strong winds and thunderstorm activity, suggesting that the likelihood of tornadoes striking the site will increase.

Potential climate change impacts on the project

Climate change could result in three moderate-risk impacts, five high-risk impacts, and one very high-risk impact on the project and its operating environment. The implementation of the mitigation measures developed for the project reduces the initial level of risk for all identified potential impacts; the highest level of residual risk would thus correspond to a moderate risk for two potential impacts.

During the construction phase, climate change could have a negative impact on work productivity, particularly by making certain operations more complex. During the operations phase, in addition to the disruption of operations and/or loss of work productivity, the increased potential for generation of acid mine drainage is also an impact that could result from anticipated climate change. In the closure phase, the only moderate-risk residual impact is that related to the generation of acid mine drainage.

While discussions of climate resilience often focus on the negative impacts of climate change, new climate conditions may also present opportunities. The opportunities identified for the project are associated with increasing temperatures and the lengthening of summer: (i) the season for outdoor work would be longer; (ii) savings on heating costs could be expected in the winter months; and (iii) accelerated revegetation during site restoration would be anticipated.

9.1 FUTURE TRENDS IN CLIMATE HAZARDS THAT MAY IMPACT THE PROJECT

ACTIVITIES AND INFRASTRUCTURE CONSIDERED

Climate change will have impacts on both project activities and infrastructure. The impacts considered are those on the health and safety of workers, the economic performance of activities, and the integrity of infrastructure, of the environment, and of ecosystems.

The activities considered in the assessment are:

— In the construction phase: (i) stripping and additional clearing of certain areas of the site to allow for the installation of facilities; (ii) various activities related to the organization of the work site, including the repair of existing roads and the upgrading of existing electrical infrastructure (generators and electrical distribution network); and (iii) the actual construction of the facilities.

— In the operations phase: (i) activities related to the ore extraction process, including drilling, blasting, loading, and hauling of ore and waste rock to the surface, pumping of mine water to keep drifts dry, and backfilling of drifts; (ii) crushing and processing of ore; and (iii) dewatering and storage of tailings and waste rock management.

— In the closure phase: (i) dismantling of existing buildings and infrastructure, including decontamination and disposal of residual waste off site; (ii) sealing of openings and restoration of the tailings storage facility and waste rock stockpile; (iii) revegetation of affected areas; and (iv) environmental monitoring during restoration and for a minimum of ten years thereafter.

The infrastructure under consideration has been grouped into the following six categories:

— Mining infrastructure—the underground mine, whose major components are the Main and Lynx access portals as well as the tunnels and drifts of the two extraction zones—and the surface mining infrastructure, consisting mainly of the overburden and waste rock stockpiles, the filtered tailings storage facility, the borrow pits, and the temporary accumulation area for mineralized rock.

— The ore processing facilities, the main components of which are the crusher, the storage silo, and the process plant, as well as the conveyors that transport the ore between these facilities; also included in this category are the industrial and process water recovery circuits, the tailings filtration plant, and the pipeline that transports the tailings from the process plant to the tailings filtration plant.

— Water management infrastructure, which includes the drinking water supply system (wells, reservoir, chlorine treatment system), domestic water treatment infrastructure (pumping system, grease trap, domestic water treatment system), contact and surface water management infrastructure (ditches, culverts, and ponds), mine water management infrastructure, and industrial and process water management infrastructure.

— Energy and telecommunication infrastructure include the power generator unit consisting of diesel generators, Osisko's electrical distribution system (network of distribution towers and cables, distribution panels, transformers, and service panels), the fuel farm, the storage area for propane, which is distributed by a network of buried lines, two telecommunication towers, the on-site Wi-Fi network, a FEMCO communication system, and a traditional emergency telephone system.

— Transportation infrastructure, including forest roads to access the site, the main site access road, service roads, haul roads, and a helipad.

— The buildings and support infrastructure, which include the multiservice complex consisting of the process plant, the parts and equipment warehouse, the garage, the core shack, the administrative offices and the miners' locker room, the camp, the northern corridor linking the camp to the multiservice complex, the First Nations cultural centre, an area dedicated to the management of residual materials, a storage area, 40 storage containers, a canvas dome, as well as a gatehouse at the site entrance.

FUTURE TRENDS IN THE SELECTED HAZARDS

Based on the description of the project (Chapter 3) and the analysis of the geographical context in which it is located (Chapter 6), the climate hazards that could potentially affect the project's activities and infrastructure as well as its operating environment are:

— extreme precipitation;

— the lengthening of summer;

— high summer temperatures;

— soil drought and forest fires;

— freeze-thaw cycles and winter thaw episodes;

— extreme cold waves;

— changes in winter precipitation patterns;

— strong winds and thunderstorm activity.

These hazards are expected to change as a result of anticipated climate change in the near term (2050). This time frame was chosen based on the project schedule (Chapter 3). Climate hazard evolution is based on the choice of indicators which, when their trends are taken into account simultaneously, are likely to give an objective representation of the frequency and intensity of the hazard in question. This assessment indicates that:

— In the short term, average summer temperatures will increase by +1.8 °C to +2.7 °C and up to +5.2 °C compared to the current average values.

— Summer temperatures will be higher and will exceed 30 °C on an annual basis; although heat waves will continue to be an exceptional phenomenon, heat wave days will occur on an annual basis.

- The general increase in temperature will simultaneously shift the winter period and lengthen summer.
- Over the entire year, the number of freeze-thaw cycles is projected to decrease; however, it will increase during the winter months (December to February).
- Although winter temperatures are on the rise, the Windfall site area will continue to experience waves of extreme cold.
- Extreme precipitation events will tend to increase in frequency and intensity.
- Soil drought events will remain infrequent and occasional, while potential fire spread days will increase by 20-30%, particularly due to the projected increase in potential evapotranspiration rates.
- The increase in the amount of winter precipitation and the trend of average winter temperatures to get closer to the freezing point suggest that freezing rain events will be more frequent and more intense.
- Snowstorms will become more clustered during mid-winter months, less frequent but more intense.
- Rain-on-snow events are likely to be more frequent due to the expected increase in winter temperatures.
- There will be an increasing trend in strong winds and thunderstorm activity, suggesting that the likelihood of tornadoes striking the site will increase.

The climate hazards selected do not all interact with the project in the same way. A preliminary list of potential impacts arising from these interactions was developed (sectorial report in Appendix 9-1) based, among others, on the *Analyse de risques et de vulnérabilités aux changements climatiques pour le secteur minier québécois* (URSTM, 2017) [climate change risk and vulnerability analysis for the Quebec mining sector] as well as climate resilience studies completed by WSP for similar mining projects in the province of Quebec. Only impacts with a moderate, high, or very high probability of occurrence were considered for further assessment.

9.2 CLIMATE CHANGE IMPACTS IN THE CONSTRUCTION PHASE AND MITIGATION MEASURES

It should be noted that only those impacts that have gone through the entire risk assessment process are listed in this section, i.e., those that have a moderate or higher probability of occurrence.

POTENTIAL IMPACTS AND INITIAL RISK LEVEL

During the construction phase, climate change impacts (refer to Tables 22, 24, and 26 in Appendix 9-1) that could adversely affect the project are as follows:

- ID#13: Insufficient drainage of site, service roads, and access roads (low risk);

- ID#18: Critical expansion or contraction of the envelope and materials (low risk);
- ID#22: Disruption of operations and/or loss of work productivity (high risk);
- ID#23: Increase in the number of work-related accidents (high risk);
- ID#24: Increased transmission of vector-borne diseases such as Lyme disease (high risk);
- ID#25: Poor road conditions (moderate risk);
- ID#29: Gradual degradation of service roads and access roads (moderate risk).

While discussions of climate resilience often focus on the negative impacts of climate change, new climate conditions may also present opportunities. The season most conducive to outdoor work would be longer, which would be beneficial for some construction activities. Planning a schedule of increased construction activities is easy to implement for some of these activities. It is important to note that some tasks are more easily performed in winter.

MITIGATION AND ADAPTATION MEASURES

The level of risk identified in the previous section does not take into account the project's mitigation measures and those already implemented or planned by Osisko. Common mitigation measures VIE 01, QUA 02, QUA 04, QUA 09, QUA 14, QUA 16, QUA 21, QUA 25, QUA 28, and QUA 29 will help reduce the risk of impacts ID#22, ID#23, ID#24, ID#25, and ID#29. Measures implemented during the construction phase have also been specified for moderate, high, and very high risks to document Osisko's efforts in increasing the project's resilience to climate change. For each of the measures identified below, sections of the EIA are referred to for further details:

- Increased monitoring during conditions conducive to forest fires (ID#22): Emergency response plan in Appendix 12-1.
- Implementation of protection systems for critical equipment or equipment at risk of spreading fire, especially fuel storage equipment (ID#22): Section 3.8.4.
- Ability to rearrange the activity schedule outside of extreme weather event periods (ID#22, ID#23): Emergency response plan in Appendix 12-1.
- Use of meteorological data collected on site to adapt mining activities to extreme conditions (ID#25): Emergency response plan in Appendix 12-1.
- Increased monitoring of road conditions, especially after extreme rain events and in the spring (ID#25, ID#29): Emergency response plan in Appendix 12-1.

If all these measures are implemented, the highest level of residual risk would be considered moderate for one potential impact (ID#22).

DETAILED DESCRIPTION OF MODERATE-RISK RESIDUAL IMPACTS

Occasional climate hazards (extreme precipitation, heat wave days, extreme cold waves, freezing rain events, snowstorms, forest fires, high winds) could have a negative impact on work productivity, particularly by increasing the complexity of certain operations. For example, adverse weather conditions could slow down construction of some project infrastructure. Added vigilance will be required if such conditions occur.

9.3 CLIMATE CHANGE IMPACTS IN THE OPERATIONS PHASE AND MITIGATION MEASURES

POTENTIAL IMPACTS AND INITIAL RISK LEVEL

During the construction phase, climate change impacts (refer to Tables 22, 24, and 26 in Appendix 9-1) that could adversely affect the project are as follows:

— ID#1: Water infiltration in drifts and tunnels (low risk);

— ID#4: Potentially contaminated particles carried by wind to the surrounding natural environment (high risk);

— ID#5: Accelerated erosion and loss of slope stability at the waste rock and overburden stockpiles and tailings storage facility (low risk);

— ID#8: Broken underground pipes and ducts resulting in environmental contamination (high risk);

— ID#12: Generation of acid mine drainage (very high risk);

— ID#13: Insufficient drainage of site, service roads, and access roads (low risk);

— ID#15: Additional energy demand for cooling and ventilation (moderate risk);

— ID#18: Critical expansion or contraction of the envelope and materials (low risk);

— ID#22: Disruption of operations and/or loss of work productivity (high risk);

— ID#23: Increase in the number of work-related accidents (high risk);

— ID#24: Increased transmission of vector-borne diseases such as Lyme disease (high risk);

— ID#25: Poor road conditions (moderate risk);

— ID#29: Gradual degradation of service roads and access roads (moderate risk).

In addition to lengthening the season that provides favourable conditions for certain activities during the operations phase, climate change also creates an opportunity for potential reductions in heating requirements due to higher winter temperatures. In addition, sufficient heating capacity allows employees to work efficiently. By the end of the mine's life, energy demand for heating will decrease by approximately 18%. Having a heating system set for periods that are less cold is an easy benefit to implement.

MITIGATION AND ADAPTATION MEASURES

The same common mitigation measures recommended for the construction phase will be applied during the operations phase, thereby reducing the risks associated with impacts that may occur during either phase. In addition, common mitigation measures AIR 01 to AIR 03, VIE 01, QUA 29, HYD 02, HYD 03, QUA 02 to QUA 04, QUA 29, NOR 08 to NOR 10, and NOR 12 will help reduce the level of risk for impacts ID#4, ID#8, ID#12, ID#13, and ID#15. Besides the additional measures put forward in section 9.2 for impacts ID#22, ID#23, ID#24, ID#25 and ID#29, details for other measures during the operations phase have been provided for moderate, high, and very high risks to document Osisko's efforts in increasing the project's resilience to climate change. For each of the measures identified below, sections of the EIA are referred to for further details:

- Maintenance of the rigorous inspection program of the state of the surface and contact water management infrastructure as well as the follow-up program for groundwater quality conducted during mining exploration activities, and integration of the new infrastructure, particularly that associated with the tailings storage facility (ID#12): Chapter 13.
- Verification of the design criteria of the various components and systems (notably water management and air conditioning and ventilation systems) by considering future climatic conditions and modifying the design before the start of construction, if necessary (ID#15): section 3.8.8.
- Provision of sufficient generators to supply power to sensitive infrastructure (ID #15): section 3.8.8.

If all of these measures are implemented, the highest level of residual risk would be considered moderate for two potential impacts (ID#12, ID#22).

DETAILED DESCRIPTION OF MODERATE-RISK RESIDUAL IMPACTS

In addition to the moderate-risk residual impact applicable to the construction phase (disruption of operations and/or loss of work productivity), the generation of acid mine drainage represents a moderate-risk residual impact in the operations phase. In fact, the ore has been identified as potentially generating acid mine drainage. Several project components are affected by this impact, mainly the tailings storage facility, the waste rock stockpile, and the surface and contact water management infrastructure. This infrastructure must ensure adequate drainage of the tailings storage facility to prevent water from flowing directly into the surrounding environment. The tailings storage facility will include a geotextile liner to limit pore water infiltration into the groundwater and robust design criteria adapted to climate change have been incorporated into the project.

9.4 CLIMATE CHANGE IMPACTS IN THE CLOSURE PHASE AND MITIGATION MEASURES

POTENTIAL IMPACTS AND INITIAL RISK LEVEL

During the closure phase, climate change impacts that could adversely affect the project include:

- ID#4: Potentially contaminated particles carried by wind to the surrounding natural environment (high risk);
- ID#5: Accelerated erosion and loss of slope stability at the waste rock and overburden stockpiles and tailings storage facility (low risk);
- ID#12: Generation of acid mine drainage (very high risk);
- ID#13: Insufficient drainage of site, service roads, and access roads (low risk);
- ID#23: Increase in the number of work-related accidents (high risk);
- ID#24: Increased transmission of vector-borne diseases such as Lyme disease (high risk);
- ID#25: Poor road conditions (moderate risk);
- ID#29: Gradual degradation of service roads and access roads (moderate risk).

With warmer temperatures, vegetation would recover more quickly during site restoration, which is an opportunity to be seized. Accelerated revegetation has a negative impact during construction and operations, particularly due to increased demand for access road maintenance. However, this will slightly reduce the time required to rehabilitate the site. During the closure phase, it is also easy to change the species that are planted so that the vegetation is better adapted to future climate conditions.

MITIGATION AND ADAPTATION MEASURES

The same mitigation measures recommended during the construction and operations phases will be applied during the closure phase, thereby reducing the risks associated with impacts that may occur during either phase.

If all of these measures are implemented, the highest level of residual risk would be considered moderate for one potential impact (ID#22).

DETAILED DESCRIPTION OF MODERATE RISK RESIDUAL IMPACTS

In the closure phase, the only moderate-risk residual impact is that related to the generation of acid mine drainage, as described in section 9.3.

10 REVIEW OF IMPACTS

10.1 SUMMARY OF RESIDUAL IMPACTS

The Windfall project will have negative and positive impacts on various components of the physical, biological, and social environments. The significance of the residual impacts after application of the mitigation or enhancement measures in the various phases of the project (construction, operations, and closure) is summarized in the project's environmental impact assessment review (Tables 10-1 to 10-3). A complete list of mitigation measures is provided in Appendix 5-2.

From this residual impact analysis, a few issues emerge that represent negative impacts of medium residual significance. Recognition of these impacts is essential as they help determine which environmental components will be subject to a cumulative impact assessment (see Chapter 11) and to possible environmental follow-up measures (see Chapter 13). Components with residual impacts of medium to high significance include:

— **Ambient air** in the operation phase is subject to a residual impact of medium significance due to the increase in emissions (crystalline silica) at sensitive receptors.

— **GHGs,** which in the construction and operations phases are subject to a medium residual impact due to the regional nature of the impact.

— **Surface water**, which is subject to a medium residual impact during the operations phase due to a constant supply of water from mine effluent. Although the effluent already exists and is regularly monitored and treated to meet standards, a minor increase in loadings to the receiving environment downstream of the effluent is anticipated over the life of the operation.

— **Ichthyofauna and benthos,** which during the operations phase shows a medium residual impact relative to the anticipated effects of effluent on the quality of surface water.

— **Avifauna (species with particular status)**, which during the construction phase shows a medium residual impact, essentially associated with the loss of habitat (deforestation). A medium residual impact in operation related to the effect of nuisances (disturbance) and risks of collision and mortality is also anticipated.

— **Large fauna**, the residual impact is below average for all phases of the project. Given the sensitivity of the communities to this component, moose and woodland caribou were nevertheless subject to a cumulative impact assessment.

— **Chiropterans**, which for the construction and operations phases show a medium residual impact. In the construction phase, the medium level of impact is associated with habitat loss, while in the operations phase, it corresponds to the effects of disturbance and collision risks.

— **First Nation traditional land use**, which during the construction and operations phases is subject to a medium residual impact. This level of residual impact is primarily caused by the need to redirect and reorganize traditional harvesting and fishing activities that were taking place in the Windfall project area. For hunting and trapping, the impact is less certain since the possible displacement of moose and small game caused by the presence of the facilities is not known. The impact is mainly felt by users of the W25B trapline, but also by those using the W25A trapline.

Besides the residual negative impacts, the project will also have various positive impacts including:

- In the physical environment during the closure phase when pre-project noise levels will be restored and restoration activities will be carried out on soils, surface water, sediments, and groundwater.
- In the biological environment during the closure phase, the restoration of vegetation cover, wetlands, and watercourses will contribute to an improvement in the habitat of ichthyofauna, herpetofauna, mammals (small and medium-sized), and avifauna in general, as well as for avifauna with special status and large wildlife (caribou and moose).
- In the social environment during the construction, operations, and closure phases as the work associated with these phases will generate economic benefits for the regional population. In addition, a positive impact is anticipated for users of traplines W25B and W25A during the closure phase, when the area will no longer have any facilities and noise and other nuisances will cease. Finally, the restoration of the natural environment in the closure phase will generate a positive residual impact for the landscape of the area that the project will stop occupying.

Table 10-1 Summary of impacts on the physical environment

Affected component	Project phase	Primary source of impact	Description of potential impacts	Common and specific mitigation (or enhancement) measures	Significance of residual impact
Ambient air	Construction	The organization of the site, stripping, and clearing, construction of works and infrastructure, transportation and traffic	Degradation of ambient air quality	Common mitigation measures: AIR01 to AIR07, AIR09; NOR01 Specific mitigation measures: P26	Low
	Operations	The presence and operation of new infrastructure, transportation and traffic, production and management of residual and hazardous materials	Degradation of ambient air quality	Common mitigation measures: AIR01, AIR02, AIR04 to AIR09; NOR01 Specific mitigation measures: P01, P26	Medium
	Closure	Final restoration	Degradation of ambient air quality	Common mitigation measures: Same as for the operations phase Specific mitigation measures: Specific mitigation measures will be identified in the final restoration plan	Low
Greenhouse gas	Construction	The organization of the site, stripping and clearing, surface preparation and access arrangement, construction of works and infrastructure, transportation and traffic	Greenhouse gas emissions	Common mitigation measures: AIR02 to AIR07; NOR01, PLA01 Specific mitigation measures: P26	Medium
	Operations	The presence and operation of new infrastructure, transportation and traffic, production and management of residual and hazardous materials	Greenhouse gas emissions	Common mitigation measures: Same as for the construction phases Specific mitigation measures: P26	Medium
	Closure	Final restoration	Greenhouse gas emissions	Common mitigation measures: Same as for the operations phase Specific mitigation measures: Same as for the operations phase	Medium
Sound environment	Construction	The organization of the site, stripping and clearing, surface preparation and access arrangement, construction of works and infrastructure, transportation and traffic	Increased noise and vibration levels in the vicinity of new infrastructure	Common mitigation measures: AIR02, NOR02, NOR03 Specific mitigation measures: P26	Low
	Operations	The presence and operation of new infrastructure as well as transportation and traffic	Increased noise and vibration levels in the vicinity of new infrastructure	Common mitigation measures: AIR02, NOR01 Specific mitigation measures: P26	Low
	Closure	Final restoration	Increased noise levels in the vicinity of site in rehabilitation Decrease in noise levels after closure	Common mitigation measures: Same as for the construction and operations phases Specific mitigation measures: No specific mitigation measures apply during the closure phase	Low
Soil	Construction	The organization of the site, stripping and clearing, surface preparation and access arrangement, construction of works and infrastructure, transportation and traffic, production and management of residual and hazardous materials	Accidental soil contamination	Common mitigation measures: QUA01 to QUA05, QUA07 to QUA09, QUA15, QUA22 to QUA26 and NOR04, NOR05, NOR10 to NOR12 Specific mitigation measures: P26	Very low
	Operations	The presence and operation of new infrastructure, water use and management, transportation and traffic, production and management of residual and hazardous materials	Accidental soil contamination	Common mitigation measures: QUA15, QUA22, QUA23, QUA25 and QUA26 as well as the standards NOR10 and NOR12 Specific mitigation measures: Same as for the construction phase	Risk of accidental spills and seepage - Very low Seepage and wind erosion - Low
	Closure	The presence of remnants of the site, final restoration, production and management of residual and hazardous materials	Accidental soil contamination	Common mitigation measures: Same as for the construction and operations phases, as well as QUA06 Specific mitigation measures: Same as for the construction and operations phases	Very low
Hydrology	Construction	The organization of the site, stripping and clearing, surface preparation and access arrangement, construction of works and infrastructure	Change in local flow regime Increase in surface runoff	Common mitigation measures: QUA01, QUA08, QUA10 to QUA13, QUA17 to QUA19, VEG01, VEG04, PLA01, PLA02, NOR07 to NOR16 Specific mitigation measures: P26	Low
	Operations	The presence and operation of new infrastructure, water use and management	Changes to watersheds in the study area Changes in the characteristic flows of the study area	Common mitigation measures: None Specific mitigation measures: P26	Low
	Closure	The presence of the remnants of the site and the final restoration	Final alteration of watersheds and characteristic flows of the study area	Common mitigation measures: QUA13, QUA17, QUA18, QUA20, QUA21, PLA01, PLA02, NOR07, NOR14, NOR16 Specific mitigation measures: P26	Low

Affected component	Project phase	Primary source of impact	Description of potential impacts	Common and specific mitigation (or enhancement) measures	Significance of residual impact
Surface water	Construction	The organization of the site, stripping and clearing, surface preparation and access arrangement, construction of works and infrastructure, transportation and traffic, production and management of residual and hazardous materials	Alteration of surface water quality	Common mitigation measures: QUA01 to QU04, QUA07, QUA08, QUA10 to QUA26, NOR06 to NOR08, NOR10 et NOR12 Specific mitigation measures: P26	Low
	Operations	The presence and operation of new infrastructure, water use and management, transportation and traffic, production and management of residual and hazardous materials	Alteration of surface water quality	Common mitigation measures: Same as for the construction phase in addition to NOR09 and NOR13 Specific mitigation measures: P01, P26	Effluent discharges - Medium Risk of accidental spills and suspended solids - Low
	Closure	Final restoration, production and management of residual and hazardous materials	Alteration/improvement of surface water quality	Common mitigation measures: Same as for the construction and operations phases in addition to NOR14 Specific mitigation measures: Same as for the construction and operations phases	Low Restoration – Positive Impact
Sediments	Construction	The organization of the site, stripping and clearing, surface preparation and access arrangement, construction of works and infrastructure, transportation and traffic, production and management of residual and hazardous materials	Alteration of sediment quality	Common mitigation measures: QUA01 to QUA04, QUA08, QUA10 to 26, NOR06 to NOR08, NOR10, NOR12 Specific mitigation measures: No specific mitigation measures apply to the construction phase	Very low
	Operations	The presence and operation of new infrastructure, water use and management, transportation and traffic, production and management of residual and hazardous materials	Alteration of sediment quality	Common mitigation measures: Same as for the construction phase in addition to NOR09 and NOR13 Specific mitigation measures: P01, P26	Risk of accidental spills - Very low Effluent discharges - Low
	Closure	Final restoration, production and management of residual and hazardous materials	Alteration/improvement of sediment quality	Common mitigation measures: Same as for the construction and operations phases Specific mitigation measures: Same as for the construction and operations phases	Very low Restoration – Positive Impact
Hydrogeology	Construction	The organization of the site, stripping and clearing, surface preparation and access arrangement, construction of works and infrastructure	Impact on the local flow regime	Common mitigation measures: HYD01, QUA01 to QUA04, QUA10 and QUA11 Specific mitigation measures: P26	Very low
	Operations	The presence and operation of new infrastructure (mine dewatering, stockpiles, and tailings storage facility), water use and management (pumped water and runoff)	Changes to local groundwater flow regime	Common mitigation measures: HYD01 Specific mitigation measures: P26	Low
	Closure	The presence of the remnants of the site, final restoration	Changes to local groundwater flow regime	Common mitigation measures: HYD01 Specific mitigation measures: P26	Low
Groundwater	Construction	The organization of the site, stripping and clearing, surface preparation and access arrangement, construction of works and infrastructure, transportation and traffic, production and management of residual and hazardous materials	Contamination or alteration of groundwater quality	Common mitigation measures: NOR10, NOR12 and NOR15, QUA07, QUA14, QUA15, QUA22 to QUA26 Specific mitigation measures: P26	Very low
	Operations	The presence and operation of new infrastructure, water use and management, transportation and traffic, production and management of residual and hazardous materials	Contamination or alteration of groundwater quality	Common mitigation measures: Same as for the construction phase Specific mitigation measures: P26	Very low
	Closure	Final restoration, production and management of residual and hazardous materials	Contamination or alteration of groundwater quality	Common mitigation measures: NOR15 Specific mitigation measures: Specific mitigation measures may be defined as part of the closure plan for the proposed infrastructure	Low Restoration – Positive Impact

Table 10-2 Summary of impacts on the biological environment

Affected component	Project phase	Primary source of impact	Description of potential impacts	Common and specific mitigation (or enhancement) measures	Significance of residual impact
Vegetation and wetlands	Construction	The organization of the site, stripping and clearing, surface preparation and access arrangement, construction of works and infrastructure, transportation and traffic, production and management of residual and hazardous materials	Loss of vegetated area and disruption of plant communities in terrestrial and wetland areas Contamination of terrestrial and wetland environments	Common mitigation measures: PLA01, QUA01, QUA17, QUA18, QUA22 to QUA26, VEG01 to VEG04 Specific mitigation measures: P26	Risk of accidental spills - Very low Loss of area - Low
	Operations	Transportation and traffic, production and management of residual and hazardous materials	Disturbance of plant communities in terrestrial and wetland environments Contamination of terrestrial and wetland environments	Common mitigation measures: QUA17 and VEG02 Specific mitigation measures: P01 and P26	Very low
	Closure	Final restoration, production and management of residual and hazardous materials	Increase in vegetated areas and wetlands	Common mitigation measures: Same as for the construction and operations phases, plus VEG03, VEG04 and NOR14 Specific mitigation measures: P26	Very low Habitat Restoration - Positive Impact
Ichthyofauna and benthos	Construction	The organization of the site, stripping and clearing, surface preparation and access arrangement, construction of works and infrastructure, transportation and traffic, production and management of residual and hazardous materials	Alteration of habitat quality	Common mitigation measures: AIR01, AIR02, FAU01, QUA01 to QUA04, QUA07 to QUA09, QUA10 to QUA26, HYD01, NOR07 to NOR14, Specific mitigation measures: P26	TSS and risk of accidental spills - Very low Changes in the hydrological regime - Low
	Operations	The presence and operation of new infrastructure, water use and management, transportation and traffic, production and management of residual and hazardous materials	Alteration of habitat quality	Common mitigation measures: Same as for the construction phase, plus QUA14 to QUA16, NOR08 to NOR10, NOR13 Specific mitigation measures: P01 and P26	TSS and risk of accidental spills - Low Effluent discharge - Medium
	Closure	Final restoration, production and management of residual and hazardous materials	Alteration/improvement of habitat quality	Common mitigation measures: Same as for the construction and operations phases Specific mitigation measures: Same as for the construction and operations phases	TSS and risk of accidental spills - Low Habitat Restoration - Positive Impact
Herpetofauna	Construction	The organization of the site, stripping and clearing, surface preparation and access arrangement, construction of works and infrastructure, transportation and traffic, production and management of residual and hazardous materials	Habitat loss and fragmentation Disturbance, collision and mortality risk Alteration of habitat quality	Common mitigation measures: QUA01 to QUA04, QUA06 to QUA09, QUA11 to QUA21, QUA22 to QUA26, VEG01 to VEG04, AIR01 to AIR04, NOR01, NOR02, NOR04 to NOR06, NOR07, PLA01, PLA02, FAU08 and FAU09 Specific mitigation measures: P26	Risk of accidental spills - Very low Disturbance , collision and mortality risk and loss of habitat - Low
	Operations	The presence and operation of new infrastructure, water use and management, transportation and traffic, production and management of residual and hazardous materials	Disturbance, collision and mortality risk Alteration of habitat quality	Common mitigation measures: Same as for the construction phase Specific mitigation measures: P26	Very low
	Closure	Final restoration, production and management of residual and hazardous materials	Habitat creation Disturbance, collision and mortality risk Alteration of habitat quality	Common mitigation measures: Same as for the construction and operations phases Specific mitigation measures: P26	Very low Habitat Restoration - Positive Impact

Affected component	Project phase	Primary source of impact	Description of potential impacts	Common and specific mitigation (or enhancement) measures	Significance of residual impact
Avifauna	Construction	The organization of the site, stripping and clearing, surface preparation and access arrangement, construction of works and infrastructure, transportation and traffic, production and management of residual and hazardous materials	Habitat loss and fragmentation Disturbance, collision and mortality risk Alteration of habitat quality	Common mitigation measures: AIR01 to AIR04, FAU02, FAU06, FAU08, FAU09, NOR01, NOR17, PLA01 and PLA02, QUA01 to QUA04, QUA06 to QUA09, QUA11 to QUA26, VEG01 to VEG04 Specific mitigation measures: P26	**Birds in general:** Habitat loss - Low Disturbance, risk of spills, collision and mortality risk - Very low **Species with special status:** Habitat loss - Medium Disturbance, risk of accidental spills, and collision and mortality risk - Low
	Operations	The presence and operation of new infrastructure, water use and management, transportation and traffic, production and management of residual and hazardous materials	Disturbance, collision and mortality risk Alteration of habitat quality	Common mitigation measures: Same as for the construction phase, in addition to FAU07 Specific mitigation measures: P26	**Birds in general:** Very low **Species with special status:** Disturbance and collision and mortality risk - Medium Risk of accidental spills - Low
	Closure	Final restoration, production and management of residual and hazardous materials	Habitat creation Disturbance, collision and mortality risk Alteration of habitat quality	Common mitigation measures: Same as for the construction and operations phases Specific mitigation measures: P26	**Birds in general:** Very low (Habitat Restoration - Positive Impact **Species with special status:** Low Habitat Restoration - Positive Impact
Large mammals	Construction	The organisation of the site, stripping and clearing, surface preparation and access arrangement, construction of works and infrastructure, transportation and traffic, production and management of residual and hazardous materials	Habitat loss and fragmentation, mainly for moose Disturbance, collision and mortality risk Alteration of habitat quality	Common mitigation measures: QUA01 to QUA04, QUA06 to QUA08, QUA11 to QUA21, NOR03 to NOR05, NOR07, NOR10, VEG01 to VEG04, PLA01 and PLA02, AIR01 to AIR04, FAU04, FAU06, FAU09 Specific mitigation measures: P26	**Caribou:** Low **Moose, black bear, and grey wolf:** Risk of accidental spills, disturbance, collision and mortality risk - Very low Loss of habitat - Low
	Operations	The presence and operation of new infrastructure, water use and management, transportation and traffic, production and management of residual and hazardous materials	Disturbance, collision and mortality risk Alteration of habitat quality	Common mitigation measures: Same as for the construction phase Specific mitigation measures: P26	**Caribou:** Low **Moose, black bear, and grey wolf:** Very low

Affected component	Project phase	Primary source of impact	Description of potential impacts	Common and specific mitigation (or enhancement) measures	Significance of residual impact
Large mammals (continued)	Closure	Final restoration, production and management of residual and hazardous materials	Habitat creation Disturbance, collision and mortality risk Alteration of habitat quality	Common mitigation measures: Same as for the construction and operations phases Specific mitigation measures: P26	**Caribou:** Low **Moose, black bear, and grey wolf:** Very low Habitat Restoration - Positive Impact
Chiropterans	Construction	The organization of the site, stripping and clearing, surface preparation and access arrangement, construction of works and infrastructure, transportation and traffic, production and management of residual and hazardous materials	Habitat loss and fragmentation Disturbance, collision and mortality risk Alteration of habitat quality	Common mitigation measures: AIR01 to AIR03, FAU02 to FAU06, FAU08, FAU09,, NOR04 to NOR08, PLA01 and PLA02, QUA01 to QUA04, QUA06, QUA07, QUA10 to QUA26, VEG01 to VEG04 Specific mitigation measures: P03, P04, and P26	Habitat loss, disturbance, collision and mortality risk - Medium Risk of accidental spills - Low
	Operations	The presence and operation of new infrastructure, water use and management, transportation and traffic, production and management of residual and hazardous materials	Disturbance, collision and mortality risk Alteration of habitat quality	Common mitigation measures: Same as for the construction phase Specific mitigation measures: Same as for the construction phase	Disturbance, collision and mortality risk - Medium Risk of accidental spills - Low
	Closure	Final restoration, production and management of residual and hazardous materials	Habitat creation Disturbance, collision and mortality risk Alteration of habitat quality	Common mitigation measures: Same as for the construction and operations phases Specific mitigation measures: Same as for the construction and operations phases.	Disturbance, collision and mortality risk - Medium Risk of accidental spills - Low Habitat Restoration - Positive Impact
Mammals—Other species	Construction	The organization of the site, stripping and clearing, surface preparation and access arrangement, construction of works and infrastructure, transportation and traffic, production and management of residual and hazardous materials	Habitat loss and fragmentation Disturbance, collision and mortality risk Alteration of habitat quality	Common mitigation measures: AIR01 to AIR04, FAU06, FAU08, FAU09, NOR1, NOR02, NOR07, PLA01 and PLA02, QUA01 to QUA04, QUA06 to QUA09, QUA11 to QUA26, VEG01 to VEG04 Specific mitigation measures: P26	Disturbance, collision and mortality risk, and habitat loss - Low Risk of accidental spills - Very low
	Operations	The presence and operation of new infrastructure, water use and management, transportation and traffic, production and management of residual and hazardous materials	Disturbance, collision and mortality risk Alteration of habitat quality	Common mitigation measures: Same as for the construction phase Specific mitigation measures: P26	Disturbance, collision and mortality risk, and loss of habitat - Low Risk of accidental spills - Very low
	Closure	Final restoration, production and management of residual and hazardous materials	Habitat creation Disturbance, collision and mortality risk Alteration of habitat quality	Common mitigation measures: Same as for the operations and construction phases Specific mitigation measures: P26	Very low Habitat Restoration - Positive Impact

N/A: not applicable

Table 10-3 Summary of impacts on the social environment

Affected component	Project phase	Primary source of impact	Description of potential impacts	Common and specific mitigation (or enhancement) measures	Significance of residual impact
Land planning, development, and tenure	Construction	No impact is anticipated on land planning and development during the construction, operations, and closure phases			
	Operations				
	Closure				
First Nations interests and treaty lands	Construction	Discussed under the First Nation Traditional land use component in section 8.6			
	Operations				
	Closure				
Population, economy, and employment	Construction	Workforce and procurement	Maintenance and creation of jobs Economic benefits for local and regional businesses Increase in the qualifications and employability of the Cree and regional workforce	Common mitigation measures: POP01 and POP02 Specific mitigation measures: P05 to P12, and P26	Positive impact
	Operations	Workforce and procurement	Maintenance and creation of jobs Economic benefits for local and regional businesses Increase in the qualifications and employability of the Cree and regional workforce Increased income for workers	Common mitigation measures: POP01 and POP02 Specific mitigation measures: Same as for the construction phase	Positive impact
	Closure	Workforce and procurement	Reduction of jobs and income Economic benefits for local and regional businesses	Common mitigation measures: POP02 and POP03 Specific mitigation measures: P05, P07, P12, P13 and P26	**Eeyou Istchee and Jamésie:** Positive impact (economic benefits) Low (-) (job reduction)
Quality of life and well-being	Construction	The organization of the site, stripping and clearing, surface preparation and access arrangement, construction of works and infrastructure, transportation and traffic, production and management of residual and hazardous materials, workforce and procurement	Alteration of the quality of life and well-being of vacationers and land users Concerns of vacationers and land users about human health risks Decreased sense of safety for users of the access road Risk of tension between First Nations and non-First Nations workers Sense of loss and undermining of Cree cultural identity	Common mitigation measures: AIR01 to AIR03, NOR01, NOR02, FAU04, FAU08, FAU09, POP01, VIE01 to 04, UTT01 to 03 Specific mitigation measures: P14 to P21, and P26	**Eeyou Istchee:** Very low to low **Jamésie:** Very low
	Operations	The presence and operation of new infrastructure, water use and management, transportation and traffic, production and management of residual and hazardous materials, workforce and procurement	Alteration of the quality of life and well-being of vacationers and land users Concerns of vacationers and land users about human health risks Decreased sense of safety for users of the access road Risk of tension between First Nations and non-First Nations workers Alteration of the psychological and social well-being of workers and difficulties in reconciling work and family life Sense of loss and undermining of Cree cultural identity	Common mitigation measures: Same as for the construction phase Specific mitigation measures: P14 to P22, and P26	**Eeyou Istchee and jamésie:** Very low
	Closure	The presence of the remnants of the site, the final restoration, and the production and management of residual and hazardous materials	Concerns of vacationers and land users about human health risks	Common mitigation measures: POP02, VIE01 and VIE04, and UTT03 Specific mitigation measures: P14, P19, and P26	**Eeyou Istchee and Jamésie:** Very low

11 CUMULATIVE IMPACT ASSESSMENT

Under the requirements of the EQA, cumulative impacts must be considered in the environmental assessment of a project. Furthermore, the Directive issued for the Windfall Lake mine project (ref. 3214-14-059; July 2017 and revised in January 2022) indicates the elements to be considered and the method to be employed in the assessment of cumulative impacts, which are the combined effects of the project on a given valued component of the environment with other past, present, or future actions (with a high probability of occurrence).

Cumulative impacts must be assessed in relation to the main project issues. The choice of the various parameters must be justified. The complete methodology is presented in Chapter 5 (Appendix 5-1).

11.1 ASSESSMENT PARAMETERS

11.1.1 IDENTIFICATION OF PROJECT ISSUES

According to the Project Directive, it is the responsibility of the proponent to define the key issues for their project. Therefore, as part of the activities associated with the completion of this impact assessment, the key issues identified and confirmed through various consultation activities completed to date include:

- **Preservation of the quality of the environment.** This issue includes protecting air quality, minimizing the contribution to climate change (GHG emissions), protecting the integrity of the water system and wetlands, and protecting surface and groundwater quality.
- **Biodiversity preservation**. This issue includes minimizing the loss of vegetation cover and wetlands, preserving terrestrial and aquatic habitats (including bird, fish, moose, and caribou) and protecting plant and wildlife species at risk.
- **Consideration of First Nations interests and concerns.** This includes maintaining the integrity of Cree traditional activities and culture as well as preserving the community and psychosocial well-being of the Cree.
- **Local concentration of economic benefits.** This issue includes considerations for community benefits and the hiring of a local workforce in the long term (after the mine closes).

It should be noted that other issues may be identified through the project's ongoing communication activities.

11.1.2 DETERMINATION OF VALUED COMPONENTS

By considering these issues and the results of the analysis of the various environmental components assessed in this project, the selection of valued components that may be subject to cumulative impacts is established. For a component to be considered valued, it must be a primary focus of the project, and must therefore:

— be highly valued by the populations concerned or by specialists, or be protected or designated by legislation; or

— be likely to be directly, adversely, and significantly affected by the project; or

— be susceptible to change from a combination of project-specific and external sources of impact.

In addition, to allow assessment of the valued components, reliable and sufficient information and data must be available for both the reference state and the historical trends.

Table 11-1 presents all the components of the physical, biological, and social environments considered in the impact assessment, as well as the rationale for their selection or exclusion as valued components.

Table 11-1 Identification of environmental components selected as valued components

Environmental component	Selected		Rationale
	Yes	No	
Physical environment			
Ambient air		X	Although valued, this component will experience only localized disturbances generated primarily by the project and its activities. Moreover, only two potential receptors are present in the vicinity of the mine site and they are located upwind of the prevailing winds. This component is therefore not included in the cumulative impact assessment.
Greenhouse gases (GHG)	X		Given the importance placed on achieving the GHG reduction targets to be met by Quebec, any increase in emissions province-wide must be taken into account to ensure an up-to-date picture at the regional and provincial levels. A cumulative impact assessment must therefore be considered for this component.
Sound environment		X	Most of the noise emissions are located around the mine site. The residual impact will be low for the sensitive receptors present in the area and no other noise-generating activities are present close enough to anticipate cumulative impacts. This component is therefore not included.
Soil		X	The impacts on soils are very localized and unlikely to generate cumulative impacts given the absence of other activities that could be a source of soil disturbance (physical or chemical). This component is therefore not included in the cumulative impact assessment.
Hydrology		X	The main effect of the project on hydrology will be localized around the site where a portion of the natural surface water flow corresponding to the developed areas of the mine site will be intercepted and treated before being released back into the environment. It should be noted that this catchment will divert water that is currently flowing into Lake SN2 to another water body, Pond 1. The facility is at the head of the watershed and although the effect will dissipate quickly as it moves downstream from the site, a portion of the watershed will have its hydrological regime altered. The anticipated residual impact associated with the project will be low. Therefore, the component is not included in the cumulative impact assessment.
Surface water	X		The impacts generated by the project on the surface water components will be felt mainly at the study area level. All intercepted surface water as well as water generated by mining activities will be collected and treated to established discharge standards before being released into Pond 1 located at the head of watersheds CE09, CE15 (Lake SN3) and CE02 (towards Lakes SN8 and SN10). Despite the treatment carried out, the quality of the water will be altered by a constant supply of low concentration contaminants (below discharge standards) that will be introduced throughout the operations of the mine site. A medium residual impact is anticipated for this component, and it is therefore selected for the cumulative impact assessment.

Environmental component	Selected		Rationale
	Yes	No	
Sediments		X	The impacts generated by the project on sediments are indirect, either through the introduction of contaminants into surface waters or in relation to the quality of the surrounding soils that can be carried to the watercourses by runoff. However, the anticipated residual impact is low and therefore this component is not selected as a valued component.
Hydrogeology and groundwater		X	The main project impacts on this component involve contamination risks and some drawdown of the water table. However, the very localized nature of the effects experienced (generally limited to the mine site) and the implementation of common mitigation measures will limit the residual impacts to a low level. For these reasons, this component will not be included in the cumulative impact assessment.
Biological environment			
Flora:			
– Terrestrial vegetation	X		The terrestrial vegetation in the study area has been significantly disturbed over the years by logging activities. In addition to mining, the forest is one of the region's most important natural resources and is home to a diverse wildlife. For these reasons, this component is selected for the cumulative impact assessment.
– Wetlands	X		Wetlands are relatively well represented in the area of the mine project and noticeable impacts are generated as a result of encroachment and dewatering associated with the mine site, but also with extensive exploration activities. The recognized importance of these sensitive and fragile ecosystems, combined with the effects described above, supports the inclusion of this component in the cumulative impact assessment.
– Plant species of special status		X	No specimens of plant species of special status were recorded at any of the 391 inventory stations. This demonstrates that few suitable habitats are present in the study area and therefore the impact on them would be difficult to aggregate with other projects or events occurring in the study area. For this reason, this component was not included in the cumulative impact assessment.
Ichthyofauna, benthos, and habitats	X		Although no species of special status were identified in the watercourses affected by the project during the inventories carried out, the discharge of effluent into Pond 1 during the operations phase will result in some degradation of the quality of fish habitat in the water bodies that make up the watersheds considered (CE09, CE15 et CE02). The anticipated residual impact of the project would be medium. This component is therefore included in the cumulative impact assessment.
Herpetofauna and habitats		X	All of the herpetofauna species recorded during the various inventories correspond to common species, although present in low densities in the project area. The anticipated impact of the project on this component is very low, so no cumulative impact is anticipated. This component is therefore not included in the cumulative impact assessment.
Avifauna and habitats	X		The habitat of bird populations in the project area has already been significantly disturbed as a result of logging in the late 1990s and early 2000s. Despite the passing years, this habitat has still not regenerated to its original state. Additional losses caused by the project could further harm local bird populations. Furthermore, five species of special status are considered likely to use the area. For these reasons, this component was included in the cumulative impact assessment.
Mammals and habitats:			
– Large mammals	X		In general, large mammals will be minimally affected by the project and its activities. Nevertheless, two species—woodland caribou (*Rangifer tarandus caribou*) and moose (*Alces alces*)—require special attention because of their scarcity, their protection status, and their apparent population decline in the region. A cumulative impact assessment will therefore be conducted for these two species.
– Small wildlife		X	The anticipated residual impacts on small fauna and small mammals are low; although their populations are not very dense at these latitudes, the habitat suitable for these species is abundant throughout the territory. These two components are therefore not included in the cumulative impact assessment.
– Small mammals		X	
– Chiropterans	X		Most bat species inventoried (5 out of 6) are species of special status, two of which are considered endangered in Canada (Schedule 1 of the SARA). In addition, the presence and rapid spread of white-nose syndrome (WNS) in Quebec, now considered the main cause of the decline of bat populations in northeastern North America, makes bats more vulnerable to cumulative impacts than any other wildlife component present in the study area. This component is therefore included in the cumulative impact assessment.

Environmental component	Selected		Rationale
	Yes	No	
Social environment			
Land use planning, development, and tenure		X	The project and its activities are consistent with planned land use and planning and respect established land tenure. Thus, no specific issues were identified in relation to this component and it will not be included in the cumulative impact assessment.
First Nations interests and treaty lands		X	No impacts associated with the project or its activities are anticipated on this component. This component is therefore not included in the cumulative impact assessment.
Population, economy, and employment		X	The project promotes regional economic development and job creation. This component is therefore not included in the cumulative impact assessment.
Quality of life and well-being		X	The project will have little or negligible impact on quality of life and well-being. This component is therefore not included in the cumulative impact assessment.
Use of the territory and its natural resources		X	The project has a low impact on hunting and fishing activities. Few non-First Nations families are present on the land and only temporarily. Since it is not possible to assess cumulative impacts on primarily transient land users, this component is not included in the cumulative impact assessment.
First Nation traditional land use	X		Project facilities and activities encroach on and interfere with First Nation traditional land use, including users of traplines W25B and W25A. These trapline users were also affected by the extensive logging activities of the late 1990s and early 2000s. For these reasons, this component was included in the cumulative impact assessment.
Public infrastructure and utilities		X	The project and its activities do not affect public infrastructures and utilities. In fact, the project ensures more regular maintenance of the main access roads and could lead to the construction of a 69 kV line. This component is therefore not included in the cumulative impact assessment.
Heritage and archaeology		X	Field surveys conducted in areas considered to have prehistoric and historic archaeological potential have not resulted in the discovery of any new archaeological objects or sites. This component is therefore not included in the cumulative impact assessment.
Landscape		X	The scarcity of observers and the low visibility of the facilities, the tailings storage facility, and the waste rock stockpile (once vegetated), result in a low residual impact. This component is therefore not included in the cumulative impact assessment.

In summary, eight valued components have been identified and will be assessed for cumulative impacts:

- greenhouse gases;
- surface water;
- flora including terrestrial vegetation and wetlands;
- ichthyofauna, benthos, and habitat;
- avifauna, specifically species with a special protection status;
- large mammals, specifically woodland caribou and moose;
- chiropterans;
- First Nation traditional land use.

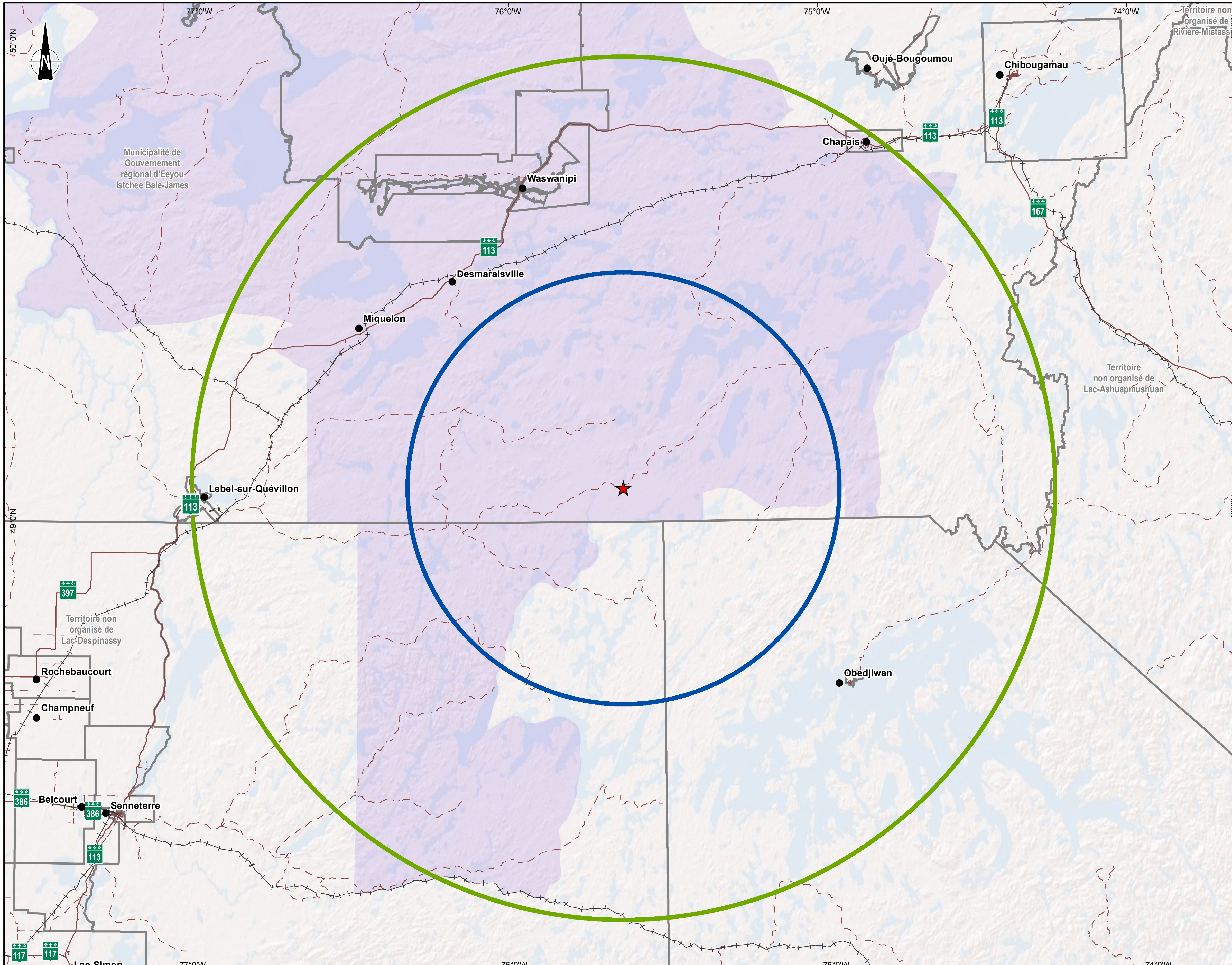
11.1.3 SPATIAL AND TEMPORAL BOUNDARIES

Table 11-2 presents the selection criteria, spatial and temporal boundaries, and indicators for each valued component selected for the cumulative impact assessment. It should be noted that due to the specific characteristics of each valued component, they may have different spatial and temporal ranges.

Table 11-2 Temporal and spatial boundaries, selection criteria, and indicators for valued components used in cumulative impact assessment

Valued component	Indicator	Temporal boundaries	Spatial boundaries
Physical environment			
GHG	% increase in emissions	2008–2035	Local, regional, and provincial.
Surface water	Number of watercourses receiving effluent	2008–2035	50 km radius around the project site.
Biological environment			
Flora (land cover and wetlands)	Area (ha) of mapped land cover or wetlands	1980–2025	100 km radius around the project site.
Ichthyofauna, benthos, and habitat	Number of watercourses receiving effluent	2008–2035	50 km radius around the project site.
Protected bird species	Assessment of potential populations and habitats of the following species: – common nighthawk – olive-sided flycatcher – Canada warbler – bald eagle – rusty blackbird	1970–2028	100 km radius around the project site.
Large mammals (woodland caribou and moose)	Presence and availability of suitable habitat	1990–2025	50 km radius around the project site.
Chiropterans	Number of sightings of the following species: – silver-haired bat – hoary bat – red bat – northern long-eared myotis – little brown bat	2003–2028	100 km radius around the project site.
Social environment			
Cree traditional land use	Visits to the area	1980–2028	The territory of the Cree community of Waswanipi as well as their designated traplines within a 100 km radius of the project site.

Map 11-1 shows the boundaries of the study areas considered for the cumulative impact assessment. First, there are two assessment areas defined by a radius of 50 km or 100 km around the mine project depending on the valued component being assessed (Table 11-2). Second, the area defined for the assessment of cumulative impacts on land use includes part of the territory of the community of Waswanipi as well as traplines W25A and W25B



Limite administrative / *Administrative boundary*

Municipalité / *Municiality*

Infrastructures / ***Infrastructures***

Route nationale / *National road*

Route forestière / *Forestry road*

Chemin de fer / *Railroad*

Projet / ***Project***

Emplacement du projet minier Windfall / *Windfall mining project location*

Zones d'études / ***Study areas***

Zone d'étude pour l'évaluation des impacts cumulatifs pour l'orignal, le caribou, le poisson et l'eau de surface (rayon de 50 km) / *Study area for cumulative impact assessment for moose, caribou, fish and surface water (50 km radius)*

Zone d'étude pour l'évaluation des impacts cumulatifs pour la flore, l'avifaune et les chiroptères (rayon de 100 km) / *Study area for cumulative impact assessment for flora, birds and bats (100 km radius)*

Limite du territoire de trappage (communauté de Waswanipi)/ *Trapline territory boundary (Waswanipi community)*

OSISKO
MINIÈRE OSISKO

Projet minier Windfall - Étude d'impacts sur l'environnement / ***Windfall Mining Project - Environmental Impacts Assessment***

Site minier Windfall, Eeyou Istchee Baie-James (Québec) / *Windfall Mining Site, Eeyou Istchee Baie-James (Quebec)*

Carte 11-1 / ***Map 11-1***

Zones d'étude pour l'analyse des impacts cumulatifs / ***Study Areas for Cumulative Impacts analysis***

Sources / Sources:
CanVec+, 1/50 000, RN Can, 2014
SDA, 1/20 000, MERN Québec, 2020
BDTA, 1/250 000, MRN Québec, 2002
BDGA, 1/5 000 000, MRN Québec, 2012
GESTIM, MRN Québec, 2022

0 9 18 km

MTM, Fuseau 9 / *Zone 9*, NAD83

2023-03-03

Préparée par / Preparation : C. Martineau
Dessinée par / Drawing : C. Thériault
Vérifiée par / Verification : M.-H. Brisson
_201_11330_19_eic11_1_168_ZE_effets_cumulatifs_230303.mxd

11.1.4 PROJECTS, ACTIVITIES, AND EVENTS CONSIDERED IN THE ASSESSMENT

An exhaustive inventory of past, current, and future local and regional projects, activities, and events was made through a review of available documentation and various meetings with First Nations and non-First Nations managers of the territory. Numerous websites, such as those of the MELCCFP, the James Bay Advisory Committee on the Environment, the IAAC, the MRNF, Hydro-Québec, EIJBRG, etc., and environmental impact assessment reports for projects in the same territory as the mine project or nearby (e.g., the Bonterra mine project) were consulted to obtain information on the relevant impacts of these projects.

Table 11-3 lists past, current, and upcoming projects, activities, and events for each of the selected valued components. This list is organized into five themes:

- natural resource development;
- infrastructure and services;
- land use (sport hunting and fishing activities);
- wildlife or protected areas;
- natural and other disturbances.

Map 11-2 presents the projects, past or present, considered for the assessment of cumulative impacts affecting the territory and for which location data is available.

Table 11-3 Projects, activities, and events that may influence valued components

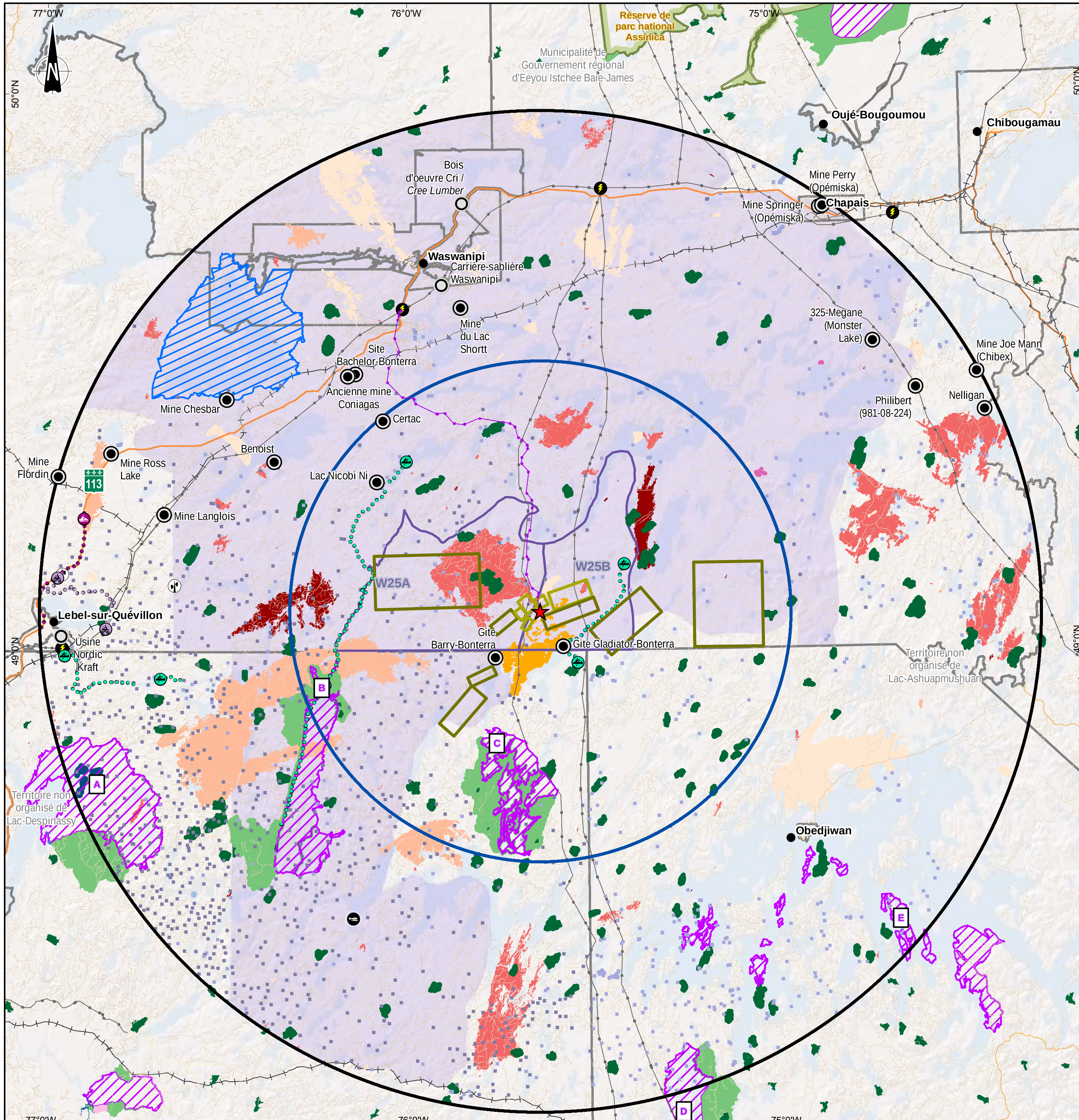
Projects, activities, and events	Past	Present	Future	Greenhouse gases	Surface water/ichthyofauna, benthos, and habitat	Flora	Bird species at risk/ large mammals/chiropterans	Land use
Natural resource development								
Mining exploration activities (other than those mentioned below).	X	X	X	Contribution to regional and provincial GHG emissions through the transportation and operation of equipment and vehicles.	Contribution to the degradation of local surface water quality and fish habitat.	Loss of forest and wetland areas associated with the construction of access roads and work areas for drilling.	Loss and alteration of habitat associated with the construction of access roads and work areas for drilling. Increased disturbance and risk of collision associated with development, vehicle traffic (land and air), and operation of generators and drills.	Increased wildlife harvesting pressure and changes in land and resource use due to improved land access (creation of new access roads). Loss of territory caused by the increase of access roads and drilling areas.
Gold processing site for the Barry and Moray projects at the Bachelor site – Bonterra, Desmaraisville (2019–2030).		X	X	Contribution to regional and provincial GHG emissions by the various planned works, transportation of ore, and operation of the process plant.	Contribution to the degradation of local surface water quality and fish habitat.	Loss of forest and wetland areas associated with the expansion of the tailings storage facilities and the Bachelor complex, and construction of a new access road.	Loss and alteration of habitat associated with the expansion of the tailings storage facilities and the Bachelor complex, and construction of a new access road. Increased disturbance and collision risk associated with development, increased regional road traffic, and site operations.	Increased wildlife harvesting pressure and changes in land and resource use as a result of improved access to the territory (improvement of existing road links). Loss of land due to the expansion of the tailings storage facilities and the Bachelor complex, and construction of a new access road.
Site of the Bonterra Barry Deposit (approximately 12 km southwest of the Windfall mine site) (2019-2030).	X	X	X	Contribution to regional and provincial GHG emissions by mine site operations.	Contribution to the degradation of local surface water quality and fish habitat.	Loss of forest and wetland areas associated with the presence of mining facilities and the gradual expansion of tailings storage facilities.	Loss and alteration of habitat associated with the presence of mining facilities and the gradual expansion of tailings storage facilities. Increased disturbance and collision risk associated with mine operations.	Increased wildlife harvesting pressure and changes in land and resource use due to improved access to the territory (improvement of existing road links and creation of new access roads). Loss of territory due to the presence of the mine site and the gradual expansion of the tailings storage facilities.
Bonterra Gladiator site (about 8 km southeast of the Windfall mine site) under exploration.	X	X	X	Contribution to regional and provincial GHG emissions due to the operation of machinery required for exploration work.	Contribution to the degradation of local surface water quality and fish habitat.	Loss of forest and wetland areas associated with the construction of access roads and work areas for drilling.	Loss and alteration of habitat associated with the construction of access roads and work areas for drilling. Increased disturbance and risk of collision associated with development, vehicle traffic (land and air), and operation of generators and drills.	Increased wildlife harvesting pressure and changes in land and resource use due to improved land access (creation of new access roads). Loss of territory caused by the increase of access roads and drilling areas.
The Langlois Mine – Nyrstar (about 50 km north of Lebel-sur-Quévillon) (2007–2020). Possibility of resumption if sold.	X		X	Not applicable since work stopped.	Contribution to the degradation of local surface water quality and fish habitat.	Loss of forest and wetland areas associated with the presence of mining and tailings storage facilities.	Loss and alteration of habitat associated with the presence of mining and tailings storage facilities.	Increased wildlife harvesting pressure and changes in land and resource use due to improved access to the territory as a result of access roads created to reach the mine site. Loss of territory due to the presence of the mine site and tailings storage facilities.
Coniagas Mine (about 1.5 km west of the Bonterra Bachelor site). This site is closed, but a project to restore the tailings storage facility has been submitted to the MRNF[1] and COMEX in 2019.	X		X	Contribution to regional and provincial GHG emissions due to the operation of machinery required to complete the restoration work.	Contribution to the degradation of local surface water quality and fish habitat.	Not applicable	Not applicable	Not applicable
Rose Lake Mine (on Road 113, about 40 km north of Lebel-sur-Quévillon). Gold mine operated in the 1930s and explored again in 1985-86. Since closed.	X			Not applicable since work stopped.	Contribution to the degradation of local surface water quality and fish habitat.	Loss of forest and wetland areas associated with recent exploration activities.	Habitat loss and alteration associated with recent exploration activities.	Not applicable, as the site is accessible.
Flordin Mine (about 30 km north of Lebel-sur-Quévillon). Gold mine explored sporadically since the 1940s, most recently in the 1980s.	X			Not applicable since work stopped.	Contribution to the degradation of local surface water quality and fish habitat.	Loss of forest and wetland areas associated with recent exploration activities.	Habitat loss and alteration associated with recent exploration activities.	Not applicable, as the site is accessible.

1 Note that since the November 2022 election, the Ministère de l'Énergie et des Ressources naturelles (MERN) has changed its name to the Ministère des Ressources naturelles et des Forêts (MRNF).

Projects, activities, and events	Past	Present	Future	Greenhouse gases	Surface water/ichthyofauna, benthos, and habitat	Flora	Bird species at risk/ large mammals/chiropterans	Land use
The Cartier Resources Toussaint Deposit (Wilson Project) and Pusticamica Gold Deposit (Benoist Project) are located 18 km east of Lebel-sur-Quévillon and 30 km east of the Langlois Mine site, respectively. Both sites are being explored.		X	X	Contribution to regional and provincial GHG emissions due to the operation of machinery required for exploration work.	Contribution to the degradation of local surface water quality and fish habitat.	Loss of forest and wetland areas associated with the construction of access roads and work areas for drilling.	Loss and alteration of habitat associated with the construction of access roads and work areas for drilling. Increased disturbance and risk of collision associated with development, vehicle traffic (land and air), and operation of generators and drills.	Increased wildlife harvesting pressure and changes in land and resource use due to improved land access (creation of new access roads). Loss of territory caused by the increase of access roads and drilling areas.
Springer copper mine (Opemiska project) of QC Copper and Gold located in the town of Chapais.	X	X	X	Contribution to regional and provincial GHG emissions due to the operation of machinery required for exploration work.	Contribution to the degradation of local surface water quality and fish habitat.	Loss of forest and wetland areas associated with the construction of access roads and work areas for drilling.	Loss and alteration of habitat associated with the construction of access roads and work areas for drilling. Increased disturbance and risk of collision associated with development, vehicle traffic (land and air), and operation of generators and drills.	Increased wildlife harvesting pressure and changes in land and resource use due to improved land access (creation of new access roads). Loss of territory caused by the increase of access roads and drilling areas.
Iamgold's Megane gold mine (Monster Lake) in the exploration phase. The site is located about 30 km south of Chapais.	X	X	X	Contribution to regional and provincial GHG emissions due to the operation of machinery required for exploration work.	Contribution to the degradation of local surface water quality and fish habitat.	Loss of forest and wetland areas associated with the construction of access roads and work areas for drilling.	Loss and alteration of habitat associated with the construction of access roads and work areas for drilling. Increased disturbance and risk of collision associated with development, vehicle traffic (land and air), and operation of generators and drills.	Increased wildlife harvesting pressure and changes in land and resource use due to improved land access (creation of new access roads). Loss of territory caused by the increase of access roads and drilling areas.
Philibert Mine of Northern Superior Resources (gold) located approximately 40 km south of Chapais. This project is in the exploration phase.	X	X	X	Contribution to regional and provincial GHG emissions due to the operation of machinery required for exploration work.	Contribution to the degradation of local surface water quality and fish habitat.	Loss of forest and wetland areas associated with the construction of access roads and work areas for drilling.	Loss and alteration of habitat associated with the construction of access roads and work areas for drilling. Increased disturbance and risk of collision associated with development, vehicle traffic (land and air), and operation of generators and drills.	Increased wildlife harvesting pressure and changes in land and resource use due to improved land access (creation of new access roads). Loss of territory caused by the increase of access roads and drilling areas.
Joe Mann Mine (Chibex) of Doré Copper (gold and copper) located approximately 47 km south of Chibougamau Former mine closed in 2007 but being reactivated.	X	X	X	Contribution to regional and provincial GHG emissions due to the operation of machinery required for exploration and eventual mining.	Contribution to the degradation of local surface water quality and fish habitat.	Loss of forest and wetland areas associated with the development of access roads and mine site work areas.	Habitat loss and alteration associated with the development of access roads and work areas for site operations. Increased disturbance and collision risk associated with development, vehicular traffic (ground and air), and site operation.	Increased wildlife harvesting pressure and changes in land and resource use due to improved land access (creation of new access roads). Loss of territory due to an increase in the number of access roads and drilling and mining areas.
Iamgold's Nelligan Mine (gold) currently under exploration about 60 km south of Chapais. This is an advanced exploration open pit mine project.	X	X	X	Contribution to regional and provincial GHG emissions due to the operation of machinery required for exploration work.	Contribution to the degradation of local surface water quality and fish habitat.	Loss of forest and wetland areas associated with the construction of access roads and work areas for drilling.	Loss and alteration of habitat associated with the construction of access roads and work areas for drilling. Increased disturbance and risk of collision associated with development, vehicle traffic (land and air), and operation of generators and drills.	Increased wildlife harvesting pressure and changes in land and resource use due to improved land access (creation of new access roads). Loss of territory caused by the increase of access roads and drilling areas.
The Springer and Perry open pit copper mines located in Chapais were combined into one large project (Opémiska project) by QC Copper and Gold.	X		X	Contribution to regional and provincial GHG emissions due to the operation of machinery required for exploration work.	Contribution to the degradation of local surface water quality and fish habitat.	Loss of forest and wetland areas associated with the construction of access roads and work areas for drilling.	Loss and alteration of habitat associated with the construction of access roads and work areas for drilling. Increased disturbance and risk of collision associated with development, vehicle traffic (land and air), and operation of generators and drills.	Increased wildlife harvesting pressure and changes in land and resource use due to improved land access (creation of new access roads). Loss of territory caused by the increase of access roads and drilling areas.
Chesbar iron mine (Canadian Mining Holding) closed since 1971, located about 27 km northwest of Desmaraisville.	X			Not applicable since work stopped.	Contribution to the degradation of local surface water quality and fish habitat.	Loss of forest and wetland areas associated with past mining activities.	Habitat loss and alteration associated with past mining activities.	Not applicable, as there is no activity and the site is accessible.
Certac gold-copper mine (Osisko), closed in 1981 but explored in 2018 and 2021.	X			Not applicable since work stopped.	Contribution to the degradation of local surface water quality and fish habitat.	Loss of forest and wetland areas associated with recent exploration activities.	Habitat loss and alteration associated with recent exploration activities.	Not applicable, as there is no activity and the site is accessible.
Lac Nicobi nickel deposit (Julie Gadoury), which was only explored in 1980 and 1993.	X			Not applicable during cessation of work.	Contribution to the degradation of local surface water quality and fish habitat.	Loss of forest and wetland areas associated with recent exploration activities.	Habitat loss and alteration associated with recent exploration activities.	Not applicable, as there is no activity and the site is accessible.

Projects, activities, and events	Past	Present	Future	Greenhouse gases	Surface water/ichthyofauna, benthos, and habitat	Flora	Bird species at risk/ large mammals/chiropterans	Land use
Shortt Lake Gold Mine (Globex Enterprises), closed in 1992 and underwent exploration drilling in 2011.	X			Not applicable since work stopped.	Contribution to the degradation of local surface water quality and fish habitat.	Loss of forest and wetland areas associated with past mining activities.	Habitat loss and alteration associated with past mining activities.	Not applicable, as there is no activity and the site is accessible.
Quarry and sand pit near Waswanipi, as well as two new borrow pits required for the Windfall project (Gravtest-3 and Gravtest-4).	X	X	X	Contribution to regional and provincial GHG emissions due to the operation of machinery and transportation vehicles.	Contribution to the degradation of local surface water quality and fish habitat.	Loss of forest area associated with the gradual expansion of the two operating sites.	Loss of habitat associated with the gradual expansion of the two operating sites. Increased disturbance and risk of collision associated with the operation of machinery, crushing equipment, and transportation vehicles.	Alteration of land use and loss of land and resources associated with the gradual expansion of the two operating sites. Disruption of traditional hunting, trapping, and fishing activities caused by the operation of machinery, crushing equipment, and transportation vehicles.
Forestry operations.	X	X	X	Contribution to regional and provincial GHG emissions from transportation vehicle traffic and machinery operation.	Contribution to the degradation of local surface water quality and fish habitat.	Loss and alteration of vegetation cover due to logging activities.	Loss and alteration of habitat associated with logging activities. Increased disturbance and collision risk associated with logging and hauling activities.	Increased wildlife harvesting pressure and changes in land and resource use due to opening up of new areas (increased accessibility) and disturbance of existing habitats.
Infrastructure and services								
Reinforcement of the 315 kV transmission system in Abitibi-Témiscamingue (2021–2025). Only the eastern end (at Lebel substation) of this project may have cumulative impacts with the Windfall project.		X	X	Contribution to regional and provincial GHG emissions due to the construction of the new 315 kV line and substation.	Contribution to the degradation of local surface water quality and fish habitat.	Loss of forest and wetland areas associated with the opening of a new right-of-way for the 315 kV line coming out of Lebel substation.	Loss and alteration of habitat associated with the opening of a new right-of-way for the 315 kV line coming out of the Lebel substation. Temporary increase in disturbance associated with construction and maintenance of the new line. Possible increase in the number of collisions of birds and chiropterans with the components of the new line.	Increased wildlife harvesting pressure due to the creation of a new right-of-way to facilitate access to the area. Alteration and loss of territory caused by the presence of the right-of-way and the power line.
New 69 kV line, approximately 85 km long, between Waswanipi substation and the Windfall mine site (2022–2023). This project includes a 69 kV/13.8 kV substation and 13.8 kV/600 V electrical substations. The line will be installed on a wooden structure.			X	Contribution to regional and provincial GHG emissions due to the construction of the new line.	Contribution to the degradation of local surface water quality and fish habitat.	Loss of forest and wetland areas associated with the opening of a new right-of-way for the 69 kV line from a new 25/69 kV substation adjacent to Waswanipi.	Loss and alteration of habitat associated with the opening of a new right-of-way for the 69 kV line Temporary increase in disturbance associated with the construction and maintenance of the new 69 kV line. Possible increase in the number of collisions of birds and chiropterans with the components of the new line.	Increased wildlife harvesting pressure due to the creation of a new right-of-way to facilitate access to the area. Alteration and loss of territory caused by the presence of the right-of-way and the power line.
Roads 113 and 1053 as well as the various access roads in the area.	X	X	X	The development of roads and access roads contributes to regional and provincial GHG emissions due to the associated construction and maintenance work and increased vehicular traffic in the area.	Contribution to the degradation of local surface water quality and fish habitat.	The opening of new access roads results in the loss of forested wetland area.	Habitat loss and alteration associated with the opening of new access roads. Increased disturbance associated with increased traffic in the area. Potential increase in the number of collisions between birds and the increased number of vehicles using the roads and access roads.	Increased wildlife harvesting pressure due to the creation of new access roads to facilitate access to the area. Alteration and loss of territory caused by the presence of roads and access roads.
Nordic cogeneration plant in Lebel-sur-Quévillon (45 megawatts) by Nexolia Bioenergy (timeline not available).		X	X	Contribution to regional and provincial GHG emissions due to the development and operation of the former Domtar mill.	None since it is on an existing industrial site.	None since it is on an existing industrial site.	None since it is on an existing industrial site.	None since it is on an existing industrial site.
Grand Alliance – Project to reopen the Grevet-Chapais railway (150 km).			X	Contribution to regional and provincial GHG emissions due to reactivation work.	Contribution to the degradation of local surface water quality and fish habitat.	Loss of vegetated areas during the upgrade of the rail corridor.	Loss of habitat during the upgrade of the rail corridor. Occasional and temporary disturbance during construction and maintenance work and during the passage of trains. Increased risk of collision associated with passing trains.	Change in land use patterns as snowmobiles used to travel through the rail corridor.
Grand Alliance – Relocation of the snowmobile trail between Lebel-sur-Quévillon and Chapais. Trail not available at this time.			X	Contribution to regional and provincial GHG emissions due to development.	Contribution to the degradation of local surface water quality and fish habitat.	Loss of vegetation due to the opening of a new snowmobile corridor.	Loss and alteration of habitat due to the opening of the new snowmobile corridor. Increased disturbance associated with snowmobile use in winter and possibly ATV use in summer.	Change in land use patterns due to the relocation of the traffic corridor. Alteration and loss of territory due to the logging required to open the snowmobile corridor.

Projects, activities, and events	Past	Present	Future	Greenhouse gases	Surface water/ichthyofauna, benthos, and habitat	Flora	Bird species at risk/ large mammals/chiropterans	Land use
Land use (non-First Nations)								
Expansion of the towns of Lebel-sur-Quévillon and Chapais.	X	X	X	Contribution to regional and provincial emissions due to increasing population activities.	Contribution to the degradation of local surface water quality and fish habitat.	Loss of vegetated area due to urban expansion.	Loss of habitat and increased disturbance due to urban expansion and increased human activities.	Increased wildlife harvesting pressure due to an increase in the number of hunting and fishing enthusiasts. Land alteration and loss due to urban expansion.
Sport hunting and regulations applicable to zones 16 and 17 (hunting and fishing).	X	X	X	Not applicable	Not applicable	Not applicable	Increased disturbance and mortality (for birds) due to hunting activities.	Disruption of traditional hunting, trapping, and fishing activities. Decreased sense of security.
Allocation of temporary shelter leases for hunting and fishing by the MRNF (as of 1982). However, an administrative suspension of private vacation leases is currently in effect in the Eeyou Istchee James Bay region. Only those already allocated are therefore considered.	X			Not applicable	Not applicable	Not applicable	Increased disturbance caused by activities related to the presence of these temporary shelters.	Disruption of traditional hunting, trapping, and fishing activities. Decreased sense of security.
Wildlife or protected area								
Wildlife reserves, protected areas, and biodiversity reserves.	X	X	X	Not applicable	Protection of fish habitat and surface water quality.	Protection of flora and its diversity.	Protection of species and their habitat.	Safeguarding the way of life of First Nations communities and supporting biodiversity.
Assinica National Park Reserve.		X	X	Not applicable	Protection of fish habitat and surface water quality	Protection of flora and its diversity.	Protection of species and their habitat.	Preservation of sites of natural and cultural interest to the Cree.
Quebec woodland caribou recovery plan (2005-2012) and plan update (2012-2022).	X	X		Not applicable	Not applicable	Not applicable	Goal to protect the woodland caribou and its habitat.	Not applicable
Assignment of special status under the Species at Risk Act and the Act respecting threatened or vulnerable species that involves protection of the habitat of species of special status.	X	X	X	Not applicable	Protection of fish species and their habitat.	Protection of species and their habitat.	Protection of species and their habitat.	Not applicable
Paix des Braves Agreement, Nadoshtin and Boumhounan Agreements, James Bay and Northern Quebec Agreement, and Agreement on Governance in the Eeyou Istchee James Bay Territory.	X	X	X	Not applicable	Not applicable	Not applicable	Continued harvesting of woodland caribou for social, food, or subsistence purposes.	Promotes Cree ownership of their development and greater Cree participation in resource development.
Natural and other disturbances								
Forest fires (cyclical phenomenon).	X		X	Contribution to regional and provincial GHG emissions due to natural phenomena.	Contribution to the degradation of local surface water quality and fish habitat.	Loss and alteration of vegetation cover.	Loss and alteration of habitats.	Disruption of wildlife and plant harvesting activities. Changes in land and resource use. Temporary loss of land.
White-nose syndrome (detected in Quebec in 2010).	X	X	X	Not applicable.	Not applicable.	Not applicable.	Significant mortality in hibernating chiropteran populations.	Not applicable



Limite administrative / *Administrative boundary*

Municipalité / *Municipality*

Chemin de fer / *Railroad*

Ligne de transport d'énergie électrique / *Electric power transmission line*

Ligne de transport d'énergie préliminaire projetée (en processus d'autorisation environnementale) / *Preliminary proposed power transmission line (ongoing environmental authorization application)*

Réseau routier / *Road Network*

Route nationale / *National road*

Route collectrice / *Collector road*

Route locale / *Local road*

Accès aux ressources et aux localités isolées / *Acess to ressources and isolated places*

Chemin forestier / *Forest road*

Chemin d'hiver / *Winter road*

Projet / *Project*

Emplacement du projet / *Project location*

Zones d'études / *Study Areas*

Zone d'étude pour l'évaluation des impacts cumulatifs pour l'orignal, le caribou, le poisson et l'eau de surface (rayon de 50 km) / *Study area for cumulative impact assessment for moose, caribou, fish and surface water (50 km radius)*

Zone d'étude pour l'évaluation des impacts cumulatifs pour la flore, l'avifaune et les chiroptères (rayon de 100 km) / *Study area for cumulative impact assessment for flora, birds and bats (100 km radius)*

Infrastructures connexes / *Related Infrastructure*

Hydroaérodrome / *Hydroaerodrome*

Tour de télécommunication / *Communication tower*

Poste électrique d'Hydro-Québec / *Electrical substation*

Sentiers / *Trails*

Canotable / *Canoe*

Motoneige / *Snowmobile*

Quad / *Quad bike*

Baux de villégiature allochtones / *Vacation Leases*

Fins d'abri sommaire en forêt / *Temporary forest shelter*

Fins de villégiature / *For vacationing purposes*

Terrain de trappage cri / *Cree trapline*

Limite du territoire de trappage (communauté de Waswanipi)/ *Trapline boundary (Waswanipi community)*

Mines et industries / *Mines and Industries*

Site industriel / *Industrial site*

Site minier / *Mining site*

Activités d'exploration d'Osisko / *Osisko Drilling Activities*

Windfall Exploration

Urban Barry

Feux de forêts / *Forest fire*

Moins de 10 ans / *Less than 10 years*

Entre 10 et 20 ans / *10 to 20 years*

Entre 20 et 30 ans / *20 to 30 years*

Plus de 30 ans / *More than 30 years*

Future exploitation forestière / *Future forest harvesting*

Aires protégées / *Protected areas* (MELCCFP, 2023)

Habitat faunique / *Fauna Habitat*

Aire de concentration d'oiseaux aquatiques / *Aquatic bird concentration area*

Habitat du rat musqué / *Common muskrat habitat*

Héronnière (aire de nidification et bande de protection 0-200 m) / *Heronry (nesting area and 0-200 m protection area)*

Écosystème forestier exceptionnel / *Exceptional Forest Ecosystem*

Forêt ancienne / *Old-growth forest*

Forêt rare / *Rare forest*

Autre désignation / *Other Designation*

Réserve de parc national du Québec / *Quebec national parc reserve*

Réserve de territoire aux fins d'aire protégée / *Protected area territory reserve*

Refuge biologique / *Biological refuge*

Réserve aquatique projetée / *Projected aquatic reserve*

Réserve de biodiversité / *Biodiversity Reserve*

Réserve de biodiversité projetée / *Projected biological reserve*

A Lac Parent / *Parent Lake*

B Lac Wetetnagami / *Wetetnagami Lake*

C Lac Saint-Cyr / *Saint-Cyr Lake*

D Brûlis-du-Lac-Oskélanéo / *Brûlis-du-Lac-Oskélanéo*

E Îles-du-Réservoir-Gouin / *Îles-du-Réservoir-Gouin*

OSISKO MINIÈRE OSISKO

Projet minier Windfall - Étude d'impact sur l'environnement / *Windfall Mining Project - Environmental Impact Assessment*

Site minier Windfall, Eeyou Istchee Baie-James (Québec) / *Windfall Mining Site, Eeyou Istchee Baie-James (Quebec)*

Carte 11-2 / *Map 11-2*

Projets touchant le territoire et considérés dans l'analyse / *Project Within the Territory and Considered in the Analysis*

Sources / *Sources*:
CanVec+, 1/50 000, RN Can, 2014
SDA, 1/20 000, MERN Québec, 2020
BDTA, 1/250 000, MRN Québec, 2002
BDGA, 1/5 000 000, MRN Québec, 2012
GESTIM, MRN Québec, 2022

0 9 18 Km

MTM, Fuseau 9 / *Zone 9*, NAD83

2023-02-24

Préparée par / *Preparation* : C. Martineau
Dessinée par / *Drawing* : C. Thériault
Vérifiée par / *Verification* : M.-H. Brisson

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NATURAL RESOURCE DEVELOPMENT

This theme encompasses the various forestry and mining activities, past, present and planned.

FORESTRY ACTIVITIES

Since 1980, forest cutting activities in the study area have been mainly related to forest industry activities. Qualitative analysis of recent aerial photographs shows that there is evidence of cutting over at least 70% to 80% of the area within a 50 km radius of the Windfall mine site (large areas or areas cut in a checkerboard pattern). The vast majority of these cuts appear to be relatively recent (20 to 40 years) since revegetation appears to be limited and of moderate size. When a 100 km radius is considered around the mine site, evidence of cutting appears to be present over approximately 50% to 60% of the area. Forest cutting appears to be concentrated in the central and southern half of the area, while areas to the north and east appear to be less exploited at this time. Forest cutting also appears to be relatively recent within this larger area.

To a lesser extent, work on various mineral exploration, mining, and other projects have also contributed to forest cutting. Also, deforestation was carried out for the use of borrow pits (sand pits or quarries), for the development of road and power line rights-of-way, for the preparation of construction sites, and for the installation of worker camps. However, this deforestation is not considered a forestry activity in its own right since it is linked to and factored into the various projects mentioned above.

In the near future, Barette-Chapais plans to cut around the Windfall mine site and to the south of it. These cuts will cover a total area of approximately 3,810 ha.

MINING ACTIVITIES

One multi-site mine is in operation, one has recently ceased operations, and one is closed within 100 km of the project. The Bonterra Mine project is a gold mining operation where ore was extracted at three sites (Bachelor, Moroy, and Barry) and processed at the Bachelor site. The Bachelor and Moroy sites located near Desmaraisville, approximately 60 km north of the Windfall project, are currently in a shutdown. The Barry site, which is still active, is an open-pit site located approximately 12 km southwest of the project. The Barry site is connected to the Bachelor site by repaired and maintained forest roads. The project started its operations in 2020 and is currently expected to last 10 years. Another potential extraction site was explored underground until 2022, the Gladiator Deposit located on the shores of Lake Barry 8 km southeast of the Windfall project (GCM, 2019). Activities at this site have reportedly been halted. The forest road to this site passes through the Windfall mine site. The Bonterra Mine sites have the potential to deliver 9,000 tonnes of gold over their lifetime, not including the Gladiator site (Wood, 2019).

The Langlois Mine was authorized to operate in 1994 and is located approximately 40 km northeast of Lebel-sur-Quévillon. The owner, Nyrstar, was mining zinc and copper deposits at a rate of 2,500 tonnes per day. The project was temporarily shut down from 2008 to 2012 and then resumed until January 1, 2020, when it underwent another indefinite shutdown (CBC, 2019a). The site is not permanently closed, it is in “maintenance” mode. The Langlois Mine site is located approximately 72 km northwest of the Windfall project.

The Toussaint Deposit (Wilson project) and Pusticamica Gold Deposit (Benoist project) of Cartier Resources which are projects under exploration. The Wilson project is a gold deposit and the Benoist project is mainly a gold deposit with copper and silver by-products. Both projects are undergoing exploration drilling to delineate the deposits. These sites are located 82 km west and 62 km northwest of the Windfall project, respectively.

QC Copper and Gold's proposed Opemiska project which combines two former copper mine sites (Springer and Perry) for open-pit copper and gold mining. This project came into being following exploration work completed in 2021 which estimated a potential of more than 100 million tonnes. The site is located in the town of Chapais, approximately 98 km northeast of the Windfall project.

Iamgold's Megane (Monster Lake) gold mine project. This project has been in exploration since 2018 (drilling and stripping). To date, approximately 360 exploratory holes have been drilled. The site is located approximately 30 km south of Chapais and approximately 84 km northeast of the Windfall project.

The Phillibert gold mine project of Northern Superior Resources is still in the exploration stage but is expected to proceed to a resource estimate in 2022–2023. The project is located approximately 40 km southeast of Chapais and approximately 87 km northeast of the Windfall project.

The Joe Mann (Chibex) underground gold and copper mine of Doré Copper which operated from 1957 to 2007 and has since closed. However, the infrastructure (offices, winches, plant, garage, and electrical station) is still in place and drilling and development work is currently underway. The owner plans to extract the existing ore and process it at the Copper Rand plant in Chibougamau. The site is located approximately 47 km south of Chibougamau and 100 km northeast of the Windfall mine site.

Iamgold's Nelligan open pit gold mine project. This project is at an advanced exploration stage and an additional 10,000 m of drilling is planned for 2023. Based on the 2019 published resources, this is a low-grade project with 96,990,000 t of inferred resources at a grade of 1.02 g Au/t, or 3,193,900 ounces of contained gold. This project is located approximately 60 km south of Chapais and approximately 98 km northeast of the Windfall project.

Former mining sites should also be mentioned:

- Coniagas. Closed since the end of the 1960s, this site is located about 1.5 km west of the Bonterra Bachelor site. This site is owned and maintained by Galaxy Lithium (Ontario) Inc. In fact, a tailings storage facility restoration project applied for an attestation of exemption from COMEV in 2019. The confirmation of exemption was issued in June 2022. According to the available schedule, the work was to be carried out over 2 to 3 years.
- Chesbar. Former open-pit iron mine closed in 1971 due to high operating and transportation costs. This site is located approximately 27 km southwest of Desmaraisville and 74 km northwest of the Windfall project.
- Certac. Former Osisko gold and copper mine closed in 1981 and located about 10 km southeast of Desmaraisville and the Bonterra Bachelor deposit. The site underwent exploration drilling in 2018 and surface exploration in 2021. The site is located approximately 51 km northwest of the Windfall project.
- Lac Nicobi. Former Nickel exploration site owned by Julie Gadoury. Work was carried out in 1980 and 1993. This site is located 21 km southeast of the Bonterra Bachelor site and 42 km northwest of the Windfall project.

— Shortt Lake Mine. This former underground gold mine owned by Globex Enterprise closed in 1992 after 8 years of operation. The site has been completely remediated. Some exploration drilling is reported to have taken place in 2011. The site is located about 13 km southeast of Waswanipi and about 63 km north of the Windfall project.

In addition, many deposits are located outside the 100 km cumulative impact study area. Most of these are located in the Abitibi region, near Val-d'Or, and mainly consist of gold deposits (MERN, 2022a). There are many more mining projects in Abitibi (gold, zinc, nickel, and lithium) and in the Chibougamau region (copper, iron, and zinc). Several gold and lithium projects are also under development between the project area and James Bay (MERN, 2022b).

Finally, various mining exploration projects managed by Osisko have been carried out since 2015, are ongoing, or are planned within the 50 km cumulative impact study area, mainly by Osisko, which remains the most active company in the area. Exploration work currently being carried out by Osisko involves two separate projects, namely:

— Windfall Exploration, which currently has 209 exploratory drill holes in five zones (Fox, Fold, Golden Bear, Bank Extension, and Windfall SW) around the Windfall mine site;

— Urban Barry, which currently has 171 exploratory drill holes in seven zones (Fox West, West, East, Chanceux, Souart-Black Dog, Rouleau, and Great Bear) to the west, east, and southwest of the Windfall mine area.

INFRASTRUCTURE AND SERVICES

INFRASTRUCTURE ALTERING THE WATER SYSTEM

The only existing infrastructure within the 100 km cumulative impact study area is the Gouin Reservoir whose main impoundment infrastructure, the Gouin Dam, was completed in 1917. This reservoir and its dam were not designed for the direct production of electricity, although a small power plant was built to supply electricity to the dam infrastructure. Its main functions were to control the flow of the Saint-Maurice River and to facilitate the transportation of wood (by floating) from the surrounding work sites. This infrastructure covers an area of 1,789 km^2 and offers over 5,600 km of shoreline. No significant changes have occurred on this infrastructure since its construction and its main role remains the control of the flow of the Saint-Maurice River. This reservoir is located approximately 65 km southeast of the Windfall mine site.

ROAD TRANSPORT AND ENERGY INFRASTRUCTURE

The road network within the 100 km cumulative impact study area consists of one numbered road (Road 113), one secondary road (Road 1053) and numerous logging roads in highly variable condition. Road 113 (formerly known as Road 58) was completed in the 1960s. Prior to this period, apart from logging and mining exploration roads, the road network was confined to the developing areas of Abitibi and northern Saguenay-Lac-Saint-Jean.

Various upgrades to Road 113 were completed in 2021–2022 and are planned by the Ministère des Transports et de la Mobilité durable between 2023 and 2024. This work mainly involves the resurfacing of various sections of the road, and repairs to three segments, a few culverts, and two bridges located on the Waswanipi and Chibougamau rivers. These works require an investment ranging from less than $1 million to $25 million.

Road 1053 begins in the town of Lebel-sur-Quévillon and runs east for approximately 115 km to Windfall Lake. Available aerial photographs, dating back to 1984, show that this road was already partially present at that time. It was gradually extended during the 1980s and 1990s to reach the Windfall mine site around 1996. It is a dirt road under the responsibility of the Ministère des Ressources naturelles et des Forêts, but maintained by the various forestry and mining companies exploring the territory or mining confirmed deposits. Currently, the maintenance is essentially provided in part by the Osisko and Bonterra Resources mine projects.

In addition to this work, various private interests have carried out or continue to carry out improvement and maintenance work on various forestry roads to ensure access to various mining and logging sites, the main ones being:

- the road linking the Barry site to the Bachelor site of the Bonterra mine (approximately 110 km);
- the access road linking the Bachelor site of the Bonterra mine and the former Coniagas mine site to Road 113 (approximately 4.5 km);
- the access road from the Windfall mine site to the Bonterra Gladiator mine site (approximately 12 km);
- the access road joining the Langlois Mine from Road 1053 (approximately 20 km);
- the access road linking the quarry/sand pit operating south of Waswanipi to Road 113 (approximately 6 km);
- the access road linking the Obedjiwan Reserve to Road 167 (approximately 170 km).

Several of these roads also provide access to various traplines, private cottage sites, and outfitters.

The only airport in the 100 km cumulative impact study area is Lebel-sur-Quévillon, which is on the western edge of this study area in relation to the Windfall mine site. This airport became operational in 2016 and primarily serves mining and paper mill workers, including about 60 in 2016 but more than 2,000 in 2018 (Radio-Canada, 2019b). This airport offers a runway whose capacity is limited to small aircraft, with a maximum capacity of 35 to 40 seats. There is also a water aerodrome at Berthelot Lake which mainly serves the clients of the Berthelot outfitter. It is located approximately 70 km southwest of the Windfall mine site.

As for the electrical infrastructure related to Hydro-Québec, the 100 km cumulative impact study area includes only sections of lines and substations. Three 735 kV transmission lines cross the area from Abitibi substation in the north to La Vérendrye substation in the south. Two of these lines form a corridor passing approximately 8 km east of the mine site while the third line passes approximately 2.5 km to the west. A 315 kV line connects the Abitibi substation to the Lebel substation by following and crossing the axis of Road 113. Finally, there are also two 120 kV lines originating from the Lebel substation. The first one connects the private substation of the Nordik Kraft plant on the outskirts of Lebel-sur-Quévillon while the second one connects the Nyrstar private substation of the Langlois Mine.

In parallel with the Windfall project, Miyuukaa Corporation plans to construct a 69 kilovolt (kV) transmission line approximately 85 km long (Kuikuhaacheu Transmission Line) between the Hydro-Québec Waswanipi substation (MICO substation) on Road 113 and the Windfall mine site (Windfall substation) (Map 11-2). The project also includes the construction of two new transformer stations, one adjacent to the existing Waswanipi facility and the other located near the Windfall mining lease. The project is currently in the environmental authorization process.

NON FIRST NATIONS LAND USE

Sport hunting and fishing activities and related recreational infrastructure are addressed under this theme. This is primarily a matter of land use by non-First Nations.

Since the opening in the early 1960s of Road 113 (originally Road 58) linking Abitibi to Chapais and Chibougamau, the territory corresponding to the sectors considered for the Windfall project cumulative impact assessment has gradually been opened up by various access roads (including Road 1053) used for both forestry and mining exploration activities. Nevertheless, mostly the southern half of the territory is being used. According to the Bonjour Québec website (Tourisme Québec), twenty-four outfitters are located within a 100 km radius of the project site, the vast majority of which are located south of the project site in the Abitibi-Témiscamingue and Mauricie regions. Within a 50 km radius, there are only four outfitters: Lac Wetetnagami (45 km southeast of the mine site), St-Cyr Royal (32 km south of the mine site), Lac Lacroix (20 km east of the mine site), and Air Tamarac of Lac Hébert (28 km northeast of the mine site). However, it is possible that some small Cree outfitters are not listed.

Within the 50 km area considered for the cumulative impact assessment, there are a large number of leases granted for private cottages (130) and for the development of temporary shelters (135). However, in the vicinity of the Windfall mine site (10 km radius), this number is greatly reduced as there are only four private cottage leases and two temporary shelter leases. The two closest leases are private cottage leases on the west shore of Lake SN1, 1.5 km west of the mine site, and on the north shore of Windfall Lake, 4 km north of the mine site. It should be noted that the issuance of private cottage leases has been administratively suspended in the entire Eeyou Istchee James Bay Territory since the signing of the new governance agreement for this territory in 2012 (MRNF, personal communication, January 2023).

WILDLIFE OR PROTECTED AREA

Areas with special protection status, as well as the management, conservation, or recovery plans of the governments of Quebec and Canada relating to the protection and management of wildlife species and habitats, are grouped under this theme.

WILDLIFE RESERVES, PROTECTED AREAS, AND BIODIVERSITY RESERVES

There are no wildlife reserves within the 100 km cumulative impact study area established around the Windfall site.

However, biodiversity reserves are planned on the JBNQA territory. The primary objective of these proposed reserves is to maintain terrestrial biodiversity. For each projected biodiversity reserve, a conservation plan is developed. Within biodiversity reserves, mining and forest management activities are prohibited. The expected time for the end of provisional protection differs from reserve to reserve and ranges from 2018 to 2025. There are five projected biodiversity reserves within the 100 km cumulative impact study area, including:

- A part of the Marais du lac Parent projected biodiversity reserve which is intended to protect a complex of marshes that is a key habitat and a well-known staging area for aquatic birds. This biodiversity reserve and its reserve territory covers a total of about 52,000 ha. It is located approximately 85 km southwest of the Windfall project.

- The Lac Wetetnagami projected biodiversity reserve, which is almost entirely within the Abitibi beaver reserve where the Atikamekw community of Obedjiwan and the Cree community of Waswanipi benefit from special hunting and trapping rights. This biodiversity reserve and its reserve territory covers a total of about 28,500 ha. It is located approximately 43 km southwest of the Windfall project.
- The Lac St-Cyr projected biodiversity reserve is located within the Abitibi beaver reserve where the Atikamekw community of Obedjiwan benefits from special hunting and trapping rights. Two outfitters, Club Kapitachuan and St-Cyr, carry out some of their activities there. This biodiversity reserve and its reserve territory covers a total of about 29,600 ha. It is located approximately 30 km south of the Windfall project.
- The Iles du Réservoir Gouin projected biodiversity reserve, which was created to ensure the protection and maintenance of biological diversity and associated natural resources, in particular to protect several ecological components of interest and representative of the ecosystems characteristic of the natural region of the Gouin Reservoir depression. This biodiversity reserve and its reserve territory covers a total of about 14,300 ha. It is located approximately 60 km southeast of the Windfall project.
- A part of the Brûlis-du-lac-Oskélanéo projected biodiversity reserve, which aims to protect this area of recovering vegetation and the activities that take place there, including vacationing, canoeing, hunting, and fishing. This biodiversity reserve and its reserve territory covers a total of about 35,000 ha. It is located approximately 90 km southeast of the Windfall project.

In addition, there is a projected aquatic reserve within the 100 km cumulative impact study area, the Lac-Waswanipi Reserve. It was created to ensure the protection and maintenance of biological diversity and associated natural and cultural resources including:

- the natural environments characteristic of the Chibougamau Depression natural region as well as Lac Waswanipi, which is part of the Nottaway River watershed;
- the traditional Cree activities of the Waswanipi community;
- the archaeological potential of the lake which was part of the waterways historically used by this community.

This aquatic reserve covers a total of 57,740 ha. It is located approximately 70 km northwest of the Windfall project.

Finally, 118 biological refuges are distributed throughout the 100 km cumulative impact study area. Biological refuges are small forested areas excluded from forest management activities and in which habitats and species are permanently protected. The nearest refuge is located about 10 km northwest of the Windfall mine site.

OTHER PROTECTIONS

ASSIGNMENT OF SPECIAL STATUS

In Quebec, some species have a special protection status under the Act respecting threatened or vulnerable species. These species are therefore subject to special attention, studies, and a management plan to promote their recovery. These actions can culminate in a program that promotes the conservation of these species. Five bird species (common nighthawk, olive-sided flycatcher, Canada warbler, bald eagle, and rusty blackbird) confirmed in the local study area, the woodland caribou, which was included in the cumulative impact assessment, and three bat species (silver-haired, hoary, and red bats) have a status in Quebec.

At the federal level, on December 17, 2014, under the recommendation of COSEWIC, the Government of Canada added three bat species to the List of Wildlife Species at Risk in Canada (Schedule I of the Species at Risk Act): the little brown bat (*Myotis lucifugus*), the northern long-eared myotis (*Myotis septentrionalis*), and the tri-coloured bat (*Perimyotis subflavus*). All three of these chiropteran species have been designated as endangered because their survival is imminently threatened by WNS (Government of Canada, 2014). Woodland caribou also have protected status in Canada, as do four of the five bird species listed above (common nighthawk, olive-sided flycatcher, Canada warbler, and rusty blackbird).

JAMES BAY AND NORTHERN QUEBEC AGREEMENT, PAIX DES BRAVES AGREEMENT, NADSHTIN AND BOUMHOUNAN AGREEMENTS, AND AGREEMENT ON GOVERNANCE IN THE EEYOU ISTCHEE JAMES BAY TERRITORY

The James Bay and Northern Quebec Agreement was signed in 1977 and is a key element in determining land use. In fact, it provides for the division of the territory into Category I, II, and III lands. Category I lands are reserved for the exclusive use of the Cree. They can be used for residential, community, commercial, industrial, or other purposes. The Cree have an exclusive right to hunt, fish, and trap on these lands.

Category II lands are contiguous to Category I lands. They are part of the Quebec public domain. These are lands where the Cree have exclusive hunting, fishing, and trapping rights. As with Category I lands, the Cree may exercise these rights throughout the year for all animal species, except those protected under federal or provincial legislation. For the purpose of these activities, they may establish any camp necessary for their practice without having to comply with the land lease provisions of the Act respecting the lands in the domain of the State. On Category I and II lands, the Cree have exclusive rights to operate commercial fisheries and outfitting operations (MRNF, 2010).

Category III lands represent all territory covered by the Agreement that is not included in Category I and II lands. On these lands, the Cree enjoy exclusive trapping rights for fur-bearing animals and certain outfitting benefits without exclusive rights. They may establish hunting, fishing, and trapping camps in the area without requiring a title from the Quebec government. Furthermore, the Cree do not need a permit to practise these activities and there is no limit on the number of catches. In addition, certain wildlife species are reserved for their hunting and fishing activities. They hold the right to harvest the fish species reserved for commercial fisheries. On these territories, hunting and fishing are permitted for both First Nations and non-First Nations (EIJBRG, 2018).

In 2002, Quebec and the Cree signed the Agreement Concerning a New Relationship Between le Gouvernement du Québec and the Crees of Québec. This “Paix des Braves” agreement establishes the terms of an adapted forestry regime for the James Bay territory. Specific forestry cutting modalities are established, such as the implementation of mosaic cutting. Through the Nadoshtin and Boumhounan agreements established for the Eastmain-1 and Eastmain-1-A/Rupert projects, respectively, mechanisms are implemented to manage road access and the use of fish and wildlife resources (by the WSI), as well as to provide contracting opportunities for the Cree and to promote their training and hiring (Hydro-Québec Production, 2004).

The Agreement on Governance in the Eeyou Istchee James Bay Territory was signed by the Cree and the Government of Quebec in July 2012. The EIJBRG aims to harmonize relations between the Jamesians and the Cree in the governance of the EIJB Territory and enables both communities to contribute significantly to the territory's prosperity (Chapter 8).

NATURAL AND OTHER DISTURBANCES

This theme includes natural disturbances that may have affected one or more valued components, in this case forest fires and white-nose syndrome (WNS).

FOREST FIRES

Forest fires periodically affect Cree traplines and terrestrial ecosystems in the areas considered for the cumulative impact assessment. These areas are entirely located in the northern protection zone of the Société de protection des forêts contre le feu (SOPFEU).

SOPFEU provides statistical information on forest fires that have occurred in two main zones, the intensive prevention zone and the northern zone. The 50 km and 100 km cumulative impact assessment areas are located entirely within the intensive prevention zone which covers southern Quebec as far north as Matagami, Broadback, and Manic 5 and as far east as the Havre-Saint-Pierre area. Available statistics for the intensive prevention zone cover 2012 to 2022 and show a total of 4,723 fires affecting an area of 188,315.3 ha.

According to data available on the website of the Ministère des Ressources naturelles et des Forêts, accessed on November 23, 2022, 46 fires have occurred within a 100 km radius of the Windfall project site between 2007 and 2021, five of which were 5 000 ha or larger. Two of these large fires have occurred near the project, the first in 2010 affecting nearly 20,000 ha less than 2 km to the northwest, and the second in 2019 affecting about 5,000 ha 22 km to the northeast.

WHITE-NOSE SYNDROME

WNS is a fungal infection that affects bats, particularly cave-dwelling species, in northeastern North America including Quebec. Bat populations affected by this disease often suffer mass mortalities accompanied with a characteristic whitish fungal growth on parts of the body, particularly the nose (Government of Quebec, 2022; ECCC, 2018).

Discovered in the winter of 2006–2007 in Howe Cave, New York, WNS spread to the provinces of Ontario and Quebec in 2010. Since WNS is spreading at a rapid rate of 300 km per year, the area and number of bats at risk continue to increase year after year. Therefore, WNS is currently the primary threat to bat populations in northeastern North America (ECCC, 2018).

11.2 CUMULATIVE IMPACT ASSESSMENT

11.2.1 GREENHOUSE GASES

The assessment of cumulative greenhouse gas impacts consists of evaluating the emissions generated by the project in addition to local, regional, and provincial emissions. This exercise is carried out in the assessment of the direct impacts of the project (Section 6.3) and is briefly repeated in this section to summarize the approach presented earlier in the study.

REFERENCE STATE

The reference state for the cumulative impact study area is the pre-project emissions level, based on available reports in Quebec (MELCCFP, 2022) and Canada (Environment and Climate Change Canada, 2021). In 2020, Quebec's total GHG emissions were 74 Mt CO_{2eq}, or 8.6 t per capita, representing 11.0% of Canada's total emissions of 672 Mt CO_{2eq}.

HISTORICAL TRENDS

At the provincial level, recent major trends are reported below (MELCC, 2021[2]):

- From 1990 to 2019, GHG emissions in Quebec have decreased by 2.7% and during this period, the population has increased by 21.5%.
- In the short term, from 2015 to 2019, Quebec's GHG emissions increased by 4.2%, from 80.9 Mt CO_{2eq} in 2015 to 84.3 Mt CO_{2eq} in 2019.
- In 1990, Quebec's GHG emissions were 86.7 Mt. CO_{2eq}. Since 2003, emissions in Quebec have been decreasing (74 Mt in 2020).
- The sector that produced the most GHG emissions in Quebec in 2020 was transportation (road, air, sea, rail, and off-road). Between 1990 and 2019, GHG emissions from the transportation sector increased by 34.6%.
- The industrial sector, which includes mining projects, came second with 22.7 Mt CO_{2eq}, or 30.6% of total emissions.
- From 1990 to 2020, industrial emissions decreased by 29.3%, from 32.1 to 22.7 Mt CO_{2eq}.
- The residential, commercial, and institutional (building heating) sector ranked third, with 8.4 Mt CO_{2eq}, or 10.0% of emissions (2019).

2 MINISTÈRE DE L'ENVIRONNEMENT ET DE LA LUTTE CONTRE LES CHANGEMENTS CLIMATIQUES (MELCC). 2021. *Inventaire québécois des émissions de gaz à effet de serre en 2019 et leur évolution depuis 1990.* Direction des inventaires et de la gestion des halocarbures, 51 p. https://www.environnement.gouv.qc.ca/changements/ges/2019/inventaire1990-2019.pdf

SIGNIFICANT PROJECTS, ACTIVITIES, OR EVENTS

Other projects in the regional study area emitting GHGs that are cumulative with the project emissions are those related to natural resource development, infrastructure and services, and the expansion of existing cities. These emissions would be in addition to those of natural origin, i.e., forest fires that have occurred in the past.

However, total GHG emissions, with all contributors, remain an unknown factor. Only one part is accounted for, that is, emissions from major operating plants or mines that are listed in the federal Greenhouse Gas Emissions Reporting Program (GHGRP) or any facility emitting more than 10,000 t CO_{2eq} under the Regulation respecting mandatory reporting of certain emissions of contaminants into the atmosphere (RDOCECA).

CUMULATIVE IMPACTS

In 2020, Quebec's total GHG emissions were 74 Mt CO_{2eq}, or 8.6 t per capita, representing 11.0% of Canada's total emissions of 672 Mt CO_{2eq}. During the operations of the Windfall mine, GHG emissions (direct and indirect) would average approximately 30.1 kt CO_{2eq}/year. These represent 0.1% of industrial emissions and 0.04% of total provincial emissions. The contribution of direct emissions is therefore **low**.

At the Canadian level, according to the national GHG inventory report 1990–2020 (Environment and Climate Change Canada, 2021), total GHG emissions in 2020 for Canada were 672 Mt CO_{2eq}. Annual emissions from project activities represent 0.004% of total federal emissions. The contribution of direct emissions from project operations is therefore **low**.

MITIGATION, COMPENSATION, AND FOLLOW-UP MEASURES

No additional mitigation measures or environmental monitoring other than those identified in Chapter 6 and the table in Appendix 5-2 are required for this valued component (GHG). In addition, the technical note (WSP, 2022) presenting the results of the project's emissions calculation includes the methods and practices implemented to minimize GHG emissions (Section 5).

11.2.2 SURFACE WATER

The assessment of cumulative impacts on surface water considers the same aspects and generates the same cumulative impacts as for the ichthyofauna, benthos, and habitat component; they are therefore dealt with jointly in section 11.2.4.

11.2.3 FLORA

The assessment of cumulative impacts on flora concerns two distinct aspects: the loss of terrestrial vegetation cover and the loss of wetlands. These aspects will be evaluated in parallel in this section.

REFERENCE STATE

The project is located in the southern part of the boreal spruce-moss bioclimatic domain, only 38 km north of the balsam fir-white birch forest boundary. The regional study area is located in ecological region 6C, the Lac Opémisca Plain region (Blouin et Berger, 2004). This ecological region is dominated by black spruce, but also includes jack pine on drier sites, white birch primarily on south-facing hillsides in association with balsam fir, and trembling aspen that colonizes sites with thin surface deposits.

In the bioclimatic domain of the spruce-moss forest, the fire cycle is the main component of forest dynamics (MFFP, 2021). Forest fires have a major influence on the composition and structure of plant communities. The effects of these fires on the ecosystem depend on their frequency, extent, and severity (RNCan, 2020). However, the study area has been minimally affected by recent forest fires, while recent evidence of low intensity fires has been observed to the west, outside the study area.

Within the flora study area (2,500 ha) described in section 7.1, terrestrial environments cover an area of 933.20 ha (37.20%), while wetlands cover 1,122.04 ha (44.88%), consisting mainly of open ombrotrophic peatlands. The remainder of the area is occupied by water environments (306.28 ha or 12.25%) and anthropogenic environments (141.67 ha or 5.67%). These features are identified on the map in Appendix 11-1.

TERRESTRIAL ENVIRONMENTS

Among the terrestrial environments, two early successional groupings (coniferous shrubland and mixed shrubland regeneration) stand out in the study area (356.55 ha or 14.26%). These two groupings are mainly associated with forestry activities, since the sectors that were logged in the late 1990s are now dominated by a shrubby regeneration of black spruce and jack pine, sometimes in association with white birch.

The second most common terrestrial grouping in the study area is black spruce-moss stands (247.19 ha or 9.87%). This grouping is often present at the edge of early successional groupings that have been subject to forest cutting. In these situations, they represent portions of territory that have been spared from forest cutting, where the tree layer is composed mainly of black spruce in occasional association with white birch or jack pine.

Four other types of terrestrial plant groupings cover more limited but still significant areas of the study area, namely:

— unspecified black spruce stands covering 56.71 ha (2.27%);
— unspecified softwoods covering 39.38 ha (1.58%);
— balsam fir-white birch stands covering 37.08 ha (1.48%);
— unspecified mixed woodlands covering 25.63 ha (1.03%).

Finally, seven other vegetation groupings were identified totalling 16.18 ha (0.65%): black spruce-lichen stands, black spruce-sphagnum stands, jack pine stands, black spruce-birch stands, unspecified softwoods with non-commercial hardwoods, non-commercial and unspecified hardwoods with unspecified softwoods, and plantations of softwoods with unspecified hardwoods.

WETLANDS

Of all wetland vegetation groupings, open and forested ombrotrophic peatland (bogs) and open minerotrophic peatlands (fens) predominate. In fact, these three types of plant groupings represent 89.87% of the wetlands in the study area (1008.43 ha out of 1122.04 ha). Within the overall distribution of wetlands in the study area, there is one main wetland cluster located in the area. This cluster, primarily composed of open, wooded ombrotrophic bogs and open minerotrophic fens, covers 784.09 ha, which represents 69.85% of the total area covered by wetlands in the study area. Within this area, the continuity between the various peatland types creates large wetland complexes where open and wooded bogs and fens intersect.

The wooded ombrotrophic bogs (237.71 ha or 9.51%) and wooded fens (13.00 ha or 0.52%) in the study area are distinguished primarily by the presence of greater than 25% tree cover. In both types of groupings, black spruce, tamarack, and heath species largely dominate the vegetation present.

HISTORICAL TRENDS

In the cumulative impact study area, in addition to the forest fires mentioned above, forestry activities are the main element that has influenced the development of plant groupings. Data from the ecoforestry map and photo-interpretation indicate that more than one third of the study area was logged between 1997 and 2000. These areas were cleared about 20 years ago and now host regenerating plant communities where the shrub layer, which can be fairly dense and tall depending on the area, is dominated by softwoods, namely jack pine (*Pinus banksiana*) and black spruce, sometimes in association with white birch (*Betula papyrifera*).

As discussed in section 11.1.4 (Exploitation of natural resources), the 50 km and 100 km radius zones around the Windfall mine site considered for cumulative impacts show evidence of forest cutting corresponding to 70–80% and 50–60% of the area harvested respectively. These cuts appear to be relatively recent, between 20 and 40 years old, thus resulting in stands in the process of recovery.

In addition to these activities that strongly influence terrestrial forest stands, exploration and mining activities as well as the expansion of certain urban areas (Lebel-sur-Quévillon, Waswanipi, and Chapais) have also contributed to reducing the area and altering the nature of the forest cover within a 100 km radius of the project site.

For wetlands, logging and mineral exploration activities are the main sources of disturbance, with machinery moving through the area and drainage being carried out. Nevertheless, the area affected since the 1960s remains small.

SIGNIFICANT PROJECTS, ACTIVITIES, OR EVENTS

Significant projects, activities, or events that may have a cumulative effect with the impacts of the Windfall project are presented in Table 11-3. In general, they have caused, are causing, and will cause a loss of forest cover and possibly wetlands, and changes to the composition of plant populations.

Of all these projects, activities, or events, forest fires and logging are the largest sources of canopy disturbance in the project study area and within a 100 km radius of the project site. Next are the power line corridors that cross the territory from north to south or east to west. Approximately 50% to 60% of the 100 km study area was affected by logging or linear infrastructure development (approximately 15,700 km^2 to 18,850 km^2 out of a total area of 31,416 km^2). In addition, planned and known cuts in the near future will affect an area south of the mine site (north shore of Lake Barry and southwest up to the northeast shore of Lac aux Loutres) corresponding to about 0.2% of the 100 km area (about 60 km^2). Therefore, the permanent encroachment associated with the Windfall project on non-anthropogenic surfaces covers a total of 1.05 km^2 and can be broken down as follows:

- 22.9% (0.241 km^2) in regenerating (i.e., recently cut) stands;
- 32.1% (0.337 km^2) in mature hardwood, mixed, and softwood stands;
- 45.0% (0.472 km^2) in wetlands.

Thus, it appears that the project will ultimately be responsible for an encroachment of 0.81 km^2 on vegetation stands not previously disturbed by other projects/activities.

CUMULATIVE IMPACTS

Considering all the disturbances caused or to be caused by other projects, activities, and significant events, the magnitude of the project's contribution to cumulative impacts on flora will be **low**. In fact, this contribution represents only between 0.005% and 0.004% of what has been and will be affected by all the activities considered.

MITIGATION, COMPENSATION, AND FOLLOW-UP MEASURES

No additional mitigation measures or environmental monitoring other than those proposed in the specific environmental assessment are required for this valued component (flora).

11.2.4 ICHTHYOFAUNA, BENTHOS, AND HABITAT

The assessment of cumulative impacts on ichthyofauna, benthos, and habitat consists of determining the potential effects on local surface water quality and therefore fish habitat of other projects that may occur within the spatial boundaries considered for this component.

REFERENCE STATE

The territory considered for the inventory of ichthyofauna and its habitat is located in the Opawica River Basin. This area includes some existing mining infrastructure such as a lined ore and waste rock stockpile and an overburden stockpile. The site is also occupied by a ramp portal dating from 2008, a sedimentation pond, and a polishing pond with water treatment units. However, most of the local study area for the biophysical environment is unoccupied, with a numerous water bodies and watercourses.

The fish species surveyed in the territory of fishing zone 17 or within a 10 km radius of the local biophysical study area are the following: striped bass, sauger, lake sturgeon, Atlantic sturgeon, splake, and lake trout. Fish species captured during inventories in the local biophysical study area include: mottled sculpin, lake cisco, walleye, brook stickleback, northern pike, lake whitefish, burbot, lake chub, white sucker, brook trout, fallfish, yellow perch, and trout-perch. It should be noted that no threatened or vulnerable fish species, or fish species suspected of being so designated, have been recorded within 10 km of the 49.05750 °N, -75.66220 °W coordinate (MFFP, 2020).

The quality of fish habitat within the watersheds affected by the selected spatial boundary had not been altered by human activities prior to the start of exploration activities at the Windfall site initiated in 2008 by Noront. For areas not receiving effluent from the mine site, the quality of fish habitat shows relatively few exceedances of the criteria established by the MELCCFP for the protection of aquatic life. However, metal concentrations appear to be present in the local study area for the biophysical environment. In general, mercury, arsenic, and lead are the three parameters that most often exceed the MELCCFP criteria for chronic effects.

Of the 31 watercourses considered in the ichthyofauna inventories, 20 provide fish habitat for the entirety of their characterized portion, six for only a portion due to various limitations (natural barriers) and five do not present favourable conditions for the establishment of aquatic fauna, besides the fact that no access for fish is possible.

The benthic communities of the four sampled lakes (SN2, SN3, SN4 and SN8) are composed mostly of arthropods (insects), followed by molluscs, and annelids. It should be noted that the arthropod species encountered do not indicate a significant degradation of the quality of the environment due to organic matter.

HISTORICAL TRENDS

The quality of aquatic habitat in the watersheds affected by the selected spatial boundary had not been significantly altered by human activities prior to the start of exploration activities at the Windfall site initiated in 2008 by Noront. The alterations brought about by the facilities installed since 2008 essentially relate to the effect of the final effluent discharging into Pond 1, which is considered to be a marginal habitat with low biological potential.

For sectors not receiving effluent from the mine site, water quality shows relatively few exceedances of the criteria established by the MELCCFP for the protection of aquatic life. However, there appear to be some concentrations of metals present. In general, mercury, arsenic, and lead are the three parameters that most often exceed the MELCCFP criteria for chronic effects. For the Windfall mine site effluent, the quality criteria required by D019 and the MDMER were all met in 2019 and 2022 with the exception of one radium 226 result in 2019. In general, the results show that the final effluent is slightly acidic, contains low levels of suspended solids (TSS), and is very poorly mineralized. Acute toxicity bioassays with Daphnia (*Daphnia magna*) and rainbow trout (*Oncorhynchus mykiss*) conducted since January 2019 have never resulted in noncompliance.

Despite these results, and as pointed out during the assessment of the project’s residual impacts, the release of contaminants even with levels below the established criteria affects the quality of the aquatic habitat over the long term, hence the medium residual impact attributed to this component.

SIGNIFICANT PROJECTS, ACTIVITIES, OR EVENTS

Considering the spatial boundary selected for this component, five other projects cross this territory, namely the construction of a new 69 kV line and its associated substation (Windfall substation), the opening of two new borrow pits (Gravtest-3 and Gravtest-4) associated with the Windfall project but outside the mine site boundaries, the exploration work completed and in progress by Osisko (Windfall Exploration and Urban Barry), and the activities of Bonterra's Barry and Gladiator deposits. The only project that could have associated effluent is the Barry Deposit currently in operation approximately 12 km southwest of the Windfall mine site. Although no information is available on this effluent, it is assumed that it would be required to meet discharge standards similar to those associated with the Windfall project.

CUMULATIVE IMPACTS

The only other project with the potential to produce effluent within the specified spatial boundaries is Bonterra's Barry Deposit. This project is in the same Level 4 watershed as the Windfall mine site effluent. However, the Barry Deposit is necessarily subject to strict discharge standards similar to those imposed on the Windfall site. In addition, water from Pond 1, which receives treated effluent from the Windfall site, follows a path of over 17 km through various lakes and watercourses before reaching the Lac aux Loutres area, which receives the effluent from the Barry Deposit. Considering the distance separating the two sites and the strict standards imposed on mine effluents, no cumulative effect is anticipated and the impact on ichthyofauna, benthos, and habitat will remain medium.

MITIGATION, COMPENSATION, AND FOLLOW-UP MEASURES

No additional mitigation measures or environmental monitoring other than those identified in Chapter 6 (Section 6.7.3) and the table in Appendix 5-1 are required for this valued component (surface water).

11.2.5 AVIFAUNA (SPECIES OF SPECIAL STATUS)

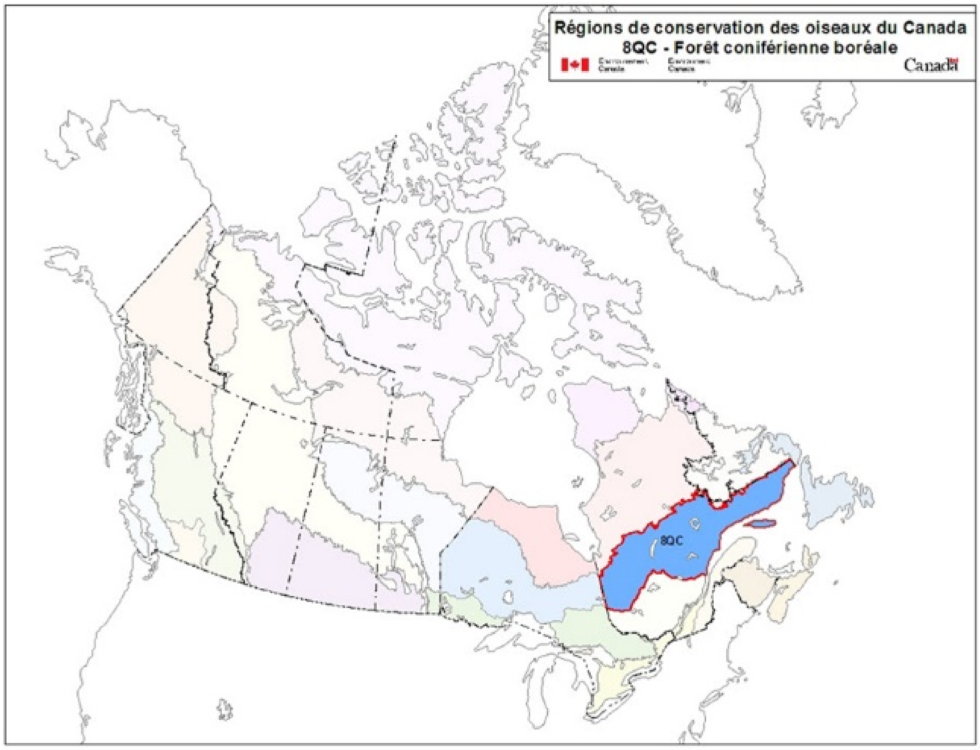
The species of special status selected for cumulative impact assessment are those confirmed to be present during inventories carried out in the mine site study area in 2016, 2017, and 2021 (WSP 2022). Five species were selected: common nighthawk, olive-sided flycatcher, Canada warbler, bald eagle, and rusty blackbird.

REFERENCE STATE

Bird Conservation Regions (BCRs) are ecologically distinct regions in North America with similar bird communities, habitats, and resource management approaches (NABCI, 2015). They are delineated by the Commission for Environmental Cooperation (CEC) and are based on a flexible-scale hierarchical framework of nested ecological units.

The Windfall project is located in BCR 8. The cumulative impact assessment study area, with a 100 km radius around the project, straddles BCR 8 and BCR 12, associated with boreal coniferous forest and boreal mixed forest, respectively. However, considering the range of BCR 12—which extends much further south—and the habitat within the local study area of the mine site, BCR 8 is selected for the reference state because it is much more representative of the habitats present around the mine site. The establishment of the reference state for the status of the five selected species is therefore based on data from the Quebec portion of BCR 8 (Figure 11-1).

Figure 11-1 Territorial range of the Quebec portion of BCR 8 (8QC)



For each of the selected species, the annual index is presented in Table 11-4 for the years 1970, 2012, and 2019. Except for bald eagles, the index in 2019 is still lower than in 1970, indicating a potential decline in the populations of these species.

Table 11-4 Annual index of abundance of bird species at risk for the Quebec portion of BCR 8 for the base year (1970), 2012, and 2019

Species	Annual index[1]		
	1970	2012[2]	2019[3]
Common nighthawk	0.11	0.044	0.059
Olive-sided flycatcher	2.90	0.79	0.91
Canada warbler	1.32	0.43	0.97
Bald eagle	0.01	0.23	0.32
Rusty blackbird	0.77	0.12	0.12

1 Indicates the average abundance estimated on BBS routes in a given year by an average observer.
2 The year 2012 corresponds to the period between the first work carried out in the Windfall area and the acquisition of the site by Osisko.
3 The year 2019 is the most recent year that reliable data is available for BCR 8.
Source: Environment Canada, 2022.

HISTORICAL TRENDS

The data compiled for BCR 8 were used to describe historical trends for the five species selected for the cumulative impact assessment for the same reasons presented for establishing the reference state. When data were not available for the Quebec portion of BCR 8, data for all of BCR 8 were used.

Thus, population trends in BCR 8 over the long term demonstrate negative data. Historical trends assessed since 1970 show that numbers have declined for all bird species included in the cumulative impact assessment. However, in the short term, the table of trends is more encouraging. In fact, the populations of these species show an increasing trend, except for the rusty blackbird.

Available population data for the Quebec portion of BCR 8 (or all of BCR 8 if data are unavailable), show that this region would support 9,000 common nighthawks, 30,000 olive-sided flycatchers, 200,000 Canada warblers, and 96,000 rusty blackbirds, representing 89.7%, 42.4%, 5.1%, and 4.2% of the total Quebec population numbers, respectively (Partners in Flight Database, 2022) (Table 11-5). Therefore, the core of the common nighthawk breeding population in Quebec is located in BCR 8.

For bald eagles, data on numbers present in BCR 8 are not available. However, the overall population in Canada and the United States is estimated to be 200,000 (Partners in Flight Database, 2022), of which 150,000 would be visiting Quebec (Dumas et al., 2022), representing 75% of the North American population.

Table 11-5 Population trends of valued landbird species by status

Species[1]	Population (number)		Proportion of the population		Annual trend of the population (%)	
	BCR 8/ Quebec	Quebec	BCR 8-QC/ Total (%)	BCR 8-QC/ Quebec	Short term (2009–2019)	Long term (1970–2019)
Common nighthawk	26,000	29,000	0.1	89.7	2.91	-1.46
Olive-sided flycatcher	39,000	92,000	2.2	42.4	1.42	-2.33
Canada warbler	220,000	4,300,000	8.6	5.1	10.00	-0.574
Bald eagle[2]	N.A.	150,000	N.A.	N.A.	6.17	8.76
Rusty blackbird	96,000	2,300,000	1.4	4.2	-0.576	-3.92

1 The population trend used is that of Quebec's BCR 8.
2 When data were not available for BCR 8 in Quebec, BCR 8 data from other provinces were used where possible; otherwise NA (not available) was indicated in the table.
Sources: Environment Canada, 2022; Partners in Flight Database, 2022, Dumas et al. 2022.

SIGNIFICANT PROJECTS, ACTIVITIES, OR EVENTS

The inventory of past, current, and future projects, activities, and events that may have or could have an effect on endangered bird species is presented in Table 11-3. The main elements that may have had an effect or could have an effect on populations of the selected bird species at risk are:

- Habitat alteration, loss, and disturbance
  - Natural resource development
  - Infrastructure and services
  - Land use (hunting and fishing activities)
  - Natural and other disturbances
- Collision risk
  - Infrastructure and services
- Habitat and species protection
  - Wildlife or protected area

HABITAT ALTERATION, LOSS, AND DISTURBANCE

NATURAL RESOURCE DEVELOPMENT

Exploitation of natural resources generally results in alteration and loss of nesting habitat (NABCI, 2012). Mining-related projects have the greatest potential effect on landbird populations in the territory. Within a 100 km radius of the project, three projects have been identified whose effects on habitat loss or alteration have occurred in the past or will occur in the near future. These are the mining projects at the Bachelor site, the Barry Mine, and the Langlois Mine. Habitat loss and alteration occur during the development of the original mine sites, but also as part of any required additional encroachment into the natural environment. To a lesser extent, mineral exploration activities also involve impacts to bird habitat through the development of access roads and work areas for required drilling.

Forestry activities also have an effect on bird communities, causing habitat losses for several species. The deforestation activities that have taken place in the study area are mainly related to the completion of work on various projects.

INFRASTRUCTURE AND SERVICES

Most projects related to new infrastructure, both linear and non-linear, and their associated expansion leads to habitat alteration and loss, as well as disturbance of landbirds. This is particularly the case in the sector for projects related to the construction or extension of power lines, as well as the reactivation of the Grevet-Chapais railway and anything related to new recreational or access trails (secondary roads).

Some bird species are sensitive to disturbance by human activities related to the presence and use of this infrastructure. Furthermore, vehicles on roads or trails increase the risk of fatal collisions (Villard et al., 2012). The main roads in the cumulative impacts study area are Road 113 and the project access road (Road 1053). Consideration must also be given to the various secondary roads leading to mine site facilities that have been developed for logging or access to the territory. The creation of a network of permanent corridors, associated with access roads to these various facilities or infrastructure, may also have a negative effect on certain migratory bird species, including increased nest predation and disturbance of certain species (Askins, 1994; Jordan, 2000). It should be noted, however, that the alteration of certain habitats through the creation of roads or trails may be beneficial to certain species that are associated with open areas.

USE OF THE TERRITORY (HUNTING AND FISHING ACTIVITIES)

The expansion of the towns of Lebel-sur-Quevillon and Chapais will inevitably lead to a loss of natural habitat. The areas adjacent to the city, although of lower habitat quality, may be used by all bird species of special status selected if their preferred habitat is located there, with the exception of bald eagles.

Recreational use of the territory by outfitters, hunting and fishing activities, and leasing of temporary shelters or private cottages may have contributed to habitat loss and increased disturbance for some nesting bird species. However, recreational use of the territory is relatively low in the study area under consideration (100 km radius around the project site) and in proportion to its size. The access roads to the private vacation or hunting and fishing sites also create disturbances for the birds (see previous section). In connection with the use of the territory, hunting and fishing activities and the associated human presence are the main elements that can produce a cumulative effect with project impacts on migratory birds in the cumulative impact study area.

WILDLIFE OR PROTECTED AREA

Certain events have led to the establishment of regulatory and legal provisions that lead to the protection of bird species and their habitats. These include:

- The Migratory Birds Convention Act, 1985 (replaced by the Migratory Birds Convention Act, 1994), Migratory Birds Regulations, and Regulations Amending the Migratory Birds Regulations (2002);

— The Environment Quality Act (1972);

— The Act respecting the conservation and development of wildlife (1993);

— The Federal Policy on Wetland Conservation under the Canadian Environmental Assessment Act (1991).

Species of special status are also protected under the Species at Risk Act and the Act respecting threatened or vulnerable species. This status implies that special attention must be paid to the protection of their habitat. It should also be noted that the creation of a network of Bird Conservation Regions (BCRs) (1999) allows the implementation of conservation plans.

Some projects such as the creation of national parks, biodiversity reserves, and protected areas could benefit migratory birds. They would benefit indirectly through the protection of their habitats.

NATURAL AND OTHER DISTURBANCES

For natural disturbances, the effects are not strictly a loss of nesting habitat, but a change in vegetation cover that may result in a change in the bird community that uses the area. This is particularly true of forest fires and windthrow where different bird species or communities may become established after the disturbance. In fact, Imbeau et al. (1999) suggest that recently disturbed areas are characterized by open-land bird assemblages.

As mentioned previously, several fires have occurred over the past 20 years in the cumulative impacts study area (100 km radius), including 5 fires affecting 5,000 ha or more. Two of these occurred in the vicinity of the project, the largest of which affected 20,000 ha within 2 km of the project.

By removing the mature vegetation cover, opening up the environment, and encouraging the recolonization of these areas by pioneer plant species, forest fires also lead to a change in the bird communities initially using these areas. Nighthawks, flycatchers, and blackbirds may benefit in the short to medium term as they are known to use more open areas, while warblers and eagles are not known to use recently burned areas and their forest edges. In fact, these last two species are more likely to be found in areas that are generally more wooded.

CUMULATIVE IMPACTS

The primary cumulative impact on bird species of special status is sporadic habitat loss that accumulates from project to project and contributes to the overall habitat loss for each species. Potential habitat for the five selected species was mapped in the local biophysical study area (Section 7.4.2 of the Impact Assessment). Within the study area, cumulative impacts (100 km radius of the mine site) have resulted in habitat loss. The cumulative impact assessment is presented for each of the selected species of special status.

COMMON NIGHTHAWK

For the common nighthawk, changes in insect populations, habitat alteration and loss, the use of chemicals, and climate change are considered the primary causes of decline (COSEWIC, 2018a; Nebel et al. 2010). Forest fire control is also one of the important factors associated with population declines of the species, as their decline affects the renewal of nesting habitats (open areas) in the boreal forest (COSEWIC, 2018a).

The potential available habitat for the common nighthawk found in the study area for the biological components (Section 7.4.2) is estimated at 9.32 km^2 (932.25 ha). The implementation of the infrastructure related to the project will result in habitat losses for this species on the order of 0.59 km^2 (59.34 ha), i.e., approximately 6% of the study area for the biological components. Considering the activities identified in the 100 km radius study area around the mine site and assuming that the habitat is fairly homogeneous and similar to the study area for the biophysical components, it is estimated that 11.87 km^2 has been or would possibly be lost permanently or temporarily out of a total of 11,715 km^2 of available habitat, i.e., a loss of approximately 0.1% of the available habitat. The Windfall project would contribute less than 5% of the potential habitat loss for the species in this study radius. In the cumulative impact study area, it must also be considered that the areas cleared by the forestry industry will provide new open environments that may become suitable habitats for the species. Forest cutting often maintains landscape heterogeneity, creating small clear-cut areas that provide clearings for nesting and feeding (COSEWIC 2007).

When mine sites are closed, reclaimed mine remnants become available to nighthawks again until the trees are large enough to create a canopy closure. Eventually, as the restored habitats mature, the landscape composition should be similar to what was present prior to the project and will be subject to the natural dynamics that prevail in the area. In summary, the Windfall project will have a positive effect on the common nighthawk, primarily in the restoration phase, through the creation of more open habitat than was initially present. No effect is anticipated once the restoration is complete.

The trend in BCR 8 shows signs of recovery in the common nighthawk population in the short term and nearly 90% of the Quebec population is in this region (Table 11-5). With the exception of the loss of habitat caused by construction in some projects, many projects contribute to the habitat for this species. Therefore, the cumulative effect on the species will be **low** since the projects inventoried in the study area represent little or no threat to the species. In some cases, these projects may even be positive for the species by opening up closed environments.

OLIVE-SIDED FLYCATCHER

For the olive-sided flycatcher, logging-related habitat loss and other anthropogenic disturbances such as development and service corridors, forest fire control, and alterations to wintering habitats (in Central and South America) are being singled out as causes explaining the species' decline (COSEWIC, 2018b). However, within the 100 km radius study area around the project, past forest fires may have been beneficial to the species.

The potential available habitat for the olive-sided flycatcher found in the local biophysical study area (Section 7.4.2) is estimated to be 11.93 km^2 (1,192.74 ha). The implementation of project-related infrastructure will result in habitat losses for this species on the order of 0.46 km^2 (45.92 ha) or approximately 3% of the local biophysical study area. The loss of habitat in the study area is directly related to the presence of permanent infrastructure for the various projects and to logging. Considering the activities identified in the 100 km radius study area around the mine site and assuming that the habitat is fairly homogeneous and similar to the study area for the biophysical components, it is estimated that 7.18 km^2 has been or would potentially be lost permanently or temporarily out of a total of 14,989 km^2 of available habitat, i.e., a loss of approximately 0.05% of the available habitat. The Windfall project would contribute approximately 6% of the potential habitat loss for the species in this study radius.

The trend in BCR 8 shows signs of recovery in the olive-sided flycatcher population in the short term, and 42% of the Quebec population is in this region (Table 11-5). Given the use of BCR 8 by the species, but the Windfall project's small contribution to potential habitat loss, the project's cumulative impact to the calculated impacts in the 100 km radius study area remains **low**.

CANADA WARBLER

Major threats to the Canada warbler include alteration of nesting, migration, and wintering habitats (the Andes in South America). These habitat losses are created due to drainage of wetland forests for urban development or conversion to agricultural land, or for industrial expansion and road construction. It is also noted that the availability of insects is reduced and that the species is subject to collisions with tall structures. The significance of each of these threats varies across the species' range (COSEWIC, 2020).

The potential available habitat for the Canada warbler found in the local biophysical study area (Section 7.4.2) is estimated at 0.79 km^2 (78.69 ha). As the project is located in the northern portion of the species' range, some of the proposed infrastructure will alter or destroy 0.09 km^2 (8.69 ha) of its potential habitat within this study area.

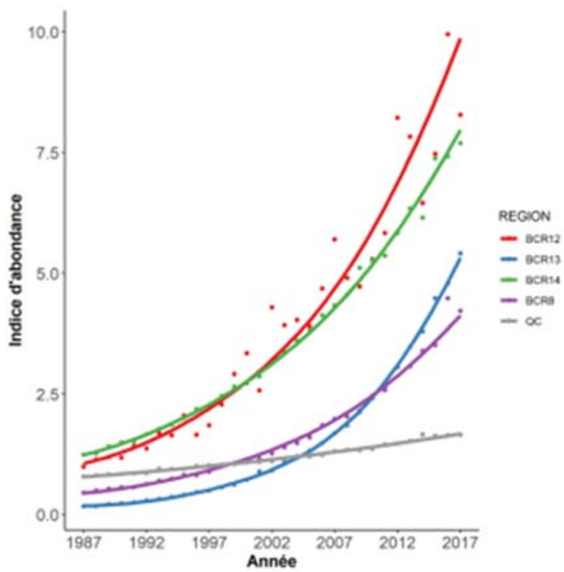
Considering the activities identified in the 100 km radius study area around the mine site and assuming that the habitat is fairly homogeneous and similar to the biophysical study area, it is estimated that 20.60 km^2 has been or would potentially be lost permanently or temporarily out of a total of 989 km^2 of available habitat, i.e., a loss of approximately 2% of the available habitat. The Windfall project would contribute less than 0.5% of the potential habitat loss for the species within this study radius (100 km).

The trend in BCR 8 shows signs of recovery in the Canada warbler population in the short term and only 5% of the Quebec population is in this region (Table 11-5). Therefore, the cumulative impact on the species is **low** considering the proportionally small numbers in the area compared to the rest of Quebec, but also because the cumulative impacts of all identified projects resulting in habitat loss are low, in addition to the fact that the Windfall project contributes minimally to habitat loss given the availability of equivalent habitat in the project study area.

BALD EAGLE

The overall population of eagles in Canada and the United States is estimated to be 200,000 (Partners in Flight Database, 2022). The primary known threats to bald eagles are residential and commercial development, energy production and mining, transportation and service corridors, biological resource use (hunting, logging), human use of the territory, and industrial, military, agricultural, and silvicultural pollution (EROP, 2019). Most of these threats are related to habitat loss and disturbance. In Quebec, since the implementation of the recovery plan for the species in 2002, bald eagle numbers have increased significantly. In BCR 8, a similar trend is also observed when compared with the other BCRs (Figure 11-2).

Figure 11-2 Bald Eagle population trends from the Christmas Bird Count between 1987 and 2017 for different BCRs and for Quebec overall



Source: Dumas et al. 2022

Within the local study area for the biophysical environment, eagles are likely to use the area for feeding and travel, but not for nesting. Based on the 100 km radius of the mine site, it is known that this species could nest further south (WSP, 2022). The Windfall project would not contribute to the cumulative loss of their nesting habitat due to other projects in this area. However, the addition of a project and the increase in human presence in its hunting territory do contribute to disturbance. Disturbance goes hand in hand with use of the territory. Increased activity at the Windfall mine site, as well as all activities that may result in disturbance, may be cumulative.

Considering the presence of large bodies of water and fish-bearing rivers in this area, similar habitats are available over large areas. The additional disturbance caused by the construction and operations of the project does not significantly add to other habitat losses and disturbances in the area. The unspoiled areas where little human activity takes place are present over large areas of land. Although the species has declined historically, it is now recognized that the overall population is recovering in Quebec. The cumulative impact is therefore **low** at the study area level and very low at the provincial level.

RUSTY BLACKBIRD

For the rusty blackbird, the primary threat to the species is the degradation of wintering grounds (southeastern U.S.) due to conversion of wetlands to agricultural and residential use. Additional threats related to agricultural, mining, and energy production activities include deforestation, "black bird" control programs, changes in surface hydrology, pollution through mercury contamination and wetland acidification, climate change and wetland drying, and disease and pests (COSEWIC, 2017). Additional threats related to agricultural, mining, and energy production activities include deforestation, "black bird" control programs, changes in surface hydrology, pollution through mercury contamination and wetland acidification, climate change and wetland drying, and disease and pests (COSEWIC, 2017). However, some pairs could nest on the periphery of the infrastructure area since several potential habitats are present there.

The potential available habitat for the rusty blackbird found in the local biophysical study area (section 7.4.2) is estimated at 8.31 km^2 (831.27 ha). Within the Windfall mine site area, 0.40 km^2 (40.43 ha) of potential rusty blackbird habitat would be affected by the project.

Considering the activities identified in the 100 km radius study area around the mine site and assuming that the habitat is fairly homogeneous and similar to the local biophysical study area, it is estimated that 9.07 km^2 has been or could possibly be lost permanently or temporarily out of a total of 10,446 km^2 of available habitat, i.e., a loss of less than 0.1% of the available habitat. The Windfall project would contribute less than 5% of the potential habitat loss for the species within this study radius (100 km).

The trend in BCR 8 shows signs of short- and long-term rusty blackbird population decline, but only 4% of the Quebec population is found in this region (Table 11-5) Considering the low use of the area by the species and the contribution of the Windfall project to potential habitat loss, the cumulative impact of the project to the calculated impacts in the 100 km radius study area is therefore **low**.

MITIGATION, COMPENSATION, AND FOLLOW-UP MEASURES

No additional mitigation measures or environmental monitoring are required for the avifauna (species of special status) valued component as compared to those presented in Chapter 7.

11.2.6 CHIROPTERANS

REFERENCE STATE

There are few data available to provide a relevant reference state for chiropterans in the region. Since the first data on bat populations in the Nord-du-Québec region date back to 2003, this year was chosen as the past temporal boundary for assessing the project's cumulative impacts on the *chiropterans* valued component. According to the latest report of the Quebec network of acoustic bat inventories, the Réseau québécois d'inventaire acoustique de chauves-souris (the Réseau), published in the CHIROPS newsletter (Jutras and Vasseur, 2011), bats of the genus *Myotis* accounted for five of the seven recordings made in 2003 in the Nord-du-Québec region (71.4%). The other two species recorded from this region were the hoary bat (1 record, or 14.3%) and the big brown bat (1 record, or 14.3%).

Acoustic inventories conducted during the 2016, 2017, and 2021 seasons as part of the Windfall project's environmental impact assessment confirmed the presence of six species of bats in the project area, for a total of 770 bat passes recorded in 2016, 8,649 passes in 2017, and 1,283 passes in 2021:

- bats of the genus *Myotis* (**6.1%** of recordings in 2016, **0.1%** in 2017, and **0.1%** in 2021), including:
  - the northern long-eared myotis (*Myotis septentrionalis*) (confirmed);
  - the little brown bat (*Myotis lucifugus*) (confirmed);
- the big brown bat (*Eptesicus fuscus*) (**1.8%** in 2016, **0.9%** in 2017, and **20.7%** in 2021);
- the silver-haired bat (*Lasionycteris noctivagans*) (**7.66%** in 2016, **8.93%** in 2017, and **65.1%** in 2021);
- the hoary bat (*Lasiurus cinereus*) (**49.35%** in 2016, **75.27%** in 2017, and **0.4%** in 2021);
- the red bat (*Lasiurus borealis*) (**12.99%** in 2016, **7.84%** in 2017, and **0%** in 2021).

HISTORICAL TRENDS

Information concerning chiropterans in the Nord-du-Québec region is too scarce and fragmentary to define historical trends for the populations of the various species. Only the Réseau data provided annual follow-up between 2003 and 2009, but the number of observations is too small to compare relative abundances from one year to the next. The presence of the species identified by the Réseau—bats of the genus *Myotis*, the hoary bat and the big brown bat—was confirmed almost every year during that period, with the exception of 2004 and 2008, when the big brown bat was absent from the recordings obtained (Jutras and Vasseur, 2011).

The main source of impact for chiropteran populations is undoubtedly the emergence of white-nose syndrome (WNS), first identified in Quebec in 2010 (U. S. Fish and Wildlife Service, 2022; RCSF, 2022) and observed since the winter of 2011–2012 in the Nord-du-Québec region up to Chibougamau (U. S. Fish and Wildlife Service, 2022; RCSF, 2022). As mentioned previously, WNS has caused significant mortalities (94% of known numbers) in resident bat populations, particularly in species of the genus *Myotis*.

Since 2003, the effects of human development projects on bat populations are mainly related to habitat loss (Tremblay and Jutras, 2010). Whether they are infrastructure and service projects (e.g., the 315 kV line between Lebel substation and Parc Aiguebelle, the future 69 kV Waswanipi-Windfall transmission line, the opening of a new snowmobile corridor) or mining projects (e.g., Bonterra's Barry and Bachelor mine sites, the Langlois Mine) all involve clearing and encroachment on wetlands, which are potential sources of habitat loss and alteration for chiropterans. These projects are also associated with the creation of roads and/or power transmission corridors that also contribute to these habitat losses, but may also be sources of positive effects for chiropterans. In fact, when moving from one site to another, bats generally use linear forest structures for guidance, such as road or power line rights-of-way (Grindal and Brigham 1998; Henderson and Broders 2008). Forest edges are also potential feeding sites for several species (ERCSQ, 2019).

Clearing activities by the forest industry (particularly between 1980 and 2022) and those associated with anthropogenic development projects are the sources of forest harvesting considered for this valued component within the established spatial boundaries.

During this period, several forest fires also occurred within the spatial boundaries considered for cumulative impacts, affecting significant areas of forested areas, some of which were probably potential chiropteran habitat (see section 11.1.4).

It should be noted that clearing activities, as well as forest fires, also contribute to fragmentation of forest habitats and result in the creation of linear features that will be used by some chiropteran species (ECCC, 2018).

In 2012, noting the mass mortality of bats caused by WNS, COSEWIC recommended endangered status for three bat species: tri-coloured bat, little brown bat, and northern long-eared myotis. This status was reviewed and confirmed in November 2013 (COSEWIC, 2014), and these species were subsequently added to Schedule 1 of SARA on December 17, 2014 (Government of Canada, 2014; COSEWIC, 2016). The little brown bat and the northern long-eared myotis had no special provincial or federal status until then. In addition, the Government of Quebec is currently in the process of assessing the status of 27 wildlife species and these two species could be granted threatened status under the Act respecting threatened or vulnerable species (chap. E-12.01) (Government of Quebec, 2022b).

In conclusion, due to the lack of specific data on regional population dynamics, there is no clear trend for the study area considered. We can therefore only assume that the population is undergoing a decline similar to that of the rest of Quebec since the main cause of this decline seems to be WNS.

SIGNIFICANT PROJECTS, ACTIVITIES, OR EVENTS

Past, current, and future projects, activities, and events that may have or could have an effect on chiropterans are presented in Table 11-2. The main elements that may have had an effect or could have an effect on chiropteran population trends are discussed below.

Apart from wind projects, which can cause direct mortality of chiropterans through collision or barotrauma (Arnett et al., 2008; Baerwald et al., 2008), the potential effects of anthropogenic development projects on bat populations are mainly related to habitat loss (Tremblay and Jutras, 2010). Human activities, especially those involving light, noise, and vibration, can also cause disturbances to bats (Bunkley et al. 2015; Stone et al. 2015; ECCC 2018), or result in direct mortality due to vehicle collisions (ECCC, 2018).

No wind farms exist within the spatial boundaries defined for the assessment of cumulative impacts on chiropterans and, according to available information, no wind projects are currently planned there.

However, forestry activities, which are significant in the region, and the development of human activities have resulted in the loss of chiropteran habitat over time, mainly through the clearing of mature forest stands and encroachment on wetlands. This is particularly true for mining activities, road infrastructure, the snowmobile corridor, and power transmission lines. To a lesser extent, hunting activities and the opening of the territory to visitors contribute to increasing the sources of disturbance for chiropterans (light, noise, vibrations) and the risk of collision.

In parallel, with the development of these human activities, and increasingly over the last few decades, actions have been taken to ensure the protection and management of wildlife species and natural habitats. The laws and regulations developed in this sense have been progressively integrated into human development activities. These include conservation plans, designation of conservation areas, and the creation of parks and reserves. Some of these activities are potential sources of positive effects for chiropteran populations.

With respect to natural disturbances, forest fires are a source of habitat loss for chiropterans. These fires, usually caused by lightning, but sometimes also by human activities, shape the forest dynamics of the region. Five major forest fires in the region (2007, 2010, 2012, 2018, and 2019) have affected nearly 55,150 ha of forest within 100 km of the Windfall mine site. Since bats preferentially seek out large diameter trees and snags in mature forest environments, their loss is a negative effect on this valued component.

The most significant source of impact to chiropteran populations as mentioned above remains the 2010 emergence of WNS in Quebec (ECCC, 2018). Since the winter of 2006–2007, the mass mortality of bats has been observed in abandoned mines and natural caves located in the northeastern United States. Most of the affected bats show specific external signs on parts of their bodies, especially their noses, which are covered with a whitish fungal infection, hence the name (Government of Quebec, 2022a) This syndrome is spreading rapidly and now affects more than 15 states in the northeastern United States. It is estimated that more than one million bats have died due to this syndrome since its discovery, which demonstrates the magnitude of this disease (Government of Quebec, 2022a; ECCC, 2018). Most North American bat species can be affected by WNS. However, bats of the genus *Myotis*, the big brown bat, and the tri-coloured bat have been particularly affected in the northeastern United States and Ontario (ECCC, 2018). As early as winter 2011, WNS was first observed in chiropteran populations in Nord-du-Québec (U. S. Fish and Wildlife Service, 2022; RCSF, 2022). While the significance of its effect on the region's chiropteran populations has not yet been assessed, WNS is nonetheless a major event in terms of cumulative impacts.

CUMULATIVE IMPACTS

The primary threats facing bats are habitat loss, wind power development, and WNS (Tremblay and Jutras, 2010). In the absence of wind projects in the region, the potential adverse effects of human development projects are primarily related to habitat loss.

Based on the assessment of the Windfall project's impact on habitat loss and disturbance to chiropteran populations, it was determined that the project would have a medium residual effect, given the protected status of this valued component. Although habitat losses are anticipated, the natural environments present on the site are of moderate quality for chiropterans (generally young forest stands and few interesting wetlands) and, due to the planned reclamation activities, the loss of habitat will not compromise the integrity of local populations. Furthermore, by avoiding deforestation during the breeding season and considering that there is sufficient replacement habitat of similar quality in the region, the effect of this habitat loss should not be significant for chiropteran populations.

Past, present, and future activities potentially resulting in habitat loss in the area include projects causing the loss of mature forests, wetlands, or potential travel corridors (steep-sided valleys, lakeshores, watercourses, etc.). Within the area considered for the cumulative impact assessment, which is a 100 km radius around the Windfall project site, there are logging activities, mineral exploration projects, the Bonterra and Langlois mine projects, associated roads and transmission lines, the opening of a new snowmobile corridor, the quarry near Waswanipi, and the expansion of the municipal boundaries of the main towns and reserves present. However, these effects are limited in area relative to the spatial boundaries considered for the cumulative impact assessment.

Forest fires have caused—and are likely to cause—much greater habitat loss within the spatial and temporal boundaries under consideration, particularly in forest stands.

Also with respect to natural disturbances, the onset of WNS has caused—and will likely continue to cause—significant mortalities in resident bat populations, particularly in species of the genus *Myotis*. The pathogenic fungus attacks bats during hibernation, and although very little data is available on the location of hibernacula in Nord-du-Québec, the closest known critical habitat for chiropterans is the Rose Lake mine hibernacula, which is located about 90 km northwest of the local biophysical study area, and the northernmost known hibernation site in the province is located about 150 km northwest of it. Because bats are able to travel hundreds of kilometres to reach their hibernation sites, the risk of resident bats identified in the local biophysical study area being impacted by WNS remains high, potentially causing a decrease in the number of bats present within the spatial boundaries considered for the cumulative impact assessment. The effects of this syndrome therefore put significant pressure on bats of the genus *Myotis* within the spatiotemporal limits considered.

Thus, the cumulative impacts of the Windfall project will likely be negligible and will consist mainly of increased disturbance of chiropterans in the vicinity of the project, as well as occasional habitat losses and alterations. Therefore, the cumulative effect on chiropterans is low in intensity given all of the existing threats, limited in range relative to the spatial boundaries considered for the cumulative impact assessment, and long in duration. The magnitude of this cumulative effect is therefore considered to be **very low.** Therefore, the project will not result in significant cumulative impacts on chiropterans.

MITIGATION, COMPENSATION, AND FOLLOW-UP MEASURES

No additional mitigation measures or environmental monitoring other than those proposed in the specific environmental assessment are required for this valued component (Chiropterans).

11.2.7 WOODLAND CARIBOU

REFERENCE STATE

Caribou from the local Assinica population (herd), which occupies the territory northeast of Lebel-sur-Quévillon, are the most likely to frequent the large mammal inventory area. The inventory conducted in March 2018 only located three caribou in the southern boundary of the inventory area, nearly 20 km from the mine site.

The 2018 results are consistent with a very low density of about 0.19 caribou per 100 km^2. Given a sighting rate of 85%, the estimated number of individuals would be about four, with a density of 0.25 caribou per 100 km^2.

Observations from the 2018 inventory, coupled with current knowledge, indicate that woodland caribou have made very limited use of the large mammal inventory area over the past decade within approximately 50 km of the proposed mine.

The large mammal inventory area is subject to significant anthropogenic disturbance from forest harvesting and the extensive network of logging roads. Therefore, anthropogenic elements disturb nearly three quarters of the large mammal inventory area. This use of the territory contributes to the disturbance of the woodland caribou. Based on the habitat selection model, the relative probability of occurrence of woodland caribou in the northern portion of the large mammal inventory area is moderate to low.

As demonstrated by the inventory results (see Section 7.5, Large mammals), the available habitat within the large mammal inventory area is of marginal quality for this species, primarily due to the high level of disturbance.

HISTORICAL TRENDS

Woodland caribou live at very low densities, varying from 1 to 2 individuals per 100 km^2 according to inventories conducted in the 1990s (Courtois *et al.,* 2003). Between 2000 and 2010, the MFFP has intensified its efforts in carrying out inventories of woodland caribou to harmonize forestry and other activities with the maintenance of this species. In inventories conducted during this period in its continuous range, nearly 3,000 caribou were counted over 190,234 km^2, for an average density of 1.5 caribou per 100 km^2 (Équipe de rétablissement du caribou forestier du Québec, 2013). In addition, between 2013 and 2017, six inventories were conducted, including two in the Nord-du-Québec region. These inventories showed a population density of 2.4 caribous per 100 km^2 for the Assinica population, which is believed to be associated with the woodland caribou using the project area. Another inventory, conducted by Rudolph et al. (2012), reported a density of 1.69 woodland caribou per 100 km^2 for this same population.

In the area inventoried by WSP in 2018—a territory of 1,600 km² around the Windfall mine site—only three caribou were observed for a resulting density of 0.19 woodland caribou over an area of 100 km². Thus, observations from the 2018 inventory, coupled with current knowledge, indicate that woodland caribou have made very limited use of the large mammal inventory area over the past decade.

SIGNIFICANT PROJECTS, ACTIVITIES, OR EVENTS

HABITAT LOSS, DISRUPTION, AND FRAGMENTATION AND DISTURBANCE

Whether direct or functional, habitat loss is the primary effect that may be associated with a project of this nature. A mine project includes several components that can alter the habitat conditions of woodland caribou. However, it concentrates the effects in a limited area, unlike other sectors of economic activity such as forestry, the establishment of infrastructure corridors (roads, energy), and private vacation resorts, which tend to spread out over the territory, thereby fragmenting the habitat and intensifying human disturbance over a significant portion of the territory.

Habitat disruption, which may be due to the reduction of its area or its fragmentation, is one of the main threats affecting woodland caribou populations (Équipe de rétablissement du caribou forestier du Québec, 2013). In general, caribou tend to avoid anthropogenic structures related to logging, roads, buildings and natural disturbances (fires and disease outbreaks). New scientific knowledge, including the functional avoidance response of caribou, has shown that these disturbances generate zones of influence avoided by woodland caribou (Équipe de rétablissement du caribou forestier du Québec, 2013). Thus, the possibility of caribou occurrence may increase or decrease depending on their distance from these anthropogenic or natural elements.

Logging activities and the establishment of major power line corridors have resulted in significant changes to the terrestrial environment and thus to the habitat conditions of woodland caribou. The primary sources of disruption and fragmentation of the environment are from forest clearing, access roads, and power lines that have disturbed much of the 50 km cumulative impact study area around the Windfall project. Roads have also facilitated access to the territory and allowed for greater use of resources, including the harvesting of caribou by sport hunters and First Nations subsistence hunters.

It should also be noted that a significant proportion of the territory was also disrupted by forest fires. As for mining development, at present it consists of only one active operation (Bonterra) including one site in shutdown (Bachelor), one operational site (Barry), and one site that has been explored (Gladiator). The Windfall mine site is the only one in development.

Development of recreational activities and hunting and fishing outfitters has remained moderate in the area, with most activity concentrated in the western half of the 50 km cumulative impact study area. The area is also used by families from the Cree community who own traplines.

PROTECTION AND MANAGEMENT OF WILDLIFE SPECIES AND HABITATS

Woodland caribou numbers have declined considerably since the beginning of the 20th century, both in Quebec and in North America (Courtois et al., 2003). Habitat loss, overhunting, and increased predation by grey wolves and black bears are considered the main causes of the decline observed over the past 150 years (Équipe de rétablissement du caribou forestier du Québec, 2013). Since the end of the 1970s, the governments of Quebec and Canada have taken measures to protect woodland caribou, including the implementation of regulatory and legal provisions that result in the protection of species and their habitats.

These include:

Canadian government

- Species at Risk Act (2002).
- Listed as threatened in Canada under the Species at Risk Act (SARA) in 2003.
- Implementation of the Recovery Strategy for Woodland Caribou, Boreal Population, in Canada in 2012.

Quebec government

- Act respecting threatened or vulnerable species (1989).
- The Natural Heritage Conservation Act (NHCA).
- The establishment of forest management guidelines for woodland caribou in 2002.
- The establishment of the Équipe provinciale de rétablissement du caribou forestier [provincial caribou recovery team] in 2003.
- Inclusion as a vulnerable species on the list of threatened or vulnerable species in Quebec in 2005.
- The implementation of the first recovery plan for woodland caribou in Quebec in 2005–2012.
- The revision of the guidelines for the management of woodland caribou habitat in 2013 and the production of the second recovery plan for woodland caribou in Quebec, 2013–2023.

CUMULATIVE IMPACTS

The assessment of cumulative impacts on woodland caribou is based on the trends in local and regional populations as well as on the status of habitats suitable for the species. With respect to woodland caribou populations, the previous sections have shown that on a regional scale, the Assinica population is the one that may use the territory surrounding the Windfall mine site. The density of this population varies, depending on the study, between 1.69 and 2.4 woodland caribou per 100 km^2. In the immediate area of the mine site, this density drops to 0.19 woodland caribou per 100 km^2, with three caribou observed approximately 20 km south of the mine site. These observations are confirmed by users of the surrounding traplines.

In terms of suitable habitat, woodland caribou generally favour large forest complexes in which they can move and feed. The area within the 50 km radius considered for the cumulative impact assessment for this valued component has changed significantly since the 1980s. In fact, a comparison of aerial photographs from 1984 and 2022 shows that in 1984, the entire area was covered by a minimally fragmented forest, with only a few areas where forestry activities had been undertaken. In contrast, the 2022 photograph shows a largely fragmented forest landscape, where only a dozen or so forest patches of notable size are still present and mostly concentrated in the southeastern half of the 50 km zone. This degradation of forest habitat will continue over the next few years as at least one forestry company (Barrette-Chapais) will be logging in the areas south of the Windfall mine site, in and around Lake Barry.

Considering the above information, it appears that the project will contribute **little or nothing** to the cumulative impacts on woodland caribou populations, given the scarcity of sightings in the area of the mine site and the existing degradation of the habitat potentially suitable for the species in the 50 km area considered.

MITIGATION, COMPENSATION, AND FOLLOW-UP MEASURES

No additional mitigation measures or environmental follow-ups, other than those proposed in the specific environmental assessment, are required for this valued component (Woodland caribou).

11.2.8 MOOSE

REFERENCE STATE

The 2018 aerial survey identified 40 trail systems corresponding to moose wintering areas in the 1,600 km^2 area, including two in the 100 km^2 moose inventory area. In the moose inventory area, a total of four individuals were observed, which corresponds to an estimated density of 0.5 moose per 10 km^2. At the level of the 1,600 km^2 large mammal inventory area, 40 wintering areas were identified, where 13 moose were counted in seven of these, including six females and seven males.

In summary, the available habitat within the large mammal inventory areas, while not possessing exceptional characteristics, does support some degree of moose density. For comparison, it is worth noting that further south (Laurentides and Gaspésie parks), densities can reach more than eight moose per 10 km^2 (Langevin and Bastien, 2013 and MFFP, 2017).

HISTORICAL TRENDS

The low density of moose in Quebec's boreal region is due in large part to the low productivity of the habitat. In fact, the forest species sought by moose for food are white birch and willow in summer, and balsam fir in winter (Dussault et al., 2002; Samson et al., 2002; Dussault et al., 2004). Mixed and regenerating hardwood forests for food, interspersed with mature stands for shelter, provide suitable habitat for moose establishment. These species and stands are sparsely distributed within the large mammal inventory area (50 km radius of the Windfall mine site). In fact, the typical forest cover in these regions has always been dominated by black spruce-moss stands, which are strongly dominated by black spruce in occasional association with white birch and jack pine, and are not very favourable for the presence of moose.

Nevertheless, forest fires in recent decades combined with forest harvesting activities have greatly modified the local and regional flora, gradually giving way to a greater proportion of leafy tree or shrub species that provide more suitable habitats for moose feeding.

However, according to the tallymen of traplines W25B and W25A located at and near the Windfall mine site, increased mining activities (exploration and operation projects), as well as increased traffic on the access road to the Windfall mine site, have increased moose scarcity in the area. As a result of all the disturbances on their traplines, tallymen are now concerned that they will have to travel greater distances to hunt moose and support themselves.

SIGNIFICANT PROJECTS, ACTIVITIES, OR EVENTS

Loss of habitat and general increase in human activity are the primary effects that may be associated with a mine project of this nature. A mine project has several components that may alter local moose habitat conditions. However, it is important to note that it does concentrate the effect in a small area, thus limiting direct habitat fragmentation and human disturbance.

Nevertheless, the opening up of the territory through the construction of better quality and maintained access roads and the construction of a new 69 kV power supply line are encouraging a gradual increase in human activity in the area surrounding the mine site, including new mining exploration projects and forest cutting operations (Lake Barry sector). These indirect activities cause greater habitat fragmentation and disturbance affecting the moose's use of the territory.

CUMULATIVE IMPACTS

The assessment of cumulative impacts on moose is based on the status of the local and regional population, as well as that of the suitable habitat for the species. In fact, these two aspects are closely related as moose populations are reported to have always been at relatively low densities due to the typical habitat of the region, which is not very productive and provides limited and poor quality food (especially in winter). Nevertheless, trapline users report that, until 2007, a moose hunt took place on the Windfall exploration site and along the access roads, but the hunting area has since been moved north. The hunters have had to go farther from the site to find moose.

In addition to increased noise and human activity in the area, major habitat changes over the past 40 years, primarily due to forestry activities and fires, have contributed to the scarcity of moose. The tallymen confirmed that after logging or major fires, moose became rarer and sometimes took several years to reclaim the territory. Nevertheless, it appears that these habitat disturbances could have a positive impact on the quality of moose habitat, in the medium term, as forest regeneration will increase the amount of food available.

Thus, it seems that at the regional and local levels, alterations to typical habitat may benefit moose populations in the medium to long term by providing them with better access to the food they seek. As for the effects of disturbances caused by human activities, these seem to have more local effects, associated with movements and noise.

Thus, in terms of cumulative impacts, past activities at the regional scale could be considered positive for the species. Locally, however, the proliferation of human activities (continued forestry activities, the presence of operating mines, the presence of numerous mining sites under exploration, and an increase in recreational activities, especially hunting and fishing) tends to keep moose away from these areas, particularly affecting users of the traplines. The cumulative impact would therefore be **medium**.

MITIGATION, COMPENSATION, AND FOLLOW-UP MEASURES

No additional mitigation measures or environmental monitoring other than those proposed in the specific environmental assessment are required for this valued component (moose).

11.2.9 TRADITIONAL USE OF THE TERRITORY AND ITS NATURAL RESOURCES

REFERENCE STATE

The Eeyou Istchee James Bay Territory where the Windfall project is located corresponds to the territory traditionally used by the Cree Nation, with one of its communities, Waswanipi, located approximately 70 km northwest of the mine site. This territory is divided into traplines and 63 are present in the traditional territory of the Waswanipi community. Two of these traplines are located at and near the mine site, namely traplines W25B and W25A respectively.

At W25B, the two main users are present on the territory most of the time, occupying a main camp located 6 km south of the mine site and occasionally two other camps on the outskirts of the local study area for the social environment. Other family and community members also occasionally use these various camps. The primary current uses of this trapline include:

- Hunting, fishing, trapping, and berry picking. These activities are mainly carried out in the centre and southern portions of the trapline and involve various wildlife species (hare, partridge, lynx, bear, marten and, when present, moose) and fish species including trout.
- Picking berries, mainly blueberries.
- Travel via existing roads and access roads as well as via the power line corridors crossing the trapline. Travel by motorboat on the lakes in the area.

With regard to hunting, one area corresponding to a wooded strip beginning about 5 km northeast of the mine site is highly valued by trapline users because of its potential for moose hunting.

Three burial sites are also present near Lake Barry and the Panache River (trapline W25A) as well as along Father Lake (trapline W25B).

Finally, it is important to mention that the two main users and the occasional users mainly consume traditional food when present on the trapline and therefore depend to a large extent on the resources available in the territory.

Compared to the W25A trapline, its use is rather sporadic throughout the year. There are seven camps that serve various user activities. The primary uses of this trapline are similar to W25B and include:

- Hunting, fishing, and trapping. Species reported include walleye, moose, goose, and beaver.
- Travel mainly via existing access roads and main roads, but sometimes also via the Panache River which is navigable in summer.

No harvesting has been reported for this trapline. As for hunting activities, the tallyman indicated his desire to protect an area near the eastern limits of his trapline. This area is favourable for the presence of moose.

The users of this trapline indicated that they mainly consume traditional foods including moose and beaver. They have apparently built a well near their camp to obtain water.

HISTORICAL TRENDS

The territory surrounding the mine project site has always been traditionally used by the Cree community for north-south travel, hunting, fishing, trapping, and berry picking. The tallymen of traplines W25B and W25A indicated that the numerous logging, exploration, and mining activities as well as the increase in vehicular travel on the territory have disturbed the environment and led to a decrease in certain game species that are important for the traditional diet, notably moose and beaver. These disturbances have forced First Nations users to travel further away to hunt.

The same is true for blueberry picking on trapline W25B, which used to take place in the area of the mine site and is now done further west.

It also appears that some fishing activities that used to be carried out are no longer carried out today, i.e., ice fishing (trapline W25B) and walleye fishing with nets (trapline W25A). It should be noted that the tallyman for trapline W25A has indicated that the abandonment of fishing with nets was due to a drop in the water level in the traditionally fished water bodies.

The two tallymen are unanimous in their desire to leave territories still rich in traditional resources to future generations. The tallyman of trapline W25B specifically mentioned the interest of younger generations in learning about traditional uses of the territory. However, the two tallymen fear the intensification of all kinds of activities on ancestral territories.

SIGNIFICANT PROJECTS, ACTIVITIES, OR EVENTS

Since the gradual opening up of the territory to logging and mining in the 1940s and 1950s, and with the completion of Road 113 (formerly Road 58) linking Lebel-sur-Quévillon, Waswanipi, and Chapais in the early 1960s, the current use of the territory and its resources by the Cree community, particularly hunting, fishing, and trapping activities, has undergone considerable changes. Over the years, land users have thus had to adapt their habits to this environment which has undergone significant changes due to:

- Various mining projects including the Flordin and Rose Lake Mines in the 1930’s and 1940’s, the Coniagas Mine in the 1960s, and the Langlois Mine in 2007; exploration by Windfall since 2007; Bonterra’s operational Bachelor and Barry sites in 2019 as well as its most recent Gladiator exploration site. The development of two 750 kV transmission line corridors in the 1970s.

- Various logging campaigns and the opening of numerous access roads, including a major campaign in the late 1990s and early 2000s focused on the Windfall mine site area.
- Various mining exploration campaigns carried out continuously over the last few decades.
- A larger non-First Nations presence, not related to the Windfall project, that engages in hunting and fishing activities via private cottages and temporary shelter leases issued prior to 2012 (no new leases have been issued since), or through outfitting operations.

In addition, the increase in mining activities (exploration and operations) in the area increases air emissions, effluent discharges, and spill risks (increased vehicular traffic) that can alter air, water, and soil quality and cause concerns for trapline users.

The new 69 kV power line connecting Waswanipi to the Windfall mine site will also open up a new corridor in the area, increasing the loss of forest cover and wildlife habitat while further opening up access to the land.

Finally, it should be noted that within a 100 km radius of the Windfall mine site, some 40 fires have occurred between 2007 and 2021, the 5 largest of which have burned over 55,000 ha of the territory. The largest of these fires occurred in 2010 near the Windfall mine site, within the boundaries of trapline W25A, less than 3 km to the northwest, and destroyed over 19,500 ha of land. These have also transformed the territory and affected the traditional use of resources.

CUMULATIVE IMPACTS

THE COMMUNITY OF WASWANIPI

The various projects, activities, and significant events mentioned above generate negative and positive cumulative impacts with the Windfall project including:

- Fragmentation of the territory and loss of vegetation cover affecting the diversity and density of wildlife in the area and reducing the hunting and trapping success for the whole community of Waswanipi.
- The obligation to abandon the use of significant parts of the territory due to the presence of mining or other installations, the nuisance caused (noise, dust, and light) and the disappearance or displacement of resources used by the community (plants and wildlife).
- The degradation of the quality of certain key environmental components of the territory's resources: air, water, and soil quality.
- Reduced sense of safety due to increased risk of traffic accidents (increased number of vehicles associated with mining, forestry, and hunting and fishing activities by non-First Nations).
- The risk of overfishing and depletion of certain game species, or poaching by workers who discover new hunting and fishing grounds through their work in mines and forestry and who return to them in their spare time. It should be noted that hunting and fishing activities are prohibited for workers at Camp Windfall.
- The appearance of new and more diversified habitats due to the progressive regeneration of the forest, which could even favour the presence of moose with a more abundant and diversified food supply.

- Greater accessibility to the territory and ease of movement for Waswanipi community members, but also for non-First Nations, thanks to the development and maintenance of forest and access roads and the opening of corridors for power lines.
- The opportunity for community members to find jobs in the various active projects near their homes.

Considering the size of the territory and the progressive regeneration of the resource affected by fire and forestry activity, the more localized nature of the mining facilities, and the benefits in terms of travel and economic spin-offs, the anticipated cumulative impact at the level of the Waswanipi community would be **medium**.

USERS OF TRAPLINES W25B AND W25A

Within the Cree community of Waswanipi, the users of traplines W25B and W25A are the main ones impacted by the presence of the Windfall project, which is located on trapline W25B, but very close to the boundary with W25A (about 1 km). In addition to project facilities and operations, past, present, and future impacts on these traplines include:

- The presence of the Barry and Gladiator sites of the Bonterra mining project which will also include work camps and generate various nuisances related to discharge, noise, light, and associated vehicular traffic.
- The two 735 kV transmission line corridors that cross these two traplines. The eastern corridor crosses almost the centre of W25B while the western corridor crosses the eastern end of W25A and even follows the boundary between the two properties for about 2 to 3 km.
- The new 69 kV line that will connect Waswanipi to the Windfall mine site will open a new corridor in the northern part of these traplines and most likely within W25A.
- Logging operations whose activities have affected most of the two traplines except for a few isolated pockets in their northern section. The main user of trapline W25B mentioned that cutting was planned in the Lake Barry area for the winter of 2023.
- The development of an extensive network of forest and access roads linking the mine sites to Lebel-sur-Quevillon and the Bonterra Bachelor mine site.
- The presence of at least three outfitters near the traplines, namely the Hebert, Lacroix, and Wetetnagami lake sites, which increase the pressure on wildlife and fish resources.
- A large forest fire occurred in 2010 on nearly a third of the area of trapline W25A.

Faced with this accumulation of impacts that have occurred over the past 50 years, but especially over the past 20-25 years on these two traplines, it is understandable that users are concerned about the future of these territories and their ability to harvest them and preserve their integrity for future generations. The accumulation of the effects of all the projects and activities on the territory and over time therefore suggests a **medium to strong** cumulative impact for the users of these two traplines.

MITIGATION, COMPENSATION, AND FOLLOW-UP MEASURES

In view of the medium to strong cumulative impact attributed to this valued component (traditional use of the territory and its natural resources) and more specifically for users of traplines W25B and W25A, it is necessary to propose mitigation measures that complement those already formulated in Chapter 8 (First Nation traditional land use) as well as those implemented by projects that have already taken place in the past. All the proposed measures to address territory use issues will be grouped in an Impact and Benefit Agreement (IBA) that is in the process of being negotiated between the mine and representatives of the Cree Nation Government and the Cree First Nation of Waswanipi (CFNW). These measures have not yet been determined, but could include:

- financial compensation;
- ensuring maximum socio-economic benefits for local communities;
- constant collaboration with the project's stakeholders, notably through various follow-up committees (environmental aspects, training and employment, business opportunities, for example);
- assistance and financing for the realization of certain forestry, wildlife, social, or cultural developments.

RESIDUAL CUMULATIVE IMPACTS

The meetings of the current environmental monitoring committee allow for the discussion and establishment of solutions to the various issues that could arise during the mine's construction activities. These meetings will continue until an Impact and Benefit Agreement (IBA) is in place and agreed to by Osisko, the Cree Nation Government, and the Cree First Nation of Waswanipi. This agreement will provide some mitigation of anticipated cumulative impacts during all phases of the project. The cumulative residual impact will then be reduced by these actions and considered medium for the entire study area.

11.2.10 REVIEW OF CUMULATIVE IMPACTS

The assessment of cumulative impacts on the eight valued components concludes that the project will only result in anticipated medium cumulative impacts for moose and traditional use of the territory and its natural resources. Low cumulative impacts on GHGs, flora, avifauna, chiropterans, and caribou in the study area (spatial boundaries) and for the periods selected (temporal boundaries). Finally, a very low cumulative effect is anticipated for water quality and ichthyofauna, benthos, and habitat. These components therefore retain their residual impact level, which is medium.

Consequently, no mitigation measures other than those proposed in the specific assessment of this project or for the cumulative impact assessment of the valued component "Traditional use of the territory and its natural resources" are required.

12 ACCIDENT RISK MANAGEMENT

12.1 GENERAL APPROACH

The purpose of the risk analysis of major technological accidents related to the Windfall project is to identify the hazards that could occur and to evaluate the possible consequences to people and the environment. It is also used to develop protective measures to prevent potential accidents or to reduce their frequency and consequences.

During the construction, operations, and closure phases (i.e., dismantling of infrastructure and rehabilitation of the project site), there is a risk of potentially dangerous events having an impact on the components of the existing environment.

Accidents and malfunctions refer to unforeseen events that occur independently of a project's normal activity or performance conditions.

The risk assessment methodology used meets the requirements of the MELCCFP guide entitled: *Analyse de risques d'accident technologiques majeurs* [Risk analysis of major technological accidents] (Théberge, 2002) hereafter referred to as the MELCCFP Guide. The first steps are to identify sensitive environmental components and external hazards and to compile a history of past accidents in similar industries. Hazards related to activities, infrastructure, or equipment are identified, leading to the development of risk-related accident scenarios. If the assessed accident scenarios may affect the population, an additional assessment is made of the individual risks. Finally, safety measures are identified to eliminate or reduce the risk of accidents and a risk management plan is developed, including an emergency response plan, to manage residual risks that cannot be eliminated.

It should be noted that all health, safety, and environmental risks will be assessed during the planning and execution of construction activities and anticipated impacts will be considered. Procedures, programs, and measures will be established for water, air, noise, and residual materials management.

The first line of defence against accidents and malfunctions is the application of the existing best practices in environmental protection and health and safety. Thus, potential accidents and malfunctions are associated with possible risks that will still exist even with exemplary and rigorously applied management systems. Despite prevention, if such events do occur, it is essential to be able to minimize the effects on the environment through planning and designing effective mitigation measures and implementing an emergency response plan.

The Windfall project is located at a considerable distance from any permanent dwellings and would pose little risk to the public in the event of an accident. However, an accident could affect people on site, property, and the environment. The geographical location of the site also implies that any outside resources mobilized in the event of an emergency could take significant amounts of time to reach the area. It is therefore important to appropriately identify risks so that the on site resources are in place to respond diligently and confidently in the event of a major accident.

The project is conceived with these measures in mind during the design, planning, and execution phases, which will be spread out over the project's entire life cycle. Such measures are therefore implemented to reduce the probability of occurrence of unforeseen accidents and malfunctions. The implementation of preventive measures will also reduce the impact of these accidents. This approach is part of a responsible management process wherein the objective is to reduce risks at the source and mitigate the effects on the environment.

Osisko is committed to ensuring that the risk management process will sufficiently reduce the plausible consequences of identified accident scenarios and therefore keep the level of risk as low as reasonably possible.

12.2 IDENTIFICATION OF SENSITIVE ENVIRONMENTAL COMPONENTS

The Windfall property is located in the Nord-du-Québec administrative region. The property is located in the municipality of the Eeyou Istchee James Bay Regional Government, more precisely in the Urban Township. The projected infrastructure will be approximately 115 km from Lebel-sur-Quévillon and 270 km from Val-d'Or by road. The Windfall property is essentially located in an isolated mining and forestry area. It consists of 286 mining claims covering an area of 12,523 hectares (ha).

The sensitive environmental components to be considered in a technological risk analysis are those that could be affected by a major accident at the mine. These primarily include the local population, mining infrastructure, and sensitive or protected environmental components near the site. The 80 km^2 (8 km by 10 km) local study area (LSA) for the social environment was delineated to include the use of the territory and its resources component likely to be affected by the project (Map 12-1). This area was used to assess the environments that could be impacted by an emergency situation occurring on the project site.

The following sections identify the major sensitive elements considered for this project.

12.2.1 BUILT ENVIRONMENT

The Eeyou Istchee James Bay Territory includes the municipalities of Chibougamau, Chapais, Lebel-sur-Quévillon, and Matagami, as well as the nine Cree communities of the Nord-du-Québec region. In 2021, the population of the Nord-du-Québec region was 45,740, or 0.5% of the population of Quebec. The region ranked as the least populated in the province.

The territory of the local study area is mainly comprised of public lands of the Eeyou Istchee Baie-James Regional Government (EIJBRG). It is almost uninhabited and is mainly used to harvest natural resources (forestry and mining) and, to a lesser extent, for vacationing and leisure activities.

There are only three public land use leases in the local study area, including two private cottage leases, the closest of which is located approximately 1.3 km from the mine site and the other approximately 2 km away. The local study area also includes a lease for lodging purposes at an outfitter with non-exclusive rights located southeast of the project, approximately 5.4 km from the Windfall mine site (Map 12-1).

Hydrographie / *Hydrography*

- Cours d'eau permanent / *Permanent watercourse*
- Cours d'eau intermittent / *Intermittent watercourse*
- Cours d'eau souterrain / *Underground watercourse*
- Canal / *Canal*
- Fossé / *Ditch*
- Plan d'eau / *Waterbody*

Infrastructures connexes / *Related Infrastructures*

- Chemin d'accès principal / *Main road*
- Route régionale / *Regional road*
- Ligne de transport d'énergie électrique / *Electric power transmission line*

Hypsométrie / *Hypsometry*

- Courbe de niveau (10 m) / *Contour (10 m)*

Zones d'études / *Study Areas*

- Zone d'étude locale du milieu biophysique / *Biophysical local study area*
- Zone d'étude locale du milieu humain / *Human local study area*

Risques dans les milieux sensibles / *Risks in sensitive environment*

- Plus grand rayon d'impact correspondant au scenario normalisé pour le dioxyde de soufre / *Greatest impact radii corresponding to the worst-case scenari involving sulfur dioxide tank (AEGL-2)*
- Zone d'impact correspondant aux plus grands rayons d'impact pour le scénario normalisé relatif aux réservoirs de propane (seuils 5 kW/m² / 1psi excluant les effets domino) / *Impact zone corresponding to the greatest impact radus for the worst-case scenario involving propane tanks (5 kW/m² / 1psi excluding domino effects)*
- Réservoir de propane projeté / *Projected Propane Tank*
- Réservoir de dioxyde de soufre projeté / *Projected Sulfur Dioxyde Tank*
- Réservoir de diesel et d'essence projeté / *Projected diesel and gas tank*

Projet / *Project*

- Infrastructure actuelle / *Current infrastructure*
- Autorisée pour l'échantillonnage en vrac 2023-2024 / *Autorized for bulk sampling purpose 2023-2024*
- Qui sera retirée / *To be removed*

Infrastructures projetées / *Planned Infrastructures*

- Ponceau / *Culvert*
- Effluent final / *Final effluent*

Catégories d'infrastructures projetées / *Categories of Planned*

- Aire d'activité / *Activity area*
- Banc d'emprunt / *Borrow pit*
- Bassin / *Pond*
- Bâtiment / *Building*
- Camp de travailleurs / *Workers camp*
- Convoyeur / *Conveyer*
- Halde / *Stockpile*
- Parc à résidus miniers / *Tailings storage*
- Route / *Road*
- Système de traitement de l'eau potable / *Potable drinking water treatment system*
- Souterrain / *Underground*
- Structure / *Structure*
- Usine de traitement de l'eau / *Water treatment plant*

Milieu humain / *Social Environment*

- Canotable / *Canoe*

Baux de villégiature / *Leisure Lease* (RDE, 2023)

- Fins d'abri sommaire en forêt / *Temporary forest shelter*
- Fins d'hébergement dans une pourvoirie sans droits exclusifs / *For lodging at an outfitter without exclusive rights*
- Fins de villégiature / *For leisure purposes*

Utilisation du territoire / *Land use* (Osisko, 2023)

- Campement / *Camp*
- Zone de pêche / *Fishing area*
- Zone valorisée pour le trappage (la délimitation de ces zones est approximative pour fins de confidentialité) / *Trapping valued area (the delimitation of these areas is approximate for confidentiality purposes)*
- Terrain de trappage cri / *Cree trapline*

Archéologie / *Archeology*

- Zone de potentiel archéologique identifiée en 2022 / *Area of archaeological potential identified in 2022*

Feux de forêts / *Forest fire* (MFFP, 2023)

- Moins de 10 ans / *Less than 10*
- Entre 10 et 20 ans / *10 to 20*
- Entre 20 et 30 ans / *20 to 30*
- Plus de 30 ans / *More than 30*

Sites miniers / *Mine Site*

- Site minier / *Mining site*

Milieu biologique / *Biological environment*

Grande faune / *Big Game*

- Réseau de piste de l'orignal / *Moose trail network*

Observations de la faune aviaire / *Avian Fauna Observations*

- Engoulevent d'Amérique (2016-2017, 2021) / *Common nighthawk (2016-2017, 2021)*
- Moucherolle à côtés olive (2017, 2021) / *Olive-sided flycatcher (2017, 2021)*
- Pygargue à tête blanche (2016-2017) / *Bald Eagle (2016-2017)*
- Quiscale rouilleux (2016-2017, 2021) / *Rusty blackbird (2016-2017, 2021)*
- Nid de quiscale rouilleux (2016) / *Rusty blackbird nest (2016)*

Habitat du poisson / *Fish habitat*

- Habitat du poisson dans le cours d'eau ou le plan d'eau / *Fish habitat in the watercourse or in the waterbody*

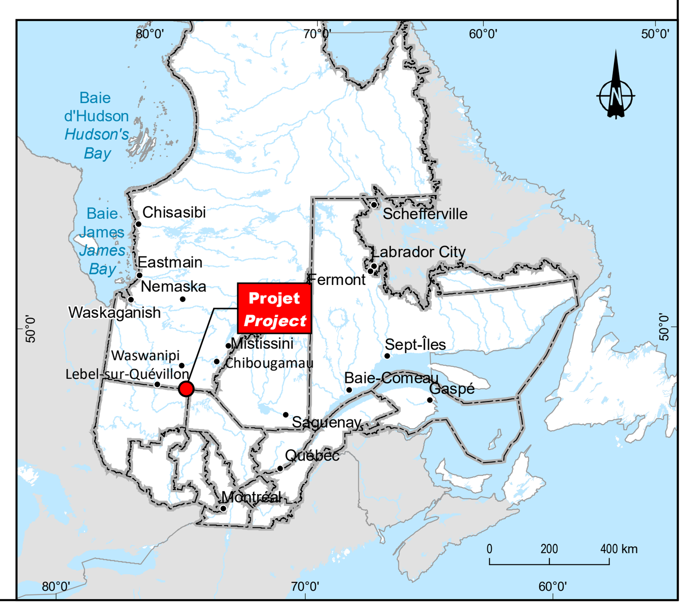
Aires protégées / *Protected Areas* (MELCCFP, 2022)

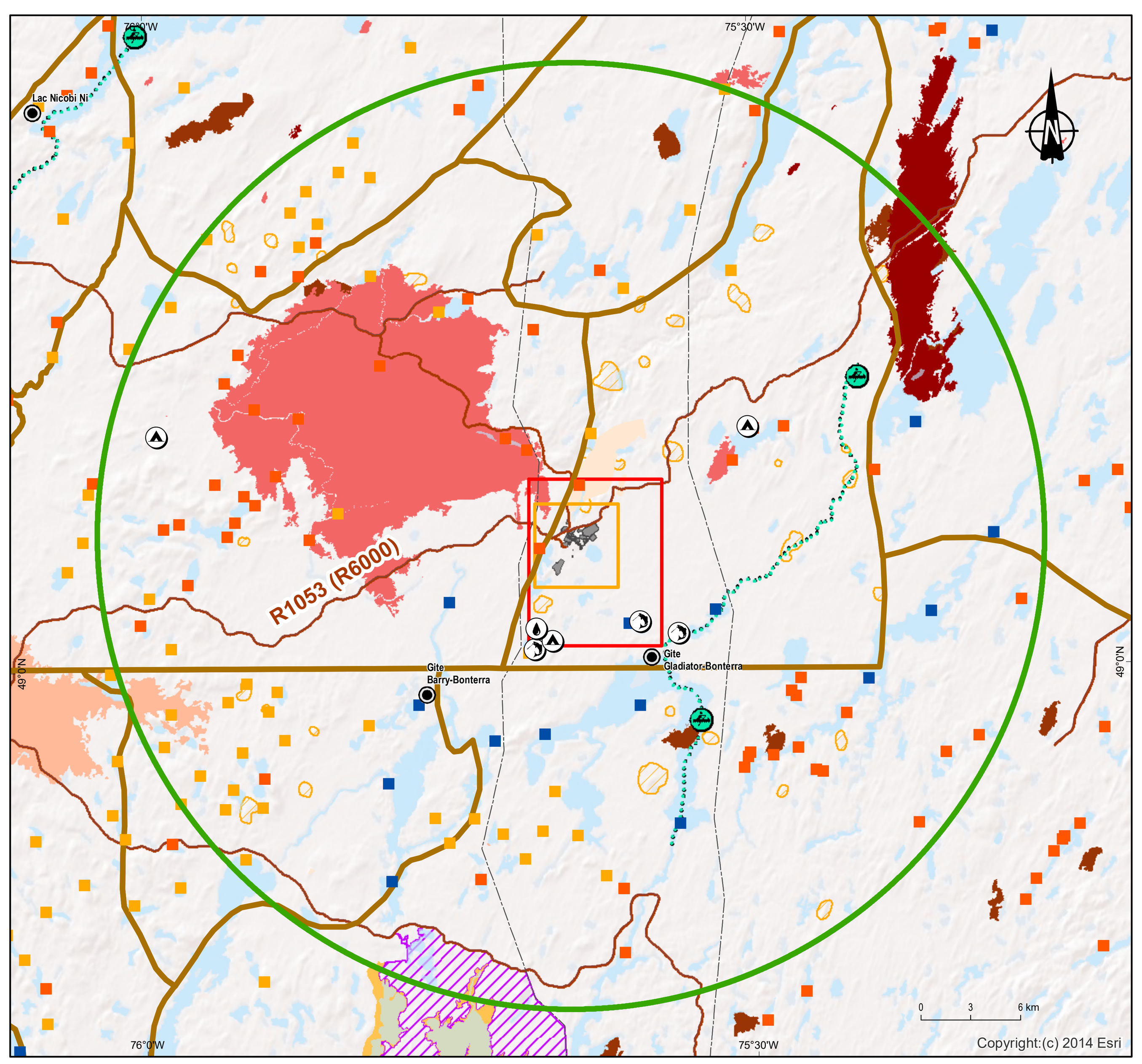
Réserve de biodiversité / *Biological Reserve*

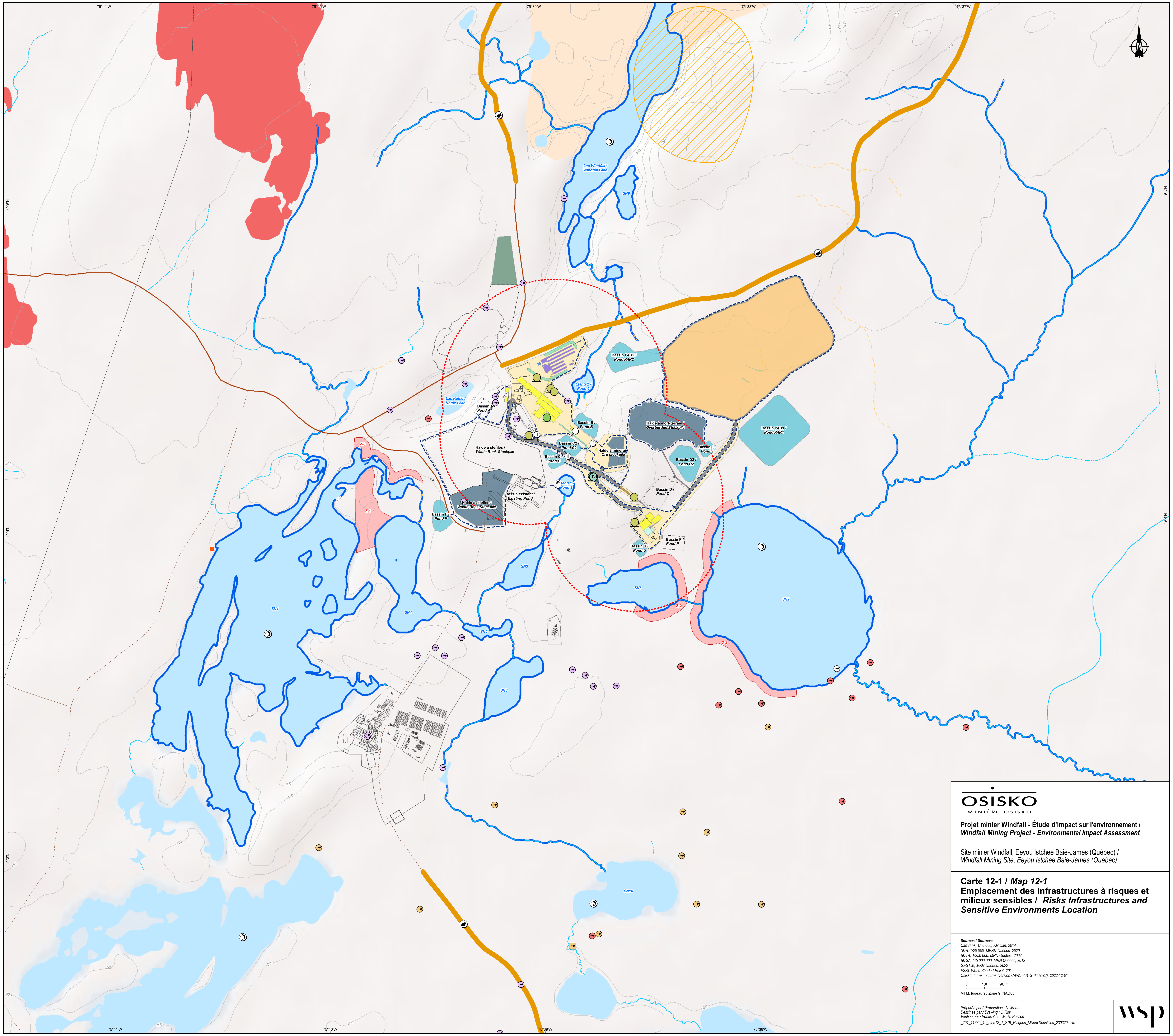
- Réserve de biodiversité projetée / *Projected biological reserve*

Autre désignation / *Other*

- Refuge biologique / *Biological refuge*
- Réserve de territoire aux fins d'aire protégée / *Protected area territory*







![OSISKO MINIÈRE OSISKO]

Projet minier Windfall - Étude d'impact sur l'environnement / ***Windfall Mining Project - Environmental Impact Assessment***

Site minier Windfall, Eeyou Istchee Baie-James (Québec) / *Windfall Mining Site, Eeyou Istchee Baie-James (Quebec)*

Carte 12-1 / *Map 12-1*
Emplacement des infrastructures à risques et milieux sensibles / *Risks Infrastructures and Sensitive Environments Location*

Sources / Sources:
CanVec+, 1/50 000, RN Can, 2014
SDA, 1/20 000, MERN Québec, 2020
BDTA, 1/250 000, MRN Québec, 2002
BDGA, 1/5 000 000, MRN Québec, 2012
GESTIM, MRN Québec, 2022
ESRI, World Shaded Relief, 2014
Osisko, Infrastructures (version CAWL-301-G-0602-ZJ), 2022-12-01

0 100 200 m

MTM, fuseau 9 / Zone 9, NAD83

Préparée par / Preparation : N. Martet
Dessinée par / Drawing : J. Roy
Vérifiée par / Verification : M.-H. Brisson
_201_11330_19_eiec12_1_219_Risques_MilieuxSensibles_230320.mxd

12.2.2 RECREATIONAL AND TOURISM ACTIVITIES

In terms of tourism activities, recreational trails are developed in the regional study area, including canoe, snowmobile, and quad bike trails. According to the Fédération québécoise du canot et du kayak (FQCK), there are no canoe routes in the LSA. As for motorized sports, the owners of public land use leases travel on the territory by snowmobile or quad bike on private trails (Map 12-1).

Wildlife harvesting activities also take place in the local study area, such as hunting, sport fishing, and blueberry picking. The LSA is also part of Quebec Hunting Zone 16 and Furbearer Management Unit (FMU) 31.

12.2.3 TREATY LAND AND VALUED AREAS

Most of the regional study area is located in the territory covered by the James Bay and Northern Quebec Agreement (JBNQA). More specifically, the local study area straddles two traplines (Map 12-1).

Four areas valued for their wildlife are located within the LSA, including one that is directly north of the project site. Three other areas are located south of the project site, one of which surrounds a Cree camp. Within these areas, there are hare habitat areas as well as moose habitat and path networks. Fishing areas (notably SN2 located south of the WTP) are also present in the LSA. Finally, a source of potable water for domestic use is located directly southwest of the Cree camp mentioned above (Map 12-1).

12.2.4 BIOLOGICAL ENVIRONMENT

The information contained in the following subsections is taken from the various sectorial reports on the site's biological environment prepared as part of this impact assessment. The objective of this section is to describe the natural environment in which the mining project site is located, including the various communities of plant and animal species that could be impacted by a major accident occurring on the project site. For more details on the biological components, the sectorial reports are available in Volume 2 and in Chapter 7 of this assessment.

VEGETATION AND WETLANDS

The vegetation present on the site is characteristic of the Lake Opémisca Plain region. As described in Chapter 7 of this assessment, in addition to black spruce dominating the landscape, jack pine is present on drier sites, white birch is present primarily on south-facing hillsides in association with balsam fir, and trembling aspen colonizes sites with thin surface deposits. A few hills and sand deposits are present in the study area, particularly in the area where the mining infrastructure is located, where peatlands are less common. The territory under study is suitable for peatland development.

In the study area, forestry activities are the main element that has influenced the development of vegetation groupings. The shrub layer is dominated by softwoods, namely jack pine and black spruce, sometimes in association with white birch.

ICHTHYOFAUNA AND BENTHOS

The main fish-bearing lakes are Windfall, SN1, SN2, SN3, SN4, SN5, SN6, SN8, as well as Pond 2. Pond 1 provides habitat for fish, but has very low potential for ichthyofauna and provides only a marginal habitat, and no fish were caught in this lake during the fishing effort. Kettle Lake has neither outfalls nor tributaries. It is not considered a fish habitat.

Of the 31 watercourses in the local study area for the biophysical environment, 20 are considered to be fish habitats. These may support fish or allow fish passage. For six watercourses, only a portion of the watercourse is considered a fish habitat, while five watercourses do not qualify as fish habitats in their entirety. Water bodies and watercourses considered to be fish habitats are indicated on Map 12-1. Lake SN2 has the highest fish diversity in the study area and had the highest fishing yield.

HERPETOFAUNA

Seventeen species of herpetofauna are likely to frequent the study area and its surroundings. The 2016, 2017, and 2021 inventories confirmed the presence of eight (8) of these species (5 anurans, 2 urodeles, and 1 snake) (Table 7-13).

Of the herpetofauna species likely to occur in the territory, the snapping turtle (special concern) and the wood turtle (threatened) are listed in Schedule 1 of SARA. Only the wood turtle has a vulnerable status; however, it has not been detected in searches despite the presence of suitable habitats.

The same is true for species likely to be designated as threatened or vulnerable, including the boreal chorus frog (*Pseudacris maculata*) and the four-toed salamander (*Hemidactylium scutatum*), which have been inventoried but not detected.

AVIFAUNA

Several avifauna inventories and targeted searches for species at risk were conducted as part of the project. These included inventories of nesting waterfowl and landbirds.

During all inventories conducted in 2016, 2017, and 2021, a total of 12 species of waterfowl (seven species) and other waterbirds (five species) were observed. Of these, six species were confirmed as nesting: Canada goose (*Branta canadensis*), American black duck (*Anas rubripes*), common teal (*Anas crecca*), ring-necked duck (*Aythya collaris*), common goldeneye (*Bucephala clangula*) and sandhill crane (*Grus canadensis*). No species of special status were observed.

As for birds of prey, six species were observed during the 2016, 2017, and 2021 inventories. The common raven (*Corvus corax*) was also observed.

Regarding land and forest bird species during the standardized inventories conducted in 2016 and 2021, a total of 56 species were observed, which included 48 species in 2016 and 40 species in 2021. In total, nesting was confirmed for nine species.

As for species associated with wetlands and their bordering areas, including passerine birds and shorebirds, a visit to the transects confirmed the presence of 30 species. Of the shorebirds, only the greater yellowlegs (*Tringa melanoleuca*) was recorded during the wetland (open peat bog and pond) visit in 2016. There is also the spotted sandpiper (*Actitis macularius*) that was recorded during the listening stations inventory and the solitary sandpiper (*Tringa solitaria*) during the spring migration only.

In summary, five species of special status were observed during the inventories: the bald eagle (*Haliaeetus leucocephalus*), the common nighthawk (*Chordeiles minor*), the Canada warbler (*Cardellina canadensis*), the olive-sided flycatcher (*Contopus cooperi*), and the rusty blackbird (*Euphagus carolinus*), of which a nest was identified south of Lake SN10.

Key avian fauna observations are shown on Map 12-1. For more detail, see the related maps in Chapter 7 of this assessment.

LARGE MAMMALS

There are mainly two large mammals on the territory, the woodland caribou (*Rangifer tarandus caribou*) and the moose (*Alces alces*). Woodland caribou are a species of special status with an average population density of 1 to 2 individuals/100 km^2. According to the surveys carried out, the population density of woodland caribou in the 50 km radius study area around the Windfall mine site is 0.19 individuals/100 km^2, which is defined as a very low density.

As far as moose are concerned, the boreal region, where the project is located, is considered to be a poorly productive habitat in summer conditions and even more so in winter conditions. In the moose-specific inventory area (100 km^2), a density of 0.5 moose/10 km^2 was estimated. Three moose habitat areas and two moose path networks were observed in the LSA.

MAMMALS – CHIROPTERANS

Acoustic inventories conducted in 2016, 2017, and 2021 confirmed the use of the local study area for the biophysical environment by the six bat species potentially present, namely bats of the genus Myotis, such as the northern long-eared myotis (*Myotis septentrionalis*) and the little brown bat (*Myotis lucifugus*), as well as the big brown bat (Eptesicus fuscus), silver-haired bat (*Lasionycteris noctivagans*), hoary bat (*Lasiurus cinereus*), and red bat (*Lasiurus borealis*). Except for the big brown bat, all these species have a special status.

MAMMALS – OTHER SPECIES

For small mammals, seven species of vole, heather vole, mouse, and shrew are present. Within the local study area of the biophysical environment, the following eight species were identified: Canadian beaver (*Castor canadensis*), red squirrel (*Tamiasciurus hudsonicus*), snowshoe hare (*Lepus americanus*), grey wolf (*Canis lupus*), eastern chipmunk (*Tamias striatus*), moose (*Alces alces*), black bear (*Ursus americanus*), and muskrat (*Ondatra zibethicus*).

12.2.5 ARCHAEOLOGICAL SITES

Four areas with archaeological potential have been identified on the Windfall project site. Two of these areas are located north of Lake SN1, one area on the eastern shore of Lake SN6, and the other on the western shore of Lake SN2. These areas would have been favourable for occupation by early First Nations due to the flat topography, good drainage, and proximity to a water body. These areas have moderate archaeological potential. These locations are shown on Map 12-1.

12.3 HAZARD IDENTIFICATION

12.3.1 IDENTIFICATION OF EXTERNAL HAZARDS

External hazards are events from natural or anthropogenic sources that can affect the proper functioning or integrity of the site.

RESILIENCE TO CLIMATE CHANGE

CURRENT CLIMATE

The climate at the Windfall project site is humid continental, characterized by a warm, slightly humid summer and a cold, long winter. Temperatures vary over a wide range, with extremes of -43.0 °C and 34.4 °C observed at the Lebel-sur-Quévillon weather station 95 km west of the study site. January is the coldest month, with an average temperature of -17.9 °C, while July is the warmest month, with an average temperature of 17.2 °C. Total annual precipitation averages 927.8 mm and is highest from April to October. Snowfalls occur from November to April and average 226.2 mm of water.

In winter as well as in summer, the winds are often from the southwest. The average wind speed is 44 km/h. During the year it ranges from 37 km/h to 50 km/h. Wind data is not available locally; within 100 km of the Windfall project site, weather stations where wind data is collected have recorded wind gusts in excess of 90 km/h; since 1973, this threshold has been exceeded on ten occasions, although the maximum wind speed has never reached 120 km/h.

Climatic conditions at the study site are described in detail in Chapter 6 of this study.

CLIMATE TRENDS AND HAZARDS

Some climate trends are already apparent from historical weather data for the Windfall project site's surroundings and are presented in the site's climate change resilience study sectorial report provided in Appendix 9-1. The projected changes in these trends in the coming years, as presented in this report, are considered in this section to adequately assess the impact of climate change on the probabilities or consequences of the accident and malfunction scenarios identified in this chapter. The climate trends considered are as follows:

- Extreme precipitation events will tend to increase in frequency and intensity.
- General temperature increases will also result in longer summers.
- Summer temperatures will be higher.
- Heat waves will continue to be an exceptional phenomenon.
- Soil drying events will continue to be sporadic and infrequent.
- The number of days conducive to the spread of forest fires will increase by 20 to 30 percent in the short term.
- Over a full year, the number of freeze-thaw cycles is expected to decrease. However, freeze-thaw cycles during the winter months (December through February) will increase by 37 to 51 percent.

- The site area will continue to experience extreme cold snaps, although it would be very surprising if temperatures were to fall below the lowest historical minimum temperatures on record.
- The increase in the amount of winter precipitation and the tendency of average winter temperatures to approach the freezing point suggest that freezing rain events will be more frequent and more intense.
- It appears that these events will become more concentrated in the mid-winter months, less frequent, but more intense.
- An increasing trend in high winds and the damage they cause is expected.
- Thunderstorm activity will also increase, suggesting that the likelihood of tornadoes striking the project site will increase.

A hazard is defined as "a phenomenon, physical manifestation, or human activity that has the potential to cause loss of life or injury, damage to property, social and economic disruption, or environmental degradation" (MSP, 2009). A climatic hazard is therefore one whose origin is wholly or partly related to one or more climatic variables. The climatic hazards identified in the site's climate change resilience study sectorial report are:

- extreme precipitation events;
- longer summers;
- high summer temperatures;
- soil drying events and forest fires;
- freeze-thaw cycles and winter thaw;
- extreme cold snaps;
- alteration of the winter precipitation pattern;
- strong winds and thunderstorm activity.

The consequences of these climatic hazards can be direct or indirect. In fact, wind, precipitation, snow, and ice can directly threaten the integrity of buildings and equipment. These weather events can also cause problems such as power outages, flooding, ground instability, or falling objects. Therefore, the potential for extreme weather conditions (high winds, heavy rain, tornadoes, etc.) at the project site is being considered in this risk assessment. However, building and mining equipment design will be in compliance with current codes and regulations to withstand the overloads created by extreme weather conditions. In addition, excessive snow and ice loads will be removed as required.

EXTERNAL HAZARDS OF NATURAL ORIGIN

EARTHQUAKES

Eastern Canada is located in a stable continental region of the North American Plate, resulting in relatively low seismic activity. Nevertheless, Natural Resources Canada (NRCan) has identified seven seismic zones in eastern Canada where activity is more significant: Northeastern Ontario, Southern Great Lakes, Western Quebec, Charlevoix-Kamouraska, Lower St. Lawrence, Northern Appalachians, and Laurentian Slope. The Eeyou Istchee James Bay Territory (project site) is not located in any of these areas (Ressources naturelles Canada, 2021).

According to NRCan statistics, there are approximately 450 earthquakes per year in eastern Canada. Of these, an average of four exceed magnitude 4, thirty exceed magnitude 3, and another 25 can be felt. A magnitude 3 earthquake is sufficient to be felt in the surrounding area and a magnitude 5 earthquake is generally the threshold for the event to cause damages.

In assessing the likelihood of strong earthquakes across Quebec, NRCan has divided the province into five seismic zones with a relative hazard on a scale from 1 (low) to 5 (high). The Eeyou Istchee James Bay Territory is located in a zone with the lowest relative hazard of 1. The probability of significant damage in this zone every 50 years is less than 1% (Ressources naturelles Canada, 2021).

Therefore, the risk of an earthquake having major consequences in the area of the site under study is considered negligible.

Nevertheless, the project's buildings and facilities will be constructed in accordance with the requirements of the National Building Code of Canada, which establishes standards for each seismic zone to ensure that buildings and facilities withstand seismic loads.

GROUND INSTABILITY

Ground instability is generally attributable to topography and the nature of the soil. Sloping areas can give rise to landslides when the materials present do not provide sufficient shear strength. This phenomenon depends on both the steepness of the slope and the composition of the soil.

Some other soil instability phenomena, such as flows, are related to particular types of soils that are plastic or heterogeneous. In addition, areas backfilled with heterogeneous materials may be subject to soil instability due to settlement or subsidence.

Given the low gradient encountered at the project site and considering that the project site is located in an area with very low susceptibility to landslides (Bobrowsky and Dominiguez, 2012), the risk related to the instability of surface deposits is considered negligible. However, landslides are likely to be affected by climate change. Therefore, stockpile erosion and landslides could occur at the site through triggers or exacerbating factors such as extreme precipitation events and increased total annual precipitation (MTQ, 2018).

FLOODING

Flooding usually occurs upstream of sills (raising of the watercourse or narrowing of the banks) that impede the flow of water. There are no sills in the LSA. Ice jams can also contribute to flooding by obstructing the flow of water, particularly at stream constrictions during spring freshet. Based on the climatology and hydrology sectorial study report prepared in connection with the project and appended to this assessment, it can be concluded that, depending on the year, ice cover on the lakes in the study area forms no earlier than the first week of November and no later than the end of November/early December. Also, the thaw takes place no earlier than mid-April, and no later than the end of May.

Flood flows were assessed as low because the watersheds involved are fairly flat, with a large percentage of lakes and wetlands.

Extreme precipitation events, rapid snowmelt, and increased rain-on-snow events are all events that can increase the likelihood of flooding. However, in terms of the project site, this would likely result in local accumulation. The water would then be drained through the existing drainage system. The risk of major flooding at the project site is considered negligible.

FOREST FIRES

The Ministère des Ressources naturelles et des Forêts (MRNF) is responsible for forest fire management in Quebec. However, the Ministère is supported by the Société de protection des forêts contre le feu (SOPFEU) in the prevention, detection, and fighting of fires. It should be noted, however, that at this latitude, a fire exclusion policy whereby any forest fire should be systematically controlled to the extent possible is applied (intensive protection zone). A human-caused fire prevention program is also in effect (Gouvernement du Québec, 2022).

Areas where forest fires have occurred in the last 10 to 20 years and those that most recently occurred in the regional study area more than 30 years ago are shown on Map 12-1.

The geographic location of the assessment site indicates a relatively high probability of forest fires developing around the site. In addition, the number of days conducive to the spread of forest fires could increase by 20-30% in the near term as a result of climate change projections as outlined in the site's climate change resilience study sectorial report provided in Appendix 9-1.

EXTERNAL HAZARDS OF ANTHROPOGENIC ORIGIN

ROAD TRANSPORTATION

The regional study area is crossed by Provincial Road 113. Chemicals and petroleum products are transported on this road to supply local and regional businesses. The existing forest roads R1050 (R1000), R0853 (R5000), and R1053 (R6000) will be used as mine access roads for employees as well as for chemical and petroleum product deliveries.

The roads are generally in good condition and do not require immediate major improvements. The Wetetnagami River Bridge (R0853-03) is also in good condition. However, the wing walls are deteriorated, but the authorities do not believe that immediate repairs are required. Therefore, possible repairs are being considered prior to the transport of project materials to prevent significant deterioration of the bridge, consequent deposition of debris in the river, or bank erosion. Bridge capacity is 138 t for long logging trucks.

The access roads are currently maintained by Osisko. Discussions are underway with the stakeholders using the roads as well as the Société du Plan Nord to agree on future maintenance procedures.

RAIL TRANSPORTATION

A Canadian National (CN) railroad that runs through the western part of the regional study area (RSA) is located approximately 100 km from the project site and is the closest rail line.

AIR TRANSPORTATION

There are two airports in the regional study area. The first is located in Lebel-sur-Quévillon (about 100 km from the site as the crow flies), while the second is under the management of the Ministère des Transports du Québec and is located between Chapais and Chibougamau (about 115 km from the site).

The risk of airplane crashes is highest in the landing and take-off maneuvering areas. For large aircraft, this area is approximately 8.5 km long from the end of the runways and approximately 5 km wide. For small aircraft, this area forms a circle of about 4 km around the centre of the runway (De Grandmont, 1994). The project site is therefore located outside the landing and take-off maneuvering areas of any nearby airfield.

In addition to the risk of accidents being high over the immediate surroundings of an airport, the risks are also high in air traffic corridors. Excluding these areas, the probability of an aircraft crash at any given location is considered very low.

POWER TRANSMISSION

There are six transmission lines in the regional study area. Power will be supplied to the site via a 69 kV power line that will be built between Waswanipi and the project site and managed by an entity independent of Osisko. As mentioned above, such lines are particularly sensitive to the climatic hazards mentioned.

VANDALISM AND TRESPASSING

The Windfall mine site could be the target of ill-intentioned individuals. Trespassing and vandalism are therefore potential dangers. However, the following measures limit the risks:

- there will be a gatehouse at the site entrance;
- site access controllers will be able to track on-site personnel and material;
- surveillance cameras will be installed on site and linked to the gatehouse;
- an intercom system will be available;
- fencing will also be installed to prevent access to the site from forest roads;
- explosives (ammonium nitrate) will be stored underground. No explosives will be stored on the surface.

12.3.2 IDENTIFICATION OF HAZARDS RELATED TO SITE ACTIVITIES

The Windfall project is intended to be a ramp-accessible underground mine, operated by conventional drifting methods of drilling, blasting, and loading and hauling of ore. The process plant will have a nominal throughput capability of 3,400 tpd. The mine plan calls for the extraction of approximately 12.2 Mt of ore and 8.5 Mt of waste rock over a 10-year mine life.

In addition to the mine and process plant, the planned infrastructure is as follows (Map 12-1)

- the new Lynx portal;
- a tailings storage facility;

— a waste rock stockpile;
— an overburden stockpile;
— an ore storage area;
— water management structures (pipes, ditches, ponds, and pumps);
— a water treatment plant with a mine effluent;
— an underground tailings filtration and backfill plant;
— a garage for mechanical maintenance;
— a core library;
— a petroleum product storage area;
— an underground explosives magazine for each of the portals;
— a camp for 406 employees with drinking and domestic water treatment systems;
— a residual materials management area;
— borrow pits;
— a gatehouse;
— a multi-service building where the process plant will be located and which will house the administrative offices, the workers' locker room and showers, the infirmary, the mine rescue room, the warehouse, and the training rooms.

The new facilities were grouped together to ensure optimal layout, thereby minimizing encroachment on the natural environment, facilitating movement between facilities, improving management of activities, and ensuring better employee safety while maintaining safe distances between facilities.

The main hazards at the site during the period covered by the environmental assessment are related to the following activities:

— use of flammable gases;
— storage and use of chemicals;
— storage and use of petroleum products;
— use of conveyors and other rotating equipment;
— use of transformers;
— transport of chemicals, petroleum products, and explosives;
— storage and use of explosives;
— operation of an underground mine;
— storage of tailings and waste rock;
— transport of mine tailings;
— water retention in ponds;
— operation of water treatment plants;
— use of air-handling systems.

USE OF FLAMMABLE GASES (PROPANE)

Propane will be supplied from on-site storage tanks. Propane is intended mainly to cover the heating needs of certain procedures and buildings/portals. Six propane tanks are planned for the project site, including:

- one (1) 40,000 USG (151,400 L) tank for heating the process plant;
- two (2) 20,000 USG (75,700 L) tanks for heating the underground mine, installed near each of the portals;
- one (1) 20,000 USG (75,700 L) tank for heating the garage and storage buildings;
- one (1) 20,000 USG (75,700 L) tank for heating the filtration, backfill, and water treatment plants;
- one (1) 20,000 USG (75,700 L) tank for camp heating and kitchen supply.

The respective locations of these tanks are shown on Map 12-1. A 35,000 L tank truck will therefore have to make a trip to the site every other day on a seasonal basis, at the very least.

Propane is a liquefied gas with an odour that is difficult to detect at low concentrations, but often contains an odorant (a product with a foul odour) that helps to detect leaks. Propane in gaseous form is extremely flammable. It can burn or explode when heated or when in an enclosed space if mixed with strong oxidizers (peroxide, chlorine, chlorine dioxide, liquid oxygen). It can displace oxygen and then act as an asphyxiant.

Propane is a substance listed in Schedule 6 of the MELCCFP Guide and Schedule 1 of the Environmental Emergency Regulations (EER) as having the potential to cause a major technological accident when stored in quantities greater than 4.50 metric tonnes. (Gouvernement du Canada, 2019). Therefore, the threshold quantity will be reached.

STORAGE AND USE OF CHEMICALS (REAGENTS)

Chemicals, some of which are considered hazardous materials under the Regulation respecting hazardous materials, will be used at the site. Table 3-12 in Chapter 3 summarizes the consumption of reagents used at the cyanidation, filtration, and backfill plants. These reagents will be supplied on a regular basis. Table 3-23 shows the frequency of supply and type of delivery for each reagent at the process plant, filtration plant, and paste backfill plant. The reagents currently anticipated and stored at the WTP are presented in Table 3-21 in Chapter 3.

The products in question will be received at the gatehouse by employees certified in the transportation of hazardous materials (THM) and directed to their storage site. Material safety data sheets for these products are attached in Appendix 3-3.

Reagents will be stored in the plant buildings where they will be used. The cyanidation and cyanide destruction products will be stored at the process plant. Reagents for the water treatment plant (WTP) will be stored in an annex to the building or in the building itself (see Map 12-1). The filtration products (flocculant and descaler) will be stored in the filtration plant building and the cement in a silo adjacent to the backfill plant.

The characteristics of the main chemicals that will be used are described below.

SODIUM CYANIDE

Sodium cyanide is a white, deliquescent solid with an almond-like odour. Sodium cyanide may, on contact with moisture in the air, carbon dioxide, or water, release hydrogen cyanide, an extremely toxic gas.

HYDROCHLORIC ACID

Concentrated hydrochloric acid is a strong acid with a pH well below 2. This characteristic makes it a corrosive substance. Hydrochloric acid gives off hydrogen chloride, a suffocating gas with a pungent odour, making it a highly toxic substance.

Hydrochloric acid is a substance listed in Schedule 6 of the MELCCFP Guide and Schedule 1 of the Environmental Emergency Regulations as having the potential to cause a major technological accident when used at a concentration greater than 30%. For the Windfall project, hydrochloric acid will be used at a concentration lower than 30% (28%).

SULPHUR DIOXIDE

Sulphur dioxide (or sulphurous anhydride) is a colourless substance with a burning, irritating match odour that is stable under normal conditions, but can react with water and steam to form corrosive sulphurous acid. In contact with water or the acid, sodium metabisulphite (and solutions), the product may release toxic and hazardous vapours. Acute poisoning from sulphur dioxide is rare because the gas is easily detected. However, accidental exposure to high concentrations can result in eye irritation and adverse effects on the respiratory system, even death.

Sulphur dioxide is a substance listed in Schedule 6 of the MELCCFP Guide and Schedule 1 of the Environmental Emergency Regulations as having the potential to cause a major technological accident when stored above the applicable thresholds. These thresholds are 2.25 metric tonnes (Théberge, 2002) and 2.27 metric tonnes respectively (for a concentration greater than 10%) (Gouvernement du Canada, 2019). They will therefore be exceeded.

SULPHURIC ACID

Aqueous solutions of sulphuric acid above 51% are low volatile, colourless, and odourless liquids. They are quite viscous, especially at concentrations above 80%. Like hydrochloric acid, sulphuric acid is corrosive and highly toxic. Aqueous solutions of sulphuric acid are non-flammable liquids. However, contact of sulphuric acid with combustible substances can generate enough heat to start a fire. Sulphuric acid also reacts with most metals, especially in the presence of water, to form flammable and explosive hydrogen gas. Sulphuric acid is completely miscible in water and is therefore a hazard to aquatic life due to its acidity.

SODIUM HYDROXIDE

Sodium hydroxide (or caustic soda) in solution is a colourless, low volatile, and odourless liquid. Sulphuric acid is completely miscible in water and is therefore a hazard to aquatic life due to its acidity.

STORAGE AND USE OF PETROLEUM PRODUCTS

Diesel and gasoline are planned to be used. They will be stored on a designated site located midway between the process plant and the filtration, backfill, and water treatment plants. There will be no underground storage. The site will include:

— four (4) 45,000 L diesel tanks;
— one (1) 1,000 L diesel tank;
— one (1) 10,000 L gasoline tank.

Diesel consumption by mobile equipment is estimated at 6,478,704 L per year. A weekly fuel delivery is planned for a volume of 124,249 L every seven days.

Six diesel generators totalling approximately 6 MW will be available for use on site. One is planned for the electrical substation, two for the process plant, two for the water treatment plant, and one for the workers' camp. Adjustments to this emergency supply strategy could still be made following Hydro-Québec requests.

DIESEL

Diesel is a product of petroleum distillation and is composed of various hydrocarbons in the C_{10} series and higher. It is a clear, amber-coloured liquid. It is not very volatile at room temperature, but can emit vapours that form an explosive mixture with air when heated. Diesel is less dense than water (density of 0.85) and insoluble in water.

GASOLINE

Gasoline is also composed of various hydrocarbons. It is a volatile, colourless liquid with its characteristic gasoline odour. It is stable under normal conditions, but extremely flammable in the presence of a flame, sparks, or heat and can accumulate in enclosed spaces. Gasoline is less dense than water (density of 0.65 - 0.8) and is insoluble in water.

OILS AND GREASES

Hydraulic and lubricating oils and greases will also be used. However, they will be used and stored inside the buildings or sheds.

These oils are hydrocarbons and come from a relatively heavy fraction of petroleum. They are therefore viscous and have high flash points.

USE OF CONVEYORS AND OTHER ROTATING EQUIPMENT

Several conveyors using hydraulic oil will be used to transport:

— crushed ore from the crusher to a storage silo, then from the silo to the process plant;
— tailings leaving the filtration plant to be temporarily stored before being loaded onto trucks for disposal at the tailings storage facility.

Hydraulic oil will also be used to ensure proper operation of a variety of rotating equipment.

USE OF TRANSFORMERS

The total anticipated electricity demand for the Windfall site is 27.4 MW.

At the south end of the power line, coming from the Windfall station, another substation will step down the voltage to 13.8 kV for distribution to the site. The output of the main transformers will feed 13.8 kV air insulated switchgears (AIS) located in an electrical room within the process plant. The main switchgears will distribute power throughout the complex. Some 13.8 kV feeders will supply transformers to further step down the distribution voltage to usable 600 V levels while others will be dedicated for the crushing and grinding circuits (i.e., for the SABC crushing circuit motors, consisting of a SAG mill, pebble crusher, and ball mill), as well as for the underground and surface infrastructure electrical distribution.

Two transformers will be required at the Windfall station. These transformers will contain mineral oil. These transformers will have a retention basin to hold any accidental spills. It should be noted that the Windfall substation and all equipment connected to the substation are owned by Miyuuka Corporation.

Only 2 transformers containing oil are planned for the project. These transformers will be located at the process plant. They will contain a volume of 4.3 m^3 of a dielectric ester fluid (*Synthetic Ester Transformer Fluid*). The data sheet for this oil (MIDEL 7131) is provided in Appendix 3-3. The other transformers will be dry. No transformers will contain polychlorinated biphenyls (PCBs).

Considering the distance between buildings on the site, 13.8 kV power will mostly be distributed using overhead lines.

ROAD TRANSPORTATION

Hazardous materials such as mine chemicals and petroleum products will be transported by tank trucks, while ball mill consumables required for the operation of the process plant will be transported by 53-foot enclosed trucks.

STORAGE AND USE OF EXPLOSIVES

Mining-related activities require the use of explosives. For rock mining (ore and waste rock), drillers will be used to drill holes for loading emulsion explosives. These explosives will be composed of a mixture of ammonium nitrate, an emulsifier, and diesel (ANFO). The explosive mixture will only be sensitized with a detonator. Because ammonium nitrate is an oxidizing material, it may explode if contaminated with organic or other oxidizing materials.

The average consumption of explosives for the Windfall project is estimated at 920 tonnes per year. The emulsions will be delivered by truck to the site and transported underground to be stored in specific bays set back from the access ramp until they are used. Therefore, no surface storage is planned.

At the Main portal, this bay is located near the entrance at the +372mRL level. At the Lynx portal, this bay is located at the--080mRL level. It is planned to store 24 containers of 1,500 kg, or 36,000 kg of explosives per magazine, but each magazine will be able to accommodate a maximum of 54,000 kg total, or 36 containers of 1,500 kg.

Ammonium nitrate (solid and solution) is a substance listed in Schedule 1 of the Environmental Emergency Regulations (EER) as having the potential to cause a major technological accident when stored in quantities and concentrations above the applicable thresholds. These thresholds are 20 metric tonnes in quantity and 81% in concentration[1]. They will therefore not be exceeded.

OPERATION OF AN UNDERGROUND MINE

The Windfall project is a ramp-accessed underground mine, operated by conventional drifting methods of drilling, blasting, and loading and hauling ore.

The mining area will consist of two portals, the Main portal and the Lynx portal, and a ramp giving access to exploration drifts. The underground drifts will be heated and ventilated by a ventilation stack and will include refuge stations.

The underground mine will consist of 94 levels, each spaced 20 m apart. Access to each of these levels will be achieved via a ramp that connects all levels. Extraction drifts will generally be 4 m wide and 5.5 m high (Figure 3-5). Drilling, blasting, and hauling of ore/waste rock will be carried out underground. All mineralized areas can be mined using the longitudinal longhole stoping method. No employees are allowed in the stopes. The filling of shovels (scoop) is remotely controlled from the control room located in the administration building.

Each production level will have a sump with a pump to collect and discharge mine water, ventilation raises (return airway and escapeway), an electrical substation, an area to stockpile ore waiting to be sent to the surface, an access to receive backfill cement when needed, and easy access to a refuge station (see Figure 3-5).

STORAGE OF TAILINGS AND WASTE ROCK

The location of the accumulation areas (overburden, ore, waste rock, and tailings) is shown on Map 12-1.

OVERBURDEN

A 21 m-high overburden stockpile is planned. The site selected for the overburden stockpile can accommodate 638,100 m^3 of organic and inorganic material. Runoff from the site will be collected by perimeter ditches, directed to a sedimentation pond (Pond J), and monitored prior to discharge to the environment. If the contact water does not meet water quality guidelines, it will be conveyed to the WTP to remove TSS before being discharged to the final effluent.

ORE

A 157,750 t (54,553 m^3) capacity ore stockpile will be located adjacent to the crushing circuit. The stockpile is designed to have a maximum height of 10 m, a bench, and 3H: 1V slopes. This stockpile, which will be used for temporary storage of ore prior to its transfer to the crusher, will rest on an elevated platform to facilitate the transfer of ore to the crusher. A perimeter drainage ditch around the crusher platform will be built to collect runoff and direct it to Pond C and then to the WTP.

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1 The thresholds considered are those prescribed for ammonium nitrate in solution.

WASTE ROCK

A waste rock stockpile is currently in use at the Windfall site. It will be enlarged to a height of 32 m and a surface area of 230,180 m^2. The waste rock will be deposited from the bottom up and not poured forward. This method allows for better control of the footprint. In addition, all the waste rock will be placed on a geomembrane.

MINE TAILINGS

The tailings storage facility will have a maximum height of 423 m in the northwestern section and 420 m in the southeastern section, resulting in a 0.5% slope to allow for water runoff into the drainage system. The planned tailings storage facility will include a dewatered tailings stockpile, a water management system, and a surrounding road. No water will be able to seep into the tailings stockpile. No water retention dikes will be required, but two basins will be installed to collect runoff water. The final surface area of the tailings storage facility will be 461,332 m^2.

Current project planning indicates that 8.2 Mt of dewatered tailings will be stored in the tailings storage facility. This tonnage assumes that approximately 40% of the tailings will be returned underground as paste backfill.

Geochemical characterization indicates that the tailings are potentially acid generating and leachable for some metals. Given the potential for acid generation, metal leaching, presence of residual traces of cyanide in tailings pore water, and a relatively permeable foundation, the tailings storage facility design includes a geosynthetic liner to prevent pore water infiltration into the groundwater.

The tailings will be trucked from the filtration plant and compacted to 95% in a controlled manner in the stockpile. They will be mechanically placed directly onto the geosynthetic system. Access routes will be required periodically in the tailings storage facility during operations to facilitate placement of tailings.

To ensure the stability of the southeast area of the tailings storage facility, a stability berm will be installed as a closure along its southern edge near Pond PAR1.

TRANSPORT OF MINE TAILINGS

BY TRUCK

Tailings, ore, and waste rock will be transported by dump truck. Each dump truck at the Windfall mine will carry a total of 36 tonnes (tailings) or 54 tonnes (ore and waste rock) per load.

Three 12 m-wide haul road sections will be constructed, as follows:

- from the Main portal to the Lynx portal with access to the crusher discharge, the ore stockpile, and the waste rock stockpile;
- from the tailings filtration plant to the tailings storage facility;
- from the tailings filtration plant to the fuel farm.

BY PIPELINE

Pipelines will be used on site to transport water and tailings. In some cases, tailings will be mixed with cement for use as backfill in underground stopes. The tailings will be sent via pipes directly to the stopes to be backfilled. Some of the backfilled stopes will be filled with waste rock and then cemented with tailings/cement paste; others will be filled with tailings/cement paste only.

Pipelines will be installed on the surface, except where there are path, road, and ditch crossings.

WATER RETENTION IN PONDS

Nine water retention ponds will be present on the project site, including:

- two ponds for the waste rock stockpile (pond A and CP);
- four ponds downstream of the industrial site and the WTP (Ponds B, C1, C2, and U);
- two accumulation ponds upstream of the paste backfill plant, the filtration plant, and the water treatment plant (Ponds D and D2);
- a pond to collect water from the extension of the waste rock stockpile (Pond F);
- a pond to collect water from the new overburden stockpile (Pond J);
- a polishing pond near the water treatment plant (Pond P);
- two collection ponds at the tailings storage facility (Ponds PAR1 and PAR2).

To retain water, the ponds will be partially dug into the ground as well as surrounded by retention dikes built on top. Their location is shown on Map 12-1. Dike heights will vary by pond. The hydraulic design parameters for the ponds are provided in Table 3-18 in Chapter 3.

OPERATION OF A WATER TREATMENT PLANT

Water treatment will be required at the Windfall project site to ensure that the quality of the water returned to the final effluent meets the criteria of D 019 and the MDMER standards (SOR 2002-222) and, considering technical and economic limitations, is intended to achieve the EDOs to be defined for the Windfall project. The water treatment system will be located southeast of the site, downstream of the industrial site and just north of Lake SN6 (Map 12-1). The WTP will be located in an existing building, adjacent to the filtration plant, Ponds D and P, and the pipelines leading back to the mine effluent site.

All infrastructure will be equipped with a collection ditch to direct contact water to collection points, which will be pumped or gravity fed to the WTP before being returned to the environment. The WTP treatment will reduce suspended solids, metals, cyanates and thiocyanates, and ammonia nitrogen.

Site contact water includes water that has passed through:

- the tailings storage facility;
- the waste rock stockpile;
- the ore stockpile;
- the overburden stockpile;
- and the industrial zone (including process water from the process plant).

Groundwater inflows will be managed underground with a separate treatment unit for TSS. The water from the underground mine is then pumped to the WTP at the surface to be reprocessed in a second circuit for TSS and then for metals, reused, and/or treated before being discharged to the environment.

The sludge generated from the treatment at the WTP will be directed to the tailings storage facility.

USE OF AIR CLEANING SYSTEMS

Dust will be released during crushing and conveying operations. Therefore, the process plant, in addition to being enclosed, will be equipped with dust collectors at the required locations to control the emission of dust to the atmosphere. In addition, wet scrubbers will be installed at the reagent dispensers.

Breakage or mishandling of this equipment could result in the accidental release of dust or other contaminants into the atmosphere.

Dust emissions from traffic, handling, and accumulation areas (e.g., waste rock stockpile, tailings storage facility) could also result in reduced visibility. At the environmental level, the impact will be limited to the property. However, these effects could be exacerbated by extreme weather conditions (e.g., high winds) and thus by the climate trends presented (section 12-8).

12.4 HISTORY OF MINING ACCIDENTS AROUND THE WORLD

Historical records of mining accidents around the world can be used to identify potential hazards and establish accident scenarios to be used in the assessment of risks. It can also be used to improve the design of infrastructure and equipment, to determine the required safety equipment, and to better define the risk management plan.

The ARIA database of the Bureau d’analyse des risques et pollutions industriels (BARPI) of the French ministry of ecology and sustainable development was consulted (Bureau d'analyse des risques et pollutions industriels, 2022).

Since the leaching process related to ore extraction is not specific to the gold industry, the ARIA database search was extended to metal ore processing in general. Accidents worldwide that have occurred since January 2010 involving the following activities were examined:

- B.07.10: mining of iron ores;
- B.07.29: mining of other non-ferrous metal ores;
- B.08.11: mining of ornamental and building stone, industrial limestone, gypsum, chalk, and slate;
- B.08.12: gravel and sand-pit mining, mining of clays and kaolin;
- B.08.99: other mining activities;
- B.09.90: support activities for other mining activities.

Results of the search for incidents that have occurred since 2010 are presented in Table 12-1.

Table 12-1 Accidentology related to metal ore processing

Date	Country	Description of the accident
Dike failure		
08/05/2011	Turkey	Inner embankments collapsed at 2 locations of a cyanide water tank at a silver ore processing plant. No leaks were detected on the outer embankments. The plant's activities were stopped, and 250 residents were evacuated. The outer embankment was reinforced. A group of experts determined that there was no risk of total collapse. A new reservoir was built to accommodate the discharges. Production resumed after a 20-day shutdown. Operating losses were estimated at $30 million (21 million euros).
04/08/2014	Canada	A dike of a collection pond for mining effluents of a copper and gold mine collapsed. The contents (10 million cubic metres of water, 13.8 million cubic metres of tailings, and 0.6 million cubic metres of pond structure) flowed into HAZELTINE Creek and Polley and Quesnel Lakes downstream. The pond contained copper, nickel, arsenic, lead, selenium, and cadmium. Authorities prohibited drinking and using the water as well as swimming. Debris was carried up to 12 km downstream. Residents complained of strong odours. The operator pumped the polluted contents of the lakes into an empty mine shaft. The mining administration conducted an investigation. In 2013, the pond had received 326 t of nickel, 177 t of lead, and 18,400 t of copper and copper compounds.
06/08/2014	Mexico	Approximately 40,000 m³ of sulphuric acid and heavy metals leaked from a copper mine collection pond. The coloured discharge polluted 2 rivers over 150 km; 20,000 people were deprived of drinking water for several days. The operator poured 100 t of lime to neutralize the effluent. Other leaks were noted in September. Measurement campaigns were carried out in the bordering country. The mining company spent 120 million euros on clean-up operations. The authorities fined the company 2.5 million euros. The Mexican federal environmental agency investigated the accident. The company believed that the discharge was due to the pond overflowing as a result of heavy rainfall. Government authorities rejected this hypothesis.
05/11/2015	Brazil	At 3:30 p.m., a breach occurred in a dam retaining iron ore waste. Draining of the reservoir had been initiated, but the structure breached at 4:20 p.m. The reservoir emptied completely into the valley below, causing a second dam to break. A mudflow of about 60 million tonnes engulfed a village of 620 inhabitants. The operator notified some residents by phone, but the list of residents was incomplete. The operator was not equipped with an alarm siren as required by good operating practice. There was no plan in place to alert the public or to evacuate, which resulted in 19 deaths and an ecological disaster. Small tremors were recorded in the area on the day of the accident, but no link to the failure of these embankment dams was established. The dam was at the limit of its capacity and was in the process of being raised. The accident scenarios had largely minimized the magnitude of the flow of tailings in case of failure; they were based on a construction height of 45 m in 2008, whereas the dam was twice as high on the day of the accident.

Date	Country	Description of the accident
25/01/2019	Brazil	In the early afternoon, one of the three dams holding back liquid waste from an iron ore mine broke. A breach in the 86 m high embankment structure caused its collapse and the release of 12.7 million m³ of toxic effluents. A destructive wave of mud buried the site's administrative buildings and part of the village downstream. The consequences of the accident were considerable. According to the reports of May 2019, there were 243 dead, 27 missing, and hundreds injured. Rescue efforts were suspended for one day due to the risk of a second dam failure at the site. Heavy material damage was noted: houses destroyed, railway bridge washed away, drinking water and electricity supply networks out of order, vehicles buried... The toxic flow spread over dozens of km² destroying crops, as well as all flora and wildlife. Drinking water sources were rendered unsafe for consumption. The structure, 86 m high and with a crest length of 720 m, was built in 1976 using the "upstream" method. This consists of creating a starter embankment, dumping mine tailings (generally fine sands with varying degrees of clay content) in the vicinity, and the progressive raising of the level during operations. According to the first hypotheses, its collapse resulted from a combination of several unfavourable factors: 1. A drainage buffer zone was impregnated with fine tailings. This would have reduced the effectiveness of the drainage of the dam embankment and caused saturation of the dam body materials. 2. The rapid overloading of these materials made failure and liquefaction conditions possible. 3. The possible influence of low magnitude earthquakes (1.8 to 2.6) that occurred just prior to the collapse.
Ground collapse/landslide		
27/06/2010	Ghana	A gold mine collapsed following heavy rains in Dunkwa-on-Offin. The mine had been abandoned by its owners and was being exploited clandestinely. According to the press, 136 miners were present at the time of the accident: Fifteen were found alive, 32 were dead, and 89 were reported missing. Rescue workers set up pumps to clear the mine entrance, but operations were hampered by bad weather conditions. The 3 owners of the mine were taken into custody.
16/12/2012	France	A slump of an embankment and mud occurred during the weekend of the 15th and 16th of December in a granite quarry. The operator found out about the incident in the press on the 17th. The upper part of the overburden, waste rock, and sludge from the washing of sand and gravel that was stored in the final stockpile collapsed and slid down the side of the stockpile. The materials stopped below, blocking the SULON watercourse for 60 m. The volume of collapsed material was estimated at between 3,800 m³ and 5,700 m³. It covered an area of 1,900 m² with a height of 2 m to 3 m. The inspection body for classified facilities and ONEMA were informed. The cause of the slump appeared to be the loading of overburden earlier in the month onto insufficiently dry sludge used for washing, which was deposited in September. The pasty sludge was crushed by the weight of the upper layers and put pressure on the embankment until it breached.
28/11/2014	France	An orange-coloured mudflow measuring several dozen cubic metres damaged a property and a section of the N86 over an estimated distance of more than 500 m. Only the exterior of the house (terraces, swimming pool, garden) was hit by the mudflow which reached a width of 25 m and a thickness of 2 m. This chaotic incident occurred on the right-of-way of the former pyrite mining operation. This flow resulted from a drift overflowing with rising water and mud. This accumulation was flushed away when the logjam that had formed by the drift's enclosing embankments gave way. It is likely that the very heavy rainfall observed in the previous weeks had put an excessive load on the reservoirs (mining and dolomitic) and a flushing effect took place through the drift. A piston effect caused by ground movements within the underground mine workings and/or within the building may have contributed to the logjam breaking.

Date	Country	Description of the accident
29/07/2019	France	In a quarry, an embankment slid for about ten metres following heavy rains. The slide continued in slow motion for a week. The water that infiltrated the embankment had a negative effect on the mechanical properties of the land. The slide was able to continue. The slide's consequences were limited to the filling in of part of the pool at the bottom of the excavation and to the destruction of an access path to the marl slope. The operator estimated that 70,000 m³ of earth had slid away. This soil came from backfill deposited in the fall of 2018 (40,000 m³) and in July 2019 (30,000 m³). The quantity of soil to be cleaned and managed on site was estimated at 10,000 m³. No other consequences were noted on the stability of natural slopes. A pool containing wild flora (filiform pondweed and hairy buttercup) was destroyed by the slide. The 2018 and 2019 backfill was sitting on top of a pre-2004 marly embankment. This embankment had been exposed to the elements for many years, making it more susceptible to collapse. In addition, the pond at the foot of the slope contributed to the loss of cohesion of the materials at the level of the detachment front. The extra weight of the new backfill, the degradation of the mechanical properties of the base, and the absence of a sound abutment at the foot of the slope contributed to the instability. The heavy rains over the weekend led to ground movement due to water infiltration in the cracks created by the overall settlement. The risk of instability caused by the underlying marl was apparently poorly assessed. The design of the embankment was inadequate in view of this risk. Its base should have been cleaned and the foot of the slope reinforced to ensure that the earth would hold.
03/10/2021	France	Following a 100-year rainfall event, a significant amount of water and waste material from a quarry flowed downhill from the storage area and onto the neighbouring agricultural land. The waste rock did not contain any hazardous or polluting materials. The material on the agricultural land was removed. Activity on this land was not affected. A berm was placed below the storage area to consolidate the foot of the waste rock stockpile. A ditch was dug at the head of the storage area and raised to contain runoff and direct it to the quarry's water management system. The operator commissioned a stability study to identify other risks of slumping and to take measures to avoid any further incidents. Runoff from the waste rock stockpile was not managed by a ditch system. As a result, the runoff flowed into a single point on the waste rock stockpile causing a flow of material below. The root cause of the incident was the lack of runoff management at the waste rock stockpile.
Fires		
06/08/2010	China	At 5 p.m., a fire broke out at the bottom of a gold mine with 329 miners: 279 managed to get out on their own and the rescue services evacuated the remaining miners, except for 7 who were reported missing. The human toll was nevertheless high: 16 deaths or hospitalizations due to asphyxiation in the shaft and several dozen injured. An electric cable may have been the cause of the fire, which was not brought under control until 8:30 a.m. the next day.
25/10/2013	France	In an underground gypsum quarry, a collision between 2 trucks caused a fire at a depth of 110 m, 3 km from the tunnel entrance. Emergency services evacuated 30 employees and transported the 2 injured drivers to hospital. Hindered at 400 m by the smoke front and vehicles left in the tunnels during the evacuation, the fire could not be reached. After consultation with the operator and taking into account the risk linked to the presence of explosives at the bottom of the quarry, it was decided not to proceed with extinguishing the fire. The next morning, emergency services and a quarry expert confirmed the fire was out; the explosives triggering system had been disabled. Activities resumed on Monday morning (October 28).
04/09/2015	France	At approximately 11:30 a.m., in a company manufacturing concrete products, a fire broke out in the area of the scale where materials were being prepared. The fire spread to several idle conveyor belts and to the base of a silo. Firefighters extinguished the fire with 2 hoses. Emergency services evacuated 22 people. The fire caused considerable material damage and 10 employees were placed on technical unemployment. The fire was caused by maintenance work involving welding machines.

Date	Country	Description of the accident
09/07/2017	France	A fire broke out at approximately 4:30 a.m. on an 11 km-long fixed conveyor used to transport ore at a mining facility. The operator's staff detected the fire and extinguished it. A 350 m-long section of a conveyor belt and metal supports were damaged by the fire. The damage was estimated at several hundred thousand euros. The operator proceeded with repairs. Activities resumed 8 days after the fire. The cause of the fire was believed to be malicious intent. A similar fire had already occurred on this fixed conveyor 5 months earlier.
22/11/2017	France	A fire broke out around 6:00 a.m. in the attic of a research building located on the site of a former uranium mine. The alarm was triggered. A security guard alerted the fire department. The building was secured: electrical power was cut off, gas and fluid lines were closed, and activity was stopped. The firefighters extinguished the fire around 7 a.m. with one hose and less than 1 m³ of water. An exhaust fan in the ventilation system was believed to be the cause of the fire. No chemicals or radioactive materials were affected.
01/06/2018	France	At about 11:15 a.m., a fire broke out at a 20,000 V live electrical transformer in a 15 m² room at a sand extraction company. Firefighters protected the company's administration building. The power supply was cut off. The fire was extinguished with foam. Production was stopped. 35 employees were placed on technical unemployment for 4 days.
30/07/2019	France	Shortly after 5 p.m., a fire broke out on a conveyor belt and a sand mixer in a quarry. The part of the plant that was affected was undergoing renovation until the end of August and was being dismantled. Firefighters put out the fire. Material damage and financial losses were limited. The burned material had to be scrapped. Blowtorch cutting was the cause of the fire.
Explosions		
06/04/2011	France	A blast in a solid rock quarry on a mountainside at around 11 a.m. caused 150 m³ of boulders to fall from the cliff located below the quarry; about 30 m of boulder protection fence was torn off and carried down the slope and materials fell onto the RD 907. No casualties were reported. The road was closed to traffic and the authorities evacuated 69 residents (23 families) from 2 hamlets located downstream from the quarry; these residents were relocated to the homes of friends and relatives or to hotels. A prefectorial order suspended the authorization to operate. On April 10, 8 families were authorized to return to their homes. The 15 other families were allowed to come and pick up their belongings, under escort and twice a day, starting on April 11. A network of sirens was set up to alert residents and ask them to evacuate their homes if necessary. The work of scaling and securing the cliff began on April 15 for an estimated duration of one month. According to the press, a "badly measured" blasting was the cause of the accident.
03/09/2014	France	During blasting in a quarry at around 4:30 p.m., the quantity of explosives required was badly estimated and the explosion sent stones flying onto neighbouring houses. No one was injured, but the roofs were damaged, one of which was pierced by a projectile.
21/03/2017	Saint Lucia	Shortly before 5:30 p.m., a container of dynamite exploded in a quarry. The explosion killed 3 people and injured about 20 others. Some of the injured were taken to Martinique for treatment. The site was burned, and the operating machinery was completely destroyed. The explosion was heard for miles around. Some witnesses reported that the walls of the houses shook and that they thought it was an earthquake. Several workers were welding the top of a barrel containing explosives. It is believed that sparks ignited the barrel and caused the disaster.
10/01/2019	France	A blasting accident in a quarry, carried out by a contractor, hurled material more than 400 m from the blasting site. The projected material struck agricultural areas, houses, and the main road bordering the site. Blasting was suspended. The inspection body for classified facilities visited the site 5 days later. It requested a report from the operator on the causes of the incident as well as the identification of the zones to be quarried where the blasting would not lead to material being projected off the site. Material was projected due to a lack of rock thickness around the hole located at a depth of 4 m. Human error while setting up the blast was the cause of the accident.

Date	Country	Description of the accident
06/03/2019	France	Blasting in a quarry carried out by a contractor hurled material more than 350 m from the blasting site. This material pierced a roof and damaged a farm fence. Material was projected due to a lack of rock thickness around the hole. Human error was involved in measuring the profile of the working face and therefore in setting up the blast. Failure to comply with the dimensioning of the working face with respect to height and slope is a breach of the applicable regulations.
10/07/2019	France	Around 11:30 a.m., a blasting operation in a quarry caused stones to be projected onto the access road and into the gardens of 2 residents. The operator warned the town hall, the gendarmerie, as well as the inspection service and went to the homes of the concerned residents. The explosives supplier and a geologist went to the site and determined the probable causes of the incident: the detonation of the first holes had set the rock mass in motion, causing an opening at a fault before the detonation of the subsequent holes. Due to the reduced containment of the holes, the detonation gases were suddenly released into the atmosphere, resulting in a projection in the opposite direction to the one initially planned.
04/10/2019	France	Due to a blasting accident in a quarry during the breakage of solid rock, blocks of stone were projected onto farmland more than 300 m away from the blasting site. This was reported on the following Monday by the farmer who had noticed the resulting impact on that Friday. The company and the mining contractor made an initial visit to the affected areas. Then a second inspection visit was carried out with the inspector of classified facilities. The projected pieces of rock (400 kg) were collected. The company resumed its activities subject to the implementation of the measures proposed by the prefectorial order. The following causes may have been at the root of the accident: 1. blasting charge spread out in a fault; 2. deviation in drilling; 3. destabilization of the rock mass by previous blasts; 4. geometry and orientation of the blast.
28/10/2021	France	While connecting the detonators during a blasting operation in a quarry, a miner noticed that a tube loaded with explosives had descended to more than 3 metres. Since the detonator wires were inaccessible, it was not connected and triggered. The blasting was nevertheless carried out. The hole was faulted and under the weight of the tube load, the tube went down too far.
09/12/2021	France	Around noon, during a blasting operation intended to detach rock from the rock mass in a quarry, a blasting accident occurred with material being projected outside the authorized perimeter. Rocks, including one weighing 20 kg, were projected onto the nearby industrial zone up to 400 m from the blasting site, causing damage to 7 buildings in particular. There were no casualties. On the day of the accident, a site inventory was carried out with all the companies in the industrial zone to provide emergency solutions. The operator contracted a roofer to assess and carry out the repair work. The blasting was carried out in a 20 m-wide zone located between the main excavation of the site and a former excavation, on the side of the industrial zone, which had 23 m high faces. The causes of this accident were, on the one hand, the unsuitable priming method, and on the other hand, the insufficient thickness of the material to be blasted. The first step, upstream of the blasting, consisted in designing the blast and positioning the holes. On this quarry, this step was carried out with a geolaser. After drilling, the thickness of the rock section to be blasted had to be verified. However, this could not be done on the side of the former excavation due to the height of the face. As a result, the small thickness of the section to be blasted was not identified and the explosive charge could not be adjusted, which led to material being projected. As for the initiation sequence, the one chosen for this blast was unsatisfactory, as it should have started on the side of the main excavation of the site and ended on the side of the former excavation. In addition, the delays between rows were too long.

Date	Country	Description of the accident
Floods		
13/09/2015	France	On Friday, September 11, staff at a gold mine received a Météo-France alert announcing a major rainfall episode. The levels in the 10,000 L and 50,000 L effluent storage basins were then lowered. On Saturday, September 12, the rainfall caused a greater than 50-year flood event in MAS D'ALARY. The mine site was flooded. The staff encountered difficulties in accessing the site; the roads were cut off, and the automatic gate at the entrance was out of order. They entered the site at 9:30 p.m. and found that the 10,000-litre basin was 75% full. The 4 pumps were working to return the water to the 50,000 L basin. The lack of ferric chloride caused the pH of the treated water to rise. The safety valve then opened to return the water to the 10,000 L basin, which contributed to it also being filled. To limit this flow, the staff forced the pH safety valve to close. In spite of these interventions, the 10,000 L basin overflowed on Sunday, September 13, at 5:00 a.m., for 49 hours. Untreated water was discharged into the natural environment. The normal uranium content in MAS D'ALARY was 1.6 mg/l. During the flooding, the concentration rose to 3.81 mg/l. With daily monitoring, the return to normal was noted in December 2015. Measurements from the various piezometers around the site did not show any impact on the groundwater. Flooding also damaged the site: 70 m of fence washed away, access gate blocked by logjams, electrical box flooded, culverts for passage under the roadway washed away creating a 15 m subsidence, damage to a safety basin... To restore the site, cleaning, earthworks and riprap construction work were spread out from October 2015 to March 2016. The operator identified 2 causes for this overflow: 1. The inflow of water was too large to be absorbed by the treatment and storage of water in the 50,000 L basin. In fact, the pumping capacity of the water from the 10,000 L basin to the 50,000 L basin was 520 m^3/h, whereas the inflow was 1,000 m^3/h. 2. The lack of ferric chloride; the order had been placed 3 weeks earlier and the delivery was scheduled on September 16.
01/01/2018	France	In a quarry, two flooding episodes occurred due to the severe weather events associated with Storm Eleanor. These lead to discharges into the Savoureuse River. First event (January 2018): the quarry floor was flooded and led to a basin filling up with sludge from the massive gullying, and to the infiltration of water in the oil tank of a crusher. The presence of stones at the bottom of a second pond caused a failure of a pump and the scraper arm of a clarifier. The overfilling of a 3rd basin led to an overflow of unclarified water into the Savoureuse. The operator estimated the volume of the stormwater flow at 37,900 m^3 (with a minimum volume of 36,000 m^3 for the containment zone imposed by a 2016 prefectural decree). Second event (March 2018): the presence of ice on the third pond combined with turbulence generated by the inflow of clarified water led to a discharge of water loaded with suspended solids into the Savoureuse. The inspection body of classified installations noted non-compliances such as the operator's lack of control of the quarry's water discharge. The ponds were not maintained in good working order, which led to non-compliance with the discharge standards for overflow water.
Pollution		
04/06/2014	France	The Office National des Forêts, accompanied by 2 gendarmes, noticed some pollution at the Kokioko Creek where a gold mine was located. The rate of suspended solids was 4,800 times higher than the legally permitted rate. The site's basins were open, allowing the muddy water to flow directly into the creek. The discharge of mud increased the turbidity, which decreased the oxygen level, clogged the soil, asphyxiated the flora, and destroyed natural habitats and biodiversity. Rehabilitation of the site with revegetation should have begun in the dry season, and not in rainy weather, to avoid sludge runoff that would damage aquatic fauna and flora. The operators were brought before the criminal court two years later for these actions. The environmental protection associations are civil parties alongside the France Nature Environnement federation. The prosecutor requested an 80,000-euro penalty.

Date	Country	Description of the accident
04/07/2018	France	A sulphuric acid (H_2SO_4) tank leaked from a flange in a shut-down uranium mine. The 20 m³ of sulphuric acid were contained in the retention tank. It was then pumped out by a specialized company. The retention system had to be renovated. The flange in question had been eaten away by acid. Contrary to what the operator believed, it was not made of stainless steel. The operator replaced the PE tank with another one made of HDPE. The inspection body for classified facilities was informed.
Other		
01/03/2012	France	A geologist examined an outcrop that had been uncovered by the creation of an unshored trench in a gold mine. For an undetermined reason, the ground subsided and the geologist was buried at the bottom of the trench.
15/03/2012	Finland	An employee taking samples near the process plant of a nickel, zinc, cobalt, and copper mine died of hydrogen sulphide (H_2S) asphyxiation. The victim did not have a gas detector or respiratory protection. Atmospheric measurements in the area indicated 50 ppm to 300 ppm of H_2S. An investigation was conducted by the police and the government agency in charge of industrial accidents. The plant was shut down. The H_2S used to purify the solution collected after the bacterial heap leaching of ores leaked outside the plant through a sampling valve left open on a pre-neutralization tank. In this tank, limestone sludge reacted with the effluent already present and formed carbon dioxide (CO_2) which displaced the H_2S already present. No gas detectors were installed outside the buildings, even though high levels of H_2S had been detected in the area of the accident over the previous two weeks. The area had been marked off, but all the personnel who happened to be in the area had not been warned of the danger. In addition, the lack of preventive maintenance made it impossible for the H_2S measurement systems to function properly. It also appeared that the ore purification process was new and that the operator, wanting to obtain an extremely pure final product, used H_2S in excessive quantities.
08/11/2012	France	The raised bed of a truck made contact with a medium voltage power line in a quarry.
06/08/2015	United States	The environmental agency was conducting an engineering study at a former gold mine to assess the mine's water discharges, ways to treat the water, and options for reclaiming the site. As workers excavated above an old access tunnel, pressurized water escaped and spilled into the nearby stream. Approximately 11,500 m³ of coloured water loaded with lead, copper, arsenic, iron, and zinc polluted 160 km of downstream rivers. The authorities prohibited navigation, swimming, watering of farm animals, and consumption of water from certain catchments. Lead and arsenic levels were 12,000 and 26 times higher than acceptable levels respectively.
08/12/2020	France	At around 1:30 p.m., demonstrators tried to break into a cobalt and nickel hydrometallurgical plant. The PPI (emergency response plan) was initiated. Non-essential personnel was evacuated. The site was secured and the installations were shut down according to the emergency procedure. Around 11:30 p.m., 2 days later, the gendarmerie responded after shots were fired. Mining machines were stolen. Various production shutdown scenarios were considered due to the risk of SO_2 and SO_3 release: 1 rapid shutdown of the acid solution plant; 2 shutdown of the acid solution plant within 24 to 48 hours. A cold shutdown was carried out 4 days after the beginning of the incidents. The fusion component restarted. The SO_2 was converted to SO_3 to avoid a corrosion problem and to empty the SO_2 pipeline, thus preventing the risk of pollution in case of malicious acts. The discharge and neutralization plant was reactivated as well as the lime production plant. The access road to the mine was unusable, concrete blocks prevented access to the mine site, and 80% of the heavy machinery was immobilized. Around 2 a.m., 7 days after the event had started, a major fire broke out on the mine site, affecting technical facilities and numerous vehicles. After the site was secured by the police, the plant's security teams began fighting the fire. Most of the extinguishing water was collected in a special retention basin. Following the numerous rains of the previous days, the retention basin, which was already quite full, overflowed at the end of the night before daybreak. Firefighters left the site 19 days later. A technical facility, numerous vehicles, and containers with 2 m³-3 m³ of coolant and 10 m³ of engine oil were destroyed. An oil spill was detected on the KWE due to the overflow of the retention basin. The protests were sparked by the sale of the site to a consortium.

Date	Country	Description of the accident
17/11/2021	France	Upon leaving a quarry, a transporter's truck was overloaded with aggregates. It returned to the facility platform after being tipped to lighten its load and respect the maximum total weight allowed. During the unloading, the flexible hose that allowed the automatic opening of the bed's tailgate broke, causing a hydraulic oil spill on the facility platform, at the foot of the stocks. The truck driver closed the tailgate, which stopped the hydraulic leak by cutting off the oil supply to the hydraulic cylinder. At the same time, the site's machine operator alerted the site manager and set up a berm to contain the leak. An employee covered the affected area with diatomaceous earth to absorb the oil and stop its spread. The area was secured and marked to prevent the passage of machinery and trucks. The affected area was progressively excavated over a distance of about ten centimetres using a loader. The soiled materials were put in large bags before being evacuated by a specialized company. In total, about 15 tonnes of material were evacuated by the specialized company. The cause of the breakage was believed to be normal wear and tear on the truck.

The accidents were classified by type: dike breach, collapse/landslide, fire, explosion, flooding, pollution, and others.

Among the recorded accidents related to extractive activities, the most relevant to the project were selected and classified by type of event, i.e., dike breaches, collapses/landslides, discharge of contaminated water to the environment, fires, explosions, and others. Although the examples presented from around the world involve contexts that may differ from the Windfall project's, it is important to learn from them in order to prevent risks that could also be encountered at the Windfall site.

12.5 POTENTIAL ACCIDENT RISKS

The identification of hazards related to the site's activities and the historical records of accidents have led to the development of the following potential accident scenarios:

- hazardous materials spill;
- mine tailings spill;
- fire/explosion;
- release of toxic gas;
- explosion of explosive material;
- release of nitrogen oxide;
- discharge not environmentally compliant (liquid effluent);
- discharge not environmentally compliant (air effluent);
- breach of a retention structure;
- subsidence of an accumulation area;
- underground subsidence;
- underground mine flooding;
- forest fire.

12.5.1 HAZARDOUS MATERIALS SPILL

12.5.1.1 CHEMICAL SPILLS

POTENTIAL CAUSES

An accident involving hazardous materials on the site's road network may be caused by a spill from a tank truck containing chemicals. Such accidents could occur as a result of the driver losing control of the vehicle due to bad weather conditions, human error or discomfort, as well as due to a collision with another vehicle on the site or with an animal.

Accidental spills of chemicals can also occur during their use, handling, or storage. Equipment failure or human error can also be the cause of a chemical spill.

POTENTIAL CONSEQUENCES

An accidental chemical spill could contaminate the soil at the spill site. The impact of a potential spill will depend, among other things, on the volume of contaminants spilled, the one-time occurrence (spill), or the recurrence (leak) of the problem.

In the case of a land-based spill, some of the product will seep into the soil until it encounters an impermeable layer or a water-saturated zone such as an aquifer. In winter, it will remain on the surface since the ground is frozen. The ratio of runoff to infiltration depends on the permeability of the soil and the characteristics of the spilled product. Some components of the spilled product may eventually volatilize into the air. Upon contact with groundwater, some of the product is also likely to solubilize.

The extent of the impact of a land-based spill will depend on the time of year, weather conditions, the characteristics of the spilled product, the quantity spilled, and the penetration depth of the product into the soil, among other factors.

Depending on the conditions of the spill (location, quantity), a portion of the spilled chemicals could migrate by runoff or seepage and reach the groundwater. The environments likely to be impacted would be the water environment as well as benthic and ichthyological fauna and their habitats. The chemicals used are mostly water soluble and will be quickly diluted. In all cases, an alteration of the water quality is expected, which includes soil contamination.

In addition, spills of certain products (such as sulphur dioxide, hydrochloric acid, etc.) are likely to cause the formation of a toxic cloud (section 12.5.4).

PREVENTIVE AND CONTROL MEASURES

STORAGE AND HANDLING

Chemicals will be used in accordance with supplier guidelines and applicable regulations. When handling chemicals, appropriate personal protective equipment (e.g., safety glasses or goggles, chemical-resistant gloves [neoprene, butyl rubber, rubber, or leather], and appropriate protective clothing [e.g., face shield]) must be worn. Equipment to be used in critical areas will be indicated by signs. They will also be defined in advance in an occupational health and safety program. The use of a respirator approved by the National Institute for Occupational Safety and Health (NIOSH) may also be required to reduce worker exposure to dust and/or fumes when handling certain chemicals.

Storage will be in accordance with compatible product classes as defined by the Workplace Hazardous Materials Information System (WHMIS), the National Fire Code of Canada (NFC), and the Regulation respecting hazardous materials.

All used chemicals that cannot be reused will be stored for up to one year in accordance with the Regulation respecting hazardous materials. Spent hazardous materials will be recovered by companies authorized to recover the products concerned. Safe collection areas with specialized containers for categorized waste and used hazardous materials will be provided at appropriate locations depending on the production site. These temporary storage areas will be inspected on a regular basis and their operating procedures will be made clear to employees to avoid mixing errors or container overflows.

The indoor tanks (sulphuric acid, sodium cyanide, caustic soda, sulphur dioxide) will be equipped with retention basins. They will be equipped with instrumentation to detect changes in the level of stored liquids. An operator will be present to supervise the unloading of these products to reduce the risk of spills. A work procedure will be developed and communicated to the operators.

TRANSPORT

It is currently planned that chemicals will be transported to the site by truck. Transportation procedures will then comply with the Transportation of Dangerous Substances Regulation and the Transportation of dangerous substances guide (Direction générale de la sécurité et du camionnage, 2019). Hazardous materials will be placed in compliant, leak-proof containers to limit the risk of a spill should they be tipped over by the transporter.

TRAINING

Employees responsible for handling and transporting hazardous materials will have received specific training on the handling and hazards involved, such as Transportation of Dangerous Substances, WHMIS, or other training appropriate to the task. Employees must be familiar with the information contained in the material safety data sheets of the hazardous products used.

EMERGENCY RESPONSE EQUIPMENT

Spill kits specific to the nature and quantity of the substances will be strategically placed on the site (storage and refuelling areas). The contents of these kits will be checked periodically.

EMERGENCY RESPONSE PLAN

A preliminary emergency response plan has been developed and will be reviewed prior to the start of construction. It includes a hazardous materials spill response procedure.

12.5.1.2 SPILLS OF PETROLEUM PRODUCTS

POTENTIAL CAUSES

Factors that may cause accidental spills of petroleum products are:

- accidents during surface or underground transportation (loss of control, collision between vehicles, etc.);
- overflowing tanks or other containers during filling;
- leaks from valves or connections;
- collisions causing fuel tank breakage (vehicle, machinery, or other);
- machinery breakdowns.

Corrosion of equipment, breakdowns, or human errors can cause diesel spills.

POTENTIAL CONSEQUENCES

The site's fuel farm will be located midway between the process plant and the filtration, backfill, and water treatment plants, and directly east of Pond 1.

An accidental spill of petroleum products could potentially contaminate soils at the spill site with hydrocarbons (MAH, PAH, PH C_{10}-C_{50}[2]). The impact of a potential spill will depend, among other things, on the volume of contaminants spilled, the one-time occurrence (spill), or the recurrence (leak) of the problem. For example, depending on the conditions of the spill, some of the spilled petroleum product could migrate by runoff or seepage to a water body or reach groundwater. If it were to reach a water body, it would have negative impacts on water quality, the biological components of the water body, and the uses of the water body. It should be noted that Pond 1 is a fish habitat. Therefore, it will have to be protected in case of a spill in the fuel farm area.

Ultimately, the spill of petroleum products such as diesel could lead to the ignition of the slick and start a fire. The consequences are described in section 12.5.3.

PREVENTIVE AND CONTROL MEASURES

It should be noted that underground equipment will preferably be electric, limiting the use of underground petroleum products as much as possible.

STORAGE AND HANDLING

To minimize the impact of petroleum product spills, the transfer and storage areas will be laid out in accordance with the specifications set out in the Building Act (Building Code and Safety Code, petroleum products section) and managed in accordance with the requirements of the chapter on petroleum equipment of the Safety Code (Building Act, r.3).

All tanks will be double-walled and equipped with level and pressure monitoring sensors and a console for measurement readings.

Secondary containment for aboveground tanks will be of sufficient capacity to hold 110% of the stored volume.

During operations, refuelling of machinery will be carried out exclusively at designated locations and will be done by trucks. Some sites, such as the underground mechanical garage, will be equipped with oil-water separators to contain accidental spills. At the gasoline and diesel dispensing stations, a reinforced concrete slab will be installed to accommodate trucks during filling and to facilitate clean-up in the event of a spill.

Petroleum product tanks will be installed away from water bodies to limit the risk of surface water contamination. The nearest water body is Pond 1 at a distance of approximately 75 m.

Permits and tank registrations with the RBQ will be kept up to date.

Petroleum products will be handled in accordance with the Regulation respecting occupational health and safety (RSST), the National Fire Protection Association Flammable and Combustible Liquid Code (NFPA 30), and the NFC.

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2 MAH: Monocyclic aromatic hydrocarbons
PAH: Polycyclic aromatic hydrocarbons
PH C_{10}-C_{50}: Petroleum hydrocarbons C_{10}-C_{50}

TRANSPORT

Petroleum products required for vehicle refuelling are currently planned to be transported to the site by truck. Transportation procedures will then comply with the Transportation of Dangerous Substances Regulation and the Transportation of dangerous substances guide (Direction générale de la sécurité et du camionnage, 2019). The company in charge of supply will have safety and emergency procedures in line with best practices in the field.

Should an accidental spill of diesel or gasoline occur during transportation or transshipment, the supplier and Osisko will ensure that emergency procedures are in place.

INSPECTION AND MAINTENANCE

Periodic inspections will be performed on all systems: containment basins, tanks, pipelines, dispensing stations, and transshipment and storage system valves. Machinery will also be inspected and maintained periodically.

TRAINING

All individuals required to participate in the refuelling of vehicles will be trained and advised of the hazards associated with the task. In addition, all control and emergency procedures will be provided.

EMERGENCY RESPONSE EQUIPMENT

Spill kits will be placed at locations where vehicles are likely to be refuelled on site. The contents of these kits will be checked periodically. The kits may contain clean soil, sand, absorbent materials, and other equipment depending on the potential hazard. If required, a storage area for hydrocarbon-contaminated soils will be provided for their subsequent disposal or treatment at an authorized centre.

EMERGENCY RESPONSE PLAN

A preliminary emergency response plan has been developed and will be reviewed prior to the start of the construction phase. It includes a hazardous materials spill response procedure.

12.5.1.3 OIL AND GREASE SPILLS

POTENTIAL CAUSES

Hydraulic oil or lubricating grease spills could occur as a result of equipment and machinery failure or mishandling.

POTENTIAL CONSEQUENCES

Such a spill could potentially contaminate soil at the spill location with hydrocarbons (PAH, PH C_{10}-C_{50}[3]).

3 MAH: Monocyclic aromatic hydrocarbons
PAH: Polycyclic aromatic hydrocarbons
PH C_{10}-C_{50}: Petroleum hydrocarbons C_{10}-C_{50}

PREVENTIVE AND CONTROL MEASURES

The following preventive and mitigation measures will be implemented:

- environmental protection and awareness training for workers;
- preventive maintenance of equipment to prevent breakage and premature wear;
- maintenance of an up-to-date ERP including a spill response procedure.

12.5.1.4 DIELECTRIC OIL SPILL

POTENTIAL CAUSES

Spillage of dielectric oil contained in transformers could be caused by corrosion of equipment, breakdown, or human error. Lightning could also be the cause.

POTENTIAL CONSEQUENCES

Dielectric oil spills could lead to contamination of surface water, groundwater, and soil. A fire could also ensue.

Ultimately, a dielectric oil spill could lead to the ignition of the slick and start a fire. The consequences are described in section 12.5.3.

PREVENTIVE AND CONTROL MEASURES

The following preventive and mitigation measures will be implemented:

- preventive maintenance of transformers and related equipment to prevent breakage and premature wear;
- use of a biodegradable dielectric ester fluid (*Synthetic Ester Transformer Fluid*) in the process plant transformer. This type of fluid has a high flash point (see data sheet for MIDEL 7131);
- presence of emergency generators at the electrical substation, the process plant, the WTP, and the workers' camp;
- maintaining an up-to-date ERP including a spill response procedure.

12.5.2 TAILINGS SPILLS

POTENTIAL CAUSES

Tailings spills could occur as a result of breakage or mishandling of the tailings transport lines between the process plant and the filtration/paste backfill plant or the surface WTP. Potential causes could be the collision of a vehicle with a pipe.

Tailings spills could also occur when tailings are transported on roads to the tailings storage facility. An accident could occur as a result of the driver losing control of the vehicle due to bad weather conditions, human error or discomfort, as well as a collision with another vehicle operating on the site.

POTENTIAL CONSEQUENCES

Characterization of the tailings showed a potential for acid generation, metal leaching, and the potential presence of residual traces of cyanide in the tailings pore water.

The spill could lead to contamination of surface water, groundwater, and soil, depending on the location of the spill. Tailings could reach a watercourse, alter water and sediment quality, and impact the biological environment. The anticipated impacts on the natural environment will be confined to the location of the spill. Since the tailings are solid, they will only spread if they reach a watercourse, in which case they will tend to settle to the bottom.

PREVENTIVE AND CONTROL MEASURES

The following preventive and mitigation measures will be implemented:

- installation of instrumentation to display any flow and pressure anomalies in the pumps and pipes;
- installation of pipes on a geomembrane in a protective berm;
- establishment of a regular inspection program for the equipment concerned;
- maintaining an up-to-date ERP that includes a response procedure in the event of a tailings transport pipe breakage.

12.5.3 FIRES/ EXPLOSIONS

POTENTIAL CAUSES

The primary fire hazard is related to operations involving flammable materials (e.g., propane, petroleum products, etc.). Fires are therefore more likely to occur at fuel storage areas and dispensing stations, at propane distribution lines, or in oil and grease storage areas.

Fire hazards arise when the concentration of flammable vapours reaches a level between the lower and upper flammable limits in ambient air, and in the presence of an ignition source.

There can be many causes for a fire at the Windfall project site. These include:

- petroleum product spills;
- major propane leaks;
- mechanical breakdowns;
- overheating of rubber;
- human error.

Transformer fires could also occur. Potential causes are contaminated transformer oil, short circuits, and overheating.

The use of faulty equipment or auxiliary heating systems can also cause fires. Fires can also occur due to electrical faults or negligence in hot work (e.g., welding).

As for explosions, they can occur when a petroleum product tank is exposed to high temperatures, for example during a fire, or when the explosive limits of propane are reached following a leak.

POTENTIAL CONSEQUENCES

In general, the consequences of a fire are primarily health effects associated with thermal radiation and toxic fumes. There can also be economic losses (shutdown of operations, significant damage to expensive equipment, etc.) as well as contamination of surface water, groundwater, and soil by extinguishing water runoff.

An uncontrolled fire can lead to an explosion. The consequences of an accidental explosion are the propagation of an overpressure wave in the air and the projection of fragments. The associated impact distances are difficult to assess as they depend on the topography, obstacles, buildings, and passive protective measures, such as a retention pond, as well as the amount of explosive substances involved. In fact, the impact may vary depending on the locations affected and the size of the explosion. An accidental explosion would likely result in a one-time impact around the affected site. However, this may present a high level of risk to workers.

The consequences of an accidental explosion are the propagation of an overpressure wave in the air and the projection of fragments. The associated impact distances are difficult to assess, as they depend on the topography, obstacles, buildings as well as the amount of explosive substances involved.

Since propane is a substance listed in the MELCCFP Guide as well as in Schedule 1 of the EER and the quantity stored on the site exceeds the thresholds, the consequences in terms of thermal radiation (fire) and overpressure (explosion) were quantified through modelling. Impact distances are presented in section 12.6.4.

PREVENTIVE AND CONTROL MEASURES

To reduce the risk of fire and/or explosion, various measures are planned, such as:

- design of transfer sites, equipment, and tanks in accordance with the requirements of applicable regulations and standards as well as best industry practices;
- preventive maintenance of tanks and related equipment to prevent premature wear;
- protective bollards around propane tanks;
- the tanks in the fuel farm will be surrounded by devices to protect them from potential collisions with vehicles in the area;
- propane tanks connected to infrastructure by buried pipelines;
- installation, layout, and management of tanks in accordance with federal (EER) and provincial (RMD) regulatory requirements;
- installation of signs at locations where flammable products are stored or used to inform workers of the precautions to be taken when using these products or when working near them;
- installation of smoke and heat detectors;
- installation of fire protection systems in buildings (fire extinguishers and automatic sprinkler systems), in compliance with the various applicable standards and codes;

- installation of a fire protection network around the site to include all infrastructure. The protection system will include a sprinkler system;
- Accessibility to portable fire extinguishers appropriate to the types of fires that may occur, in all locations where a fire is likely to occur; all fire prevention systems will comply with NFC and NFPA requirements;
- fire fighting equipment in vehicles;
- inspection program for fuel, flammable liquid, and combustibles storage areas;
- preventive maintenance of transformers and related equipment to prevent breakage and premature wear;
- firewall and retention pond for transformers containing a dielectric fluid;
- refuge stations near the work sites that comply with the requirements of the Regulation respecting occupational health and safety in mines;
- maintenance of an up-to-date ERP that includes a fire response procedure as well as an underground evacuation procedure;
- maintenance of an ERP including a fire and explosion response procedure.

12.5.4 RELEASE OF TOXIC GAS

POTENTIAL CAUSES

The toxic gases likely to be emitted are primarily sulphur dioxide, hydrogen cyanide, and hydrogen chloride.

A release of toxic gas could occur, in particular, at the:

- sodium hydroxide tank;
- sodium cyanide mixing tanks;
- hydrochloric acid tanks;
- distribution lines.

Factors that could cause a leak or release of gas include:

- equipment or pipe failure;
- a malfunction;
- uncontrolled chemical reaction;
- human error;
- fire.

POTENTIAL CONSEQUENCES

The consequences of a leak or release of toxic gas depend on the gas, the quantity released, and the pressure of the leak.

Hydrogen cyanide gas is highly flammable. It can form explosive mixtures with air. The release of hydrogen cyanide could cause an explosion and endanger the lives of people nearby.

Hydrogen chloride is a colourless, suffocating gas that smokes when exposed to moist air. Anhydrous hydrogen chloride is a non-flammable, non-explosive compound. However, in the presence of moisture, it is corrosive to almost all metals and the reaction releases hydrogen, a highly flammable and explosive gas.

Since sulphur dioxide is a substance listed in Schedule 1 of the EER and the amount stored on the site exceeds the EER threshold, the toxic effects were quantified through modelling. Impact distances are presented in section 12.6.4.

Since sulphur dioxide is a substance listed in the MELCCFP Guide and in Appendix 1 of the EER and the quantity stored on the site exceeds the thresholds, toxic emissions were quantified through modelling. Impact distances are presented in section 12.6.4.

PREVENTIVE AND CONTROL MEASURES

To reduce the risk of release of flammable and toxic gases, various measures are planned, such as:

- establishment of an inspection and maintenance program for equipment;
- development of specific work procedures;
- installation of gas detectors in the most at-risk areas;
- implementation of safety measures to prevent leaks (buildings for valves, double-walled tank within an enclosure);
- maintenance of an up-to-date ERP including a gas leak response procedure.

12.5.5 EXPLOSION OF EXPLOSIVE MATERIAL

SURFACE EXPLOSIONS

POTENTIAL CAUSES

A surface explosion could occur during the transportation of explosive materials. It should be noted that, as previously mentioned, explosive materials will not be stored on the surface.

POTENTIAL CONSEQUENCES

The consequences of an accidental explosion are the propagation of an overpressure wave in the air and the projection of fragments. The associated impact distances are difficult to assess as they depend on the topography, obstacles, buildings as well as the amount of explosive substances involved. In fact, the impact may vary depending on the locations affected and the size of the explosion. An accidental explosion would likely result in a one-time impact around the affected site.

PREVENTIVE AND CONTROL MEASURES

The explosives used will be packaged Senatel Pyromex emulsions and unpackaged Subtek Eclipse emulsions, chemically sensitized and specifically designed to moderate blasting in underground mines.

The delivery of explosives will be carried out by the specialized contractor in accordance with the regulations of the Commission des normes, de l'équité, de la santé et de la sécurité du travail (CNESST) and the specifications of the Transportation of Dangerous Substances Regulation (CQLR, c. C-24.2, r. 43). Vehicles used to transport explosive agents will be marked for this purpose and individuals handling the explosives will have the required training and skills.

Explosives and detonators must be delivered separately, in accordance with Osisko's internal procedure for the transportation of explosives (STY-RSK-STD-063):

- The transporter of explosives arriving at the site must check in at the gatehouse and wait there until the unloading crew is ready to receive him.
- A security perimeter must be set up at the unloading site and the transporter must proceed straight to the site.
- The crew must proceed quickly with the unloading. The loader operator must place the pallets of explosives in a safe location in full view of any observers. The loader must be equipped with a Plexiglas module or other metal-free material.
- The transporter may then leave the premises.
- The explosives supervisor must secure the explosives with red tape and keep them in sight.
- The explosives should be moved to the temporary or main underground storage facility without delay.

UNDERGROUND EXPLOSIONS

POTENTIAL CAUSES

Fire in a magazine, mishandling of explosives, or impact of debris on explosives storage could lead to an underground explosion.

POTENTIAL CONSEQUENCES

An uncontrolled explosion could result in the projection of debris and significant air displacement in the mine workings, causing injury and/or loss of life and significant property damage.

PREVENTIVE AND CONTROL MEASURES

The storage of explosives and detonators is governed by an internal procedure (STY-RSK-STD-062) which follows legal requirements, such as those pertaining to the distances to be respected between detonators and explosives and to the method of disposal of explosives packaging.

STORAGE

Management of the explosives storage facilities will be the responsibility of Osisko. It will ensure that:

- Storage arrangements (location, distance, size, etc.) will comply with relevant provincial and federal provisions, including the Regulation respecting hazardous materials (RMD), the Explosives Regulatory Division's Quantity Distance Principles, as well as the Guidelines for Bulk Explosives Facilities (Natural Resources Canada, 2014).

— The storage areas will comply with the requirements of Division X of the Regulation respecting occupational health and safety in mines (CQLR, chapter S-2.1, r. 14) and will be located more than 60 m from the shaft, stations, emergency exits, refuge stations, and any potential source of fire, in addition to being equipped with ventilation and a fire protection system.
— The storage facilities shall be secured to prevent unauthorized personnel from entering and shall comply with provincial and federal explosives legislation (R.S.Q., c. E-22 and R.S.C., 1985, c. E-17) regarding construction standards, safe distances from service buildings, safeguards, and well-ventilated and moisture-free areas. All products used will be clearly identified.
— Products stored together will be compatible (e.g., detonators will be stored separately from explosives).
— No-smoking signs will be posted within the blasting area.

USE

To prevent any negligence or error, the transportation of explosives will be entrusted to an approved supplier specializing in this field. Osisko will ensure that its employees comply with all requirements for the handling and use of explosives. All handling of explosives will comply with the Regulation respecting occupational health and safety in mines. To avoid any risk of sudden explosion, personnel will follow the manufacturer's instructions when handling explosives and when loading them into the drill holes. Finally, since explosives can explode when in close proximity to a fire, all sources of heat and open flame, as well as other pyrotechnic or flammable substances, shall be kept away from explosives at all times. Signs for employees and contractors will be posted at locations where explosives are used, indicating precautions to be taken, conditions of use, and all other relevant product information.

The various components of the explosives will be stored and delivered separately from the detonators, thus minimizing the risk of an accidental explosion. The detonators will only be installed once they are returned to the loading site. Osisko or the designated contractors will ensure quality control and calibration of the equipment, the proper storage of explosives, and the proper functioning of the security and alarm systems.

Finally, a rigorous management of the blasting activities and the blasting plan will be carried out to reduce the risks of hazardous gas emission during faulty blasts. Any abnormalities will be recorded and analyzed to prevent them from recurring.

12.5.6 NITROGEN OXIDE EMISSIONS

POTENTIAL CAUSES

The use of ammonium nitrate in explosives is accompanied by the emission of gases, namely carbon dioxide (CO_2), nitrogen (N_2), hydrogen (H_2), nitrogen oxides (NOx), sulphur dioxide (SO_2), and carbon monoxide (CO). Under normal operating conditions during blasting, none of these gases pose a health risk to workers or the public. However, nitrogen oxide fumes from burning explosives or ammonium nitrate are extremely toxic. These types of fumes can result from a failed blast. Their colour varies from light brown at low concentrations to dark orange brown at high concentrations and high temperatures.

POTENTIAL CONSEQUENCES

Nitrogen oxide vapours pose a real risk to workers on the site. The odour of nitrogen dioxide can be detected at concentrations ranging from 0.1 ppm to 5 ppm. The vapours are irritating and corrosive to the eyes and respiratory tract. The severity of symptoms may vary depending on the conditions of exposure (concentration of the product, duration of contact, etc.).

PREVENTIVE AND CONTROL MEASURES

To prevent any negligence or error, the handling and use of explosives shall be entrusted to an approved supplier specializing in this field.

Osisko will ensure that it complies with all requirements for the handling and use of explosives.

All handling of explosives will be in accordance with the Regulation respecting occupational health and safety (RSST). To avoid the risk of a sudden explosion, personnel should avoid shocks, friction, and anything that could cause a spark. Finally, since explosives can explode when near a fire source, all sources of heat and open flame, as well as other pyrotechnic or flammable substances, should be removed before recovery of the dispersed material begins. Signs for employees and contractors will be posted at locations where explosives are used, indicating precautions to be taken, conditions of use, and all other relevant product information.

In addition, several measures will be put in place to reduce the risk of accidents during the manufacture of explosives in emulsion form. The various components of the explosives will be stored and delivered separately from the detonators, thus minimizing the risk of an accidental explosion. The detonators will not be installed until they are in the blasting area. The supplier must ensure the quality control and calibration of the equipment, the proper storage of the emulsion, and the proper functioning of the security and alarm systems. Finally, the supplier must also ensure the quality of the explosive emulsion.

A rigorous management of the blasting activities will be carried out to reduce the risks of hazardous gas emission during faulty blasting. Any abnormalities will be recorded and analyzed to prevent them from recurring. Any major accident involving nitrogen oxide vapours will require evacuation.

12.5.7 DISCHARGE OF NON-COMPLIANT WATER

POTENTIAL CAUSES

Malfunction of the water treatment system could result in the accidental release of harmful substances into the site’s final effluent. Potential causes may include:

- water treatment system malfunction (existing treatment system or final effluent treatment system);
- monitoring equipment failure or damage;
- design, operational, or human error.

POTENTIAL CONSEQUENCES

Discharge of untreated or partially treated contact water or water from mine dewatering could contaminate surface waters (watercourses and water bodies) in violation of the Metal and Diamond Mining Effluent Regulations (MDMER) and Directive 019 pertaining to the mining industry.

In addition, the release of environmentally harmful substances could result in impacts to wildlife and/or plant species in an area extending beyond the site.

The discharge of raw effluent (without treatment) could potentially have an impact on the water quality of Pond 1 and Lake SN3. Lake SN3 contains fish while Pond 1 is a fish habitat.

Potential effects on the benthic community would be linked to a contamination that could lead to an increase in mortality, a decrease in benthic abundance and diversity, as well as a decrease in recruitment (eggs and larvae), food consumption, and growth rate.

Fish can ingest highly toxic substances and pass them on to predators that feed on them. Discharge of untreated raw water into the aquatic environment can affect the health of fish communities. Generally, fish populations may be affected by a discharge at different times of the year if their habitat or prey are affected with respect to spawning, nursery, feeding, migration, and overwintering.

Fish with the ability to move through their habitat and, therefore, able to potentially move to less contaminant-exposed areas during a spill, are less likely to experience the effects of such an event, the exception being during spawning and egg incubation periods.

PREVENTIVE AND CONTROL MEASURES

The following preventive and mitigation measures will be implemented:

- Flow and pressure measurements to detect any flow anomalies at the pumping and treatment facilities at the final effluent discharge point.
- Continuous measurement of environmental discharge standards (continuous for pH and flow) as required by Directive 019 and the MDMER.
- In the event of non-compliance, the water will be recirculated upstream of the treatment facility to avoid discharge of substandard water to the final effluent or to any other location not authorized by the MELCCFP.
- The final effluent is pumped; therefore, it will be possible to stop pumping in the event of a WTP failure.

12.5.8 DISCHARGE OF NON-COMPLIANT AIR EMISSIONS

POTENTIAL CAUSES

Dust and other airborne contaminant emissions and exposures could occur during facility operations. The following events could result in the accidental release of harmful substances to the atmosphere:

- malfunction of an air-handling system (e.g., dust collector, wet scrubber) due to design or operational error, human error, breakdown, etc.;

— failure or damage to tracking equipment.

POTENTIAL CONSEQUENCES

Discharge without treatment or with partial treatment of the air could contaminate the ambient air on site and thus contravene the Clean Air Regulation (CAR) and potentially have an impact on human health and life. The products likely to be emitted from the process plant and tailings filtration plant are mainly dust, as well as copper sulphate, lead nitrate, and hydrogen chloride, as mentioned in Chapter 3.

PREVENTIVE AND CONTROL MEASURES

The following preventive and mitigation measures will be implemented:

— Establishing a regular inspection program for air-handling systems.

— Measurements to be taken every three years to meet the air discharge standards established by the CAR.

— Ducted dust extraction system.

— Water spraying of roads.

12.5.9 BREACH OF A RETENTION STRUCTURE

POTENTIAL CAUSES

Breach of one of the water retention structures (ponds) could be caused by:

— a flaw, failure, or weakness in the design, construction, or material of the dike;

— an extreme natural event such as a major earthquake, an exceptional flood, or a landslide;

— human error: operating error, inadequate monitoring or maintenance, etc.;

— aging of the structure.

POTENTIAL CONSEQUENCES

Failure of a dike surrounding one of the retention ponds (section 12.3.2) could cause significant property damage and release contaminants (e.g., TSS, leachate, debris, etc.) into the soil and nearby watercourses and water bodies in violation of the MDMER and Directive 019.

PREVENTIVE AND CONTROL MEASURES

The following preventive and mitigation measures will be implemented:

— geotechnical and hydrogeological studies including dike stability;

— third party design of the dikes;

— consideration of local seismic data in dike design;

— establishment of an inspection and maintenance program for the retention structures;

— establishment of a water management plan;

- depending on the level of significance of the structures, a risk analysis of the dike failure and potential consequences;
- maintenance of an up-to-date ERP including a dike failure response procedure;
- design criteria for retention ponds that meet those stipulated in D019 with respect to design floods, freeboard, and emergency spillways.

12.5.10 SUBSIDENCE (TAILINGS OR STOCKPILE)

POTENTIAL CAUSES

Accumulation areas will be developed to the east and west of the ore processing area. These include a waste rock stockpile, an ore stockpile, an overburden stockpile, and the tailings storage facility (Map 12-1). The instability of stockpiles can be caused by errors and omissions in their design .

POTENTIAL CONSEQUENCES

Instability of the slopes of the stockpiles could lead to the collapse (sliding) of materials outside the containment zone. The collapse of a stockpile could result in injury or loss of life as well as significant property damage. However, the presence of workers at the time of the collapse would increase the severity of the incident. Such an incident could also have consequences on the watercourses and water bodies possibly affected.

PREVENTIVE AND CONTROL MEASURES

The following preventive and mitigation measures will be implemented:

- installation of geotechnical monitoring instruments;
- geotechnical characterization of loose materials and backfill;
- hydrogeological and geotechnical studies;
- analysis of slope stability;
- establishment of a monitoring program.

12.5.11 UNDERGROUND SUBSIDENCE

POTENTIAL CAUSES

Subsidence and/or cave-ins could occur in the underground drifts. Potential causes could be:

- unsuitable mining method;
- design defect in the supporting elements;
- damage to the rock mass;
- seepage;
- earthquake.

POTENTIAL CONSEQUENCES

The collapse of rock in an underground mine could result in injury or loss of life as well as significant property damage.

PREVENTIVE AND CONTROL MEASURES

The following preventive and mitigation measures will be implemented:

- geotechnical characterization of the lithologies found on the site to define the proper design criteria required to ensure the stability of the drifts;
- Closure of areas at risk of subsidence or collapse.

12.5.12 UNDERGROUND MINE FLOODING

POTENTIAL CAUSES

Water infiltration is an inherent hazard in mining operations. In an underground mine, fractures in the rock connected to water tables above the excavation could lead to flooding.

POTENTIAL CONSEQUENCES

Water infiltration into underground drifts could result in property damage as well as a shutdown of operations in the affected areas.

PREVENTIVE AND CONTROL MEASURES

The following preventive and mitigation measures will be implemented:

- redundant water evacuation pumps;
- operating procedures;
- temporary shutdown of underground operations in the event of a hazardous situation and evacuation of personnel from the underground mine.

12.5.13 FOREST FIRES

POTENTIAL CAUSES

Forest fires can result from human activity, but the most common cause is lightning. Conditions conducive to forest fires are closely related to dry soil conditions, which are in turn related to high temperatures and lack of precipitation over prolonged periods.

POTENTIAL CONSEQUENCES

The magnitude of the consequences of a forest fire scenario depends on the cause of the event, the location of the fire, and the time of year; the ultimate consequences are therefore difficult to predict and quantify. In addition to the devastation that a fire directly affecting mine infrastructure can have (see section 12.5.3), forest fires occurring in close proximity to the site can also cause traffic difficulties in the affected area. Loss of access due to deteriorating roads can result in the area becoming totally isolated. When traffic on access roads is compromised, evacuation capacity can be quickly affected which, in the case of an emergency, creates health and safety risks for on-site personnel.

In addition, forest fires can have impacts on the social and natural environment of the territory, particularly through the degradation of air quality due to increased concentrations of toxic smoke in the lower atmosphere and the destruction of natural habitats due to the fire's propagation through the area's vegetation (either on the ground or in the air through the fallout of ashes).

PREVENTIVE AND CONTROL MEASURES

The following preventive and mitigation measures will be in place to reduce losses associated with the potential occurrence of a forest fire:

- brush clearing of the site;
- periodic consultation of fire hazards provided by SOPFEU;
- a water reserve for fire protection;
- formation of a response team;
- maintenance of an up-to-date emergency response plan including a forest fire response procedure and an evacuation procedure for the site.

12.6 QUANTITATIVE ASSESSMENT OF CONSEQUENCES

12.6.1 MATERIALS SELECTED FOR ASSESSMENT OF THE CONSEQUENCES

As part of the risk analysis of major technological accidents associated with the Windfall project, a modelling of the consequences of propane and sulphur dioxide (SO_2) was carried out. These are the products that will be present on the site during the mine's operations phase in quantities above the EER thresholds.

12.6.2 SOFTWARE USED AND METHODOLOGY

The PHAST (Process Hazard Analysis Software Tool) model, version 7.2, was used to perform the sulphur dioxide and propane consequence modelling. The methodology and parameters used for the modelling are described in section 2 of the modelling report included in Appendix 12-1.

FLAMMABILITY RANGE

The emission of propane is a fire or explosion hazard under the following conditions:

- presence of a flammable substance (propane);
- presence of an oxidizer (oxygen/air);
- presence of an ignition source (spark/high heat).

The flammable or explosive range is defined by the lower flammability limit (LFL) and the upper flammability limit (UFL). Flammable vapour concentrations for propane are listed below. At concentrations below the LFL of propane (2.1%), the mixture is too weak to burn and at concentrations above the UFL of propane (9.5%), the mixture is too rich to burn.

OVERPRESSURE EFFECT

The overpressure levels normally evaluated to determine the consequences of an explosion accident are shown in Table 12-2.

For modelling purposes, impact distances were evaluated for a 1 psi overpressure explosion. This would result in partial demolition of buildings (rendering them unusable with 90% of the windows broken) and is considered the threshold for minor damage to structures. This threshold is also the level at which irreversible effects can occur and is considered the zone of significant danger to human life. This is the threshold for emergency planning recommended by CRAIM, the Conseil pour la réduction des accidents industriels majeurs [Council for the reduction of major industrial accidents].

In addition, the distances travelled due to an overpressure explosion of 3 psi were evaluated for the combined tanks (domino effect). This threshold would cause damage to the steel structures of the buildings, which would be deformed and torn from their foundations. This threshold also corresponds to lethal effects and delimits the zone of serious danger to human life.

Table 12-2 Thresholds of overpressure effects

Overpressure		Effects on structures	Effects on humans
kPa	Psi		
2.1	0.3	Safe distance (0.95 probability of no serious damage below this value); damage limited to the ceilings of houses; 10% windows breaking.	Effect thresholds delimiting the area of indirect effects of windows breaking on humans.
6.9	**1**	Partial demolition of houses making them uninhabitable, 90% of windows broken, threshold for slight damage to structures.	Thresholds of irreversible effects delimiting the “zone of significant danger to human life.”
13.8	2	Partial collapse of ceilings and walls of houses. Possible damage to large hydrocarbon tanks.	Thresholds of lethal effects delimiting the “zone of serious danger to human life.”
20.7	**3**	The steel structures of the buildings are deformed and torn from their foundations, threshold of significant destruction of windows, thresholds of domino effects.	Thresholds of lethal effects delimiting the “zone of very serious danger to human life.”

THERMAL EXPOSURE

The thermal exposure that can be experienced by people exposed to a fire depends on several factors and will vary between individuals. It is usually quantified by limiting the physical calculations to the fire source, i.e., the thermal radiation flux (kW/m^2) and the exposure time (seconds) of individuals. The exposure time may be limited by the duration of the fire and/or the reaction time of the exposed individuals.

The various thermal exposure thresholds are presented in Table 12-3.

Table 12-3 Thermal exposure thresholds

Flux (kW/m^2)	Load $(kW/m^2)^{4/3}.s$	Effects on structures	Effects on humans
3	600	n/a	Thresholds of irreversible effects delimiting the “zone of significant danger to human life.”
5	**1,000**	Threshold of significant destruction of windows.	Second-degree burns after 40 seconds, threshold of lethal effects delimiting the “zone of serious danger for human life.”
8	**1,800**	Threshold of domino effects and corresponding to the threshold of serious damage on structures.	Thresholds of lethal effects delimiting the “zone of very serious dangers to human life.”

n/a : not applicable.

The impact distances were evaluated at a thermal radiation of 5 kW/m^2 since at this level there is a significant destruction of glass, and it is the threshold of lethal effects delimiting the zone of serious danger for human life (second-degree burns after 40 seconds). This is the threshold for emergency planning recommended by CRAIM.

For combined tanks (domino effect), the impact distances were evaluated at a threshold of 8 kW/m^2. At this threshold, there would be serious damage to structures, and it is also the threshold of lethal effects delimiting the zone of very serious danger to human life.

TOXIC EFFECTS

Reference values describing thresholds for human toxicity can be assessed using different criteria by different agencies and countries. When available, the use of Acute Exposure Guideline Levels (AEGL) is recommended by CRAIM.

Each criterion is divided into three levels according to the degree of severity of the effects involved. For sulphur dioxide, reference values for AEGLs are available for five exposure durations (10 min, 30 min, 60 min, 4 hours, and 8 hours).

The toxic effect threshold reference values, shown in Table 12-4, are calculated for a short-term, one-time exposure following an accident. They do not consider effects caused by long-term chronic exposure to small doses. Reference values for a 60-minute exposure are used.

Table 12-4 Toxic effect thresholds

Criterion	Description	Value for sulphur dioxide 60-minute exposure
AEGL-1	The airborne concentration (expressed as ppm or mg/m^3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic nonsensory effects. However, the effects are not incapacitating and are transient and reversible upon cessation of exposure. Concentrations below AEGL-1 represent an exposure level associated with the perception of moderate odour, taste, or other sensory irritation.	0.2
AEGL-2	The airborne concentration (expressed as ppm or mg/m^3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape. Concentrations below AEGL-2 but equal to or greater than AEGL-1 represent exposure that could cause significant discomfort.	**0.75**
AEGL-3	The airborne concentration (expressed as ppm or mg/m^3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death. Concentrations below AEGL-3 but at or above AEGL-2 represent exposure that may cause serious long-lasting or irreversible adverse health effects or an impaired ability to escape.	30

Sulphur dioxide emissions can cause a toxic cloud to form and disperse over large distances. The AEGL-2 value of 0.75 ppm was selected for this substance because this is the concentration above which individuals could experience irreversible or serious and long-lasting adverse health effects, as well as an impaired ability to escape (CRAIM, 2017).

DOMINO EFFECT

CRAIM defines a domino effect as follows: "A first incident which, by its consequences, may generate or result in other event(s) or accident(s) whose consequences will add to the first, either inside or outside the site." Domino effects are a chain reaction following a first accident resulting from the relative proximity of equipment.

To trigger a second event, the consequences resulting from the first accident must reach certain thresholds that are damaging to the nearby equipment. The thresholds used to evaluate domino effects are those provided in the CRAIM guide, i.e., 20.7 kPa for overpressure and 8 kW/m2 for thermal radiation.

12.6.3 ASSESSED SCENARIOS

PROPANE

Six tanks are planned to be installed: five 20,000 USG tanks and one 40,000 USG tank.

The impact radius was calculated for a 20,000 USG tank and a 40,000 USG tank. In fact, the results for tanks of the same size are the same.

For each tank, the following scenarios were considered. The catastrophic failure scenario is a complete spill of the tank's contents and is a scenario identified in the Environmental Emergency Regulations:

— Worst-case scenario: Catastrophic failure of propane tank (one for each volume).
— Alternative worst-case scenario: 0.2 inch leak in the transfer hose when connecting to a tank truck (one for each volume)
— Domino effect: Given the proximity between two of the tanks, a domino effect was considered (modelling including the total volume of the two tanks).

These scenarios represent worst-case scenarios and do not take into account the preventive measures implemented as part of the project. They represent the consequence if the modelled event were to occur, regardless of the probability of it happening.

SULPHUR DIOXIDE

The following scenarios were selected to assess consequences for the sulphur dioxide tank. The catastrophic failure scenario is a complete spill of the tank's contents and is a scenario identified in the Environmental Emergency Regulations.

— Worst-case scenario: Catastrophic failure of the 36 m^3 tank.
— Alternative worst-case scenario: 0.2 inch leak in the upper part of the tank (safety valve).
— Alternative scenario: 0.1 inch leak lasting 2 minutes when filling the SO_2 tank.

12.6.4 MODELLING RESULTS (IMPACT DISTANCES)

PROPANE TANKS (20,000 USG)

Table 12-5 Impact distances (m) for the 20,000 USG tanks

Scenario	Description	Consequence	Thermal exposure (5 kW/m^2)		Overpressure effect (1 psi)		LFL	
			1.5/F	4/D	1.5/F	4/D	1.5/F	4/D
Worst-case scenario	Catastrophic failure	Distance with respect to lower flammability limit of 21,000 ppm (LFL)	n/a	n/a	n/a	n/a	73	114
		Fire Torch	503	503	n/a	n/a	n/a	n/a
		Vapour cloud explosion (premature)	n/a	n/a	470	470	n/a	n/a
		Vapour cloud explosion (late)	n/a	n/a	463	477	n/a	n/a
Alternative worst-case scenario	Leak	Distance with respect to lower flammability limit of 21,000 ppm (LFL)	n/a	n/a	n/a	n/a	7	6
		Fire Torch	18	16	n/a	n/a	n/a	n/a
		Vapour cloud explosion (late)	n/a	n/a	17	n/a	n/a	n/a

n/a : not applicable.

PROPANE TANK (40,000 USG)

Table 12-6 Impact distances (m) for the 40,000 USG tank

Scenario	Description	Consequence	Thermal exposure (5 kW/m^2)		Overpressure effect (1 psi)		LFL	
			1.5/F	4/D	1.5/F	4/D	1.5/F	4/D
Worst-case scenario	Catastrophic failure	Distance with respect to lower flammability limit of 21,000 ppm (LFL)	n/a	n/a	n/a	n/a	99	149
		Fire Torch	638	638	n/a	n/a	n/a	n/a
		Vapour cloud explosion (premature)	n/a	n/a	593	593	n/a	n/a
		Vapour cloud explosion (late)	n/a	n/a	592	605	n/a	n/a
Alternative worst-case scenario	Leak	Distance with respect to lower flammability limit of 21,000 ppm (LFL)	n/a	n/a	n/a	n/a	8	7
		Fire Torch	17	15	n/a	n/a	n/a	n/a
		Vapour cloud explosion (late)	n/a	n/a	17	16	n/a	n/a

n/a : not applicable.

PROPANE TANKS (DOMINO EFFECT)

Table 12-7 Impact distances (m) in case of domino effect

Scenario	Description	Consequence	Thermal exposure (8 kW/m^2)		Overpressure effect (3 psi)		LFL	
			1.5/F	4/D	1.5/F	4/D	1.5/F	4/D
Worst-case scenario	Catastrophic failure	Distance with respect to lower flammability limit of 21,000 ppm (LFL)	n/a	n/a	n/a	n/a	118	175
		Fire Torch	570	570	n/a	n/a	n/a	n/a
		Vapour cloud explosion (premature)	n/a	n/a	291	291	n/a	n/a
		Vapour cloud explosion (late)	n/a	n/a	349	365	n/a	n/a

n/a : not applicable.

SULPHUR DIOXIDE (SO_2) TANK

Table 12-8 Impact distances for AEGL-2 (0.75 ppm)

Scenario	Weather category	Distance to AEGL-2 (m)
Worst-case	1.5/F	28,458 [1]
	4/D	25,763 [1]
Alternative worst-case	1.5/F	9,842 [1]
	4/D	2,601 [1]
Alternative	1.5/F	5,910 [1] (7,492 [2])
	4/D	1,041 [1] (1,274 [2])

Notes:
1 Results are presented over a 60 minute averaging period.
2 Results are presented over a 10 minute averaging period since the duration of the discharge is 2 minutes.

12.6.5 POTENTIAL IMPACTS ON SENSITIVE ENVIRONMENTS

The impact radius for each of the scenarios are shown in Figures 1 through 7 of the modelling report included in Appendix 12-1.

PROPANE

For propane, three different coloured circles surrounding each of the tanks represent the impact radius of each flammable vapour concentration exposure effect threshold, the thermal radiation exposure effect threshold, and the overpressure (late explosion) exposure effect threshold respectively. As can be seen from the map, for all scenarios, it is expected that some project infrastructure (e.g., buildings) would be affected in the event of an accident. This is due to the tanks being located near the mining infrastructure.

For example, the process plant and the backfill filtration and water treatment plants will be impacted by accidents related to nearby propane tanks. The workers' camp could also be impacted.

It should be noted that in a 1-psi overpressure explosion, there would be partial demolition of the buildings (potentially rendering them unusable with 90% of the windows broken). A 3 psi overpressure explosion (estimated for the combined tanks located north of the process plant) would result in damage to the steel structures of the buildings, which would be deformed and torn from their foundations. As for thermal radiation, the impact distances represent the radius of a significant destruction of windows and the danger zone for human life (second degree burns after 40 seconds).

As far as natural environments are concerned, potential impacts would be felt in particular on water bodies located within an impact radius. The water bodies that could be affected would be Lakes SN2, SN3, and SN6, Ponds 1 and 2, and Kettle Lake. Kettle Lake could receive debris from the fire and/or explosion. These water bodies, with the exception of Kettle Lake, are fish habitats.

SULPHUR DIOXIDE (TOXIC CLOUD)

With respect to the impact of an event involving sulphur dioxide, the airborne concentration (expressed in ppm or mg/m^3) in the areas exposed to the cloud will be high enough that exposed individuals, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape. The assessment showed that, under the least favourable weather conditions, the toxic cloud generated by the release of this substance could disperse over a significant distance, even outside the boundaries of the LSA. In these cases, all elements identified in section 12.2 that are part of the LSA would obviously be affected, including the project area. Elements outside the LSA would also be affected, such as two Cree camps, several private cottage leases, and two canoe routes (Map 12-1).

12.7 RISK MANAGEMENT PROGRAM

To ensure the safety of workers, the public, and the environment during operations, a program will be established to manage risks that cannot be eliminated with existing preventive measures. The main features of this program will be as follows:

- implementation of an environmental and health and safety management system;
- environmental monitoring during the construction and operation phases;
- development of safe operating procedures;
- setting up an equipment maintenance program and a periodic inspection program;
- training workers, particularly on the operation of equipment, the risks inherent in activities, as well as safe work methods and personal protective equipment;
- visual identification system for stored chemicals, piping, and connections to loading and unloading areas;
- safe storage of chemicals;
- investigation of accidents and incidents to determine causes and implement corrective actions;
- rigorous change management process.

To this end, policies have been developed, including the *Osisko Health and Safety Policy* and the *Osisko Environmental* Policy. These policies are available on the Osisko website (https://www.osiskomining.com/sustainability/).

12.8 PRELIMINARY EMERGENCY RESPONSE PLAN

An ERP is an indispensable tool to ensure a quick and effective response when an emergency situation arises. A preliminary plan has been developed. It is presented in Appendix 12-2.

This document includes:

- the roles and responsibilities of responders;
- telephone numbers of key external responders;
- alert and mobilization procedures;
- emergency response procedures;
- evacuation procedures;
- the process of restoring normalcy.

The emergency plan developed will be known to internal stakeholders, updated annually, readily available in emergency situations, and easy to consult.

Response measures will be in accordance with applicable regulations and industry best practices. When required, this plan will be revised and adapted to any new activity on the site.

13 ENVIRONMENTAL PROGRAMS

13.1 MONITORING AND FOLLOW-UP PROGRAM

As part of the activities associated with the construction, operations and closure phases, Osisko will put in place the human and financial resources required to carry out the project's environmental monitoring and follow-up program. In fact, it is currently anticipated that approximately eleven resources will be assigned to environmental and water management at the site, including the operation of the water treatment plant, to ensure the deployment of this program, not to mention the collaboration of other departments when required. In addition, the use of subcontractors' services is also considered according to potential specific needs. As such, the following sections present the various activities proposed for the monitoring and follow-up program for the construction, operations and closure phases.

13.1.1 CONSTRUCTION

During the construction phase, an environmental monitoring program will be implemented during the work to ensure compliance with environmental commitments and obligations. It also aims to verify that proposed mitigation measures are incorporated into the project and that laws, regulations and other environmental considerations are respected in the plans and specifications.

This environmental monitoring program will be prepared and operated by Osisko and will include all of the commitments made in this document and subsequent responses to the COMEX as part of the environmental assessment process. Aspects covered by this program will include:

— Monitor and supervise all tasks that require preventive, mitigating or corrective measures with respect to the environment.

— Ensure that the work is carried out in compliance with the laws, regulations and conditions of the certificates of authorization and define mechanisms to follow up on possible non-compliance during the work.

— Follow up on sedimentation ponds under construction and related equipment (pumps, dikes, weirs, ditches, etc.).

— Ensure that work areas are well defined and that machinery encroachment is limited.

— Offer environmental support and make workers aware of the impacts of their activities.

— Ensure compliance with the procedures for refueling petroleum equipment used for the project.

— Validate the presence of containment measures for petroleum tanks of mobile equipment (pumps, generator sets, etc.).

- Supervise and follow procedures in the event of an accidental spill, including the monitoring of temporary storage conditions for contaminated soils, if applicable.
- Ensure that the deadlines for biological restriction periods are met and that the environmental monitoring associated with the project is properly carried out.
- Note the presence of birds near the borrow pits and work areas during the summer period (approximately mid-May to mid-August).

One of the activities of the monitoring program will also be to ensure that all necessary approvals and permits have been received. To this end, a list of conditions and commitments made in this study and in any authorizations that will be issued for the project will be developed. The above list represents only a portion of the total commitments that Osisko will be required to follow. This list will serve as a basis for the development of the environmental monitoring program, which will then be the concrete tool that can be deployed in the field during the work by Osisko officials as well as those of the general contractor mobilized on the site. This program will be updated throughout the course of the work.

A site meeting will be held with the general contractor of the work and the Osisko environmental monitor at the very beginning of the work. The purpose of this meeting will be to inform and raise awareness among site personnel about the environmental monitoring program and the safety provisions that will apply throughout the construction period, and the general operation of the monitoring activities.

During the work, mitigation measures will be rigorously followed, especially during work carried out near sensitive environments, waterways and water bodies. TSS emissions to water and the presence of any accidental leakage of petroleum products will be particularly monitored in the vicinity of these environments. Photographs will be taken to document how the work was completed.

In general, the environmental monitor will conduct regular visits to the work areas, ensure that the various commitments, obligations, measures and other requirements are rigorously respected by the stakeholders, evaluate the quality and effectiveness of the measures applied and note any non-compliance observed. He will then have to report his observations to the worksite manager so that appropriate preventive and corrective measures can be taken as soon as possible, if necessary. He will also ensure that workers report any spills without delay to authorities.

13.1.2 OPERATIONS

An environmental follow-up program will be implemented at the Windfall project site during the operations phase. It will be enhanced by the conditions of the project’s authorizations. The purpose of this program is to identify and document any changes in the environment from baseline (whether project-related or not), to verify the accuracy of the impact assessment, and to evaluate the effectiveness of the mitigation measures included in the EIA. The proposed follow-up will address the following components:

- ambient air quality;
- underground air quality;
- greenhouse gas emissions;
- geochemistry of ore, waste rock and tailings;

- compliance of mining effluents;
- surface water quality;
- groundwater quality;
- drinking water quality;
- the compliance of sewage water;
- ichthyofauna and benthos;
- the social environment;
- the stability of the retaining structures.

The following sections present each aspect of the overall environmental follow-up program. This program will be carried out in compliance with municipal and governmental requirements applicable to the project.

On a monthly basis, it is planned to continue sending water quality data from the sampled water to the final effluent through the Environmental Monitoring System (EMS) named “Système de suivi environnemental (SENV)”. Osisko's account on this MELCCFP electronic platform is open, so Osisko will have to provide the data with the certificates of analysis no later than 30 days after the end of the month, with some exceptions. Each quarter, final effluent water quality data is also sent to ECCC through their Mine Effluent Reporting System (MERS) 45 days after the end of the quarter.

An annual follow-up report will be completed as required for companies subject to D019. The document and its attachments are generally filed by March 31 annually. The latter is already produced and includes

- Annual site activities: number of meters of surface and underground drilling, bulk sampling, exploration ramp pumping, spill reporting certificates during the year, progressive restoration activities.
- Water Management: water flow diagram, description of changes made during the year to the water treatment system, total volumes of water pumped, recirculated and returned to the effluent (water withdrawal declaration and payment of charges) including drinking water developments, third party validation of measurement elements and calibration reports attesting to the validity of the results provided, portrait of water quality at effluent, calculation of loads and results of annual monitoring requested in D019 (with certificates of analysis), characteristics and results of bi-annual groundwater sampling (with certificates of analysis)
- Tailings management: details on the accumulation areas, changes during the year, annual table of waste rock stockpile capacity and volumes stored on the surface, nature of the deposit and characteristics of the accumulation areas (water protection mode).

Thus, this annual deliverable will be maintained and improved in relation to the nature of the activities carried out at the site.

AIR QUALITY

FUGITIVE EMISSIONS

The objective of the ambient air quality monitoring program related to fugitive emissions implemented following the project's completion will be to measure the impact of mining activities on air quality and then to determine the compliance and acceptability of mining activities in relation to applicable standards and criteria.

Sampling will be conducted in a manner consistent with the methods outlined in the reference document List of designated Reference and Equivalent Methods (US EPA 2018). The results of the analysis will be compared to the standards presented in the most recent version of the Air Quality Standards and Criteria available on the MELCCFP website (https://www.environnement.gouv.qc.ca/air/criteres/index.htm). If the analysis reveals that a threshold value or emission standard has been exceeded, the event must be investigated and corrective measures applied as appropriate.

The ambient air quality follow-up program for the Windfall project will address all air emissions from the operation of the project:

- dust and nitrogen dioxide from the mine ventilation;
- total suspended particulates (TSP) that can be filtered and condensed;
- crystalline silica dust;
- metals and metalloids.

STATIONARY SOURCES

In addition to the fugitive emissions generated by the general operations at the Windfall site, the process plant will include various stacks that will represent stationary sources. The latter will also be monitored using the reference methods prescribed in the Sampling Guide for Environmental Analysis - Booklet 4 - Sampling of Atmospheric Emissions from Stationary Sources. As stipulated by the Clean Air Regulation (CAR), sampling will be initiated within a period not exceeding one year from the start of plant operation and repeated every three years.

UNDERGROUND AIR QUALITY

An underground mine is a confined area where the ambient air quality can be degraded by activities such as blasting, the nature of the ore, the backfill products and the widespread use in modern underground mines of diesel powered equipment, machinery and vehicles, which release contaminants into the mine atmosphere. It should be noted that Osisko plans to use, for the most part, underground electric machines and vehicles for those that do not have to come to the surface. The overall objective of the ventilation response program for underground mines is to ensure that the ventilation and source capture systems are capable of removing, diluting and maintaining the various contaminants in the mine within the required maximum standards and concentrations, including monitoring the quality of the work environment through appropriate records and logs, and through proper maintenance of diesel equipment.

The program primarily targets the following facilities and equipment:

- surface and underground ventilation networks (fans, ducts, doors, etc.)
- active, abandoned workplaces (drifts, stopes, raises, garages, workshops, etc.);
- diesel-powered equipment: maintenance, exhaust emissions (scooptram, trucks, service vehicles, etc.)
- source capture system, dust/fume collectors, gases, dusts (repair shops, welding shops, crushers, etc.);
- measuring and sampling devices, instrumentation / CO, NOx, etc.

Air quality follow-up in the Windfall underground complex will be conducted in accordance with the requirements of the Regulation respecting occupational health and safety in mines (Division IV, S-1) and the Regulation respecting occupational health and safety (Chapter S-2.1, r. 13 and Schedule I). Appropriate measuring instruments will be used to assess air quantity and quality, as well as to characterize contaminants and fresh air flows supplied to the workplace. This regulation is not the subject of any specific deliverable other than to collect in an action plan the corrective measures that may be necessary following an inspection by the authorities.

GREENHOUSE GASES

GHG emissions monitoring is a legal requirement under the Regulation respecting the mandatory reporting of certain emissions of contaminants into the atmosphere (RDOCECA) (in Quebec) and the National Pollutant Release Inventory (NPRI, federal). This requirement applies to the operations phase of a facility and deliverables are due annually by May 31st and June 1st respectively. As such, the current exploration emissions monitoring and reporting program will be maintained and expanded to include a separate deliverable for the operations phase. More specifically, it will track the amount of fuel used in the operations and the associated GHG emissions, all in compliance with the provincial government's RDOCECA requirements. The emissions inventory produced will also have to comply with the reporting requirements of the Federal GHG Reporting Program. It will also include monitoring associated with the federal NPRI.

Reports are submitted through the electronic platforms of both levels of government and the reports must be certified by a third party auditor. Every three years, for the sake of transparency, the group conducting the audit must be changed. It is not currently anticipated that Osisko will be subject to the Cap and Trade System (C&T System) as stationary source emissions are estimated to be below 25,000 tCO2Eq per year per facility.

GEOCHEMISTRY OF TAILINGS, WASTE ROCK AND ORE

As part of the activities associated with the restoration plan update, which must be completed every 5 years, a characterization of the geochemistry of the tailings, waste rock and ore must be performed. This study will cover the areas that will be developed in the next five years. This characterization will be based on the recommendations of the Guide de caractérisation des résidus miniers et du minerai (MELCC, 2020) to ensure that the tests are in line with expectations, particularly in terms of the number of samples, the nature of the tests to be performed and the content of the reports presenting the results.

MINING EFFLUENT

The objective of the mine effluent monitoring is to ensure that the quality of the effluent respects the applicable standards and criteria as well as to collect information that will help evaluate and interpret the results of the biological monitoring (benthos and fish). In addition, it will allow to verify the effectiveness of the mitigation measures put in place to reduce the potential impacts of mining activities. This follow-up includes characterization of the mine effluent and lethal and sublethal toxicity testing using samples taken from the effluent.

Osisko already has a mine effluent and the follow-up program will continue. The discharge point will also be maintained near Pond 1. As a guide, the criteria to be met at the final effluent are those of D019 and the Metal and Diamond Mining Effluent Regulations (MDMER). In addition, depending on the nature of the ore, the process, the tailings or the calculation of the Environmental Discharge Objectives (EDOs), other requirements at the point of discharge of the final effluent may be added at the time of issuance of the Certificate of Authorization. A summary of the general parameters that will be evaluated is presented below.

DIRECTIVE 019

Directive 019 establishes regular monitoring of a limited list of physicochemical and biological parameters, with a variable frequency depending on the given parameter, as well as annual monitoring for a more exhaustive list of parameters (Table 13-1). The monitoring of mining effluent during exploration activities will be maintained for operations activities and will continue until the final cessation of mining activities. As mentioned earlier, this data is collected in the annual report sent to the MELCCFP on March 31 of each year.

Table 13-1 Parameters and frequency of measurement or sampling of final mine effluent under Directive 019

Parameter	Frequency
pH and flow	Continuous
Suspended matter	Three times a week
As, Cu, Fe, Ni, Pb, Zn, total cyanides1	Once a week
Acute toxicity	Once a month
Parameters from Table 2.4 of Directive 019 Group 1: Alkalinity, chlorides, BOD5, COD, flow, hardness, fluorides, hydrocarbons (C10-C50), TSS, pH, dissolved solids, total solids, phenolics (phenol index), sulfates, turbidity, ammonia nitrogen, total Kjeldahl nitrogen, nitrates+nitrites, total phosphorus, Al, As, Cd, Ca, Cr, Co, Cu, Fe, Mg, Mn, Hg, Mb, Ni, Pb, K, Na, Zn. Group 2: Cyanates, total cyanides, thiocyanates. Group 3: Sulfures, thiosulfates. Group 4: Acute toxicity	Once a year

1 Total cyanides will only be performed once the mine is in operation and the cyanide will be used in the ore extraction process.

METAL AND DIAMOND MINING EFFLUENT REGULATIONS (MDMER)

Under the MDMER, final effluent monitoring includes all physicochemical parameters at the frequency specified in the MDMER. As an example, Osisko received approval from the ECCC to go to a reduced frequency for metals and radium as the measured concentrations were below 10% of the monthly average criteria for one consecutive year. Table 13-2 details the analyses required under the MDMER. Monitoring of the mine effluent will continue until the mine is closed. As previously mentioned, 45 days after the end of each quarter, final effluent water quality data (with certificates of analysis) are also sent to ECCC through their MWDS system.

Table 13-2 Parameters and frequency of measurement or sampling of final mine effluent under the MDMER

Parameter	Frequency
pH, temperature, As, Cu, Ni, Pb, Zn, Ra226[1], total cyanides, suspended solids, non-ionized ammonia	Once a week[1, 3]
Acute lethality	Once a month[2]
Hardness, alkalinity, conductivity, nitrate, chloride, sulfate, phosphorus, Al, Cd, Cr, Co, Fe, Hg, Mn, Mo, Se, Tl, U	Four times a year
Sublethal toxicity of Lemna minor	Twice a year

1 The owner or operator of a mine other than a uranium mine may reduce the frequency of testing for radium-226 at a final discharge point to at least once per calendar quarter, with each test conducted at least one month apart, if the concentration at that final discharge point is less than 0.037 Bq/L for 10 consecutive weeks.

2 The owner or operator of a mine may reduce the frequency of an acute lethality test at a final discharge point to once per calendar quarter if, for 12 consecutive months, the effluent at that final discharge point is not acutely lethal according to that test.

3 The owner or operator of a mine may reduce the frequency of testing for arsenic, copper, cyanide, lead, nickel, zinc or un-ionized ammonia at a final discharge point to at least once per calendar quarter, with each test being conducted at least one month apart, if the monthly average concentration of the substance at that final discharge point is less than 10% of the value set out in column 2 of Schedule 4 of the MDMER.

ENVIRONMENTAL DISCHARGE OBJECTIVES (EDOs)

The method for calculating and interpreting environmental discharge objectives determines the concentrations and loads of contaminants that can be discharged to an aquatic environment without compromising water uses. These concentrations and loads, called Environmental Discharge Objectives or EDOs, are determined from the characteristics of the receiving environment and the level of quality necessary to maintain water uses.

Sampling and measurements will be done in accordance with the requirements of Directive 019, the MDMER and the MELCCFP's Guide d'échantillonnage à fins d'analyse environnementale (MDDEP, 2008). Standard precautions will be taken to avoid contamination during the sampling and transportation of samples. The analysis of the parameters will be performed by a laboratory accredited by the MELCCFP and in accordance with the analytical methods recognized by the latter. Rigorous quality control and assurance measures will be in place for sampling and laboratory analysis. Monitoring requirements (parameters, frequency, detection limit, etc.) and reporting are set out in the authorizations issued at the start of operations. Osisko will carry out these follow-ups according to the conditions dictated by the government authorities.

SURFACE WATER QUALITY

Surface water quality monitoring is conducted in addition to the mine effluent characterization required under the MDMER. The objective is to monitor the performance of the Windfall site and to observe changes in environmental conditions in the receiving waters. The monitoring also allows to obtain measurements of environmental variables to support the interpretation of the results of the biological monitoring (benthos and fish). The surface water quality monitoring parameters for the receiving environment covered by the MDMER are presented in Table 13-3.

Table 13-3 Parameters considered for surface water monitoring under the MDMER

Parameter	Frequency
pH, hardness, alkalinity, conductivity, temperature, dissolved oxygen	Four times a year
Harmful substances mentioned in Article 3 (As, Cu, Total cyanide, Pb, Ni, Zn, TSS, Ra226, non-ionized ammonia)	
Substances referred to in paragraph 4(1) (Al, Cd, Cr, Co, Fe, Hg, Mn, Mo, Se, Tl, U, nitrate, chloride, sulphate, phosphorus)	

Follow-up under the MDMER during exploration activities will be maintained and will end when the mine is closed. The surface water sampling stations used for regulatory monitoring will be located at the same locations as currently, i.e., in the exposure area and in the reference sector.

Sampling and measurements in the effluent receiving environment will be conducted in accordance with MDMER requirements. Standard precautions will be taken to avoid contamination during the sampling and transportation of samples. The analysis of the parameters will be performed by a laboratory accredited by the MELCCFP and in accordance with the analytical methods recognized by the latter. Rigorous quality control and assurance measures will be in place for sampling and laboratory analysis. The expected detection limits presented in the MDMER will be rigorously checked.

The more comprehensive MDMER water quality monitoring data is submitted through the Environmental Effects Monitoring (EEM) Submission System by March 31 of each year.

GROUNDWATER QUALITY

According to D019, a groundwater quality monitoring program, including piezometry monitoring, must be implemented near any high-risk development such as an ore processing plant, a tailings accumulation area, a petroleum or chemical storage area, etc. The monitoring thus verifies the potential for significant degradation of groundwater quality during mining operations. The monitoring allows to verify the potential of significant degradation of groundwater quality during mining operations.

A network of observation wells for regulatory monitoring is currently present at the site (see Table 629 in Section 6.10). This monitoring network will be enhanced to ensure that the upstream and downstream hydraulics of all developments at risk are covered. Monitoring will consist of sampling groundwater and measuring water elevation in these observation wells. The general procedure will consist of:

— identify the observation well;

— take the coordinates with a GPS (if previously surveyed);

— measure the height of the casing from the ground;

— measure the water elevation (static level) relative to the casing before sampling;

— sample the groundwater.

Groundwater sampling will be conducted according to recognized standard methods. During the sampling, physicochemical parameters will be measured: pH, electrical conductivity, dissolved oxygen, ORP and temperature. Procedures are described in the Guide d'échantillonnage aux fins d'analyses environnementales: cahier 3 - Échantillonnage des eaux souterraines (MDDEP, 2011). Well water is usually sampled using dedicated systems in each well to limit the risk of cross contamination.

The parameters analyzed will be those required in Table 2.1 of Section 2.1.1.1 of D019 in addition to the parameters targeted for site-specific hazards. Depending on the nature of the ore, the process or the tailings, other parameters will be added to the monitoring of groundwater quality in the authorizations issued by the government authorities. The analytical parameters will therefore include the following:

- C10-C50 petroleum hydrocarbons;
- major ions (bicarbonates, calcium, chlorides, magnesium, potassium, sodium, sulfates);
- dissolved metals (Ag, Al, As, B, Cd, Co, Cr, Cu, Fe, Hg, Mn, Mo, Ni, Pb, Se, Sb, Sn, Sr, U, Zn)
- total and available cyanides;
- sulfides, total phosphorus;
- ammoniacal nitrogen, nitrites and nitrates.

This monitoring will be done twice a year, in the spring when the water table is at its highest, and in the summer when it is at its lowest.

In order to confirm the validity of the measurement methods of the different parameters, a quality control program will be applied. Duplicate samples will be taken during the follow-ups corresponding to at least 10% of the samples taken. These samples will be sent to the laboratory for analysis and to verify the concordance of their results with those of the original samples. Field blanks and transport blanks will also be taken during each campaign and sent to the laboratory.

The results of the chemical analyses will be compared to the Surface Water Resurgence Criteria (RES) of the Guide d'intervention – Protection des sols et réhabilitation des terrains contaminés (Beaulieu, 2021). In addition, the RES criteria for metals will be adjusted to a hardness representative of the surrounding water. Parameters without criteria are compared to values obtained during previous monitoring to detect any significant trends or variations.

As part of the D019 annual monitoring report sent by March 31 of each year, the location of installed observation wells and groundwater monitoring data will be provided to the MELCCFP. This report will include the items detailed in D019, which are:

- the dates of the collection;
- a map of the sampling sites;
- analytical results of the samples;
- certificates of analysis from the laboratory.

If required, recommendations on corrections or modifications to the groundwater monitoring program will be provided.

DRINKING WATER

In addition to the well monitoring network for the facilities at risk, Osisko will monitor the water quality of the mine site's drinking water supply wells on a regular basis as long as there are workers occupying the camp.

The sampling frequencies and the various physicochemical and biological parameters for drinking water sampling are taken from the Regulation respecting the quality of drinking water (Q-2, r.40) and are presented in Table 13-4. Note that the number of employees considered is less than 500, since the work camp only allows for a maximum of 406 people. Finally, it is important to mention that the well that supplies the water generates raw water that is considered to be of good quality. Treatment is necessary to eliminate iron and manganese and to carry out chlorination before distribution.

Table 13-4 Frequency of sampling and applicable physicochemical and biological parameters

Substance	Distribution system category - Number of users	Minimum number of samples	Sampling period
Total coliforms and E. coli	21 to 1,000 people	2	Monthly
Certain substances on Schedule 1 of the Drinking Water Quality Regulation[1, 2]	≥21	1	Annually, between July 1 and October 1
Nitrates + Nitrites	≥21	1	In each of the quarters beginning January 1, April, July and October, with a minimum interval of two months between the dates of withdrawal
Lead and copper	≥21 and ≥500	2	Annually, between July 1 and October 1
Chlorites, chlorates[3]	All	1	In each of the quarters beginning January 1, April, July and October, with a minimum interval of two months between the dates of withdrawal
Trihalomethanes	≥21 and ≥5,000	1	
Turbidity	All	1	Monthly

1 Antimony, Arsenic, Barium, Boron, Bromates, Cadmium, Chromium, Cyanides, Fluorides, Mercury, Lead, Selenium and Uranium.
2 Iron and manganese will be added to this list since they are specifically targeted by the treatment applied.
3 A pH reading must be taken at the time of sampling and recorded on the analysis request form.

SEWAGE WATER

The sewage water treatment system, which will be installed at the Windfall project site, will require regular monitoring to ensure the proper functioning of its components and to detect any malfunctions that could lead to contamination. As mentioned in Chapter 2, there are still uncertainties associated with the type of systems that could be implemented at the Windfall site. Once the nature of this system is established, an analysis program will be established in accordance with the expectations of the MELCCFP, which will determine the parameters to be analyzed and the sampling frequency.

Analyses will be performed by a laboratory accredited by the MELCCFP, when required by the parameter concerned. Note that final discharge standards will be established during the authorization process. These standards will be based on the environmental objectives obtained, the final technology selected, and the MELCCFP's Guide to Setting Discharge Standards for a Domestic Wastewater Treatment Facility.

ICHTYOFAUNE ET BENTHOS

Biological monitoring is required in the context of the national EEM monitoring program (Environment Canada, 2012), a requirement of the MDMER. This monitoring involves developing a study design and then sampling and analyzing sentinel fish populations, benthic invertebrate communities, and sediments in areas exposed to mine effluents and in a reference area. Effluent toxicity testing is also required. This follow-up is carried out on a three-year basis.

As previously mentioned, Osisko is already involved in follow-up activities associated with the MDMER. The initial study was conducted in 2020 and a 2nd round is planned for the fall of 2023. A study plan will be filed in winter 2023 and the final report is expected in June 2024. The following paragraphs detail the standard flow of a fish population study.

Prior to conducting biological monitoring, a study plan must be submitted and approved by ECCC six months before going into the field. Its purpose is to describe the conduct of the biological monitoring study. The study plan should contain information relevant to site characterization, sampling methods and periods, analytical methods, quality assurance and quality control measures that will be taken to validate the study in question, as well as a summary of information from previous biological studies. Once the study plan is approved, biological monitoring can be conducted. For the Windfall site, biological monitoring includes the following:

- monitoring of sentinel fish populations;
- monitoring of benthic invertebrate communities;
- monitoring of supporting environmental variables and sediment quality.

FISH POPULATION MONITORING

The purpose of the fish study is to determine whether or not the mine effluent has an effect on fish. In the case of the Windfall site, the reference water body is SN2 Lake while the reference water body for the exposed phase work is SN11. It must be possible to compare sufficiently large populations of fish in order to collect the number of fish needed for statistical analyses. The objective of the study is to examine two sentinel fish populations, in the case of the Windfall project, lake whitefish (*Coregonus clupeaformis*) and darkblotched tail (*Notropis hudsonius*). This allows to determine if there are differences in the growth, reproduction, survival, and condition of these populations and to monitor mercury concentrations in fish tissue (an indicator of fish consumption potential). For this purpose, specimens will be collected from the exposed area in SN11 and the unexposed reference area in SN2 to compare length, body weight, gonad and liver weight, fecundity, and egg size. The results are compared statistically to check for any significant differences in the following parameters:

- age (survival);
- height by age (body weight by age);
- relative gonad weight (gonad weight versus body weight, energy utilization and reproduction);
- condition (body weight vs. length, energy storage and condition);
- Relative liver weight (liver weight in relation to body weight, energy storage and condition)

In addition, a fish tissue analysis is only required if the mine has measured, during the effluent characterization:

- An annual average concentration of total mercury equal to or greater than 0.10 µg/l in the effluent **or** if the detection limit of the method used for analysis of at least two out of four samples in a given calendar year is equal to or greater than 0.10 µg/l.
- A total selenium concentration in the effluent equal to or greater than 10 µg/l **or** an annual average total selenium concentration equal to or greater than 5 µg/l for a given calendar year **or** either the detection limit of the method used for any sample is equal to or greater than 10 µg/l or equal to or greater than 5 µg/l for at least two out of every four samples for a given calendar year.

Effluent testing for both parameters has been conducted over the past five years and no exceedances have been detected. Fish tissue analysis is not currently required.

MONITORING OF BENTHIC INVERTEBRATE COMMUNITIES

Mines are required to conduct a benthic invertebrate community survey to determine if their effluent is affecting fish habitat. For this purpose, benthic invertebrates will be collected in the same areas as for the monitoring of fish populations. The following community descriptors are used to determine the potential effects of effluent on benthic communities:

- total invertebrate density;
- richness (number of taxa);
- equitability;
- coefficient of Bray-Curtis.

SEDIMENT MONITORING

Whenever benthic invertebrate community monitoring is undertaken, sediment and water samples should be collected at the same sampling stations and at the same time to determine the water quality of the environment as well as the total organic carbon content and on the sediments, to identify the particle size distribution. The methodology to be applied is described in detail in Chapter 7 of the Metal Mining Environmental Effects Monitoring Technical Guide (Government of Canada, 2012).

SOCIAL ENVIRONMENT

The purpose of social monitoring is to assess the effectiveness of the proposed measures to mitigate impacts on the social environment during the operation of the Windfall project. The results allow, if necessary, to adjust these measures in order to better respond to the identified impacts. As Osisko is already engaged in an ongoing dialogue with First Nations and non-First Nations land users, this approach is consistent with the continuity of operations. The continuation and dissemination of the results of the activities will be defined by the terms and conditions in the Impact and Benefit Agreement (IBA). Generally, Osisko publishes strategic studies (reclamation plan, environmental impact study) on its own website.

As required by the Act to amend the Mining Act (section 101.0.3), a follow-up committee will be set up by Osisko to encourage the involvement of the communities concerned in the project. This committee will be established prior to the construction of the mine and will be maintained throughout the life of the mine until the work set out in the mine site restoration plan is completed. The composition of the follow-up committee will respect the rules established by law by having in its organization at least one representative of the Council of the Cree First Nation of Waswanipi, one representative of the economic sphere, one member of the community of Waswanipi and one representative of EIJBRG. In addition, the W25A and W25B tallymen or a family member will be included on this committee.

Osisko undertakes to file an annual report on the activities of the follow-up committee and to make it public. The annual report, the content of which will be defined more specifically in collaboration with the members of the committee, will include at least the following elements: the nature and number of activities carried out; the roles and mandates of the local stakeholders involved; the subjects and concerns addressed; the actions undertaken; the level of satisfaction of the local stakeholders; and the action taken or not taken on the recommendations, if any. Finally, in order to maintain harmonious relations with the other communities adjacent to the project (Opitciwan and Lac Simon), Osisko will update the information on its activities when they express an interest.

STABILITY OF RETAINING STRUCTURES

A monitoring program for retaining structures (dams) is required under the Dam Safety Act (R.S.Q., chapter S-3.1.01). For the purposes of this Act, "dams" means works intended to divert or retain the waters of a watercourse or those of a lake or reservoir listed in the Répertoire toponymique du Québec. This is not the case at Windfall. However, minimum safety standards apply to any structure that intercepts or diverts water from a watercourse. In the case of the Windfall project, the ponds are considered retention structures even though they do not intercept or divert watercourses.

These monitoring and follow-up activities will be undertaken by Osisko and will include all works related to water management at the Windfall site. These structures will be subject to systematic visual inspections throughout the year:

- A seasonal detailed visual inspection, at least four times a year, by a qualified person with appropriate training, which consists of a detailed observation of the components of the infrastructure in question to ensure that there are no anomalies. The targeted components will be retaining structures, ditches, weirs, culverts, pipes, etc.
- An annual statutory inspection by a geotechnical and design specialist to visually assess the condition of the components that ensure the safety of the site. This inspection should ideally be done in the spring, after the melt, but before the vegetation appears. An inspection report, with supporting photos, will be prepared and forwarded to the Ministry.
- If necessary, a specific inspection will be used to follow up on abnormal observations noted during previous detailed or statutory inspections.

These inspections will be conducted in accordance with best practices and in compliance with the Dam Safety Act and the requirements of the MELCCFP D019. The details of these conditions will be enshrined in the ministerial authorizations that will be issued for the project.

13.1.3 CLOSURE

This section includes the follow-ups that will be conducted during the Windfall site closure phase as outlined in the current restoration plan (WSP, 2022) and the restoration plan submitted as part of this study (WSP, 2023). In the closure phase, there are two periods, the post-operations sub-phase and the post-restoration sub-phase. Post-operations is the period between the cessation of production and the completion of site restoration work, while post-restoration is initiated thereafter until a satisfactory condition for the protection of the receiving environment is achieved. The restoration program and associated follow-ups are reviewed every five years, in accordance with the Mining Act, and according to the Guide de préparation du plan de réaménagement et de restauration des sites au Québec (MERN, 2022). It is also at this time that the geochemical study of the materials on the site is updated.

Finally, it should be noted that the restoration work associated with the closure of the site will be subject to a monitoring program adapted to the nature of the work and based on the requirements that were established during the construction phase.

SURFACE AND GROUNDWATER QUALITY

POST-OPERATIONS SUB-PHASE

In accordance with D019, regular monitoring of final effluent will continue until Osisko applies for post-operations monitoring. The MDMER stipulate the same requirements under Part 4, which describes the criteria operating mines must meet to be considered closed. During the post-operations sub-phase, the surface and groundwater monitoring program that was in place during mine operation will continue so that qualitative and quantitative changes in mine effluent can be assessed during the transition period. If there is still mine effluent, it will continue to be treated to meet the discharge requirements in D019. The monitoring system set up during the operations phase and the associated measuring instruments can still be used during the post-operations period. At the federal level, the mine site is officially deemed closed three years after written notice is given to ECCC and a biological monitoring study has been completed.

All known potential sources of contamination upstream of the final effluent discharge point will be monitored. The current design of the site infrastructure is expected to capture all contact water at the site. However, only the final effluent is expected to require monitoring during both the operations and post-operations periods. Tests will also be conducted on the quality of runoff from other potential sources of contamination, as well as that flowing into the mine site's drainage system. Pursuant to the requirements of D019 (section 2.12.2.1) and in compliance with section 31.51 of the EQA, Osisko will conduct mine site characterization before completing the restoration work in order to identify and limit contaminant emission and, ultimately, make any necessary adjustments to the work.

Samples will be taken and the runoff will be measured at the sampling station at the frequency and for the periods identified in Table 2.8 of D019. Since geochemical analysis of the tailings, waste rock, and ore showed them to be potentially acid-generating and leachable, samples will be taken weekly during the six months after mine operations end and then bi-monthly until the restoration work is completed. At least 4 days, 7 days, and 15 days must elapse between the weekly, bi-weekly, and monthly samplings, respectively.

For groundwater, the minimum monitoring frequency will be the same as during the operational phase. D019 requires that groundwater quality monitoring be conducted at least twice a year, generally in the spring and summer, to represent high- and low-water periods. The groundwater monitoring program is detailed in section 13.2.7.

POST-RESTORATION SUB-PHASE

Post-restoration monitoring of mine wastewater and groundwater will be conducted in accordance with section 2.11 of D019. The same measurement and sampling station as that used during the post-operations period may continue to be sampled. If mine effluent is still being generated after the tailings storage facilities have been restored, the sampling station for this effluent must be located at the effluent's point of discharge from this facility and the water will be treated as required before it is discharged into the environment. Two years after the restoration work is completed, the need to maintain the treatment and pond system will be assessed. Depending on post-restoration water quality results, the ponds in certain areas may gradually be dismantled.

The sampling frequency at the effluent stations will change to 8 times per year for 10 years, as shown in Table 2.9 of D019. Monitoring must be conducted for at least 10 years after restoration, as the tailings and waste rock may generate acid and leachate. At least one sample will be taken each spring and one each fall, with at least 30 days between samples. If runoff is intermittent or effluent is present for short periods of time, the time between sample collections will be adjusted to meet the minimum monitoring frequency (D019, Table 2.9, 2012).

Under D019, the frequency of groundwater monitoring is the same as during the post-operations period, that is, at least twice a year. The sampling wells used during the operations phase will be retained and sampled.

VEGETATION OF THE SITE

The proposed restoration work at the Windfall site includes revegetation of all areas affected by mining activities in accordance with the Guide (MERN, 2022). Agronomic monitoring of the vegetated areas is planned to confirm that the soil conditions are adequate for plant growth, to verify the viability of the vegetation cover and to identify, if necessary, the need to implement additional corrective measures.

As some areas will be rehabilitated during the operation of the site, including the first two phases of the tailings storage facility, seeding will be carried out to optimize revegetation methods for reclamation at the end of the mine's life.

The restoration plan for the Windfall site calls for annual agronomic monitoring for 5 years following the completion of restoration work.

INTEGRITY OF THE WORKS

The integrity of the structures will be monitored annually during the post-restoration period. The objective of this follow-up is to verify the stability of the engineering covers put in place during the restoration, as well as the geotechnical stability of the structures. Any failure or deviation from the expected performance of the works will be addressed.

The main structures targeted by this follow-up are the waste rock pile and the tailings storage facility. In general, these structures are designed to be stable over the long term. Following site restoration, it is expected that the physical stability of the waste rock pile and tailings storage facility will be improved by the installation of the engineered cover to reduce water inflow into the pile.

The site security measures put in place to restrict access to underground openings (ventilation shafts and ramp) will also be observed during the monitoring of the integrity of the structures.

POST-RESTORATION WATER QUALITY MONITORING PROGRAM DISCONTINUED

After 10 years of water quality monitoring, if the requirements of section 2.11.3 of D019 are met and decreasing trends in contaminant concentrations are observed, Osisko may consider discontinuing the water quality monitoring described in the preceding sections, subject to the approval of the MRNF and the MELCCFP.

13.2 BIODIVERSITY PROGRAM

Biodiversity loss is an important societal issue for responsible project proponents who must develop measures that balance economic development with the inevitable losses associated with the nature of the development. Among the issues identified in the EIA (section 4.8.1 and chapter 14) is that of biodiversity preservation. Indeed, it has been shown that the Windfall project will result in a loss of area and habitat degradation (Chapter 7). This loss will be the result of the conversion of the natural environment (initial state) to that of the mining environment. As habitats are lost, fragmented, or degraded, they would lose their ability to support all species that depend on them. In addition to these losses directly associated with the Windfall project, the cumulative impact assessment, presented in Chapter 11, identifies potential and cumulative alterations that the project may have on other past, present, and future activities on the insertion environment and the overall quality of valued environmental components.

Following the impact assessments (Chapter 10) and the project issues (Chapter 14) presented, Osisko understands that the greatest impacts of the Windfall project will be on certain wildlife groups since it involves habitat losses and potentially on the displacement of species valued for hunting by the Crees.

In return, Osisko is committed to developing a biodiversity program, the principles and objectives of which are to be defined, among others, with the members of the Waswanipi Cree community. Reflection has begun and preliminary meetings have been held, but the approach has yet to be defined. Osisko wants to ensure that the program will be based on real needs identified by the community. Discussions will be part of the strategy to identify interesting projects, document and analyze these projects and then finalize the selection of the project(s) that will be retained. Once the program is defined, it will be necessary to develop an action plan to implement the identified project(s).

The biodiversity program could take the form of a research project on one or more valued species. Such a project would choose a theme that would improve knowledge of either the consequences of the opening of the territory on wildlife or the impacts of climate change. The objective would be to find ways to enhance the biodiversity, special status species found in the study area.

With the different phases of the Windfall project, and the planning of the closure of the site at the outset, it is intended to cover the period of construction and operations that corresponds to the period when the loss of habitat will be felt. By developing the biodiversity program, Osisko hopes to compensate for the net loss equivalent to the duration of the development activities.

14 ASSESSMENT OF THE CONSIDERATION OF ISSUES

As part of the activities associated with the impact assessment for the Windfall project, various issues were identified and confirmed during the various consultation activities carried out with the non-First Nations and First Nations populations in the project area. These issues include:

— **Preservation of the quality of the environment.** This issue includes protecting air quality, minimizing the contribution to climate change (GHG emissions), protecting the integrity of the water system and wetlands, and protecting surface and groundwater quality.

— **Preservation of biodiversity.** This issue includes minimizing the loss of vegetation cover and wetlands, preserving terrestrial and aquatic habitats (including bird, fish, moose, and caribou) and protecting plant and wildlife species at risk.

— **Consideration of First Nations interests and concerns.** This includes maintaining the integrity of Cree traditional activities and culture as well as preserving the community and psychosocial well-being of the Cree people.

— **Concentration of economic benefits locally.** This issue includes considerations for community benefits and the hiring of a local workforce in the long term (after mine closure).

However, it must be kept in mind that as project-related communication activities are ongoing, other issues could eventually be identified.

The impact assessment completed in Chapters 6 to 8 not only provided a better understanding of the project's impacts on the affected environmental components but also, by extension, of the major issues identified and presented above. In addition, the mitigation measures presented in these chapters and the monitoring and follow-up programs presented in Chapter 13 have addressed the various concerns raised in relation to these issues.

Table 14-1, presented below, lists each of the issues and summarizes the information concerning them, including the desired objectives, the management and design choices integrated into the project, and the proposed actions and measures, followed by an assessment for each issue. This demonstrates that the issues have been considered and integrated and allows us to conclude the Windfall project's environmental impact assessment.

Table 14-1 Assessment of the consideration of issues raised by the project

Issue	Desired objectives	Management and design choices integrated into the project	Actions taken and measures proposed under the EIA	Assessment of the issue
Preservation of the quality of the environment	– Preserve air quality, minimize GHG emissions, protect the integrity of the water system and wetlands as well as surface and groundwater quality.	– The sites used for the installation of the various facilities were chosen in areas already disturbed by human activities, away from wetlands and water bodies whenever possible. – Optimized surface traffic due to the position of the Lynx portal and the nearby process plant infrastructure. – Design of the structures according to the watersheds on the site to minimize the impact on the various watercourses and lakes in the study area. – Full characterization of mining materials to implement adequate protection measures for the water system. – On-site ore processing to reduce the number of trucks on local and regional roads. – Recirculation of 77% of the water used by the process plant. – Installation of a cyanide destruction unit in the tailings of the activated carbon adsorption circuit of the process plant. – Reuse of the tailings generated by the process plant, which is mixed with cement before being directed to the underground backfill. This reduces the amount of material that must be stored on the surface by 40%. – Treatment of drainage water, process water, and water from the various stockpiles in a four-step process before it is released into the environment. – Only one effluent will be used and it will be the same as currently used for advanced exploration activities (Pond 1); relocation of the effluent during the study to take into account environmental concerns. – Connecting the project to the provincial power grid to reduce air emissions. – Use of electric vehicles and machinery in the mine. – Predictive study of climate change effects and integration of findings into project design criteria to provide safety factors, especially for water retention structures. – Sorting and off-site disposal of waste as it is produced. On-site composting of organic materials. – Management of tailings by dry stacking, significantly reducing project risks since there will no longer be any dikes for the tailings storage facility. – Closure and restoration of the cells in the tailings storage facility as soon as they reach full capacity.	– Completed atmospheric modelling for the construction and operations phases (Chapter 6, Section 6.2.1, and Appendix 6-1). – Calculation of construction and operations phase GHG emissions (Chapter 6, Section 6.3.1, Appendix 6-2). – Completed environmental soil characterization (Chapter 6, Section 6.5.1, Appendix 6-4). – Completed surface water characterization (Chapter 6, Section 6.7.1, Appendix 6-7). – Completed groundwater characterization (Chapter 6, Section 6-9). – Modelling studies of the effects of dewatering underground drifts, estimation of the water percolation rate under the membrane of the waste rock stockpile and for the tailings storage facility (Chapter 6 and Appendix 6-8). – Environmental characterization of in situ sediments (Chapter 6, Section 6.8.1, Appendix 6-7). – Hydraulic modelling of the area surrounding the mining facilities in relation to the surface water catchment area (Chapter 6, Section 6.6.1, Appendix 6-5). – Geochemical characterization of materials (Chapter 3, Section 3.1.5, and Appendix 3-1). – Existing and planned sound environment studies (Chapter 6 and Appendix 6-3) – Ongoing consultations with land users as part of the project design to incorporate traditional knowledge and address project concerns (Chapter 4). – Common and specific mitigation measures for air quality, GHG emissions, surface and groundwater, soils and sediments (Chapter 6, Appendix 5-2). – Additional planned environmental monitoring and follow-up measures (Chapter 13).	– During the construction phase, impacts are expected to be very low to moderate and mitigation measures will be monitored. – The expected impacts on the quality of the environment during operations will also be very low to moderate. Air quality/GHG emissions and surface water quality will be given special attention in the monitoring programs implemented because of the importance to wildlife and the concerns expressed by land users. – During and following closure, low to very low impacts are anticipated as well as several positive impacts associated with the cessation of activities, site reclamation, and monitoring of effluent quality that will be maintained post-restoration for at least 10 years. – In summary, it appears that the issue of preserving the quality of the environment has been considered diligently and seriously at all stages of the Windfall project so as to minimize the disturbances generated, and to ensure an effective restoration that should allow a return to natural conditions similar to or better than those prevailing prior to the start of the work.

Issue	Desired objectives	Management and design choices integrated into the project	Actions taken and measures proposed under the EIA	Assessment of the issue
Biodiversity preservation	– Minimizing the loss of vegetation cover and wetlands, preserving terrestrial and aquatic habitats (including bird, fish, chiropteran, moose, and caribou), and protecting plant and wildlife species at risk.	– The sites used for the installation of the various facilities were chosen in areas already disturbed by human activities, away from wetlands and water bodies whenever possible. – Design of the structures according to the watersheds on the site to minimize the impact on the various watercourses and lakes in the study area. – Integration of the inventory results in the study of project location alternatives to minimize impacts on species with status. – Installation of a cyanide destruction unit in the tailings of the activated carbon adsorption circuit of the process plant. – Selection of ore processing methods to minimize ground encroachment and plant size. – Reuse of already active areas that will be converted to other uses. – Reuse of the tailings generated by the treatment plant, which is mixed with cement before being directed to the underground backfill. This reduces the amount of material that must be stored on the surface by 40%. – Treatment of drainage water, process water, and water from the various stockpiles in a four-step process before it is released into the environment. – Only one effluent will be used and it will be the same one as currently used for advanced exploration activities (Pond 1). – Sorting and off-site disposal of waste as it is produced. On-site composting of organic materials. – Management of tailings by dry stacking, significantly reducing project risks since there will no longer be any dikes for the tailings storage facility. – Closure and restoration of the cells in the tailings storage facility as soon as they reach full capacity.	– Inventory of vegetation, wetlands, and the water environment (Chapter 7, Section 7.1.1, Appendix 7-1). – Ichthyofauna and benthos inventory (Chapter 7.2.1, Appendix 7-2). – Herpetofauna inventory (Chapter 7, Section 7.3.1, Appendix 7-3). – Avifauna inventory (Chapter 7, Section 7.4.1, Appendix 7-4). – Large mammal inventory (Chapter 7, Section 7.5.1, Appendix 7-5). – Chiropteran inventory (Chapter 7, Section 7.6.1, Appendix 7-6). – Inventory of fur-bearing animals and small mammals (Chapter 7, Section 7.7.1, Appendix 7-7). – Interviews with tallymen and their families, as well as their participation in field inventories to integrate traditional knowledge into the project (Chapter 4). – Common and specific mitigation measures for vegetation, wetlands, water environments, aquatic wildlife, herpetofauna, avifauna, terrestrial wildlife, and species with status (Chapter 7, Appendix 5-2). – Additional planned environmental monitoring and follow-up measures (Chapter 13). – Biodiversity program (Chapter 13).	– During the construction phase, the expected impacts are very low to moderate and are specifically related to habitat loss, disturbance/collision risk, and alteration of habitat quality (accidental spills). Particular attention will be paid to monitoring the implementation of proposed mitigation measures and compliance with them. – The expected impacts on the quality of the environment during operations will also be very low to moderate. Discharges associated with site effluent into fish habitat and potential wildlife disturbance/collision (particularly for chiropterans) will be given special consideration in the monitoring programs put in place due to the high importance placed on fish habitat and the protected status accorded to several wildlife species present in the area. – During and following closure, low to very low impacts are anticipated as well as several positive impacts associated with the cessation of activities, site revegetation, and monitoring of effluent quality that will be maintained post-restoration for at least 10 years. – In summary, it appears that the issue of biodiversity preservation has been considered diligently and seriously at all stages of the Windfall project so as to minimize the disturbances generated on fauna and flora, and to ensure an effective restoration that should allow a return to natural conditions similar to or better than those prevailing prior to the start of the work.

Issue	Desired objectives	Management and design choices integrated into the project	Actions taken and measures proposed under the EIA	Assessment of the issue
Consideration of First Nations interests and concerns	– Maintenance of the integrity of traditional activities and Cree culture, preservation of the community and psychosocial well-being of the Cree people.	– The sites used for the installation of the various facilities were chosen in areas already disturbed by human activities, away from wetlands and water bodies whenever possible. – Placement of noisy infrastructure (e.g., crushers) as far as possible from sensitive receptors. – On-site ore processing to reduce the number of trucks on local and regional roads. – Establishment of a relationship of communication and dialogue with the Cree community of Waswanipi and with the tallymen of traplines W25B and W25A, and consideration of their concerns. – Construction of a Cree cultural centre for the employees of the mine site. – Treatment of drainage water, process water, and water from the various stockpiles in a four-step process before it is released into the environment. – Only one effluent will be used and it will be the same as currently used for advanced exploration activities (Pond 1); relocation of the effluent during the study to take into account environmental concerns. – Sorting and off-site disposal of waste as it is produced. On-site composting of organic materials. – Management of tailings by dry stacking, significantly reducing project risks since there will no longer be any dikes for the tailings storage facility. – Liaison Officer hired in 2017 by Osisko during the exploration phase to assist Cree workers on site and facilitate the recruitment of Cree workers for the project. – Organization of cultural exchange activities and sharing of the Cree way of life at the camp through posters explaining elements of Cree culture. – Osisko's existing responsible procurement, human resources, professional development, workplace harassment, and community relations policies. – Implementation of worker reconciliation measures with an employee assistance program. – Donation and sponsorship program for the Cree and Jamesian communities focusing on the promotion of science and education, the environment, or health and sport; support for cultural and community activities and socioeconomic partners. – Collaboration and advanced exploration agreements with host communities and the intention to finalize an Impact and Benefit Agreement with the Cree Nation Government and the Cree First Nation of Waswanipi. – Grant to study the effects of commuting on workers and their families. – Closure and restoration of the cells in the tailings storage facility as soon as they reach full capacity.	– Maintaining a constant link with the Cree community of Waswanipi and the tallymen to facilitate the exchange of information. – Consultations in the Cree community of Waswanipi with translation services to enable communication with unilingual Cree elders. – Addressing the concerns raised in the various consultations (Chapter 4). – Proposed common and specific mitigation measures to limit the effect on First Nations communities and their activities (Chapter 8, Sections 8.4.2 to 8.4.4 and 8.6.2 to 8.6.4). – Additional planned environmental monitoring and follow-up measures (Chapter 13).	– During the construction phase, the expected impacts are very low to moderate and are specifically associated with traditional land use. Particular attention will be paid to monitoring the implementation of proposed mitigation measures and compliance with them. – The expected impacts on environmental quality during operations will also be low to moderate and are also closely associated with traditional land use. Concerns are primarily centred around hunting success and access to harvesting areas. A special communication link will be maintained with the members of the Waswanipi Cree community and more specifically with the users of the traplines directly affected by Windfall site activities. – During and following closure, low to very low impacts are anticipated as well as several positive impacts associated with the cessation of activities, site revegetation, and monitoring of effluent quality that will be maintained post-restoration for at least 10 years. – In summary, it appears that the issue of considering First Nations interests and concerns has been taken into account diligently and seriously at all stages of the Windfall project so as to minimize the disruption to their traditional activities. Reclamation of disturbed areas will be carried out in such a way as to ensure a return to pre-construction conditions, while taking into account the expectations of the First Nations community.

Issue	Desired objectives	Management and design choices integrated into the project	Actions taken and measures proposed under the EIA	Assessment of the issue
Concentration of economic benefits locally	– Encouraging community benefits and the hiring of a local workforce in a long-term perspective (after the mine closes).	– Implementation of a local hiring policy for both employees and service providers. – Networking meetings with businesses in the Nord-du-Québec region to forge ties with them and integrate them into project development. – Liaison officer hired in 2017 by Osisko during the exploration phase to assist Cree workers on site and facilitate the recruitment of Cree workers for the project. – Osisko's existing responsible procurement, human resources, professional development, workplace harassment, and community relations policies. – Current workforce training initiatives related to mining industry jobs. – Integration of ongoing training programs to help employees relocate following mine closure. – Implementation of worker reconciliation measures with an employee assistance program. – Donation and sponsorship program for the Cree and Jamesian communities focusing on the promotion of science and education, the environment, or health and sport; support for cultural and community activities and socioeconomic partners. – Collaboration and advanced exploration agreements with host communities and the intention to finalize an Impact and Benefit Agreement with the Cree Nation Government and the Cree First Nation of Waswanipi.	– Economic impact assessment (Chapter 1, Section 1.4.2, Chapter 3, Section 3.14, Appendix 1-1). – Consultations with various stakeholders to learn about programs in the region and develop long-term relationships. – Proposed common and specific mitigation measures to promote the strengthening of the local economy (Chapter 8, Sections 8.3.2 to 8.3.4).	– The Windfall project has placed great importance on taking this issue into account in all phases of the project. Local hiring and procurement are among Osisko's priorities and are applied to all of its activities. The overall impact in relation to this issue is positive.

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CHAPTER 9

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CHAPTER 11

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